BRITISH WILD FLOWERS IN THEIR NATURAL HAUNTS

HORWOOD

BRITISH WILD FLOWERS

1. Great Spearwort (*Ranunculus Lingua*, L.) 2. Marsh Marigold (*Caltha palustris*, L.) 3. Grass of Parnassus (*Parnassia palustris*, L.) 4. Sundew (*Drosera rotundifolia*, L.) 5. Water Dropwort (*Œnanthe fistulosa*, L.)

No. 1. Great Spearwort
(Ranunculus Lingua, L.)

a, Achene. b, Upper stem-leaf and upper part of plant with stem-leaf, with axillary flower-buds, and one terminal flower with 5 petals, and stamens on hairy flower-stalk.

No. 2. Marsh Marigold
(Caltha palustris, L.)

a, Group of 8 follicles, with seeds. b, Seed. c, Upper part of plant, with stem-leaf, flowers in various stages, 1 expanded, showing 5 petaloid sepals and stamens (indefinite), with central follicles.

No. 3. Grass of Parnassus
(Parnassia palustris, L.)

a, Flower, on long peduncle, showing 5 petals; 5 stamens with 5 scales between, and central pistil. The 5 sepals alternating with petals can be just seen. b, Scale, with glands enlarged. c, Seed. d, Capsule, with valves and recurved persistent sepals. e, Flower, with upper stem-leaf, showing 5 sepals. f, Rootstock, with radical leaves (compare these with those of Nuphar lutea).

No. 4. Sundew
(Drosera rotundifolia, L.)

a, Andrœcium, with 5 stamens, and gynœcium, with pistil with 5 styles. b, Tentacle from leaf-margin. c, Leaf, with some tentacles bent down, imprisoning an insect captive, other tentacles in the act of bending. d, Capsule dehiscing by valves. e, Seed. f, Plant, with rosette of radical leaves with glands, and 2 scapes with flowers in various stages in scorpioid cyme.

No. 5. Water Dropwort
(Œnanthe fistulosa, L.)

a, Flower (enlarged), from above, showing irregular petals, notched, indexed, 5 stamens, and pistil. b, Partial umbel, with pistils, showing 2 divergent styles. c, Flower, with calyx teeth, petals fallen, and pistil with spreading styles. d, Umbel of 5 rays, with leaf sheathed at base below. e, Leaf, with narrow distant segments.

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a, Achene. *b*, Upper stem-leaf, and upper part of plant with stem-leaf, with axillary flower-buds, and one terminal flower, with 5 petals, and stamens on hairy flower-stalk.

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No. 4. Sundew
(*Drosera rotundifolia*, L.)

a, Androecium, with 5 stamens, and gynaecium, with pistil with 5 styles. *b*, Tentacle from leaf-margin. *c*, Leaf, with some tentacles bent down, imprisoning an insect captive, other tentacles in the act of bending. *d*, Capsule dehiscing by valves. *e*, Seed. *f*, Plant, with rosette of radicle leaves with glands, and 2 scapes with flowers in various stages in scorpioid cyme.

No. 5. Water Dropwort
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A New BRITISH FLORA

BRITISH WILD FLOWERS

IN THEIR NATURAL HAUNTS

Described by A. R. HORWOOD
With Sixty-four Plates in Colour
Representing 350 *Different Plants*
From Drawings by J. N. FITCH
and Many Illustrations from Photographs

VOLUME V

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Section X

FLOWERS OF THE BOGS AND MARSHES

FLOWERS OF THE BOGS AND MARSHES

Marsh plants, or Helophytes as they are called, are unlike aquatic plants in that though their roots grow in water-logged soil in which there is 80 per cent of water, yet their stems are never quite submerged and are usually erect, many aquatic plants being submerged and lying on the surface of the water. They usually grow in shallow water, if submerged at all, and in still or but little disturbed water.

Most of the marsh plants are perennials, and a large number have creeping rhizomes, such as *Phragmites* or Reed, Reed Mace, Iris, Yellow Flag, Flowering Rush, Bulrushes, Cotton Grass, Bur Reed, Sedges, &c. Some are tufted, as Purple Loosestrife, Water Plantain, also members of aquatic vegetation, and they build up a layer of dead stems growing from the topmost aided by the capillarity of the dried stems and water, as in the case of the Tussock Sedge. They contain air-spaces as in Rushes. Many have the mesophytic habit, and others are Xerophytes. The seeds contain air-spaces, which assist in dispersing them by water.

Two types of formation may be recognized at least, and there are probably others. Many indeed are amphibious, growing half on land half in water. The two recognized formations are the Reed formation and the Bush Swamp formation.

In classifying the marsh and water plants, we have regarded as belonging to the latter all the plants which grow in or by the sides of lakes, rivers, streams, and ditches, and have reserved for the marsh plants those that grow mainly in true bogs or marshy tracts that are separate or can be distinctly marked off from the latter. In this way, while Reeds are included in Section VIII (and some others here mentioned which occur in Section VIII), they are equally marsh plants. The grouping by Lakes, Rivers, Streams, &c., is partly artificial (just as in the case of roadside plants), for the benefit of the touring botanist, who can better follow such classifications than the cut-and-dried divisions into Hydrophytes, and, as here, Helo-

phytes. With the Reed in the Reed formation one finds Bulrush, Reed Mace, Flowering Rush, Iris, Galingale, Hummock Sedge, Water Plantain, Arrowhead, Bur Reed, Great Hairy Willow Herb, Great Yellow Loosestrife, Sweet Flag, Buckbean, Purple Loosestrife, Great Spearwort, Water Dropwort, &c.

Zones can be recognized, moreover, in this formation named after the dominant species or genus, such as phragmiteta, scirpeta, heleocharetа, cariceta, typheta, equiseteta. The Hydrophytes are tall, slender, and upright, usually unbranched. As will be seen some of those that grow in true bogs, requiring acid humus, must also be considered Oxylophytes, and high- or low-moor plants. Some parts of marsh and bog land are covered or interspersed with shrubs or trees, one or more of which give to each type a character of its own. Such are Alneta, where one finds Purple Loosestrife, Meadow Sweet, Buckbean, Sedges, Willows, Guelder Rose, and the Nettle.

Saliceta, on banks of swamps, are characterized by the Crack and White Willows, Great Yellow Loosestrife, Great Hairy Willow Herb, Valerian, Meadow Sweet, &c., with Reeds, and higher up, Bittersweet, Great Bindweed, and Hop. In other places, Betuleta and Pineta are characterized by the dominance of Birches and Pines with their own ground flora.

Out in the midst of the pools rises the tall, graceful, and stately Great Spearwort. Its yellow chasubles shine like melted gold in the sun. Down by the sides of the meres, and in wet marshy meadows, Kingcups play a kindred part. Here, too, the lovely white, veined petals of the Grass of Parnassus, with the scale-like honey glands, spot the meadows in autumn, where the Bog Bean and Marsh Helleborine lie hid amongst the mulchy sedges and moist undergrowth. In the little bog-pools the insectivorous Sundew glistens like sparkling drops of dew in the sun, to attract its insect prisoners, rare viands for a plant!

Diminutive forests are formed by the Water Dropwort, which grows, like Valerian, in low-lying meadows, forming dense undergrowth, with flowers pure and white. On the moors or in wet bogs the Cranberry and Wild Rosemary, in less upland morasses, are found here and there, the first being sought after eagerly for its fruit in autumn. Bog Pimpernel, with its choice pink blossoms, trails in the moist hollows close by where Water Violet swims in the quiet pools, anchored only by its webwork of foliage. Crouching low down amid the sedges and rushes the Bog Speedwell is a true marsh species, and Marsh Lousewort grows on the borders of moist meadows where Bog Bean flourishes.

Photo. L. R. J. Horn

BROAD OR SHALLOW LAGOON WITH AQUATIC VEGETATION

Showing floating leaf associations covering the surface. Marginal to this is a fen association, which gradually encroaches on the aquatic vegetation, with a thicket scrub of Sweet Gale, Willow, &c.

The shiny leaves and uncommon flowers of the Butterwort are a peculiar feature in the same habitat as Sundew. In upland pools, quite immersed save for the erect flower-stalks, grows the quaint Bladderwort, which, like Sundew, is insectivorous. In favoured spots the Bog Bean flowers, but not everywhere. Golden Dock invades many an inland marsh with its tall golden panicles of yellow flowers. Bog Myrtle grows in upland bogs with Asphodel, which makes the moors bright golden-red in autumn here and there. White Willow lines the sides of the marshes with its silvery foliage glistening in the sun. Amongst wet sedges and herbage Marsh Orchis rises with its pink blooms, encircling the green expanse with its choice colour. The sedges and rushes, &c., include common Joint-rush, Galingale, Common Spike Rush, Cotton Grass, Prickly Twig Rush, Hummock and Great Prickly Sedge.

There are about 250 paludal plants, and we have described twenty-eight in this series.

For further general notes on Marshes and Bogs, see Heaths and Moors, and "Hints and Notes" on both sections; and also Section I, Vol. I, where an alternative grouping is considered.

Great Spearwort (Ranunculus Lingua, L.)

This fine plant has been recognized by its achenes in deposits of Interglacial, Neolithic, and Roman age. It is found in the Warm Temperate Zone, in Temperate Europe, N. and W. Asia, as far as the Himalayas. It is absent in East Cornwall, South Wilts, Gloucester, Worcester, Carmarthen, Cardigan, Montgomery, Denbigh, Mid Lancs, Isle of Man, Peebles, Selkirk, Haddington, Stirling, Kincardine, Banff, Westerness, Cantire, S. and Mid Ebudes, W. Ross, Sutherland, Caithness, and the Northern Isles. It is local in Ireland, and is found in the Channel Islands.

The Great Spearwort is an aquatic Hydrophyte or water plant, or Hygrophyte or moisture-loving species, living in the middle of pond or lake, half-submerged, and being also a typical marsh plant, occurs also in swamps and ditches. Usually it grows some distance from the margin, and in this way is hard to reach, unlike its congener the Lesser Spearwort, which is found on the ground surrounding a pond or in marshes and wet ground. With the Greater Spearwort grow Frogbit, Bur Reeds, the Sweet and Yellow Flags.

Though aquatic it is erect, and grows out of the water in the same way as the Flag or Reeds. It grows in a group of some extent, usually

not in deep water, or in wet, peaty soil. It is tall, erect, and graceful, and the flowers being largely terminal and bright yellow form quite a golden patch in the otherwise green marshes. The stem is hollow.

Perhaps from the long, entire, spear-shaped, aerial leaves, giving the English name its significance, one can best recognize this handsome species. They are half-clasping, and the radical leaves are stalked, while the rest are not, and have a semi- rather coarsely-toothed edge. The lower, sometimes submerged, leaves are tongue-shaped (hence *Lingua*) or heart-shaped, blunt, 3 in. broad, 8–9 in. long. The carpels are pitted and have a sword-like beak.

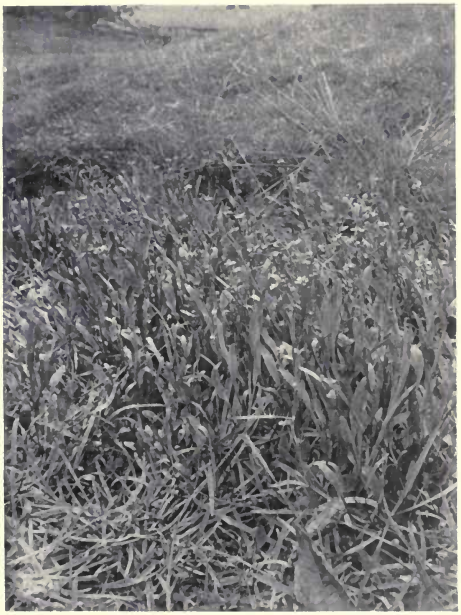


Photo. Flatters & Garnett

GREAT SPEARWORT (*Ranunculus Lingua*, L.)

The flowers are large, yellow, nearly 2 in. in diameter, in a sort of panicle. The glands of the petals have a small scale. The achenes are pitted. The style is broad.

Great Spearwort varies from 2 to 4 ft. in height. Flowers can be found from June to August. It is a perennial, deciduous, herbaceous plant.

Pollination is as in the Lesser Spearwort, where the flowers are scarcely expanded when the anthers open outwards, covering the sides towards the petals with pollen; but in this case the stigma is mature first. Insects in the case of the former feed on the abundant honey in little scales at the base of each petal, and so dust themselves with pollen at the same time. The stigmas are concealed by the stamens and undeveloped. As the stamens open they bend out, and turn their pollen-covered sides outwards. The outer stamens develop before the innermost stamens join the others, and the stigmas becoming dusted with pollen, can be pollinated with their own pollen or that brought from other flowers. All visitors alighting on the middle, bearing pollen,

cross-pollinate some stigmas, those alighting first on petals touching the anther and stigmas, either causing cross- or self-pollination. The flower being half-drooping may also be self-pollinated from this reason. The visitors are Flies, or Diptera, Syrphidæ, *Syritta*, *Cheilosia*, *Melithreptus*, Muscidæ, *Scatophaga*, *Anthomyia*; Hymenoptera, Apidæ, *Halictus*; Lepidoptera, *Satyrus*, *Pamphilus*.

Spearwort is dispersed by its own agency. The achenes are aggregate, and dispersed around the parent plant.

This handsome species is a Hydrophyte or water plant and aquatic, or a Helophyte or marsh plant.

A fungus, *Æcidium ranunculacearum*, forms orange-yellow groups of "cluster-cups" on the leaves.

The specific name (once a genus) *Lingua* was bestowed by Pliny, and means a tongue, and was used in allusion to the shape of the leaves. Possibly Pliny's plant, however, was the Hart's Tongue.

It is called also Spear Crowfoot and Sparrow Weed. The Lesser Spearwort was used under the name "flame" as a cure for "cankers" or ulcers. It is a poisonous plant, and the Lesser Spearwort is of the same nature.

Photo. Matson

GREAT SPEARWORT
(*Ranunculus Lingua*, L.)

ESSENTIAL SPECIFIC CHARACTERS:—

6. *Ranunculus Lingua*, L. — Stem-leaves entire, subserrate, sessile, stem erect, flowers large, yellow, carpels pitted, style broad with ensiform tip.

Marsh Marigold (Caltha palustris, L.)

This is an Arctic plant found in Pre-, Inter-, and Late Glacial, Neolithic, and Roman deposits. It is a plant of the Cold Temperate and Arctic regions, found in Arctic Europe, North and W. Asia, as far as the Himalayas, and in North America. So widely distributed a plant occurs in every part of Great Britain, and in Scotland grows at 3400 ft. in the Highlands. It is found in Ireland.

The Marsh Marigold is hygrophilous, i.e. fond of moisture, always confined to marshy tracts, where there are some lime salts in the soil. It

is associated in spring with the early-flowering sedges, and sallows, and osiers, and with it grow the marsh-loving Horse-tail, and the pale lilac-tinted Cuckoo Flower or Lady's Smock. In such marshy tracts it forms big clumps which cover the water-meadows as with intertwining chains of gold. It prefers the damp hollows where it is half-rooted in spongy, watery ground. It is found also by stream-sides and in swampy woods.

The Marsh Marigold has a prostrate or somewhat erect habit. The plant is dark-green, rank, hairless, forming conspicuous clusters with

Photo. J. H. Crabtree

MARSH MARIGOLD (*Caltha palustris*, L.)

attractive blooms. The rootstock is horizontal, short, the stem not rooting at the nodes. The stem may be erect or ascending. The radical leaves are long-stalked, rounded, heart-shaped, with two deep lobes at the base, and a narrow sinus, scalloped, toothed, glossy. The stipules are membranous, entire in bud, and enclose the leaf. The flowers are few, terminal, regular, large. Sepals of a bright yellow colour take the place of the petals. They are overlapping and close, unequal, round to egg-shaped. The follicles are spreading, with a very short beak, and many-seeded.

Marsh Marigold is 1–1½ ft. high. Flowers may be found from March to May, and this is a perennial plant.

The flower is rendered conspicuous by the petaloid yellow sepals. There is an abundance of honey, which is secreted in two shallow

depressions below the ovary, and is protected, as there are no petals, by a fold which helps to retain it. The plant is homogamous, that is to say the stigma and the pistil ripen at the same time, and in the ordinary course, as they are more or less on a level, self-pollination would result. But the flowers are much visited, and hence they are frequently cross-pollinated. Furthermore, the anthers open away from the centre or pistil, i.e. outwards, the outer series first. There are in some countries flowers which have no pistil, a further reduction of the floral axis, along with the ordinary type.

The flowers are 40 mm. in diameter, and hence attractive. The visitors are Diptera (Stratiomyidæ), *Odontomyia*, (Syrphidæ), *Cheilosia*, *Ascia*, *Rhingia*, *Eristalis*, (Muscidæ), *Scatophaga*, *Anthomyia*; Coleoptera (Nitidulidæ), *Meligethes*; Hymenoptera (Apidæ), *Andrena*, *Osmia rufa*, *Bombus terrestris*, *Apis mellifica*, &c.

The seeds are dispersed by the wind. The aggregate fruits consist of many follicles, with many seeds which are blown out by the wind when the follicle is ripe and dry.

The Marsh Marigold is a peat-loving plant, being dependent on a more or less peaty soil, or acid humus, such as that afforded by a bog, or when alkaline by a marsh.

Puccinia calthæ is a fungus which infests it, as does *Pseudopeziza calthæ*.

The beetles *Donacia dentipes*, *D. lemnæ*, *Prasocuris hannoverana* feed on it, and the Homopterous insect *Dorthesia urticæ*.

Caltha, given by Pliny, is the Latin name of some plant, probably the Pot Marigold, and *palustris* refers to its marshy habitat. The English name is from *Mary* (i.e. Virgin Mary), and *gold*, in allusion to its colour.

This plant is called Bassinet, Blob, Boots, Bullflower, Butter-blob, Big Watercup, Great Butter-flower, Carlock-cups, Chirms, Claut, Crow Cranes, Crazy, Dandelion, Drunkard, Fire o' Gold, Water Goggles, Golden Cup, Gollin, Halcups, John Georges, Johnny Cranes, King-cob, Marsh Mallow, Mare-blob, Mayflower, Meadow Bouts, Moll-blob, Publicans and Sinners, Soldier's Buttons. In Oxfordshire Marsh Marigolds and Buttercups are called Publicans and Sinners.

"The wild marsh marigold shines like fire."—*Tennyson*:

alluding to the name Will (Wild) fire. It is called Open Gowan from its open flowers, as opposed to the closed flowers of the Lockin Gowan.

It is said in Iceland that if the Marsh Marigold is taken with certain ceremonies and carried about it will prevent the wearer from

having an angry word spoken to him. It is very acrid and poisonous, and those who have eaten it have been affected by it. The buds are salted and pickled in the same way as capers. From the "petals" a yellow dye is extracted, after boiling with alum. It is not eaten by cattle unless there is a lack of other herbage. Children use it for making garlands on May Day. The "petals" are often eaten by a beetle (*Chrysomela*).

Essential Specific Characters:—

11. *Caltha palustris*, L.—Stems numerous, erect, leaves reniform, large, shiny, sepals yellow, large, petals wanting, follicles with short beak.

Grass of Parnassus (Parnassia palustris, L.)

There are not any instances of the occurrence of Grass of Parnassus in early beds. It is confined to the North Temperate Zone of Europe, N. Africa, Siberia, Western Asia, as far east as N.W. Himalayas, E. and W. North America. It is found generally in Great Britain, but not in the Peninsula province in Dorset; and in S. Hants only in the Channel province; not in Kent or S. Essex in the Thames province; throughout Anglia; not in W. Glouc, Monmouth, Hereford in the Severn province. In Wales it occurs only in Carnarvon, Denbigh, Flint, and Anglesea; in the Trent province; throughout the Mersey, Humber, and Tyne provinces; and in the Lakes province generally, except in the Isle of Man. It is found in the whole of the W. Lowlands; not in Peebles or Selkirk in the E. Lowlands; or Stirling, N. Perth in E. Highlands; throughout the W. Highlands, except in N. Ebudes; and in the N. Highlands, except in W. Ross; in the North Isles, except in the Hebrides. It is found at 2700 ft. in the Highlands.

This beautiful plant is one of the features of bogs in the autumn, when its white flowers are scattered in profusion over the flat water-meadows around more truly boggy tracts. It is found in such places as the Great Spearwort, Sundew, Bog Pimpernel, Water Violet, Bog Speedwell, Marsh Lousewort, Butterwort, Bladderwort, Bog Bean, Marsh Helleborine, Marsh Orchis, Cotton Grass, and other hygrophilous or helophilous plants frequent.

This is not a grass, but a delicate herbaceous plant, with few flowering stems, slender, erect or wavy, angular, bearing a single, clasping, stalkless leaf halfway up the stem. The radical leaves are stalked with a heart-shaped form. The plant has the rosette habit.

The flowers are of a beautiful cream or white colour, with free,

blunt sepals. The veined petals have a short claw, and the honey is contained in fringed petal-like yellow scales or nectaries. There are 4 stigmas. The flower in sunshine is sweet-scented, but loses its scent at night. The Grass of Parnassus is about 10 in. high at its best. It is a late-flowering plant, blooming from August to October. The plant is a deciduous, herbaceous perennial, increased by division.

Only 5 anthers are borne on the 10 stamens, the others are melliferous at the bottom, and are crowned by as many as 17 yellow globular glands, resembling honey, but dry. They may serve to attract flies. The immature anthers lie near the conical ovary, which rises up in the centre and overtops them. They ripen first successively, and elongating come to just above the top of the stigma, with the back to it, and open away from it, and as each does this another follows each day, and afterwards the stigmas on the sixth day develop. The nectaries are just opposite each petal, alternate with the stamens, and each is shortly stalked, with a broad, fleshy disk, secreting honey in two hollow depressions, or on the inner side, and they leave it fully exposed. The yellow-knobbed glandular bodies or staminodes surround the base of the ovary, and render the nectaries conspicuous, but they are dry though they look like drops of liquid, and flies are deceived by it, the smaller travelling round the flower, the larger resting in the middle, dusting their sides with pollen in younger flowers, cross-pollinating older ones if they pass out to them. The visitors are *Eristalis*, *Helophilus*, *Syrphus*, *Melanostoma*, *Melithreptus*, *Syritta*, *Sarcophaga*, *Pollenia*, *Tipula*, *Tenthredo*, Ichneumonids, *Pemphilus*, *Gorytes*, *Coccinella*.

Photo. Flatters & Garnett

GRASS OF PARNASSUS (*Parnassia palustris*, L.)
(probably var. *condensata*, Wheldon and Travis)

The capsule is many-seeded, and is membranous, allowing the

seeds to be emptied out by the wind. The seeds are minute and weigh only .00003 of a grain.

Grass of Parnassus is a peat-loving plant and requires a humus or peat soil, which is to be found only in moist situations on a variety of rock soils.

A cluster-cup fungus, *Uromyces parnassiæ*, attacks the Grass of Parnassus.

Parnassia, Linnæus, is from the Mount of Parnassus, and was called *gramen parnassium* by Dodonæus. The second name (also Latin) refers to its paludal habitat.

Grass of Parnassus is called White Buttercups, White Liverwort.

Essential Specific Characters:—

111. *Parnassia palustris*, L.—Stem erect, short, radical leaves petiolate, cordate flowers solitary, white, large, petals veined, with claw, with scales or nectaries fringed with hairs, and yellow glands.

Sundew (Drosera rotundifolia, L.)

This interesting plant is found to-day, and not earlier, so far as we know, in the North Temperate and Arctic Zones in Arctic Europe, Siberia, Western Asia, East and West North America, from the Arctic Circle to Florida. In Great Britain it is absent from North Wilts, East Gloucs, W. Gloucs, Cardigan, Carnarvon, Flint, Mid Lancs, Linlithgow, Stirling; and in the Highlands is found at 2300 ft.; but in many counties where it once grew it has disappeared owing to drainage, &c.

Wherever the Sundew is found it is a certain sign of the existence, now or formerly, of a typical bog. It is a plant of the bog or heath, living the life of a Xerophyte, and is associated with such true bog plants as Grass of Parnassus, Cranberry, Rosemary, Bog Pimpernel, Lousewort, Butterwort, Bladderwort, Bog Myrtle, Bog Asphodel, &c. It prefers a shallow pool or wet ground in the middle of some upland bog, where it grows on spongy peat.

The interest attaching to this peculiar plant refers not to its habit of growth so much as to its habit of capturing and assimilating its food, which in this case is organic. It is, in other words, insectivorous, attracting and imprisoning flies in, and by aid of, its glandular sticky leaves (hence the first Latin and English names), which close up when touched, being highly sensitive. The juices secreted[1] in the hollow of

[1] The secretion, which is shiny, giving the plant its name, is at the base of the glandular tentacles which enable the plant to capture its prey. Sir Francis Darwin found that plants fed on meat were more vigorous than those kept without animal food. See also Charles Darwin, *Insectivorous Plants*.

the leaf are able to digest the flies, just as food is digested by gastric juices in the stomach.

The Sundew is not a tall plant, having long-stalked, rounded leaves (as broad as long, hence the second Latin name), fringed with glands and tentacles. The general shape is spoon-shaped. The racemose flower-stalks, with flowers all turned one way, are more or less erect. The flower-stalk is without leaves. The flowers are small

Photo. J. H. Crabtree

SUNDEW (*Drosera rotundifolia*, L.)

and white, only opening in sunshine. In the autumn stoles with bulbs are put forth.

This "plant-animal" is about 6 in. high. The flowers bloom in July and August. It is perennial. The flowers are cleistogamic. The stamens are numerous, and united with the petals, which do not fall. The anthers open outwards, and cross-pollination is thereby encouraged. The flowers are in two series. The styles are bent inwards, and the stigmas are club-shaped. The anthers and stigmas ripen together. Insects, usually flies, are attracted to the glandular leaves, and imprisoned and slowly digested, and pollination may be assisted by the miscarriage of such efforts to utilize insect prisoners for food by their being attracted instead to the flowers.

The capsule splitting opposite each loculus allows the seeds to be dispersed to some distance around the parent plant.

Sundew is a peat-loving plant, and can only subsist in a peaty soil, which is obtained in certain moist hollows on hills and lowland ground.

Drosera, Cordus, is from *drosos*, dew, and the second Latin name refers to its rounded leaves.

Sundew is called Lust-wort, Moor-grass, Moor-wort, Red Rot, Rosa Solis, Youth-wort. It is called Red Rot because "Sheepherds do call it the Red Rot because it rotteth sheep".

The name "Rosa Solis" is also the name for a liquor prepared from it. In regard to the name Sundew Lyte says: "This herbe is of a very strange nature and marvellous, for although that the sunne doe shine not, and a long time thereon, yet you shall finde it alwaies moist and bedewed, and the small haires thereof alwaies full of little drops of water, and the hotter the sun shineth upon this herbe, so much the moyster it is, and the more bedewed, and for that cause it was called Rosa solis in Latine, which is to say in English, the dewe of the sun, or sun Dewe".

The Italian liqueur Rossoli is prepared from it in part. It is acrid and caustic, and curdles milk. The Sundew was supposed to remove warts and corns, and to take away freckles and sunburn, presumably in the last case by Doctrine of Signatures! This plant produces a stimulating spirit when distilled with wine. It was once used as a tincture.

Essential Specific Characters:—

116. *Drosera rotundifolia*, L.—Leaves obovate, flat, with red glands, radical, petioles hairy, flowers small, white, on long stalks, seeds chaffy.

Water Dropwort (Œnanthe fistulosa, L.)

In spite of its tender character this plant has been found and identified from seeds in Interglacial beds at West Wittering in Sussex. It is found in the North Temperate Zone at the present day in Europe and N. Africa. In this country it is found throughout the Peninsula, Channel, Thames, Anglia, and Severn provinces, except in the last in Monmouth; in Wales only in Glamorgan, Brecon, Carnarvon; Trent provinces; in the Mersey province, except in Mid Lancs; in the Humber, Tyne, and Lakes provinces; and in Dumfries, Kirkcudbright, Ayr, Renfrew, Berwick, Mid Perth, or from Ayr southwards. It is rare in Scotland, but common in Ireland.

Water Dropwort is a hygrophilous or moisture-loving species which is found in most marshes, and in wet places where a marsh may once have existed formerly. It is also found in ditches, and on the borders

of rivers, lakes, ponds, and other tracts of water; but most profusely in water meadows, in hollows once (or now) forming part of a marsh.

As the second Latin name denotes, the stem and the leaf-stalks of this plant are fistular or hollow. It is freely stoloniferous, with

Photo. Flatters & Garnett

WATER DROPWORT (*Œnanthe fistulosa*, L.)

creeping stems or shoots, and forms extensive beds where it grows for that reason, and being tall and erect they dot the wet meadows in summer over a wide area. The stem leaves have thread-like pinnæ. The stalks exceed the leaves in length, these last being 2–3, pinnate, with leaflets divided into three nearly to the base.

The flowers are white, in small umbels with few rays, stout flower-

stalks, and no bracts or leaf-like organs. The fruits are numerous, crowded, angular.

The plant is 2–3 ft. high, and flowers from July to September. It is perennial, increased by stolons.

As the first Greek name implies, the Water Dropwort (and others) has a smell like wine, which helps to make it attractive to insects. The outer flowers are male, and the plant is polygamous. The petals are inflexed or turned inwards, the styles are long, erect, and armed with points. It is arranged so that insects can cross-pollinate it. The visitors are *Stratiomys*, *Empis livida*, *E. rustica*, *Antherix*, *Syritta pipiens*, *Eristalis nemorum*, *E. arbustorum*, *E. sepulcralis*, *Lucilia*, *Trichius fasciatus*, *Macropis*, *Heriades*. The anthers and stigma ripen together in some flowers which are complete in the centre.

The fruits are flattened, angular, and furrowed, and so the more readily dispersed by the wind, and being but slightly attached are easily detached by it or by passing animals.

This is one of the peat-loving plants that require a peaty soil in which to flourish, and where the conditions are more or less perpetually moist.

A beetle, *Lixus paraplecticus*, a moth, *Depressaria nervosa*, and a fly, *Simulium reptans*, feed upon it.

Œnanthe, Theophrastus, is from the Greek *oinos*, wine, *anthos*, flower, and the second Latin name refers to its fistular character. It is called Water Dropwort and Hemlock Dropwort. It is a poisonous plant like Wild Celery, Fool's Parsley, and other umbellifers.

Essential Specific Characters:—

128. *Œnanthe fistulosa*, L.—Root fibrous, slender, with runners, stem hollow, leaves pinnate, shorter than the petioles, which are fistular, the lower ones flat, flowers white at first, pink, in few-rayed umbels, fruit with rigid divergent or spreading styles.

Valerian (Valeriana dioica, L.)

Widespread as a marsh plant Valerian is found throughout the North Temperate Zone in Europe generally. In Great Britain it is found in Cornwall and S. Somerset in the Peninsula province; throughout the whole of the Channel, Thames, Anglia, and Severn provinces; in Glamorgan, Brecon, Montgomery, Carnarvon, Denbigh, Flint, and Anglesea in Wales; in the whole of the Trent and Mersey provinces, except in Mid Lancs; and in the Humber, Tyne, Lakes provinces, except in the Isle of Man. In Scotland it is found in Dum-

No. 1. Valerian
(*Valeriana dioica*, L.)

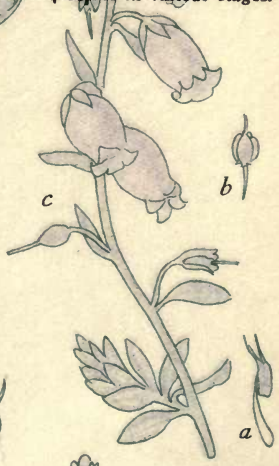
a, Staminate floret, with 5 petals, tubular below, and stamens in centre. *b*, Pistillate floret, showing corolla, with pistil, and inferior ovary. *c*, Fruit, crowned by pappus. *d*, Upper part of plant, with pinnatifid stem-leaves in opposite pairs, with flowers in cyme in various stages.

No. 2. Cranberry
(*Oxycoccus palustris*, Pers.)

a, Flower, with rotate corolla-lobes cut back, showing stamens and style. *b*, Flower, with ovary and style. *c*, Stamen, with purple filament and yellow anthers. *d*, Berry. *e*, Plant, showing creeping rooting stem, alternate leaves, and raceme with flowers, with long corolla-lobes turned back.

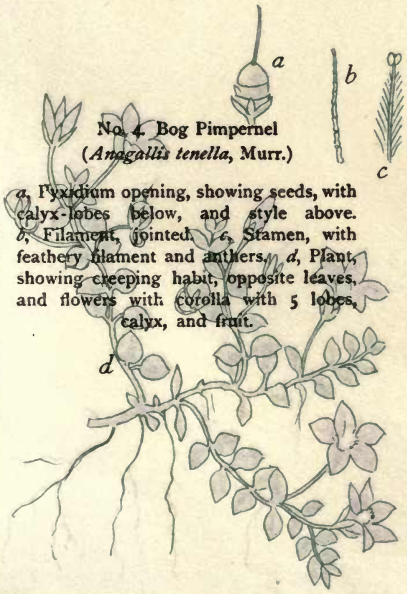
No. 3. Wild Rosemary
(*Andromeda polifolia*, L.)

a, Stamen, with awned anthers. *b*, Ovary, with style, corolla removed. *c*, Part of flowering stem, with leaves, and flowers drooping, with revolute corolla lobes, and 4 sepals in various stages.



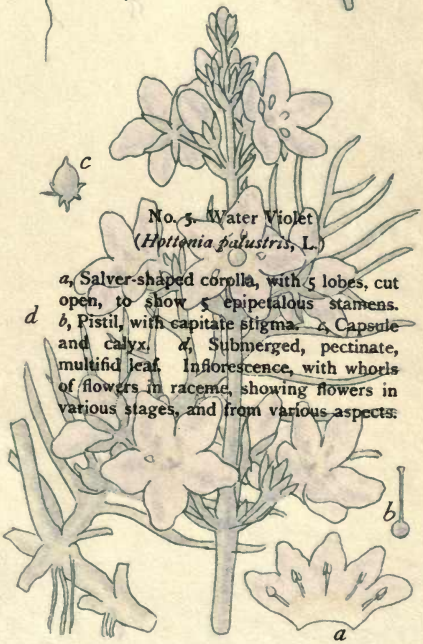
No. 4. Bog Pimpernel
(*Anagallis tenella*, Murr.)

a, Pyxidium opening, showing seeds, with calyx-lobes below, and style above. *b*, Filament, jointed. *c*, Stamen, with feathery filament and anthers. *d*, Plant, showing creeping habit, opposite leaves, and flowers with corolla with 5 lobes, calyx, and fruit.



No. 5. Water Violet
(*Hottonia palustris*, L.)

a, Salver-shaped corolla, with 5 lobes, cut open, to show 5 epipetalous stamens. *b*, Pistil, with capitate stigma. *c*, Capsule and calyx. *d*, Submerged, pectinate, multifid leaf. Inflorescence, with whorls of flowers in raceme, showing flowers in various stages, and from various aspects.



No. 1. Valerian
(Valeriana officin. L.)

a, Staminate floret, with 5 petals, tubular below, and stamens in centre. b, Pistillate floret, showing corolla, with pistil, and inferior ovary. c, Fruit, crowned by pappus. d, Upper part of plant, with pinnatifid stem-leaves in opposite pairs, with flowers in cyme in various stages.

No. 2. Cranberry
(Oxycoccus palustris, Pers.)

a, Flower, with rotate corolla-lobes cut back, showing stamens and style. b, Flower, with ovary and style. c, Stamen, with purple filament and yellow anthers. d, Berry. e, Plant, showing creeping rooting stem, alternate leaves, and racemose with flowers, with long corolla-lobes turned back

No. 3. Wild Rosemary
(Andromeda polifolia, L.)

a, Stamen, with awned anthers. b, Ovary, with style, corolla removed. c, Part of flowering stem, with leaves, and flowers drooping, with revolute corolla-lobes, and capsule in various stages.

No. 4. Bog Pimpernel
(Anagallis tenella, Murr.)

a, Fruit-stem opening, showing seeds, with calyx-lobes below, and style above. b, Pistil, pointed. c, Stamen, with leathery filament and anthers. d, Plant, showing creeping habit, opposite leaves, and flowers with corolla with 5 lobes, calyx, and fruit.

No. 5. Water Violet
(Hottonia palustris, L.)

a, Salver-shaped corolla, with 5 lobes, cut open to show 5 capsulous stamens. b, Pistil, with capitate stigma. c, Capsule and calyx. d, Submerged, pectinate, multifid leaf. Inflorescence, with whorls of flowers in racemé, showing flowers in various stages, and from various aspects.

1. Valerian (*Valeriana dioica*, L.). 2. Cranberry (*Oxycoccus palustris*, Pers.). 3. Wild Rosemary (*Andromeda polifolia*, L.). 4. Bog Pimpernel (*Anagallis tenella*, Murr.). 5. Water Violet (*Hottonia palustris*, L.).

fries, Kirkcudbright, Ayr; in E. Lowlands in Roxburgh, Berwick, Haddington, Edinburgh, Linlithgow, Fife, Stirling, and W. Sutherland; and up to 2000 ft. in Northumberland. It is absent from Ireland.

Valerian grows in moist places such as wet meadows, marshes, and bogs. There it is as common as Water Dropwort, Marsh Marigold, Joint Rush, Marsh Arrowgrass, Common Spike Rush, and many other paludal types of vegetation. Tall and graceful, Valerian has simple stems with egg-shaped, stalked, radical leaves, spoon-shaped, and

Photo. Flatters & Garnett

VALERIAN (*Valeriana dioica*, L.)

undivided. The stem-leaves are pinnatifid, or with lobes divided nearly to the base, few, obtusely and coarsely toothed. The stem is square in section.

As the second Latin name suggests, the plants have stamens and pistils on different flowers. The first as well as the second has an inconspicuous calyx, with a prominent rim round the top of the ovary in the female. The flowers are tetramorphic. The corolla is monopetalous, with small tube, and has either rudimentary or no anthers, or the corolla may be large or smaller, with no pistil or a very rudimentary one. There are 3 stamens, which protrude from the flesh-coloured petals. The flowers are panicled. The fruit is small, ribbed, and smooth.

The Valerian is 1–2 ft. high. It flowers in May and July. It is a deciduous, herbaceous plant increased by division.

The honey is secreted in a small pouch with a green, fleshy ring ½ mm. from the base of the tube. The flowers are diœcious, stamens and pistils being on different plants, and are usually cross-pollinated. The male flowers are larger than the female, and are the first to be visited; but the female open first according to Kerner. The tube in the male plant is 2½ to 3½ mm. long, wider above; the female is only 1 mm., and the honey is accessible to short-lipped insects. The capitulum or head of the flower is not as conspicuous as in *V. officinalis*. It flowers so early that the plant is exposed to much less competition. Insects are numerous but not varied. There are 4 kinds of flowers: 1, male flower without rudiment of pistil and large corolla; 2, male flower with rudimentary pistil and smaller corolla; 3, female flower with traces of anthers and still smaller corollas; 4, female flower with scarcely any trace of anthers and very small corollas. It is visited by *Apis mellifica*, *Andrena albicans*, *Eristalis arbustorum*, *Rhingia rostrata*, *Tipula*, *Pieris napi*, *Meligethes*.

The calyx of the fruit is provided with feathery hairs which aid in wind dispersal.

This Valerian is addicted to wet land, and a peat-loving plant, requiring a more or less peaty habitat, such as that of a marsh or bog.

Two little fungi may be discovered parasitic upon it. They are *Uromyces Valerianæ* and *Synchytrium aureum*. A Thysanopterous insect, *Phlœothrips albipennis*, and a moth, *Depressaria pulcherimella*, feed upon it.

Valeriana may be from the Latin *valere*, to be powerful or well, because of its medicinal effects, and the second Latin name refers to its diœcious character.

This plant is an ornamental plant. It has been used for hysteria. Cats are fond of it, and rat-catchers also employ it.

Essential Specific Characters:—

145. *Valeriana dioica*, L.—Stem erect, radical leaves ovate, petiolate, stem-leaves pinnatifid, with terminal lobe, plants imperfectly diœcious, flowers white or rose-coloured, staminate flowers larger.

Cranberry (Oxycoccus palustris, Pers. = O. quadripetala, Gilib.)

Though an Arctic plant the Cranberry has not been found in any early deposits. At the present day it occurs in the North Temperate and Arctic Zones in Arctic Europe, but not in Turkey, in N. Asia, and

America. It is local in Great Britain, found only in Somerset in the Peninsula province; the Isle of Wight, N. Hants, and Sussex in the Channel province; Surrey, S. Essex in the Thames province; E. Suffolk, Norfolk, Cambridge, Hunts in Anglia; but does not occur in Glouc s or Hereford in the Severn province; not in Radnor or Pembroke in S. Wales; and in N. Wales, not in Montgomery or Merioneth; in the Trent province, not in Leics; in the Mersey province, not in Mid Lancs; in the Humber province, not in S.E. Yorks; but throughout

Photo, Flatters & Garnett

CRANBERRY (*Oxycoccus palustris*, Pers. = *O. quadripetala*, Gilib.)

the Tyne and Lakes provinces, except in the Isle of Man; in the West Lowlands, not in Wigtown; in E. Lowlands, not in Peebles, Selkirk, Haddington, or Linlithgow; in the E. Highlands generally, except in N. Aberdeen and Elgin; in Dumbarton, Cantire, North Ebudes, and E. Ross. It ascends to 2700 ft. in the Highlands. It is native in Ireland.

Cranberry is a true bog-loving plant, growing at high elevations in spongy peat-bogs where *Sphagnum* and other bog-mosses grow. It is associated with Grass of Parnassus, Sundew, Wild Rosemary, Bog Pimpernel, Bog Speedwell, Butterwort, Bladderwort, Bog Myrtle, Bog Asphodel, and many others.

The acid nature of the fruit is referred to in the first Greek name. The plant is a trailing evergreen, with a rooting angular stem, slender, and creeping. The leaves are egg-shaped, lance-shaped, coarsely-toothed, with turned-back margin, entire, and bluish-green below.

The flowers are pink with a wheel-shaped corolla, and the flower-stalks are 1-flowered, terminal, slender, long, and simple. The segments of the red corolla are turned back.

The stem is 3 in. high at most. Flowering is in full swing in June, right up to August. The flower is in bloom for nearly three weeks.

It is a shrub, perennial, propagated by layers, and worth cultivating for the fruit.

The flowers are as in the Whortleberry, but the corolla is wheel-shaped, and the anthers, which are broad, are awnless. The stamens form a tube and are projecting, the anthers being yellow, and the filaments purple and pubescent. The corolla lobes are narrow and linear. The style is filiform, the stigma blunt. The stamens on the outside are closely ranked, and insect visitors must penetrate to the stigma between the anthers. The berry is edible and red when ripe, and is eaten and dispersed in this way.

The Cranberry is a peat-loving plant which grows only in a humus or peaty soil, and is confined to certain woods and hilly moors.

A beetle, *Chailocnema sahlbergi*, two moths, Manchester Treble-bar (*Carsia imbutata*), *Mesotype virgata*, are found upon it.

Oxycoccus, Cordus, is from the Greek *oxys*, sharp, *coccus*, fruit or berry, because of its acridity, and Cranberry is given because it is ripe when the cranes (as they call herons) appear. The second Latin name refers to the 4 petals.

The names by which it is known include Bog-berry, Corn-berries, Cramberries, Cranberry, Craneberry, Cranna-berries, Crawberry, Crawnberries, Crone, Crones, Fenberry, Fen-grapes, Marsh Berries, Marsh Worts, Moonog, Moor-berries, Moss-berries, Moss Millions, &c.

The berries are sharp, and used in tarts and preserves. This rare heath is capable of cultivation.

Essential Specific Characters:—

191. *Oxycoccus quadripetala*, Gilib.—Shrub, stem prostrate, filiform, rooting, leaves small, glaucous below, margins revolute, evergreen, flowers rose, terminal, corolla rotate, segments reflexed, berries scarlet.

Wild Rosemary (Andromeda polifolia, L.)

Though not found there at the present day this typical bog plant has been discovered in Late Glacial beds at Hailes and Corstorphine near Edinburgh. At the present time it is found in the North Temperate and Arctic Zones in Arctic and Alpine Europe (not in Greece or in Turkey), Siberia, N. America. In Great Britain it is found in N. Somerset, W. Norfolk, Hunts, Stafford, Salop, Glamorgan, Cardigan, N. Wales, except in Montgomery, Merioneth, and Anglesea; Derby; in the Mersey province except Mid Lancs; in the Humber province except in S.E. and N.W. York, Northumberland; in the Lakes province except in the Isle of Man; in the E. Lowlands except in Wigtown, Roxburgh, W. Perth, Edinburgh, Stirling, and Ebudes. It is local in Ireland.

Photo. A. R. Horwood

WILD ROSEMARY (*Andromeda polifolia*, L.)

Wild Rosemary is a bog plant which is at home only in those few tracts where peat bogs still exist. It is owing to drainage that they are becoming more and more scarce year by year. Wild Rosemary is found in the same habitats as the Sundew, Butterwort, Bladderwort, Bog Myrtle, and the Asphodels.

The plant is an evergreen shrub, with a trailing, slender, leafy stem, which is woody, and rooting at the base. The leaves are lance-shaped, alternate, rolled back,[1] bluish-white beneath, smooth, and stalked.

The flowers are in terminal clusters, drooping, pink, the flower-stalks much longer than the flowers, which have 4 sepals, and a rounded corolla with 5 lobes, turned back. The capsule is erect, with egg-shaped seeds, which are made up of 5 lobes. The berries are edible.

The plant is not usually more than, and usually much less than, 2 ft.

[1] This is an adaptation to the physiologically dry conditions, as in other heath plants, and to prevent the stomata on the under side from being filled with water and so prevent respiration or breathing.

high. It is in flower from May to September, the berries maturing late in the autumn. It is a shrub which may be propagated by layers.

With its drooping flowers, which are small and purple, it is not very conspicuous. The stamens are ten in number, and not longer than the corolla, the filaments are bearded, and the short anthers are awned. The style is not divided into lobes, but the stigma is blunt or dilated, and the floral mechanism is much like that in *Vaccinium* and *Oxycoccus*.

The capsule splits up into 5 valves, and the seeds fall out and are blown away also by the wind.

Like other heath and bog plants this is a peat-loving plant, and grows in a peat soil.

The fungi *Rhytisma andromedæ* and *Exobasidium andromedæ* attack Rosemary.

Andromeda, a name given by Linnæus, is from Andromeda, a beautiful woman in mythology, daughter of Cepheus, king of Ethiopia; and the second Latin name refers to the polished leaves.

This rare plant is called Marsh Holy Rose, Moor-wort, Marsh and Wild Rosemary. The name Rosemary is given because it was formerly placed with the Rosemary group.

Many legends, &c., cluster around it. In Sicily they say it is beloved by fairies. An old Spanish proverb connects it with love, and has been thus rendered:

> "Who passeth by the rosemarie
> And careth not to take a spraye,
> For woman's love no care has he,
> Nor shall he though he live for aye".

On St. Agnes' Eve it was used as a love charm. There is a proverb:

> "While rosemary flourishes the lady rules".

It was used in the bridal crowns, and at the ceremony was dipped in scented water. Beaumont and Fletcher in the *Scornful Lady* ask: "Were the rosemary branches dipped?" Sprigs of it were once carried at funerals:

> "To show their love the neighbours far and near
> Follow'd with wistful look the damsel's bier;
> Sprigg'd rosemary the lads and lasses bore,
> While dismally the parson walked before".

Gay writes of Rosemary sprinkled on graves. Formerly it was much used at funerals and weddings, and garlands of Rosemary were laid on the biers of unhappy lovers.

It was superstitiously held to assist memory, and regarded as the symbol of remembrance:

"Rosemary is for remembrance
Between us day and night,
Wishing that I may always have
You present in my sight".

Ophelia in *Hamlet*, addressing Laertes, says (Act IV, Sc. 5):

"There 's rosemary, that 's for remembrance".

At Christmas a decoction of it was said to make the old young again. The following was said of a gouty, crooked, old queen:

"Of rosemaryn she took six pounde
An grounde it well in a stownde";

"and they mixed it with water in which she bathed three times a day, taking care to anoint her head with 'gode balm' afterwards. Soon her old flesh came away, and she became so young, fresh, and tender she soon began to look out for a husband". Probably many of these refer to Rosmarinus.

Essential Specific Characters:—

192. *Andromeda polifolia*, L.—Small evergreen shrub, stem filiform, woody, rigid, branched, leaves lanceolate, acute, alternate, margins revolute, glaucous below, flowers rose-purple, in drooping raceme, terminal, tufted, fruit a dry berry.

Bog Pimpernel (Anagallis tenella, Murr.)

Though a true bog plant it belongs rather to southern types (not northern), and has not been discovered up to the present in any ancient deposits. In the North Temperate Zone it occurs in Europe, south of Belgium, except in Russia, E. Siberia, N. Africa, and Temperate S. America. In Great Britain it is found in every part of the country except Middlesex, W. Gloucs, Roxburgh, Stirling, Perth, Forfar, W. Ross, E. Sutherland, more particularly in the west. It is native in Ireland.

Bog Pimpernel, like many other paludal plants, has become scarce on account of agricultural improvements owing to drainage and cultivation. It is a typical bog plant, growing on spongy, peaty wastes, as well as in less peaty tracts or marshes richer in lime, and in wet meadows and damp places caused by perpetual springs or the overflow from lakes and rivers.

The stems are prostrate, ascending at the tip and rooting at intervals, creeping, numerous, round or square, smooth, branched with purplish joints. The leaves are opposite, nearly stalkless or but shortly stalked, small, egg-shaped, entire, smooth. The flowers are pink, large, borne on simple, erect, finally turned-back flower-stalks, 1-flowered, in the axils of the leaves. The flowers are bell-shaped, large, with dark veins. The calyx is shorter than the corolla and dotted with red. The corolla is wheel-shaped or funnel-shaped. The

Photo Hinkins & Son

BOG PIMPERNEL (*Anagallis tenella*, Murr.)

anther-stalks are connected below. The capsule opens by a transverse fissure in the centre. The cells where the capsule opens are linear and loose, but larger, more rounded elsewhere. The seeds are brown, flattened on one side, and toothed.

Bog Pimpernel flowers from August to September. The height is about 3 in. It is perennial, propagated by division, and worth cultivating.

The flower is similar in form to that of Scarlet Pimpernel, but red or pink with darker veins. The anther-stalks are united at the base forming a cylinder, the flower campanulate, and rather large, the corolla is wheel-shaped and erect, and the anther-stalks are very hairy, filling the corolla, to prevent the honey from being spoilt by rain. The

anthers are yellow, the style tapers, and is longer than the anthers, and the stigma is simple. It is not likely to be self-pollinated owing to the projection of the stigma.

The capsule splits up transversely allowing the seeds to fall out around the parent plant.

The Bog Pimpernel is a peat-loving plant, and requires a peaty soil.

The second Latin name refers to its slender trailing or creeping stems. It is known by the name of Bog Pimpernel and Moneywort. It is a pretty flower and quite worthy of a place in our rock-gardens and bog-pools.

Essential Specific Characters:—

206. *Anagallis tenella*, Murr.—Stem procumbent, leaves round, shortly stalked, ovate, not dotted, flowers pink, in the axils, solitary, filaments united below, corolla infundibuliform.

Water Violet (Hottonia palustris, L.)

This local, but widely-dispersed aquatic, once known in the London area, is generally found in the Northern Temperate Zone in Europe, except in Spain, Greece, and Turkey, and Western Siberia. In Great Britain it is found in the Peninsula province in Somerset; in the Channel province, in S. Wilts, Dorset, N. Hants, Sussex; throughout the Thames province and Anglia; in the Severn province, not in Gloucs, Monmouth, Hereford; in Wales, only in Carnarvon, Denbigh, Flint, Anglesea; but throughout the Trent, Mersey, and Humber provinces; in Durham and Westmorland, from which last it ranges to the south coast. It is found in Down in Ireland.

Water Violet is an aquatic plant, which is local but uniform in its habitat, frequenting the larger tracts of water in England and Wales, especially where still but not stagnant pools exist. It used to be found in Battersea Meadows, but is extinct there owing to drainage, and its occurrence is much more restricted than formerly. It is also a marsh plant, growing in wet, peaty hollows. There is no doubt that it was originally terrestrial, and that it has but recently adopted an aquatic habitat.

Water Violet is a floating plant, with fine, white, capillary roots, which penetrate deep into the mud. The aerial stem is a scape, and leafless. The leaves are not perfect whorls, submerged, with leaflets each side of a common stalk, in tufts, and prostrate.

The flowers are white, lilac, or pale-purple, and borne in whorls, stalked, growing on a long-stalked scape, which is naked and smooth.

The flowers are in spikes. The corolla greatly exceeds the calyx, and is salver-shaped, the petals being notched at the extremity. The oblong anthers are yellow. The raised aerial flower-stalks indicate the plant's former terrestrial origin. The seeds are oval, inserted in a receptacle within the capsule.

The plant is 1 ft. in height, and flowers from July to August. It is perennial, propagated by seeds, and worth cultivating.

The flower is dimorphic. The stamens and pistil are relatively in

Photo. H. Irving

WATER VIOLET (*Hottonia palustris*, L.)

the same position as in *Primula*. The flowers of the Water Violet may be cleistogamic. Honey is secreted by the ovary. The tube is 4–5 mm. in both forms, the male and female organs standing, in one in the entrance, and in the other projecting 3–4 mm. When damp the pollen-grains in the long-styled form are spherules .011 to .014 mm. broad, and in the short-styled form they are .018 to .023 mm. The stigma is rough and velvety in the former, and the papillæ are larger than in that of the latter, which is fairly smooth. Organs of equal height are touched by the same parts by insects seeking honey, cross-pollinating the flower legitimately. Those which feed on pollen do not thrust the head into the flower in short-styled forms, and do not touch

No. 1. Bog Bean
(*Menyanthes trifoliata*, L.)

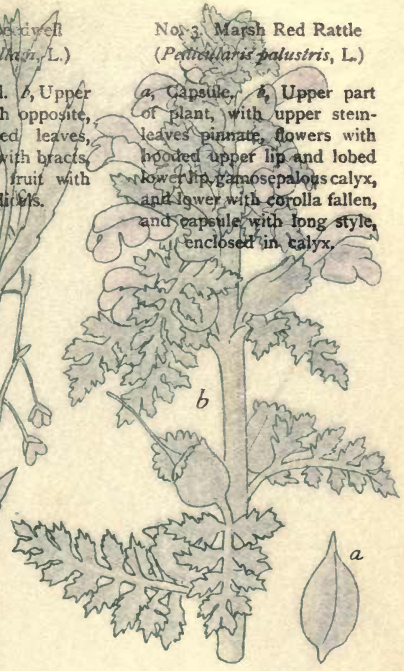
a, Capsule, dehiscing by valves, showing seeds. *b*, Ovary, with style, and showing calyx-teeth below. *c*, Trifoliate leaf. *d*, Raceme, with flowers in various stages, showing corolla-lobes, with bearded fringe, 5 stamens, and stigma.

No. 2. Bog Speedwell
(*Veronica scutellata*, L.)

a, Capsule, 2-lobed. *b*, Upper part of plant, with opposite, lanceolate, toothed leaves, axillary racemes, with bracts, and flowers and fruit with reflexed pedicels.

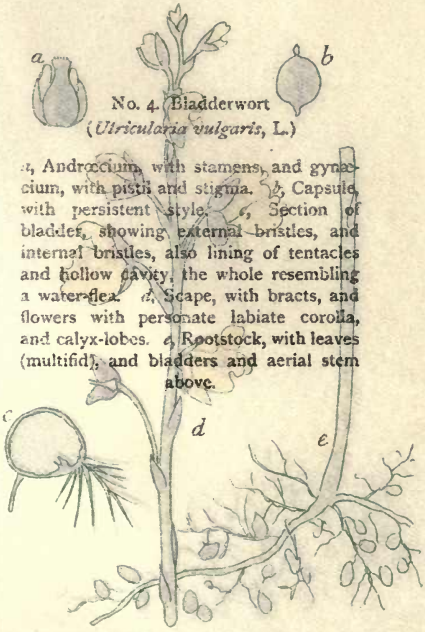
No. 3. Marsh Red Rattle
(*Pedicularis palustris*, L.)

a, Capsule, *b*, Upper part of plant, with upper stem-leaves pinnate, flowers with hooded upper lip and lobed lower lip, gamosepalous calyx, and lower with corolla fallen, and capsule with long style, enclosed in calyx.



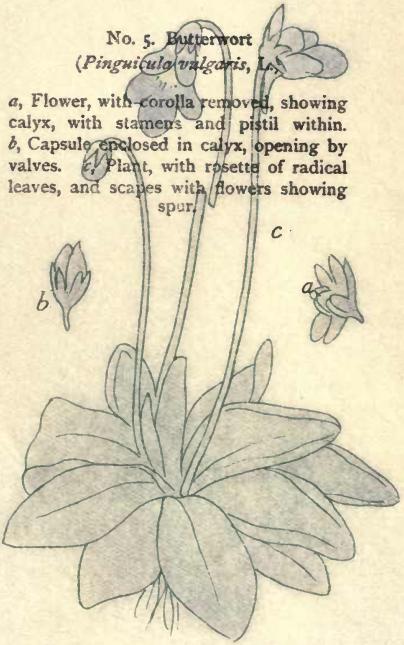
No. 4. Bladderwort
(*Utricularia vulgaris*, L.)

a, Androecium, with stamens, and gynaecium, with pistil and stigma. *b*, Capsule, with persistent style. *c*, Section of bladder, showing external bristles, and internal bristles, also lining of tentacles and hollow cavity, the whole resembling a water-flea. *d*, Scape, with bracts, and flowers with personate labiate corolla, and calyx-lobes. *e*, Rootstock, with leaves (multifid), and bladders and aerial stem above.



No. 5. Butterwort
(*Pinguicula vulgaris*, L.)

a, Flower, with corolla removed, showing calyx, with stamens and pistil within. *b*, Capsule enclosed in calyx, opening by valves. *c*, Plant, with rosette of radical leaves, and scapes with flowers showing spur.



1. Bog Bean (*Menyanthes trifoliata*, L.). 2. Bog Speedwell (*Veronica scutellata*, L.). 3. Marsh Red Rattle (*Pedicularis palustris*, L.). 4. Bladderwort (*Utricularia vulgaris*, L.). 5. Butterwort (*Pinguicula vulgaris*, L.).

the stigma, which they touch only in long-styled forms, where they have to thrust the head to reach the pollen, and visits to several of these running cause illegitimate cross-pollination; and where it is more effective than in short-styled forms, because probably the latter are fewer and the former alone useful. It is visited by a Hymenopterous insect, *Pompilus*, and the flies *Empis*, *Eristalis*, *Rhingia*.

The capsule is 5-valved and many-seeded, and opens below, allowing the seeds to fall out, and fall in the water to sink or float.

As an aquatic plant it is not dependent on soil, but as a marsh plant requires a peat soil.

Hottonia, Boerhaave, was named after Pierre Hotton, a professor at Leyden (d. 1709), and the second Latin name refers to its marshy habitat.

Water Violet is called Bog Featherfoil, Featherfoil, Water Gilliflower, Water Milfoil, Water Yarrow. The first name is in reference to its feathery leaves.

The roots consist of white capillary fibres, which strike deep into the mud, and the leaves grow in tufts below the water, while just the upper part of the stem rises above it. Water Violet is attractive enough to be planted in ponds as an ornament.

Essential Specific Characters:—

198. *Hottonia palustris*, L.—Flowering stem a scape, leafless, erect, leaves submerged, in whorls, pectinate, finely divided, flowers pink, lilac, whorled, in racemes. terminal, corolla salver-shaped.

Bog Bean (Menyanthes trifoliata, L.)

Being strictly paludal this plant is one of those widely preserved in ancient deposits, as in Preglacial beds in Norfolk, Early Glacial beds in Norfolk, Interglacial beds at West Wittering, Late Glacial and Neolithic deposits. To-day it is found in Arctic Europe, Siberia, Dahuria, N. and W. India, N. America, in the North Temperate and Arctic Zones. It is found in every county of Great Britain except Hunts, and it grows at 1800 ft. in the Lake District.

The Bog Bean is a typical bog plant, growing only in the last resorts of the wild-fowler to-day, and not rarely surviving the drainage of its habitat wherever it grows. Damp hollows at the side of hills, wet meadows bordering streams, and true bogs or marshes are the places in which to search for this plant.

The habit is more or less prostrate. The rootstock is matted, stout, creeping. The stem is ascending, leafy, round in section. The

leaves are ternate or 3-lobed, trifoliate (hence *trifoliata*). The leaflets are blunt, entire, with very short stalks, equal, inversely egg-shaped or oblong, wavy, the ultimate nerves having the tips free within the larger areoles. The sheath of the leaf-stalk is long and narrow, and not so long as the many-flowered scape.

The flowers are in a raceme with a leaf opposite it, white or pink, or flesh-colour, the upper surface of the corolla clothed with beautiful whitish filaments, or densely fringed within or bearded. The flower-

Photo. B Hanley

BOG BEAN (*Menyanthes trifoliata*, L.)

stalks are long, the ultimate ones short, stiff, spreading. The bracts are short, blunt, and broad. The sepals are oblong, blunt. The stamens are reddish. The capsule is blunt-pointed, many-seeded, the seeds small, polished.

The plant is 1 ft. high. It flowers, when it does flower, which it does not always do, in July, but I have seen it in bud in April. The plant is perennial, propagated from cuttings, and worth cultivating.

Honey is secreted by the base of the ovary. The flowers are usually heterostylic or dimorphic, a long-styled and a short-styled form being found; but not everywhere, for in West Greenland plants of homomorphic type occur, with the pistil and stamens of the same

length. No doubt the flower is rendered more conspicuous by the bearded surface of the corolla. The stamens, with purple anthers, are inserted on the tube, and the style is very slender, the stigma 2-lobed. The tube is somewhat funnel-shaped or bell-shaped, and accessible to most insects. The bearded filaments serve to keep out flies and protect the honey from the rain. The papillæ of the stigma in the long- and the short-styled forms differ. So does the pollen, as in the Primrose. Few insects visit the flowers, as they grow in rather secluded spots, and are hidden under herbage, &c.

The capsule contains many seeds, dispersing them on opening partly by aid of the wind.

Bog Bean is a peat-loving species, growing on peat soil or watery wastes overlying clay.

The leaves are attacked by a fungus, *Protomyces menyanthii*. Two moths, *Spilosoma urticæ*, the Light Knot Grass (*Acronycta menyanthidis*), adopt the Buckbean as their food plant.

Menyanthes, Dioscorides, is from the Greek *men*, month, *anthos*, flower; and the second Latin name refers to the trifoliate leaves. Buckbean is from *buckerbeane*, Dutch *bocks boonen*. It is called Bean Trefoil, Beckbean, Bogbean, Bog Hop, Bog-nut, Brookbean, Buckbean, Marsh Claver, Marsh Cleever, Marsh Clover, Doudlar, Threefold, Bog, Marsh or Water Trefoil. It is called Bog Trefoil because of its clover-like leaves, and Bog Hop because of its well-known bitter properties and place of growth.

Bog Bean was said to be a tonic and febrifuge, or cure for fever. It has been used in place of Hops, and was formerly used for dropsy and rheumatism, whence its rarity in some districts. In Lapland they eat the powdered roots.

Essential Specific Characters:—

212. *Menyanthes trifoliata*, L.—Stem ascending, terete, leaves trilobed, leaflets obovate, flowers pink, fringed.

Bog Speedwell (Veronica scutellata, L.)

Though an Arctic plant no seeds of this common bog plant have as yet been discovered in peat or other deposits yielding such remains. It is found in Arctic Europe, N. Africa, N. and W. Asia, N. America in the Arctic and N. Temperate Zones. It occurs in every part of Great Britain except Merioneth, Linlithgow, northward to the Shetland Isles. In Yorks it is found at the height of 2200 ft. It is found in Ireland and the Channel Islands.

Bog Speedwell is a hygrophyte, or moisture-loving plant, which grows in damp places, and was probably once more frequent, but owing to drainage is now local. It grows in marshy tracts and bogs with Bog Pimpernel, Asphodel, &c., and is found by the margins of pools, lakes, as well as in ditches, brooks, and rivers, where the ground is flooded.

The habit is that of a trailer, the plant being seldom more than suberect. It gives off young shoots above the surface; the stem is subangular, smooth, and branched. A characteristic feature is to be found in the long lance-shaped-linear leaves, slightly toothed along the margin, opposite, stalkless, and smooth. In a variety the stems and leaves are hairy.

Photo. A. R. Horwood

Bog Speedwell (*Veronica scutellata*, L.)

The flowers are borne on alternating racemes, which are axillary, loose, wavy, and many-flowered. The bracts or leaflike organs are lance-shaped. The flower-stalks are pendulous. The calyx is deeply cut. The corolla is wheel-shaped, white or pinkish, with purple veins. The capsule consists of two rounded lobes, which are flattened, with rounded, flat, yellow seeds.

Bog Speedwell is often 2 ft. long. The flowers open in June, July, and August. The plant is perennial, propagated by division.

The floral mechanism is like that of Ivy-leaved Toadflax, but the flowers are in axillary racemes, and the plant grows in boggy places where it is obscured by herbage, which helps to support it, and little likely to be cross-pollinated by insect agency very frequently. The corolla is white or pink, wheel-shaped, the 2 filaments are thicker in the middle, and the anthers are white. The style is drooping and white, the stigma also turned back and yellow.

The capsules on turned-back flower-stalks are margined and fringed with hairs, and adapted mainly for wind dispersal.

The Bog Speedwell is a peat-loving plant, and requires a peat soil.

The second Latin name refers to the shape of the capsule, shield-like or salver-shaped.

This plant is distinguished from other species by the narrow, usually smooth leaves. The leaves are slightly toothed, and the flower-stalks loose and straggling, turned back in fruit.

Essential Specific Characters:—

236. *Veronica scutellata*, L.—Stem slender, glabrous, leaves toothed, linear-lanceolate, sessile, flowers white or pale-pink in alternate racemes, axillary, capsule of two flat, rounded lobes, fruit-stalk deflexed.

Marsh Red Rattle (Pedicularis palustris, L.)

As an Arctic plant the occurrence of this plant in Neolithic beds in Edinburgh and Renfrewshire is quite what one would expect. It is general throughout the Arctic and Temperate Zones in Arctic Europe (but not in Spain or Greece) and N. Asia. It is found in all parts of Great Britain, except N. Somerset, as far north as the Shetlands up to 1800 ft. in the Highlands. It is native in Ireland and the Channel Islands.

Marsh Red Rattle is a typical hygrophile, growing in wet marshy ground at the sides of pools where thick reed-beds are formed. It is also common to the sides of streams which have overflowed. Growing in true bogs with bog species it merges into the marsh and wet-meadow type of plant. It is a hemi-parasite living on grass roots.

This plant is bushy, erect, and compact, with several ascending branches springing just above the base. The leaves have lobes each side of a common stalk, and the leaflets are deeply and regularly much divided nearly to the base, giving the plant very much the appearance of a bracken fern. The branches are purple-tinged, a feature of marsh plants. The whole plant is smooth.

The flowers are large and reddish-purple or crimson. The calyx is much inflated, downy, ovate, egg-shaped, and divided into two deeply-cut lobes. The upper part of the corolla has a short, blunt beak, with a triangular lobe each side. The capsule is curved and longer than the calyx.

The plant is 2 ft. in height very frequently. It flowers in June and July. It is annual, and propagated by division. It is quite worth placing in the bog-garden.

The flowers are like those of *P. sylvatica*, but the tube is shorter. They contain honey secreted at the base of the ovary. The corolla has a cylindrical tube with an enlarged throat into which insects thrust the head. The upper lip is 3-toothed, narrow; the lower, 3-lobed, serving as an alighting-place. The 4 stamens are concealed by the upper lip. The two posterior anther-stalks are hairy, and serve to protect the honey from the rain and flies, and the anthers are adherent by the close-set hairs near the base in Common Red Rattle, but not in this plant, as they are close together.

Photo. Flatters & Garnett

MARSH RED RATTLE (*Pedicularis palustris*, L.)

The seeds, contained in a capsule which splits open above, are dispersed around the plant automatically or by the wind.

Marsh Red Rattle is a peat-loving plant, and will only grow on a peat soil, or where there is clay with humus.

A cluster-cup fungus, *Puccinia paludosa*, attacks the leaves. A beetle, *Longitarsus holsaticus*, infests Marsh Lousewort.

Pedicularis, Gerarde, is from the Latin *pediculus*, louse, because it was said to produce a lousy disease in sheep. The second Latin name refers to the marshy habitat.

This plant is called Cock's-comb, Cow's-wort, Dead Men's Bellows, Rattle-grass, Lousewort, Moss Flower, Red Rattle, Suckies. The name Rattle-grass, according to Gerarde, is explained because the dry, somewhat inflated calices rattle audibly when shaken. Lyte explains Lousewort as follows: "In Latine *Pedicularis*, that is to say Louse herbe, in high Dutch Leuszkraut, by cause the cattell that

pasture where plentie of this grass groweth become full of lice". But this is due to their poor condition.

Essential Specific Characters:—

240. *Pedicularis palustris*, L.—Stem erect, solitary, purple, branched throughout, leaves pinnatifid, flowers crimson, calyx hairy, ovoid, 2-lobed.

Bladderwort (Utricularia vulgaris, L.)

Though paludal, there is no record of Bladderwort in early seed-bearing beds. The present range is Europe, N. Africa, Siberia, N. America, or the N. Temperate Zone. In Great Britain it is found in the Peninsula, Channel, Thames, Anglia, and Severn provinces; in the last in E. Gloucs, Warwick, Stafford; in Wales in Glamorgan, Radnor, Carnarvon, Flint, Anglesea; in the Trent province; in the Mersey province, except Mid Lancs; in the Humber, Tyne, and Lakes provinces, except in the Isle of Man; in the W. Lowlands, E. Lowlands, except Peebles, Selkirk, Linlithgow; in the E. Highlands, except in Stirling, S. Perth; in the W. Highlands, except in Cantire, Ebudes (S., Mid, and N.); and in E. Ross and the Northern Isles. It ascends to 1500 ft. in the Highlands. It is a native in Ireland and the Channel Islands. Probably few persons that have not made systematic botanical surveys, or visited special stations for certain plants, have had the good fortune to discover the elusive Bladderwort.

Though typical of bog and marsh formations it is also found, more seldom now than formerly, in pools and ditches, and may also occur here and there in ponds, but its chief habitat is the bog-pools on the side of moist mountains. In this way it is common to either formations.

The bladders are on short stalks. They are about one-tenth of an inch long. The green translucent utricles,[1] as they are called, consist of two layers of cells, the outer large, and forming many-angled cells, with smaller rounded cells in the angles. The inside of the bladder is filled with absorbent processes in groups two long and two short.[2]

The lower side is straight, the upper arched, and in general form it resembles a water flea. Two sets of processes surround the entrance, two long and branched above, others straight in groups around the mouth, which has a collar within, with a flap which closes the cavity, and can be easily pushed aside by a minute aquatic insect or crustacean entering, but effectually closes it once the insect is within. The walls

[1] Hence the first Latin name, and also the English name. The utricle or bladder in this plant must not be confounded with the utricle or fruit in sedges (also bladder-like in form externally).

[2] See Charles Darwin, *Insectivorous Plants*.

are contracted in the entrance, and the flap is semicircular so that it cannot be pushed aside.

This is a floating plant, with much-divided leaves as in nearly all aquatic submerged plants, the branches and segments thread-like, and attached to them are numerous egg-shaped bladders or pitcher-like bodies assisting in floating and also in obtaining insectivorous matter for food. There are no roots.

The flowers of this originally terrestrial plant are single, borne on

Photo. J. Ward

BLADDERWORT (*Utricularia vulgaris*, L.)

an erect scape, the corolla yellow, large, with a conical spur, in which is the nectary, the upper lip entire, equalling the palate, and the lower lip is rolled back. When the plant has flowered the bladders fill with water and sink. The calyx is divided into two segments nearly to the base. There are only two stamens.

The scape may be 6 in. long. The flowers bloom in June and July. It is a perennial plant propagated by division. In autumn the plant dies down, except the terminal part, and a bud is formed.

An insect alighting on the lobes of the lower lip, visiting the flower, thrusts its proboscis beneath the upper lip to reach the honey. This is secreted in the spur in the lower lip, which is in 3 parts, the spur part fitting into the upper lip and lateral lobes, and the insect touches with

its back first of all one of the lobes of the stigma which project beyond the anthers. Their papillose surfaces are at first directed downwards and stand near the upper lip. The insect then touches the anthers, which open downwards, and is dusted with their pollen. The stigma is irritable, and capable of folding upwards immediately it is touched, so that pollen from the same flower cannot be applied to the stigma, and rows of hairs on its edge brush the pollen from the insect's head as it draws back. The flower is closed and accessible only to flies.

The globular capsule opens by 2 valves, bursting irregularly, and allows the seeds to be dispersed in the water and to sink or germinate in the mud at the margin.

Bladderwort is aquatic, and more or less independent of soil, though addicted to more or less upland peaty districts as a helophyte or marsh plant.

A beetle, *Phyllobrotica quadrimaculata*, feeds upon it.

Utricularia, Linnæus, is from the Latin *utriculus*, a little bladder, from the bladder-like pitchers or floats, and the second name (Latin) suggests that it is of common occurrence, which, however, is not the case.

It is known as Bladder-snout, Bladder-wort, Hooded Water Milfoil. The latter name was applied because of the hooded flowers and finely-divided leaves.

Essential Specific Characters:—

244. *Utricularia vulgaris*, L.—Stem submerged, floating, leaves pinnate, with filiform segments, flowers yellow, spur half as long as the lip, conical, upper lip equal to palate, margin of lower lip reflexed.

Butterwort (Pinguicula vulgaris, L.)

Butterwort is found in the Arctic and North Temperate regions in Arctic Europe, N. Asia, and N. America, but it is not found in any early deposits like other members of its association. In Great Britain it is absent in the Peninsula province from Cornwall, and in the Channel province occurs only in Dorset and N. Hants; in the Thames province only in Herts, Berks, Oxford, Bucks, Anglia; in the Severn province not in W. Gloucs; in S. Wales not in Radnor, Pembroke, Cardigan; in N. Wales not in Montgomery; in the Trent province not now in Rutland; in the Mersey, Humber, Tyne, and Lakes provinces; W. Lowlands; E. Lowlands not in Selkirk; E. Highlands; in the W. Highlands not in Mid Ebudes; N. Highlands and North Isles. It is rare in the south of England, and ascends to

3000 ft. in the Highlands. It is a native of Ireland and the Channel Islands.

When bogs were more numerous Butterwort was to be found in many different parts of the country, but chiefly, as now, in the north. It is fond of spongy pools amongst the wild morasses of the north, on the sides of hills, as well as at lower levels. It is associated with Sphagna, Drosera, Rosemary, Bog Pimpernel, &c.

The plant has a rosette of 8 radical leaves, 1½ in. long, ¾ in. broad, which are thick, greasy (hence the first Latin name), and fleshy. They are entire, coated with crystalline points and pale-greenish in colour, blunt, egg-shaped, succulent, prostrate, the central hollow, with a short, broad stalk. The older leaves are flat or convex, rosette-like in form. The margins are curved inwards.

Photo. Flatters & Garnett

BUTTERWORT (*Pinguicula vulgaris*, L.)

The flowers are purple, large, nodding, with an awl-like spur, straight, as long as the petals, the upper lip divided into two, the lower into three. The scape is smooth and dilated. The corolla is gaping. The capsule is subglobose.

The glandular hairs on the upper surface of the leaves are of two kinds; the larger glands are circular in outline from above, thick, finely divided by radial divisions into 16 cells containing a light-green secretion. They differ in size and in the length of the stalk. The fluid is sticky, and can be drawn out into threads 18 in. long. A leaf may bear as many as 500,000 glands. Insects that alight upon them are at once caught. The leaf margin curls over, bringing the insect so imprisoned to the centre, where the glands are more numerous. Not only are insects caught, but pollen, seeds, &c., adhere to the leaves. The insects are slowly "digested" by the aid of the fluid secretion. The plant is thus insectivorous.

Butterwort is 6 in. in height. Flowers should be sought in May. The plant is a perennial, increased by division.

The flowers are open, conspicuous, and visited by bees. The stigma, which is not sensitive, i.e. does not move, is pushed up by the insect when it draws out its proboscis. A fly which enters the flower

rubs against the stigma with its back, and dusts it with pollen from another flower, so bringing about cross-pollination. When it retreats it pushes back the stigma. The capsule splits open, and thus allows the seeds to be dispersed around the parent plant.

This curious plant, the Butterwort, is a peat-loving plant, and requires a peat soil.

Pinguicula, Gesner, is from the Latin *pinguis*, fat, because the leaves are thick and unctuous; and the second Latin name indicates that it is common, which is true only relatively, i.e. where bogs exist.

Butterwort is also known as Beanweed, Bog Violet, Butter Plant, Butter-root, Clowns, Earning-grass, Eccle, Rot Sheep, Thickening Grass, Yorkshire Sanicle, Sheep-root, Sheeprot, Steep-grass, Marsh Violet, White Rot. It is called Sheep-root "because when turned up by the plough sheep greedily feed on it", and Sheeprot because it was supposed that it caused the liver-rot in sheep, a disease common on wet land where the plant grows, and caused by the Liver Fluke, *Distomum hepaticum*.

A writer says: "They call it white Rot, and not white roote, as Gerard saith, for the country people doe thinke their sheepe will catch the rot if for hunger they should eate thereof, and therefore call it the White Rot, of the colour of the herbe, as they have another they call the Red Rot, which is Pedicularis Red Rattle". Beanweed was given it because it comes up like a bean in the spring.

It is called Butterwort from the greasy feel of its leaves, as if melted butter had been poured on them. The name Earning Grass alludes to its property of acting as rennet, to "earn" meaning to curdle. Rot-grass is another name based on the supposed power of the plant to cause rot in sheep. Steep-grass refers also to the curdling property, "steep" being rennet in Lancashire and Cheshire, and Thickening Grass alludes also to the curdling property.

Gerarde says the juice was rubbed in cows' udders when cracked. In the north in the time of Linnæus they put fresh leaves in reindeers' milk and strained it, and after a day or two it became tenacious, as the whey and cream do not separate. It does not act on cows' milk in the same way.

Essential Specific Characters:—

245. *Pinguicula vulgaris*, L.—Flowering stem a scape, leaves radical, in a rosette, oblong, fleshy, with recurved margins, with crystalline points, flowers purple, corolla gaping, petals oblong, distinct.

Golden Dock (Rumex maritimus, L.)

This is one of those marsh plants that commonly occur in ancient deposits, being found in Preglacial, Early Glacial beds in Norfolk, Interglacial beds in Suffolk, and Late Glacial beds in Suffolk. To-day it is found in the North Temperate Zone in Europe, N. and W. Asia, N.W. India, N. America. In Great Britain it is found in Somerset, Dorset, Sussex, Kent, Surrey, S. Essex, Middlesex, Berks, Oxford, in Anglia except W. Suffolk, in Worcester, Warwick, Stafford, Salop, the Trent province, the Mersey and Humber provinces except in S.W.

Photo. Horwood

GOLDEN DOCK (*Rumex maritimus*, L.)

Yorks, or from Northumberland to Kent and Somerset; and in Ireland and the Channel Islands.

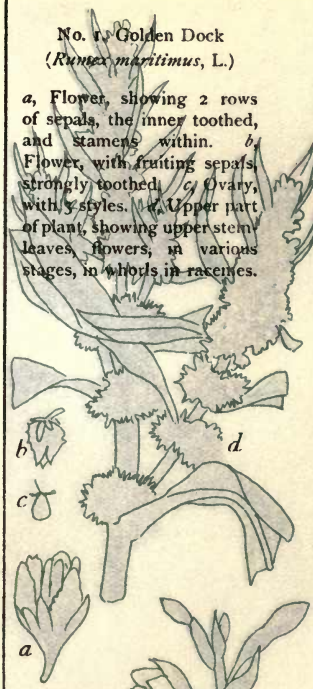
Native in marshes but rare, the Golden Dock has within recent years become widely distributed, in ballast and otherwise, around the shores of reservoirs and other tracts of water, as well as in waste places here and there. In the past it was dispersed doubtless with other plants by wildfowl.

The stem is tall, erect, branched, reddish, furrowed, and rough. The radical leaves are stalked, oblong-lance-shaped, narrowed at the base, bluish-green, flat, wavy, scalloped, the upper leaves linear-lance-shaped, incurved upwards.

The flowers are yellow, in a panicle with spreading branches, with 3 enlarged petals, with hair-like bristles on each side of a tubercle, as

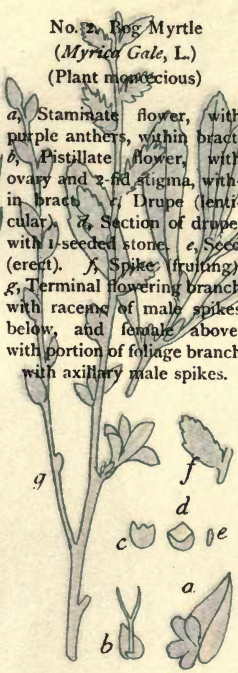
No. 1. Golden Dock
(*Rumex maritimus*, L.)

a, Flower, showing 2 rows of sepals, the inner toothed, and stamens within. *b*, Flower, with fruiting sepals, strongly toothed. *c*, Ovary, with 3 styles. *d*, Upper part of plant, showing upper stem-leaves, flowers, in various stages, in whorls in racemes.



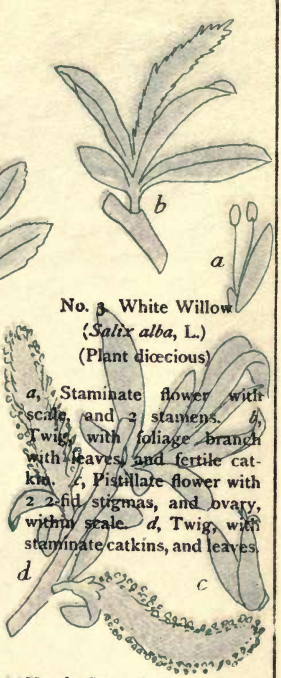
No. 2. Bog Myrtle
(*Myrica Gale*, L.)
(Plant monœcious)

a, Staminate flower, with purple anthers, within bract. *b*, Pistillate flower, with ovary and 2-fid stigma, within bract. *c*, Drupe (lenticular). *d*, Section of drupe, with 1-seeded stone. *e*, Seed (erect). *f*, Spike (fruiting). *g*, Terminal flowering branch with raceme of male spikes below, and female above, with portion of foliage branch with axillary male spikes.



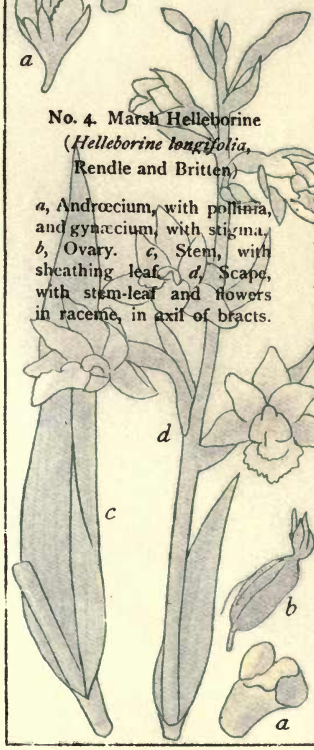
No. 3. White Willow
(*Salix alba*, L.)
(Plant diœcious)

a, Staminate flower with scale, and 2 stamens. *b*, Twig, with foliage branch with leaves, and fertile catkin. *c*, Pistillate flower with 2 2-fid stigmas, and ovary, within scale. *d*, Twig, with staminate catkins, and leaves.



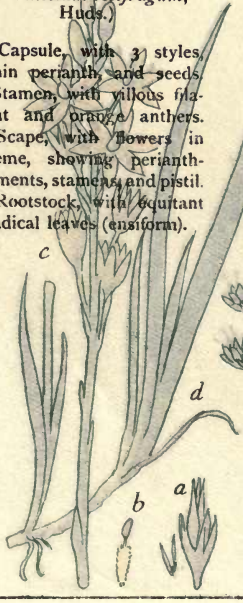
No. 4. Marsh Helleborine
(*Helleborine longifolia*, Rendle and Britten)

a, Androecium, with pollinia, and gynæcium, with stigma. *b*, Ovary. *c*, Stem, with sheathing leaf. *d*, Scape, with stem-leaf and flowers in raceme, in axil of bracts.



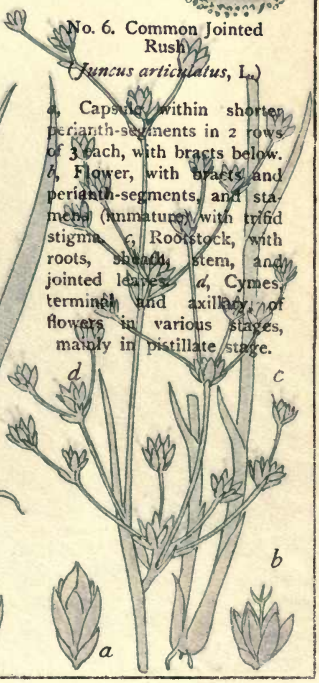
No. 5. Bog Asphodel
(*Narthecium ossifragum*, Huds.)

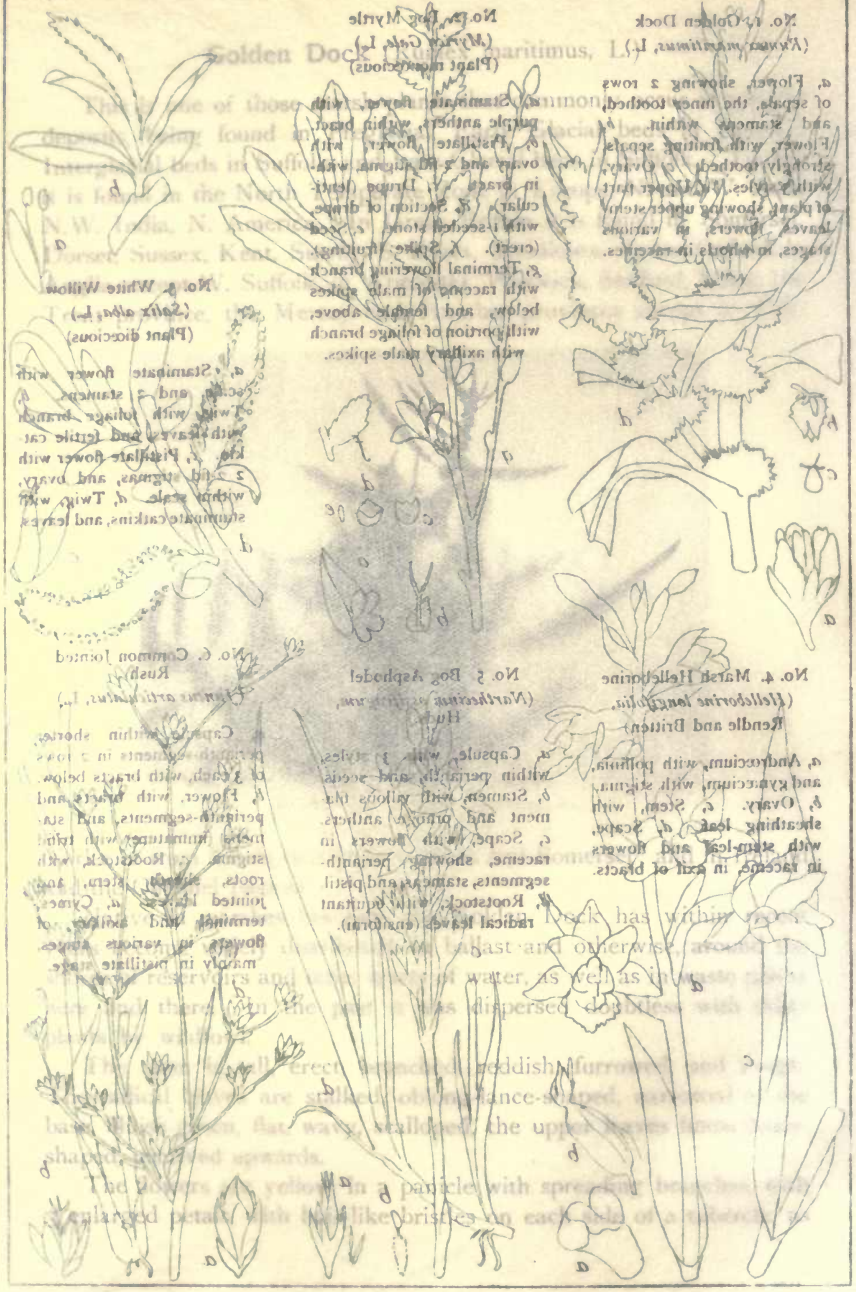
a, Capsule, with 3 styles, within perianth, and seeds. *b*, Stamen, with villous filament and orange anthers. *c*, Scape, with flowers in raceme, showing perianth-segments, stamens, and pistil. *d*, Rootstock, with equitant radical leaves (ensiform).



No. 6. Common Jointed Rush
(*Juncus articulatus*, L.)

a, Capsule, within shorter perianth-segments in 2 rows of 3 each, with bracts below. *b*, Flower, with bracts and perianth-segments, and stamens (immature) with trifid stigma. *c*, Rootstock, with roots, sheath, stem, and jointed leaves. *d*, Cymes, terminal and axillary, of flowers in various stages, mainly in pistillate stage.





1. Golden Dock (*Rumex maritimus*, L.). 2. Bog Myrtle (*Myrica Gale*, L.). 3. White Willow (*Salix alba*, L.). 4. Marsh Helleborine (*Helleborine longifolia*, Rendle and Britten). 5. Bog Asphodel (*Narthecium ossifragum*, Huds.). 6. Common Jointed Rush (*Juncus articulatus*, L.).

long as the petals, in dense whorls often running together. The nut is small, with elliptic sides and 3-sided.

Golden Dock is 2 ft. high. Flowers may be looked for in July and August. The plant is perennial, and propagated by roots.

The flowers are pollinated by wind. The stamens are six in number, with anthers fixed by their base, 3 thread-like styles, and large penicillate stigmas. The flowers are hermaphrodite. The stigmas and anthers ripen together. The nuts are winged, and when they fall they are carried to a distance by the wind.

Golden Dock is a helophyte or marsh plant growing in saline soil, and a sand-loving plant growing also in sand soil.

Rumex, Pliny, is Latin for sorrel, and the second Latin name refers to its habitat, by the sea.

Golden Dock is also called Small Water Dock.

Essential Specific Characters:—

269. *Rumex maritimus*, L.—Stem erect, branched, leaves lanceolate, narrow at the extremities, flowers perfect, petals rhomboidal, in crowded whorls.

Bog Myrtle (Myrica Gale, L.)

Though unknown in a fossil state in England Bog Myrtle is found in the Oak Zone in Gothland and elsewhere. In the N. Temperate Zone it is found in W. and N.W. Europe, N. Asia, and N. America. In Great Britain it is absent in the Peninsula province in Somerset; in the Channel province in N. Wilts; in the Thames province in Essex, Herts, Oxford, Anglia, but not in Northants; in S. Wales it is absent in Brecon and Radnor; in N. Wales; in the Trent province not occurring in Leics, and Rutland, or Derby; in the Mersey province not in Mid Lancs; in the Humber province not in N.W. York; in the Tyne province not in Durham; in the Lakes district; W. Lowlands; in the E. Lowlands only in Edinburgh; in the E. Highlands not in Stirling; W. Highlands, N. Highlands; in the North Isles, except in Shetlands, or from Caithness to Cornwall; elsewhere in the Highlands it is found at 1800 ft. It is a native of Ireland.

Bog Myrtle in name indicates its habitat, which is essentially paludal, and the plant is a decided xerophyte, adapted to drought like other bog plants; as with other bog species, too, it is frequent also on moors where there is less moisture.

The plant is shrubby, small though it be, usually smooth and erect, with lance-shaped, inversely egg-shaped, smooth leaves, which are

more or less coarsely-toothed, and bitter in taste, shortly stalked, downy beneath.

The flowers are in spikes, with bracts, the male ones in spikes crowded and erect, with broad, egg-shaped, hollow, leaflike organs, and red anthers, the female having red styles. The berry, a drupe, is 2-winged, small, and lens-shaped.

The plant is 2–4 ft. in height. The flowers bloom in May, June, and July. Bog Myrtle is a deciduous shrub, propagated by layers.

The plant is usually dicœcious, but the flowers may be complete.

Photo. Dr. Somerville Hastings

BOG MYRTLE (*Myrica Gale*, L.)

The flowers are in short catkins. The male has 2 bracteoles and 4 stamens, and the female has 4 bracteoles, 2 syncarpous carpels, and 1 orthotropous ovule. The flowers are pollinated by the wind. The styles are stigmatic all over. The anthers open outwards, and are fixed by the base. The pollen is powdery, held by the catkin scales till it is blown away. The drupe, containing a 1-seeded stone, may be dispersed by birds or by the wind, being enclosed in a winged perianth.

Bog Myrtle is a peat-loving plant, requiring essentially a peat soil.

A beetle, *Orchestes iota*, several Lepidoptera, Light Knot Grass (*Acronycta menyanthidis*), Sweet Gale Moth (*A. myricæ*), Rosy Marvel (*Noctua subrosea*), *Antithesia dimidiana*, *Tortrix viburnana*, *Anchylopera siculana*, *Peronæa lipsiana*, *Euchromia arbutella*, *Sericoris politana*, Powdered Quaker (*Orthosia gracilis*), Argent and Sable (*Cidaria*

hastata), *Coleophora orbitella*, and a Heteropterous insect, *Lygus spinolæ*, are found on it.

Myrica, Theophrastus, is the Greek name for tamarisk, and the specific name is the same as an English name of the plant.

Sweet Gale is called Candleberry Myrtle, Devonshire Myrtle, Dutch Myrtle, Gale, Gales, Gall, Gall-bushes, Gaul, Gawan, Gold, Golden Osier, Golden Withy, Gole, Goule, Gow, Goyle, Moor Myrtle, Moss Wythan, Myrtle, Burren Myrtle, Scotch Gale, Stinking Willow, Wild Sumac, Sweet Willow, Withwind, Withwine. As to Gale, there is a place called Gale moor, from the prevalence of the plant, near Whitchurch, Salop. It is called Sweet Gale from its sweet aromatic odour. Gall is so called from the plant having been supposed to be the gall in Scripture. Gerarde says as to the name Gaul: "This gaule groweth plentifully in sandy places of England, as in the Isle of Elie, and in the Fennie countries thereabouts, whereof there is such store in that country, that they make fagots of it and sheaves which they call Gaule sheaves to burne and heate their ovens".

The leaves are bitter and used in place of hops, but fragrant, and yield an essential oil. The catkins boiled are suitable for making candles. If not boiled a long time Bog Myrtle causes a headache. Calf-skins used to be tanned with it. It dyes wool yellow. It was used in Sweden to kill bugs and lice, and to cure the itch, and in Wales branches were laid under the beds for this purpose. It was used as a vermifuge. They use it as a garnish in Islay and Jura, and lay it between linen to perfume it and keep away moth. It has been used for besoms.

Essential Specific Characters:—

281. *Myrica Gale*, L.—Bushy shrub, leaves lanceolate, obovate, serrate, catkins reddish, sessile, fruit with resinous glands, small.

White Willow (Salix alba, L.)

As with the Crack Willow there have been no traces of this tree preserved in early leaf or seed deposits. It is found in the N. Temperate Zone in Europe, N. Africa, N. and W. Asia, N.W. India. In Great Britain it does not grow in N. Devon, E. Kent, Monmouth, Glamorgan, Cardigan, Carnarvon, Flint, Derby, Mid Lancs, S.E. Yorks, Isle of Man, Kirkcudbright, Haddington, Linlithgow, Mid Perth, N. Perth, Banff, Easterness, Westerness, Mid and N. Ebudes, N. Highlands, North Isles, but generally elsewhere. It is planted in Sutherland and the Hebrides. In Ireland and the Channel Islands it is perhaps never native.

As with the Crack Willow the White Willow is a sure indication of moist conditions, and its favourite situation is by the waterside, whatever shape that may take, whether a stream, a lake, a marsh, or a bog. But it is also a lowland plant, and is absent from dry conditions generally.

The White Willow is less lofty than the Crack Willow, with (in

Photo. G. B. Dixon

WHITE WILLOW (*Salix alba*, L.)

proportion) a stouter stem and the branches ascending, but tapering and spreading, the twigs olive-coloured, silky, and hard. The bark is fissured. The leaves are long, lance-shaped, finely toothed, bluish below, downy or silky both sides, and glandular. The leaves are arranged in spiral whorls. The stipules, or leaflike organs, are egg-shaped, and fall. The lowest teeth are glandular.

The flowers are in slender lax catkins, with hairy stamens and deeply-cloven stigmas. The capsule is sessile. The scales of the catkins are linear, and not so long as the stamens. The plant is dicœcious.

The tree is 80 ft. high. It flowers in April and May. It is a deciduous tree propagated by seeds.

The flowers are adapted, as in *S. fragilis*, to visits by insects, and are also pollinated by the wind, having been derived from such ancestors (see *S. fragilis*). The honey is half-concealed.

The seeds are fringed with white silky hairs, and are thus blown to a distance by aid of the wind. The hairs help to fasten the seed also when it has come to rest on the ground.

Like other willows White Willow is a humus-loving plant growing on a peat soil, but is also a clay-loving plant (pelophilous) and will grow on clay soil.

The margins of the leaves are galled by *Eriophyes marginatus* and *Cecidomyia clausilia*. A beetle, *Elater sanguineus* (*rufipennis*); several Hymenoptera, *Cimbex variabilis*, *Nematus capreæ*; Lepidoptera, Camberwell Beauty (*Vanessa antiopa*), Red-tipped Clearwing (*Trochilum formicæformis*), Striped Twin-spot Carpet (*Cidaria salicata*); several Homoptera, *Idioceris adustus*, *I. cupreus*, *I. herrichii*, visit it.

The second Latin name refers to the white colour of the tree, due to the pubescence of the leaves. This tree is called Duck Willow and White Willow.

It is used for fencing-poles, crates, fuel, being pollarded like the Crack Willow, and the bark is used for tanning.

Essential Specific Characters:—

285. *Salix alba*, L.—Tree, spreading, twigs pliable, leaves lanceolate, silky both sides, catkins lax, erect, capsule subsessile.

Helleborine (Helleborine longifolia, Rendle and Britten = *Epipactis palustris*, Crantz)

There is no trace of this Orchid in a fossil state. It is found at the present day in Europe and Siberia in the North Temperate Zone. In Great Britain it is found in the Peninsula province, but not in W. Cornwall; in the Channel province, except in W. Sussex; in the Thames province, except in S. Essex; in Anglia, except in Hunts; in the Severn province not in Gloucs, Monmouth; S. Wales in Glamorgan and Carmarthen; N. Wales not in Montgomery or Merioneth; in the Trent province; in the Mersey, Humber, Tyne, Lakes provinces, except in the Isle of Man; and in Berwick, Haddington, Edinburgh, Fife, N. Ebudes. From Fife and Perth it is general elsewhere to the south coast; being local and rare in Ireland and the Channel Islands.

This orchid is almost entirely confined to watery places, being a typical hygrophyte, growing in wet reed beds by the side of pools, as well as in true marshes and bogs. It is associated with the Bogbean, Marsh Orchis, Grass of Parnassus, Cotton Grass, and other typical paludal plants.

It has a slender but rigid, suberect flowering stem, slightly downy. The leaves are lance-shaped, acute, the upper ones terminated in a sharp point, clasping. The bracts or leaflike organs are not so long as the flowers.

Photo. Flatters & Garnett

MARSH HELLEBORINE (*Helleborine longifolia*, R. and B. = *Epipactis palustris*)

The flowers are in a loose spike, with green and purple flowers, and slightly drooping. The lip is scalloped, oblong, longer than the perianth, white, with reddish streaks. The calyx is purplish-green, with pale lance-shaped sepals, the petals white, with pink streaks. Marsh Helleborine is about 1 ft. high. It blooms in July and August. The plant is perennial, and propagated by division.

There are two staminodes each side of the terminal lobe. The single anther is stalkless and hinged to the top of the column. The lip has a hinged terminal portion, which by a rebound causes an insect to fly upward when it leaves the flower and rub the rostellum, which exudes a sticky fluid and cements the pollinia or pollen-masses to the insect. It is visited by the honey bee, flies, *Sarcophaga*, *Cœlopa*, and *Crabro*. The lip is long, in two parts, with a narrow connecting hinge. The outer part closes the flower, but an insect on alighting presses it down.

The capsule is pendulous, and, being light, the seeds are liable to fall out and be dispersed by the wind.

This beautiful orchid is a peat-loving plant growing in an essentially peaty soil.

Helleborine is an old name applied in allusion to the supposed

resemblance to *Helleborus*, and the second Latin name refers to the length of the leaves.

ESSENTIAL SPECIFIC CHARACTERS:—

290. *Helleborine longifolia*, Rendle and Britten.—Stem tall, leaves lanceolate, bracts shorter than the flower, flowers green, lip white and red and purple, label blunt, crenate calyx purplish-green.

Bog Asphodel (Narthecium ossifragum, Huds.)

Though a northern bog plant no trace of it occurs amongst the remains of Arctic plants found in North Britain and other parts. It is distributed generally in the North Temperate Zone north of the Alps, Pyrenees, N. Asia, N. America. In Great Britain it is not found in N. Wilts; in the Thames province only in Kent, Surrey, Berks, Bucks; and not in Suffolk, Northants, in Anglia; but elsewhere in E. Gloucs, S. Lincs, Notts, Mid Lancs, S.E. Yorks, Haddington, Stirling, as far north as the Shetlands, and up to 3200 ft. in the Highlands. It is found also in Ireland very generally.

Photo. Flatters & Garnett

BOG ASPHODEL (*Narthecium ossifragum*, Huds.)

Bog Asphodel is a characteristic bog plant growing at high elevations in wild morasses on mountain-sides, as well as in more lowland stations. As Watson says: "The drainage and enclosure of bogs and marshes no doubt must gradually banish this plant from many of its localities". It is rare in the south-eastern counties, abundant in Scotland.

The flowering stem, at first prostrate, is then erect, surrounded at the base with many sword-like leaves, and so having the grass habit. The leaves are half as long as the stem, and have marked ribs.

The flowers are a rich golden-yellow or deep-orange, large and spreading, with woolly anther-stalks. The slender flowering stem has one bract at the base, and is tapering; the flowers have very short

stalks, with 6 perianth segments, longer than the stamens, in which the anthers are deep-orange. The capsule is red, oblong, smooth, with 6 ridges and furrows, and longer than the perianth.

Bog Asphodel has a stem 6–10 in. long. It is in flower in July and August. It is a perennial, propagated by division.

There is no honey, but the flowers are conspicuous and scented. There are 6 stamens, 3 below the ovary, 3 on the perianth segments. The anther-stalks are woolly and awl-shaped. The anthers open inwards at the same time as the stigma, and are linear, deep-orange, on white anther-stalks. The style is short and the stigma blunt. The flower is adapted for cross-pollination by pollen-collecting bees and flies.

The seeds are pale-yellow, very small, and the testa is 8 mm. long. The seeds are provided with hairy outgrowths, which aid in their dispersal by the wind.

Bog Asphodel is a peat-loving plant, and requires a peat soil, growing in bogs and marshes.

Narthecium is from the Greek *narthex*, the name of a tall umbelliferous plant, and *ossifragum*, from *os*, bone, *frango*, I break, refers to reputed properties. The plant is called Bog Bastard or Lancashire Asphodel, Yellow Grass, Knavery, Maiden Hair, Move Grass, Rosa Solis.

As to the last, Ellis says: "This moor-grass, in the parish of Wing (Bucks) they call Rosa Solis, as it is distinguished by shepherds from other grasses, who know it by its three-square leaf rapier-like; for the blade, like that, is thickish and shaped somewhat in the flag kind, bearing a yellowish flower, like that of a daffodown-dilly, and seldom runs above a handful high in a spongy soft substance". The names Lancashire Asphodel and Maiden Hair are to be explained thus: "In Lancashire it is used by women to die their haire of a yellowish colour", Gerarde says. Parkinson says his friend Anthony Salter of Exeter told him they called it Knavery there.

Essential Specific Characters:—

304. *Narthecium ossifragum*, Huds.—Flowering stem a scape with few leaves, erect, decumbent, leaves ensiform, ribbed, rigid, flowers yellow, racemose, capsule red, triangular.

Common Jointed Rush

(Juncus articulatus, L. = J. lamprocarpus, Ehrh.)

This common marsh plant is known to us from its present distribution alone, which covers the North Temperate Zone in Europe, N. Africa, N. and W. Asia, Himalayas, N. America. In Great Britain it is found everywhere, except in Berwick, as far north as the Shet-

Photo. C. R. Mapp

THE HABITAT OF THE COMMON JOINTED RUSH (*Juncus articulatus*, L. = *J. lamprocarpus*, Ehrh.)

lands, and up to 2400 ft. in the Highlands, being a native of Ireland and the Channel Islands.

The Common Jointed Rush is a semi-aquatic plant which grows near water, either in wet places, such as ditches, or by the side of brooks and rivers. It is also to be found on the margins of lakes and pools. But a more constant and certain habitat perhaps is marsh land where there is a continuous humid atmosphere. A favourite spot is a mountain bog, where it grows profusely in the streaming moisture of the mountain-side.

This is a tall, erect, slender, and graceful plant, the stem flattened lengthwise. The leaves are jointed, hollow, with septate divisions internally, the pith not being continuous.

The flowers are apetalous, without a corolla, borne in a much-branched panicle, which is erect, forked, the branches long, and flowers 4–8, clustered, and suberect. The 6 perianth segments are not so long as the shining erect capsule [hence the second (Greek) name], which is beaked and dark-brown. The inner segments are blunt. There are 6 stamens. The capsule is 3-chambered, and opens by 3 valves, alternate with the walls. The pericarp has woody layers which contract.

The stem is 2 ft. high. The flowers open in June, July, and August. It is a perennial plant, propagated by seeds.

Jointed Rush is proterogynous, and pollinated by the wind, like all rushes. There are 6–12 flowers, with 6 stamens. Each flower lasts a day. It is female in the morning, and later hermaphrodite.

The capsule contains many seeds, splitting by 3 valves when ripe, and letting the small seeds fall around the parent plant or be dispersed by the wind.

The Jointed Rush is a peat-loving plant and grows in peaty soil, being also a clay-loving plant and addicted to clay soil.

It is attacked by a fungus, *Entorrhiza cypericola*; several Homoptera, *Liburnia quadrimaculata*, *L. reyi*, *L. lepida*, and *Cicadula fasciifrons*; Lepidoptera, *Bactra lanceolata*, *Argyrolepia baremanniana*; *Colcophora cæspitella*.

The older specific name refers to the jointed stem. Jointed Rush is called Spart, Closs Spart, Strit. The name Rish is an early variant, and is found in Percy's *Reliques*:

> "All the wyves of Tottenham
> Came to see that syzt
> With wyspes, and kexis, and ryschys there lyzt".

In Cornwall Rish means a list or tally. "I'll begin a new rish" is the same as "I'll turn over a new leaf".

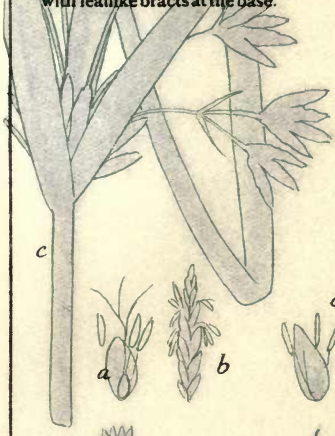
There is a superstition that they turn into horses as soon as you bestride them. The following is a cure for thrush in Devonshire. Three rushes are taken from any running stream, passed separately through the mouth of the infant, and then thrown back into the water. As the current bears them away, so it is believed will the thrush leave the child.

Essential Specific Characters:—

306. *Juncus articulatus*, L.—Stem erect, glabrous, compressed, leaves jointed within, hollow, flowers in terminal clusters, 4–8, inner perianth segments blunt.

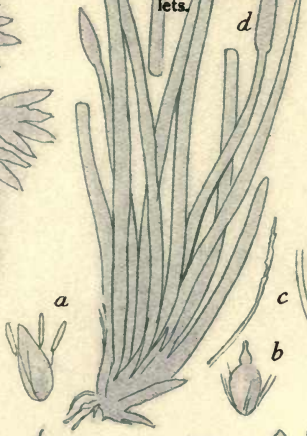
No. 1. Galingale
(*Cyperus longus*, L.)

a, Flower, with glume, 3 stamens, and pistil with 3 stigmas and long style. *b*, Spikelet, with glumes, and anthers ripe. *c*, Flowering stem, with spikelets in clusters of 3–8, with bracts below, in an umbellate cyme, with leaflike bracts at the base.



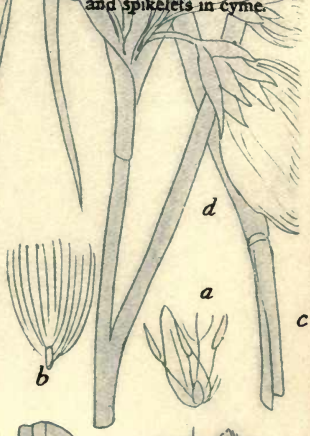
No. 2. Common Spike Rush
(*Eleocharis palustris*, Roem. and Schult.)

a, Flower, with glume, 3 stamens, and pistil with 2 feathery stigmas. *b*, Nut, with 6 bristles. *c*, Bristle, enlarged. *d*, Plant, showing rootstock, and tufted stems, with terminal solitary spikelets.



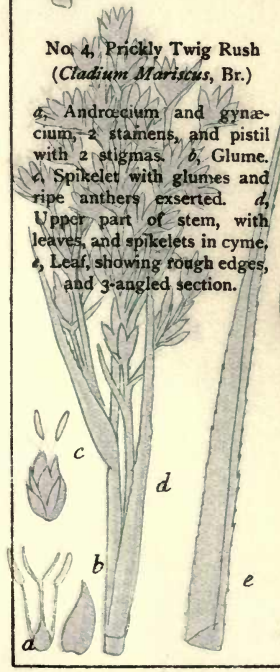
No. 3. Cotton Grass
(*Eriophorum angustifolium*, Roth)

a. Flower, with glume, 3 stamens, pistil with 3-fid stigmas on long style, and bristles. *b*, Nut, with long cotton-like bristles. *c*, Leaf, sheathed below, 3-angled above. *d*, Stem, with alternate leaves, and spikelets in cyme.



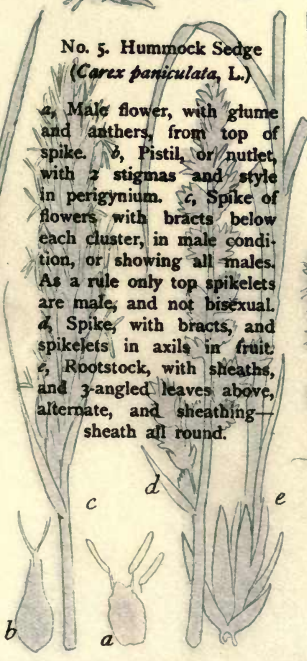
No. 4, Prickly Twig Rush
(*Cladium Mariscus*, Br.)

a, Androecium and gynæcium, 2 stamens, and pistil with 2 stigmas. *b*, Glume. *c*, Spikelet with glumes and ripe anthers exserted. *d*, Upper part of stem, with leaves, and spikelets in cyme. *e*, Leaf, showing rough edges, and 3-angled section.



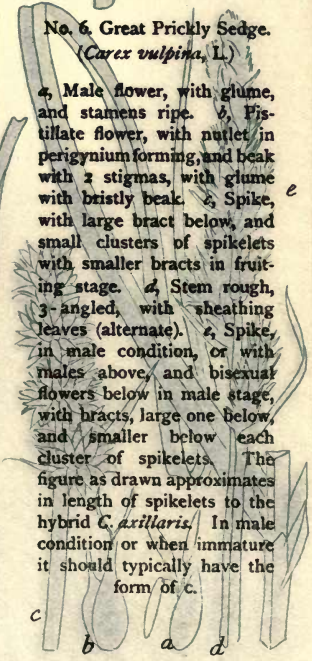
No. 5. Hummock Sedge
(*Carex paniculata*, L.)

a, Male flower, with glume and anthers, from top of spike. *b*, Pistil, or nutlet, with 2 stigmas and style in perigynium. *c*, Spike of flowers with bracts below each cluster, in male condition, or showing all males. As a rule only top spikelets are male, and not bisexual. *d*, Spike, with bracts, and spikelets in axils in fruit. *e*, Rootstock, with sheaths, and 3-angled leaves above, alternate, and sheathing—sheath all round.



No. 6. Great Prickly Sedge.
(*Carex vulpina*, L.)

a, Male flower, with glume, and stamens ripe. *b*, Pistillate flower, with nutlet in perigynium forming, and beak with 2 stigmas, with glume with bristly beak. *c*, Spike, with large bract below, and small clusters of spikelets with smaller bracts in fruiting stage. *d*, Stem rough, 3-angled, with sheathing leaves (alternate). *e*, Spike, in male condition, or with males above, and bisexual flowers below in male stage, with bracts, large one below, and smaller below each cluster of spikelets. The figure as drawn approximates in length of spikelets to the hybrid *C. axillaris*. In male condition or when immature it should typically have the form of c.



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No. 4. Prickly Twig Rush
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a, Androecium and gynaecium, 3 stamens, and pistil with 2 stigmas. *b*, Clume. *c*, Spikelet with glumes and ripe anthers exserted. *d*, Upper part of stem, with leaves, and spikelets in cyme. *e*, Leaf, showing rough edges, and 3-angled section.

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a, Male flower, with glume and anthers, from top of spike. *b*, Pistil, or nutlet, with 2 stigmas and style in perigynium. *c*, Spike of flowers with bracts below each cluster, in male condition, or showing all males. As a rule only top spikelets are male, and not bisexual. *d*, Spike, with bracts, and spikelets in axils in fruit. *e*, Rootstock, with sheathe, and 3-angled leaves above, alternate, and sheathing—sheath all round.

No. 6. Great Prickly Sedge.
(*Carex paniculata*, L.)

a, Male flower, with glume, and stamens ripe. *b*, Pistillate flower, with nutlet in perigynium forming, and beak with 2 stigmas, with glume with bristly back. *c*, Spike, with large bract below, and small clusters of spikelets with smaller bracts in fruiting stage. *d*, Stem rough, 3-angled, with sheathing leaves (alternate). *e*, Spike, in male condition, or with males above, and bisexual flowers below in male stage, with bracts, large one below, and smaller below each cluster of spikelets. The figure as drawn approximates in length of spikelets to the hybrid *C. axillaris*. In male condition or when immature it should typically have the form of *c*.

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3. Cotton Grass (*Eriophorum angustifolium*, Roth.). 4. Prickly Twig Rush (*Cladium Mariscus*, Br.).
5. Hummock Sedge (*Carex paniculata*, L.). 6. Great Prickly Sedge (*Carex vulpina*, L.).

Galingale (Cyperus longus, L.)

This maritime sedge is not represented in any of the early deposits in Great Britain. To-day it is to be found in the North Temperate Zone in Europe, South of France and Germany, and in North Africa. In Great Britain it is found on the coasts of West Cornwall, N. Somerset, South Wilts, Dorset, Isle of Wight, East Kent, Pembroke, and the Channel Islands.

This plant is a maritime species, which is very rare, and only found in the above counties growing in marshes by the sea, and not ever far inland.

Galingale has a characteristic appearance from its umbelled spikes. The rootstock is creeping. The stems are erect, few, slender, 3-sided, with many leaves below. The leaves are not numerous, spreading. There are 3 bracts below the rays of flowers, like the leaves but unequal, thickened below.

The flowers are borne on a twice-compound umbel, with linear rays again becoming umbellate, both general and partial involucres, or whorls of leaflike organs, being long and unequal. The spikelets are linear-lance-shaped, curved, in two rows, flattened, with reddish-brown glumes, with green keel or midrib, and paler margins. The stigmas soon fall.

Galingale is 2–3 ft. high. Flowers are open in July. Galingale is a perennial, propagated by means of suckers.

Photo. H. Irving

GALINGALE (*Cyperus longus*, L.)

The flowers are bisexual. There are 1–3 stamens, the styles deciduous, not swollen at the base, and there are 2–3 stigmas. The embryo is embedded in endosperm. The

flowers, like other Cyperaceæ, are anemophilous, but insect visits are not excluded.

The fruit is a 3-sided nut, which falls to the ground when ripe, being indehiscent.

This handsome sedge is a peat-loving plant growing in peat soil.

Cyperus, Theophrastus, is from the Greek for a kind of rush, and the second Latin name means long. Galingale is called Cypress, Cypress-root, Galangal.

The roots are eatable, aromatic, bitter, and were formerly used as a medicine.

Essential Specific Characters:—

318. *Cyperus longus*, L.—Stem triquetrous, tall, leaves lanceolate, flowers in umbels, lax, glumes red with a green keel.

Common Spike-rush (Eleocharis palustris, Roem. and Schult.)

The antiquity of this plant is shown by its occurrence in the Pre-glacial deposits of Pakefield, Suffolk, early Glacial beds at Beeston, Norfolk, Interglacial, Late Glacial, Neolithic, and Roman deposits at Silchester. At the present day it is found in the Arctic and N. Temperate Zones in Arctic Europe, North Africa, N. Asia, N. India, and N. America. It is found in every county in Great Britain, except Montgomery, as far north as Sutherland, and up to 1200 ft. in Yorkshire, as well as in Ireland and the Channel Islands.

This is a typical marsh plant, growing along the margins of watery wastes, and covering large areas, with Arrowgrass, Sedges, and other paludal species. It is also common in wet meadows, bordering streams, and around ponds and pools. Common Spike-rush is a true hygrophyte.

The root is creeping, giving forth several leaves and stems in a clustered manner, and the plant has a tufted grass-like habit. The stems are stout or slender, flattened at the margin, with numerous leafless sheaths, the glumes beardless, lance-shaped and acute at the base, membranous and blunt transversely.

The flowers are in terminal spikes, round, reddish-brown, oval, naked, with lance-shaped, acute bracts or leaflike organs at the base, the lowest glume half-clasping the spike, with anthers which come to a point. The nut is inversely egg-shaped, plano-convex, the margins smooth, with style egg-shaped below, shorter than the 4 bristles.

Common Spike-rush is 8 in. in height. The flowers are in bloom in July. The plant is a perennial, propagated by suckers. The flowers

are pollinated by the wind, bisexual. There are 3 stamens, the style is deciduous, and there are 2 stigmas. The anthers are apiculate, coming to a point. The fruit is a nut flattened on the border and finely furrowed, which falls to the ground when ripe, not opening.

This Spike-rush is a peat-loving plant, and addicted to a peat soil.

Eleocharis, R. Brown, is from the Greek *helos*, marsh, and *chairo*, I delight, and the second Latin name refers to the habitat, marshy. It is also called Aglet-headed Rush.

Photo. Flatters & Garnett

COMMON SPIKE RUSH (*Eleocharis palustris*, Roem. and Schult.)

ESSENTIAL SPECIFIC CHARACTERS:—

319. *Eleocharis palustris*, Roem. and Schult.—Root creeping, leaves and stems tufted, cæspitose, the latter sheathed, glume surrounding the spike, fruit swollen at the top.

Cotton Grass (Eriophorum angustifolium, Roth)

This Arctic plant is found in Preglacial deposits in Norfolk and Suffolk, and at Hoxne, Suffolk, in Interglacial beds. To-day it is to be found in N. Temperate and Arctic Europe, except N. Asia, N. America. In Great Britain it is found in every part of the country except W. Gloucs, Montgomery, Mid Lancs. It is commonly distributed elsewhere from the Shetlands to Cornwall and Sussex, and

up to 3500 ft. in the Highlands, as well as in Ireland and the Channel Islands.

The upland bogs are characterized in some parts by the prevalence of Cotton Grass giving rise to a typical botanical association. Not only does this one grow at high elevations, but also in more lowland situations, and in marshes with sedges and orchids of a less special nature. The waving tufts of cottony bristles, borne on long, slender, drooping stems give this a peculiar habit of its own.

The habit of the Narrow-leaved Cotton Grass is like that of the others, sedge- or grass-like. There is a long, stout rootstock. The stem is wiry, solid, rigid, bluntly 3-angled or nearly round in section, stout, smooth, leafy, not tufted. The leaves are nearly all radical, and variable a good deal in breadth, and are flat, and triangular above for more than half the length, channelled below, smooth, linear.

The flowers are in a cyme, with solitary (or more) heads. The bracts are 2–3. The glumes are lead colour, egg-shaped, oblong, lance-shaped, with a broad membranous margin. The fruit-stalks are smooth. There are 4–12 spikelets, and the bristles are 1 to 2 in. long, three or four times as long as the spikes. The nuts are inversely egg-shaped, blunt-pointed.

This Cotton Grass is 18 in. high. The flowers bloom in May and June. The plant is perennial, propagated by division.

The Cotton Grasses are all pollinated by the agency of the wind. The flowers are perfect or bisexual. There are 3 stamens, and the style is as long as the perianth, which is represented by the bristles, and is not enlarged below, at length falling. There are 3 turned-back stigmas. When pollination has taken place the perianth or bristles get longer, and together form the cotton so characteristic of this group, which, owing to the crowded flowers in this form, are very conspicuous when full size. The nut is provided, moreover, with this light, silky cotton, a fringe of hairs, as a means of dispersal by the wind.

The Cotton Grass is a peat-loving plant requiring a peat soil, rarely growing on clay soil, when it is a clay-loving plant.

A beetle, *Cryptocephalus biguttatus*, Lepidoptera, *Elachistes eleochariella*, *E. rhynchosporiella*, Marsh Ringlet, *Cœnonympha typhon*, *Glyphipteryx haworthana*, Haworth's Minor (*Celæna haworthii*), are found on it.

Eriophorum, Theophrastus, is from the Greek *erion*, cotton, and *phero*, I bear or carry, from the cottony heads, and *angustifolium* (Latin) refers to the narrow leaves.

It is called Cat's-tails, Sniddle Flock, Moor Grass. The second

name is from its resemblance to flocks of wool. Sniddle is a generic name applied to sedges generally and to allied plants.

The hairs have been used for pillow-linings since Pliny's day, as well as for cushions. The cotton is of too brittle a texture to weave, but it has been used for articles of dress in Germany, and for paper. The country folk once used the cotton as wick for lamps.

COTTON GRASS (*Eriophorum angustifolium*, Roth)

ESSENTIAL SPECIFIC CHARACTERS:—

323. *Eriophorum angustifolium*, Roth.—Stem rigid, rounded, leaves linear, flat, triangular above, peduncles smooth, spikelets corymbose bristles three times as long.

Prickly Twig Rush (Cladium Mariscus, Br.)

Though unknown in a fossil state in Great Britain, this sedge is found in Prussia in the Birch, Pine, and Oak Zones, and in Gothland. To-day it ranges in the N. Temperate Zones from Gothland southward, N. Africa, Siberia. In Great Britain in the Peninsula province it grows only in W. Cornwall and N. Somerset; in the Channel province only in Dorset, Isle of Wight, S. Hants; in the Thames only in

E. Kent; in Anglia not in Bedford; in the Severn province only in Worcester, Warwick, Stafford, Salop; in S. Wales it grows only in Glamorgan and Pembroke; in N. Wales in Carnarvon, Flint, Anglesea; in the Trent province in Lincs; Chester in the Mersey province; in the Humber generally, except in N.W. Yorks; in the Tyne province, except in Northumberland; in the Lakes province, except in the Isle of Man; W. Lowlands, except in Renfrew and Lanark; in Berwick in E. Lowlands; Forfar in E. Highlands; in the W. Highlands it does not occur in Main Argyle, Dumbarton; W. Ross and W. Sutherland in N. Highlands. It is local in England from the Border southward. It is found also in Ireland.

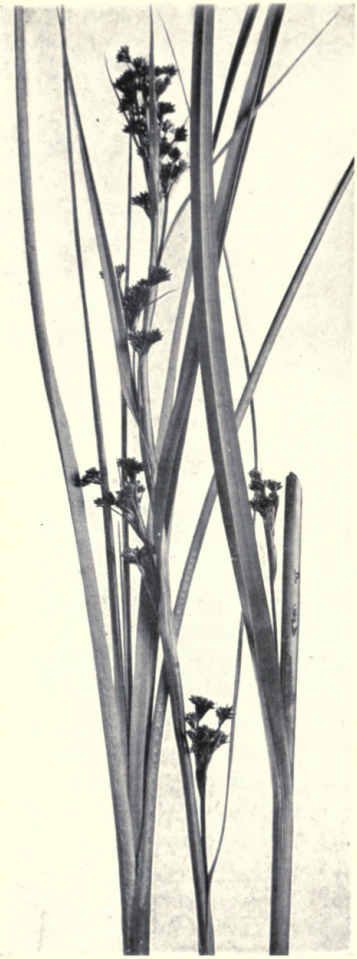


Photo. H. Irving

PRICKLY TWIG RUSH (*Cladium Mariscus*, Br.)

Prickly Twig Rush is a characteristic bog plant which grows especially in lowland districts near the sea, and most uniformly in E. Anglia.

The first Greek name suggests (as does the English one) the rigid prickly character of the head of the plant. It has rounded stems, which are erect, stout, leafy, and smooth, with leaves which are long, rigid, 3-angled at the tip, rough on the margin.

The flowers are borne in a dense corymb-like compound cyme, axillary or terminal, which is contracted, the flowers being collected in dense spikes, 3 flowers in each. One nut only is fertile.

Prickly Twig Rush is 3 ft. in height. The flowers are in bloom in July and August. The plant is perennial, increased by division.

The flowers are pollinated by the wind, bisexual, or the lower male.

There are about two flowers, with one fertile above. There are 2 stamens, with anthers coming to a point. The style is swollen at the base, and falls eventually. There are 2–3 stigmas.

The fruit is a nut, which is 3-sided and does not open, when ripe falling into the water or upon the ground quite close to the plant.

This handsome sedge is a peat-lover, lingering only in peat soil at Wicken fen.

Reed Tussock (*Lælia cœnosa*), a moth, is found upon Prickly Rush.

Cladium, P. Br., is from the Greek *clados*, a twig, and *mariscus* is Latin for a kind of rush.

The plant is also called Shere- or Shear-grass, Lesch, Sedge, and Twig Rush. Turner says as to the name Shear-grass: "The edges of thys herbe are so sharpe that they will cut a mannis hande and have a certaine roughness which maketh them to cut the sower, of which propertye the Northern men call it Sheregres. It hath a long stalke and thre square, and in the top of that is a sort of little knoppes instede of sedes and floures much like unto oure gardine gallingal. The people of the Fenne countreys use it in for fother and do heate ovens with it." It was used for lighting fires at Cambridge. In the East it was said to have formed the Crown of Thorns.

Essential Specific Characters:—

324. *Cladium Mariscus*, Br.—Stem half round, smooth, leaves long, rigid, serrate, triquetrous above, flowers in a panicle of 1–3 spikelets.

Hummock Sedge (Carex paniculata, L.)

The Hummock Sedge is found in the North Temperate Zone south of Sweden to the Canaries, and in W. Siberia. It is not found in any early plant beds. In Great Britain it is absent in the Peninsula province from N. Devon, but occurs throughout the Channel and Thames provinces; not in Hunts in Anglia; is general in the Severn district; in S. Wales it does not grow in Radnor; in N. Wales only in Carnarvon, Denbigh, Anglesea; in the Trent province; in the Mersey it does not grow in Mid Lancs, but is general throughout the Humber and Tyne provinces; Lakes province in Cumberland; in W. Lowlands it does not grow in Renfrew; E. Lowlands, not in Peebles, Selkirk, Roxburgh; not in Mid or S. Perth in E. Highlands; in W. Highlands not in Mid or N. Ebudes; in N. Highlands not in E. Ross, E. Sutherland, but occurs in the Hebrides and Orkneys, and also in Ireland and the Channel Islands.

The Hummock Sedge is a paludal type of sedge, growing in large

clumps in wet places or by the sides of rivers, in damp woods, and also in marshes, amongst other common types, such as the Great Prickly Sedge and others.

It has a clustered, bushy habit, with 3-sided stems, which are leafy and stout, rough above. The root is densely aggregated together, forming a tufted surface. The leaves are rough, long, and flat.

The spikelets of the flowers are in a panicle with wide branches, the sterile male flowers at the top. The panicle is three times compound. The fruit is broad, egg-shaped, coming to a sharp point, swollen below, with nerved perigynia, the beak deeply cleft, and the glumes margined. Hummock Sedge is 3 ft. in height. The flowers expand in June and July. The plant is a perennial, propagated by suckers.

The spikelets are bisexual, and male at the top only; the base of the style is swollen. The bisexual flowers are proterogynous, the stigma ripening first, and are pollinated by the agency of the wind.

The fruit is a nut, which falls when ripe into the water or upon the ground.

Like other sedges this is a peat-loving plant, growing in a peat soil.

Two beetles, *Cercus pedicularius*, *C. bipustulatus*, and a moth, *Elachista paludum*, are found on it.

In bogs it forms solid patches which serve as stepping-stones do on moist ground.

Essential Specific Characters:—

326. *Carex paniculata*, L.—Stem thick, triquetrous, with many long, rough, tufted leaves, spikes in a panicle, pale-brown, fruit many-veined, bracts setaceous, nut ovoid.

Great Prickly Sedge (Carex vulpina, L.)

This common sedge is found throughout the N. Temperate Zone in Europe, N. Africa, Siberia, and N. America. It is not known in any early deposits. In Great Britain it does not grow in Cardigan, Isle of Man, Dumfries, Kirkcudbright, Roxburgh, Stirling, Mid and N. Perth, Easterness, Westerness, Main Argyle, E. Ross, E. Sutherland, Caithness, Orkneys, Shetlands, but elsewhere generally, and in Ireland and the Channel Islands.

The Great Prickly Sedge is a common object wherever damp

Photo. L. R. J. Horn

HUMMOCK SEDGE

Open aquatic vegetation, with reed swamp, of reed, &c., invading the former, and marginal association of fen carr, with scrub of Willow, Sweet Gale, Alder, &c., with Hummock Sedge.

ground occurs. It grows in moist hollows by the roadside, around ponds, pools, and in ditches, as well as more generally and profusely in wet meadows, marshes, and bogs.

The stems are few, 3-angled, with sharp, rough edges and convex sides, from a tufted base, and stoloniferous, with creeping runners. The leaves are rather broad and flat, glossy, and fairly long.

The flowers are in a more or less cylindrical compound spike with many crowded flowers, the male ones above, spreading, with bristle-like bracts which are longer than the spike, and suberect. The fruit is egg-shaped, coming to a sharp point, plano-convex, pale-green, with an egg-shaped, brownish nut. The glumes are pale-brown, with a roughish awn. This tall sedge is 1–1½ ft. or more in height. Flowers are found in May, up till August. The plant is a perennial, propagated by suckers.

Photo. Flatters & Garnett

GREAT PRICKLY SEDGE (*Carex vulpina*, L.)

This common sedge has a floral mechanism similar to *C. paniculata*, and is likewise proterogynous and pollinated by the wind. The fruit is a nut, and when it is ripe it falls to the ground close to the parent plant.

Great Prickly Sedge is a peat-loving plant growing in a peat soil, or pelophilous and flourishes on clay soil.

Beetles are commonly found on this and allied sedges, e.g. *Dromius longiceps*, *D. sigma*, *Donacia obscura*, *D. thalassina*, *D. impressa*, *D. vulgaris*, *D. affinis*, *Chastocnema Sahlbergi*. Several Lepidoptera are fond of sedges, such as Smoky Wainscot (*Leucania impura*), Small Wainscot (*Nonagria fulva*), *Hydrelia incana*, Gold Spot (*Plusia festucæ*). *Elachista gleichenella*, *E. kilmunella*, *E. rhynchosporella*, *E.*

eleochariella. The Homoptera *Liburnia pullala, L. lugubrina, Dicraneura flavipennis, D. aureola* also frequent them.

The second Latin name means fox-coloured, in allusion to the colour of the flowers.

Essential Specific Characters:—

327. *Carex vulpina,* L.—Stems numerous, rough, tufted, broad, spikelets in a compound spike, cylindrical, bracts long, setaceous.

Section XI

FLOWERS OF THE HEATHS AND MOORS

FLOWERS OF THE HEATHS AND MOORS[1]

The plants which are found on heaths and moors are those that require humus in a sour (or acid) and free state. The soil is barren and not rich in nitrogen that can be readily assimilated, and consequently unsuited for cultivation. The soil is not rich in lime, and in this respect differs from some marshes, but is similar to that of bogs, which indeed are usually interspersed amongst heaths and moors. But there are in some cases upland marshes which are comparatively rich in lime and peat. The soil of a bog or fen on deep peat, however, is acid, not alkaline in reaction.

The raw humus covers a sterile subsoil of diverse character. Of ericetal species there are about 80, of which we describe 29 here. More than all other plants, even on wet soils, heath plants are xerophilous, and we see in them adaptations to physiologically dry conditions. Heaths are exposed to the wind like halophytic vegetation, and few trees grow on such tracts, except in the low moors. Many marsh plants grow there also. The adaptations to xerophytic conditions include a felt of hairs on the under surface of the leaf, as in the Creeping Willow, and this serves the purpose of keeping open the pores or stomata on the leaves, and at the same time depresses transpiration. Papillæ surround or project over the pores for the same reason in sedges. A coating of wax covers the leaf in the Rosemary and Cranberry (see last section). Many stems and leaves are exceptionally thick, and the above are also sclerophyllous. Filiform or threadlike leaves are developed. Heaths, Ling, and Cotton Grasses are comparatively all but leafless. Some leaves present their edges to the light, as in Iris and Asphodel.

The adaptation to dry conditions is connected with the soil characters. The soil is physiologically dry. There are, however, some genera which include marsh or bog species, and others that require a

[1] Cf. Section X, where moors are dealt with in some detail in discussing bogs and marshes also. It is the wetter types of moors that are specially referred to there.

medium supply of moisture, that do not grow in dry places, with the broadest leaves, which is not what one would expect. *Galium palustre* has narrower leaves than *G. Aparine*, a mesophilous species. Moreover, some heath plants can grow on dry warm soil and on cold wet soil, as Ling, Crowberry, &c. This suggests that there is some correspondence between the two types of soil, and that some of the factors of life in the case of marsh plants necessitate an economy in the use of water. There is a transpiration optimum, and marsh plants may have to depress their transpiration.

A wet soil is cold, the roots can absorb no water if the temperature of the soil sinks below a certain degree, and the soil is thus what is called physiologically dry. This is seen in the later character of heath and moor or marsh plants, and in the fact that the flowers are in bloom much later than on dry soils. The plants are clothed with hairs, therefore, to prevent an excess of transpiration over absorption, and this is accelerated by high winds. Respiration is affected owing to the soil being badly aerated or lacking in oxygen, so that the activity of the aerial parts must be the less, owing to the less amount of oxygen absorbed by the roots by marsh plants. Hence the ability of Heaths that grow on heaths and dry warm soil to grow on moors, as a heath is just as badly aerated, with often periodically soaked raw humus or dry peat. Peat retains water more than other soils except clay. The cause of physiological drought here may also be due to the abundance of humous acids, &c., in moor soil or peat, which affect the roots and prevent or deter absorption, so that the plants wilt if transpiration is rapid.

Though many plants of heaths and moors exhibit the above xerophilous characteristics, others are hydrophilous in character, and so are the adaptations to which they give rise in the flora.

Transitional from marsh associations is the low-moor formation, which is characterized by humous acids in the soil containing vegetable accumulations, forming peat with Reeds, with much nitrogen. The water contains calcium and potassium compounds, and is thus like a marsh, often enclosing a marsh or adjoining it.

Sedges grow in tufts, giving rise to sedgemoor, and other plants are Cotton Grass, Rushes, Arrowhead, Helleborine, Angelica, Bogbean, Marsh Bedstraw, Marsh Willowherb, Grass of Parnassus, and Willow, Birch, Alder, Heaths, &c.

Several associations can be recognized, as amblystegiata (from a moss), cariceta, eriophoreta, molinieta, junceta, &c. There are usually herbaceous perennials and a ground flora of mosses forming two layers below the former. Few are ligneous, and only a few are annuals, as

Rhinanthus. The flowers bloom late because of the cold atmosphere. Most plants are dense, tall, and tufted, a few are runners, such as Sedges and Bogbean, and Mosses may predominate.

Grass-heath may be formed by Matgrass, *Molinia*, Sedges, Sweet Vernal Grass, Bents, and Ling. The soil is dry and not deep.

The high-moor or heather-moor formation is characterized by the occurrence of bog mosses, and it is here that bogs are distributed amid the drier-soil Oxylophytes. The soil is moist and the air damp, and the moisture of the sphagnum moor is derived largely from this last and dew. The high-moor may follow a low-moor formation. Like some bogs the high moor is poor in lime salts, and the peat contains little assimilable nitrogen, phosphorus, or potassium compounds, Sphagnum not being calciphilous.

A sphagnum moor contributes to the steady descent of water, the mass exhibiting great capillarity. The plants die and fresh layers arise above it, forming a thick layer of spongy peat below, acid in nature. Peat is encouraged only by the presence of moisture. The moss rises high in the middle, and gradually grows at the margin.

The soil formed is loose, and the species it nourishes have travelling shoots. Typical of this formation are Sedges, Cotton Grass, Silvery Hair Grass, Bog Asphodel, Arrowhead, Whortleberry, Cranberry, Rosemary, Cross-leaved Heath, Ling, Cloudberry, Sundew, Red Rattle, Dogwood, Bog Myrtle, Creeping Willow, and Sedges, Cotton Grass, Ling, Birch, &c., form special associations.

The plants that produce peat are chiefly Bog-moss, Hair-moss, Bulrushes, Cotton Grass, Heath, Ling, &c.

Forest moors originated from pools or lakes in forest regions, and exist now where the forests have disappeared as high-moor formations, and contain clay formed during the Ice Age.

Following a tundra formation open forest arose, and moors were formed, with Birch and Pines, and Oak came to form high forest, then Beech.

There are notable differences between the low and high moors. The former have the surface covered with water, in the latter the plant subsists on moist soil or above water. Low moors have a flat, high moors a convex surface. The former is characterized by Sedges, Grasses, Rushes, Hypna; the latter by Bog-moss and Heath. A low moor is relatively rich in lime, a high moor is poor in lime. The peat of the low moor is black, and one cannot recognize the included remains; that of a high moor is light, and animals and plants in it are well preserved. While the peat in the former is heavy, rich in mineral

salts, the latter is light, with few mineral salts. Low-moor peat is greasy and wet; high-moor peat is dry, and conducts acid salts well. On a low moor the soil is rich in flood material, on a high moor it is poor; and there are few fungi in the first, many in the latter. Mycorhiza and carnivorous plants are rare on low moor and common on high moor. The high moor is obliged to depend for moisture on the atmosphere.

A sort of lichen-heath develops in which *Empetrum*, Birch, Heath, Juniper, &c., occur, and *Carex*, Hair-grass, Mat-grass, and Rushes also occur, and in their absence Lichens.

The dwarf-shrub heath is treeless, with dwarf evergreen shrubs, mainly ericaceous and small-leaved, stunted, and xerophilous. The temperature is usually low, and the atmosphere not dry. The soil is a quartz-sand mainly reconstructed during the Ice Age. Over this there is a layer of humus where Ling and Whortleberry form a thick dense scrub of not more than 1 ft. high, forming heather-peat or raw humus, acid and inimical to ordinary forest mild humus plants. Heather is the dominant plant, and is associated with lack of nutrient substances and a low temperature.

Many plants are decumbent or prostrate, being frequently wind-swept, and the shoots are curved and brittle. Ling, Empetrum, Cross-leaved Heath, Broad-leaved Whortleberry, Thyme, &c., and of the pinoid type Juniper (deciduous, thin-leaved plants), Broom, Furze, are typical. These plants form the chief food of game, whose distribution is regulated by their occurrence.

Several associations are made up by the dominant species, as Callunetum, Ericetum Ericæ Tetralicis, Myricetum, Myrtilletum.

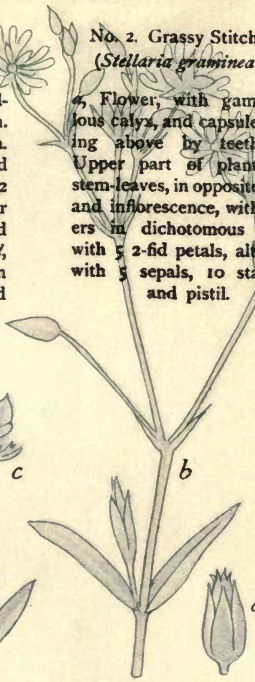
On the heaths and moors we find the pretty deep-blue Milkwort growing in tufts, as radiant as some alpine flower. Grassy Stitchwort links its life with Furze or Broom. Tormentil, with its straggling flowers, forms tufts amid the tussocks. Spread over the turfy sward the creamy flowers of Heath Bedstraw betray the sterile soil. Cat's Foot is rare, and found on the lonely heath. Wall Hawkweed, with many another of this group (of which there are some 200 species), grows on the bare patches near the woods. Sheep's Bit Scabious on rocky heaths or hills chooses a hollow, in which its blue tassel-like blooms, with the graceful pendent bells of the Hare-bell, reflect the colour of the sky. The heaths, too, are clad in a wide mantle of Whortleberry, Cross-leaved Heath, Crimson Heath, and Ling. Where Furze grows the Dodder trails on it, sponging as a parasite, as do Eyebright and Red Rattle, and Common Sylvan Cow-wheat on roots

No. 1. Milkwort
(*Polygala vulgaris*, L.)

a, 8 stamens, with connate filaments forming split sheath. *b*, Pistil, style, and stigma. *c*, Flower, with 2 petaloid inner sepals, and petals, 2 outer united with lower hooded one, and combined with staminal sheath. *d*, Upper part of plant with alternate stem-leaves and flowers in raceme.

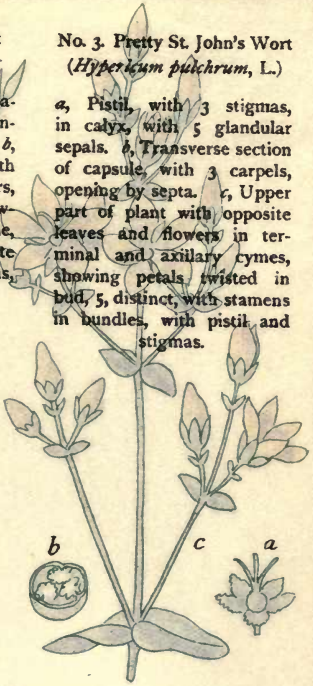
No. 2. Grassy Stitchwort
(*Stellaria graminea*, L.)

a, Flower, with gamosepalous calyx, and capsule opening above by teeth. *b*, Upper part of plant with stem-leaves, in opposite pairs, and inflorescence, with flowers in dichotomous cyme, with 5 2-fid petals, alternate with 5 sepals, 10 stamens, and pistil.



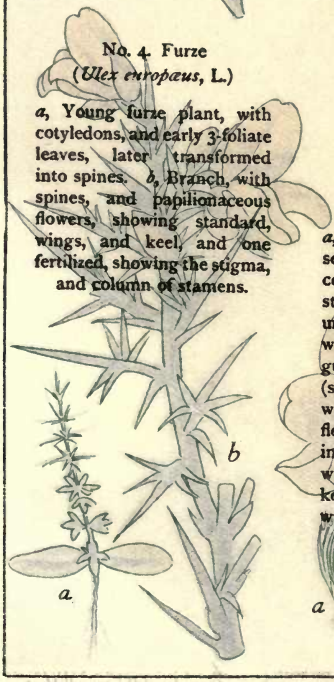
No. 3. Pretty St. John's Wort
(*Hypericum pulchrum*, L.)

a, Pistil, with 3 stigmas, in calyx, with 5 glandular sepals. *b*, Transverse section of capsule, with 3 carpels, opening by septa. *c*, Upper part of plant with opposite leaves and flowers in terminal and axillary cymes, showing petals twisted in bud, 5, distinct, with stamens in bundles, with pistil and stigmas.



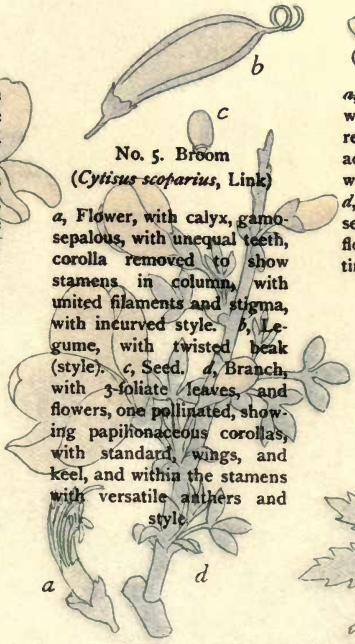
No. 4. Furze
(*Ulex europæus*, L.)

a, Young furze plant, with cotyledons, and early 3-foliate leaves, later transformed into spines. *b*, Branch, with spines, and papilionaceous flowers, showing standard, wings, and keel, and one fertilized, showing the stigma, and column of stamens.



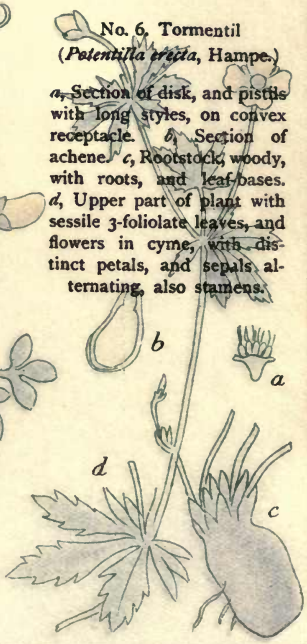
No. 5. Broom
(*Cytisus scoparius*, Link)

a, Flower, with calyx, gamosepalous, with unequal teeth, corolla removed to show stamens in column, with united filaments and stigma, with incurved style. *b*, Legume, with twisted beak (style). *c*, Seed. *d*, Branch, with 3-foliate leaves, and flowers, one pollinated, showing papilionaceous corollas, with standard, wings, and keel, and within the stamens with versatile anthers and style.



No. 6. Tormentil
(*Potentilla erecta*, Hampe.)

a, Section of disk, and pistils with long styles, on convex receptacle. *b*, Section of achene. *c*, Rootstock, woody, with roots, and leaf-bases. *d*, Upper part of plant with sessile 3-foliolate leaves, and flowers in cyme, with distinct petals, and sepals alternating, also stamens.



No. 1. Milkwort
(Polygala vulgaris, L.)

a, 8 stamens, with connate filaments forming split sheath. b, Pistil, style, and stigma. c, Flower, with 2 petaloid inner sepals, and petals, 3 outer united, with lower booded one, and combined with stamens sheath. d, Upper part of plant with alternate stem-leaves and flowers in raceme.

No. 2. Grassy Stitchwort
(Stellaria graminea, L.)

a, Flower, with gamosepalous calyx, and capsule opening above by teeth. b, Upper part of plant with stem-leaves, in opposite pairs, and inflorescence, with flowers in dichotomous cyme, with 5 2-fd petals, alternate with 5 sepals, 10 stamens, and pistil.

No. 3. Derby Scholar's Weed
(Hypericum pulchrum, L.)

a, Pistil, with 3 stigmas, in calyx, with 5 glandular sepals. b, Transverse section of capsule, with 3 carpels, opening by septa. c, Upper part of plant with opposite leaves and flowers in terminal and axillary cymes, showing petals twisted in bud. d, distinct, with stamens in bundles, with pistil and stigmas.

No. 4. Furze
(Ulex europæus, L.)

a, Young furze plant, with cotyledons, and early 3-foliate leaves, later transformed into spines. b, Branch, with spines, and papilionaceous flowers, showing standard, wings, and keel, and one terminal, showing the stigma, and column of stamens.

No. 5. Broom
(Cytisus scoparius, Link)

a, Flower, with calyx, gamosepalous, with unequal teeth, corolla removed to show stamens in column, with united filaments and stigma with incurved style. b, Legume, with twisted beak (style). c, Seed. d, Branch with 3-foliate leaves, and flowers, one papilionaceous, showing standard, wings, and keel, and within the stamens with versatile anthers and style.

No. 6. Tormentil
(Potentilla erecta, Hampe.)

a, Section of disk, and pistils with long styles, on convex receptacle. b, Section of achene. c, Rootstock woody, with roots, and leaf-bases. d, Upper part of plant with sessile 3-foliolate leaves, and flowers in cyme, with distinct petals, and sepals, alternating, also stamens.

1. Milkwort (*Polygala vulgaris*, L.). 2. Grassy Stitchwort (*Stellaria graminea*, L.). 3. Pretty St. John's Wort *Hypericum pulchrum*, L.). 4. Furze (*Ulex europæus*, L.). 5. Broom (*Cytisus scoparius*, Link.). 6. Tormentil (*Potentilla erecta*, Hampe.).

of grass. In the hollows and moist places on the heaths a strong aroma is scattered by Pennyroyal. Creeping Willow, like the Heath and Ling, spreads far and wide. Wood-rush sometimes strays here from the woods. All over the moors and heaths the nodding heads of the Meadow Rush wave in the vernal breeze. Here the skylark is singing overhead, the sky is blue or grey, and all conspires to raise the soul to the tune of Heaven's high caroller. The early Sedge, with its scent of musk, and green-ribbed Sedge, Small Bent Grass, Heath Hair Grass, all wave their slender, graceful panicles backwards and forwards with the infinite rhythm of the wind, and here and there dense tufts are formed by the Matweed.

Milkwort (Polygala vulgaris, L.)

Milkwort has never been found fossil. To-day it is met with in the Temperate and Arctic Zones in Arctic Europe, North Africa, Siberia, Western Asia. It is absent in Great Britain from North Devon, South Wilts, South Hants, Essex, Herts, Bedford, Stafford, Salop. In South Wales it is found only in Glamorgan and Brecon; in North Wales only in Carnarvon and Anglesey; in the Mersey province it is absent from Mid Lancs; it occurs in Durham; in the West Lowlands not in Renfrew or Lanark; in the East Highlands it is found only in Mid Perth, Forfar, South Aberdeen; in the West Highlands it does not occur in the Clyde Isles, Cantire, and not in the Orkneys. It ascends to 3000 ft. in the Highlands.

The Common Milkwort is a plant of the meadows and heaths, and always thrives best on high or rising ground; and though in the moist meadows of more lowland pastures laid to grass it luxuriates in a moist habitat along with Heath Bedstraw, Furze, and Broom, and the Harebell, yet as a rule it prefers, as do the majority of ericetal species, a dry atmosphere, even stony surfaces, and there it is undoubtedly xerophilous, or adapted to drought.

Milkwort has a trailing habit, very similar to the Rockrose, having numerous simple, unbranched stems, which are semi-erect, not ligneous or woody, as in the Rockrose. The leaves are distant, linear-lance-shaped, acute, the lower more oblong. It is thus a wiry plant with a semi-erect habit.

The flowers are deep-blue or pink, in terminal racemes, with sepals with branching veins and wings nearly as long as the corolla. The capsules are inversely heart-shaped and notched, the lobes being equal, the seeds with arils.

The plant is seldom 6 in. high, and is usually hidden away in the grass. It is in flower in May and June. The Milkwort is perennial, and can be propagated by division.

The flower has 5 sepals, the inner two petaloid, three small, linear, and the 2 alæ large and coloured, making the flower conspicuous. The corolla is tubular, the petals combined below with the staminal sheath, the median forming a hood, and inside are digitate processes

Photo. H. Irving

MILKWORT (*Polygala vulgaris*, L.)

on which an insect visitor is supported. The short stamens are attached to the tube in two groups, and bear hairs directed downwards. The pistil is in the middle, and bears a spoon-shaped stigma with a clammy stigmatic lobe bent downwards, which touches the proboscis when inserted and covers it with pollen. The short anthers lie in the concavity of the corolla just over the stigmatic lobe, shed pollen upon it, and withdraw to the side. The insect clings to the digitate processes. The visitors are Hymenoptera (Apidæ), Lepidoptera, *Polyommatus*. Behind the hollows is a clammy disk which is thus touched by an insect searching for honey, and, being thus sticky, when the proboscis is withdrawn it carries away pollen to another flower, and there this

is cleared off by the disk. When insects do not visit it the stigmatic lobe bends down, and self-pollination usually results.

The fruit is dispersed by the agency of the wind. The capsules are flattened, notched and margined, and light, so that they can be blown by the wind, while the seeds are downy.

Milkwort is a sand-loving plant and flourishes mainly on a sand soil, but may be found also where some amount of humus has collected, and, like other ericetal species, is partly a peat-loving plant.

The Lepidoptera *Penipelia palumbella*, *Prothymia viridaria* feed on Milkwort.

The name *Polygala*, given by Dioscorides, from the Greek *polus*, much, *gala*, milk, was given in reference to a supposed property it had of increasing milk as a meadow plant, and the second (Latin) name in reference to its universal occurrence.

Milkwort is called Cross-flower, Four Sisters, Gang Flower, Procession Flower, Robin's Eye, Rogation Flower. Gerarde says it is called Milkwort on account of its "vertues in procuring milke in the brests of nurses". It was carried in processions on Rogation Days (hence names), and Gerarde says: "The maidens which use in the countries to walke the procession do make themselves garlands and nosegaies of the Milkwort".

It has been used to promote expectoration, as a bitter infusion it was used for coughs, and the root when powdered has been applied in cases of pleurisy. The plant is ornamental, and some varieties bloom in winter. Some are greenhouse plants, and all free-flowering and handsome in colouring.

Essential Specific Characters:—

45. *Polygala vulgaris*, L.—Stem ascending, simple, leaves scattered, radical, smaller, oblong, upper linear-lanceolate, flowers blue, pink, white, in raceme, lower petal crested calyx wings with veins branched.

Grassy Stitchwort (Stellaria graminea, L.)

The Grassy Stitchwort has been found in deposits of Roman age. At the present day it is found in Arctic Europe, Siberia, Western Asia, as far as the Himalayas. It is common in every county in Great Britain except North Ebudes and the Hebrides. In Yorkshire it grows at an altitude of 1500 ft.

The Grassy Stitchwort is to be found on dry pastures and hedge-banks, usually where there is or has been a heath, for it is a strictly ericetal species, associated with such plants as Furze and Broom, Tor-

mentil, Wood Betony, and other xerophilous species. Here the grass habit is most pronounced, enabling the plant to clamber up between the *chevaux-de-frise* of a furze bush under the best conditions. Without some such support this tall but graceful, though spreading, plant would be unable to hold itself erect. It has a square and smooth suberect stem, jointed and grooved. The leaves are linear-lance-shaped, opposite, distant, and few, smooth, but fringed with hairs and stalkless.

The flowers are numerous, small, panicled, and borne on spreading,

Photo. B. Hanley

GRASSY STITCHWORT (*Stellaria graminea*, L.)

forking flower-stalks, with leaflike organs with membranous margin. The petals are narrow, as long as the 3-nerved sepals, and divided into two nearly to the base. The sepals are acute, the stamens numerous, the anthers red. The capsule is longer than the calyx, oblong, and the flower-stalks are turned down in front at first, then at right angles. The whole plant is dark-green and shining, not bluish-green. Grassy Stitchwort is 1 to 2 ft. high. The flowers last from April till August. It is a perennial plant, increasing by division.

The 5 nectaries surround the base of the 5 outer stamens. The plant is pollinated in three stages. First of all the 5 outer stamens curve toward the centre, the anthers open first and are smothered in pollen, then they curve out and down. The inner stamens bend outwards and take their place, the anthers being still closed, and the

style immature, and it is curved inwards, with the papillar surfaces turned outwards. The 5 inner stamens open before the other outer 5 have withered, but remain bent outwards. In the second stage the inner stamens wither and shrivel, the style lengthens, becomes erect, and spreads out, turning the papillar surfaces up and the curves of the papillæ outwards and downwards. In the third stage, insects, if not too small, settle in the middle of the flowers, and thus are bound to touch the pollen in young flowers to reach the nectaries, or the stigmatic papillæ in older ones. If insects do not visit the flower, the stigmas in curving outward touch the anthers enveloped in pollen. *Volucella bombylans* is a regular visitor. Whilst most plants have complete flowers, in some the stamens are not properly developed.

The seeds are dispersed by the plant itself, for the 6-valved capsule, when ripe, opens and allows the seeds to fall first round the parent plant, hence it is usually found growing in clumps like the Greater Stitchwort.

Grassy Stitchwort is a sand-loving plant and requires a sand soil, or barren ground such as that derived from granitic rocks or sandy formations.

The plant is infested by the fungi *Melampsora cerastii* and *Ustilago violacea*, and it is galled by *Brachycolus stellariæ*.

The second Latin name refers to the grass-like habit of the plant. Its only other English name is Starwort.

Essential Specific Characters:—

56. *Stellaria graminea*, L.—Stem quadrangular, smooth, leaves sessile, narrow, edged with cilia, flowers small, white, petals deeply cleft, as long as the sepals, in forked panicles, bracts ciliate, rough.

Pretty St. John's Wort (Hypericum pulchrum, L.)

This plant is not found in seed-bearing beds. It is a plant of the Northern Temperate Zone, found in Arctic Europe, eastwards to Lithuania and Turkey. In Great Britain it is generally common, but does not occur in Hunts, Radnor, Montgomery, Merioneth, Peebles, Selkirk, Stirling, Mull, or West Ross, and ascends to a height of 2200 ft. in the Highlands.

The Pretty St. John's Wort, a plant not belying its name, is an ericetal species, which is found on high ground in copses and along hedges, where the soil is more or less dry, for it is practically xerophilous. But another and more typical habitat is heathland or commonland, where it grows in company with Grassy Stitchwort, Sheep's Bit

Scabious, Red Rattle, Common Sylvan Cow-wheat, and Heath Hair Grass.

This is an erect, slender, tall-stemmed plant, smooth, with similar branches, which are few and distant, the stem-leaves heart-shaped to egg-shaped, shining, rigid, clasping, perforate, the upper ones not so long. The plant generally grows in isolated patches.

Photo. Flatters & Garnett

PRETTY ST. JOHN'S WORT (*Hypericum pulchrum*, L.)

The flowers are in loose cymes, yellow, tinged with red, of a beautiful golden colour, with 5 petals and 5 broad, blunt, entire sepals fringed with black glands or black glandular teeth, half as long as the petals, which are glandular and fringed with black glands. The anthers are red, the styles 3. The filaments (36) are united below in three bundles. The capsule is 3-chambered, subconical.

This plant is often 18 in. high. It flowers in July and August. It is perennial, and a deciduous, herbaceous plant increased by division of the root.

The flowers are more conspicuous than in Perforate St. John's Wort, and cross-pollination is more assured than in the latter. Otherwise the two plants have a very similar floral mechanism adapted to the same end. There is no honey, but much pollen.

Seeds are dispersed by the plant's own agency. The capsule is septicidal, and the seeds are dispersed by breaking up of the valves, aided by the wind.

Pretty St. John's Wort is a rock-loving plant and addicted to a rock soil, which is derived from older rocks.

The beetles *Libia cyanocephala*, *Cryptocephalus moræi*, *Chrysomela hyperici* feed on St. John's Wort.

The flowers are prettier than those of some of the other species (hence the Latin name *pulchrum*), and are tinged with red.

Essential Specific Characters:—

62. *Hypericum pulchrum*, L.—Stem erect, single, terete or round in section, glabrous, leaves cordate, clasping, smooth, the upper oblong, flowers golden-red, sepals and petals also obtuse, fringed with stalked glands.

Furze (Ulex europæus, L.)

Though ubiquitous in certain habitats, no traces of Furze occur in Glacial deposits. The present range is from Denmark to Italy, the Canaries, and Azores, or the Warm Temperate Zone. Furze is found in every part of Great Britain northward to Scotland, and though rarer in the North it ascends to 2100 ft. in Wales. It is found in the Channel Islands.

There is not a heath in the country which lacks a patch, however small, of the dry-soil-loving Furze, unless it has been rigorously under cultivation for a long time. But even then a bit here and there will keep cropping up to indicate the former state of the country before the universal enclosure, and consequent obscuring of the native flora, 100 years (or in some cases 200, or even 300 years) ago.

Furze is a dense, much-branched, stunted shrub, with no leaves in the older stages, when they take the form of long thread-like spines, which are straight and furrowed or branching. The stem is hairy and spreading. The cotyledons are succeeded by trifoliate leaves with egg-shaped leaflets which soon disappear.

The flowers are golden-yellow, lateral, with egg-shaped bracts, free, borne upon the spines, the teeth of the calyx coming together, yellow, with black hairs, and shaggy. The wings of the flower are larger than the keel, the petals shortly clawed. The pods are black, and clothed with brownish hair, and on maturity burst and scatter the seeds to a distance.

The plant is 6 ft. high usually. The flowers bloom in April right up to August in different parts or even later, and as early as January in some seasons. Furze is an evergreen shrub, and propagated by seed.

The calyx is larger and coloured, the alæ are longer in proportion, and project beyond the keel, being locked at the base with it. When

pressed down the flower bursts open. It has thus an explosive motion, much as in Dyer's Greenweed.

Furze is dispersed by ants, and also by the plant itself, the seeds being thrown out of the pods by a catapult movement.

It is a sand-loving plant, requiring a dry, sandy soil; but it is also a humus-loving plant, needing a humus soil to some extent.

It is galled by *Asphondylia ulicis*. *Pseudococcus aceris* and *Placopthorus rhododactylus* also attack it.

The Thysanoptera *Thrips ulicis*, *Sericothrips staphylinus*, and the

Photo. J. H. Crabtree

FURZE (*Ulex europæus*, L.)

moths *Grapholitha ulicetana*, *Butalis grandipennis*, *Anarsia spartiella*, *Gelechia malvella*, the Homoptera *Livella ulicis* and *Aphis ulicis* feed on it; and so do the beetles *Philorhinum sordidum*, *Micrambe vini*, *Timarcha violaceonigra*, *Luperus nigrofasciatus*, the Homoptera *Deltocephalus coronifer*, *Livilla ulicis*, and *A. rytæna*, the Heteroptera *Piezodorus lituratus*, *Heterogaster urticæ*, *Dictyonota crassicornis*, *Hypsitylus bicolor*, *Asciodema obsoletum*, &c.

Ulex is Pliny's name, but what he intended for it is wrapped in obscurity; the second name applies to its European distribution.

Furze is called Prickly Broom, Firsun, French Furze, Frez, Fur, Furrys, Great Furze, Furzen, Furzen-bushes, Fuzz, Gorse, Gorst, Goss, Gost, Ling, Lwyce, Ruffet, Thorn, Broom, Vuz, Whin, and Whins.

Photo. L. R. J. Horn

HEATHLAND, WITH THE COMMON FURZE

Common land, with Furze associations, on sandy gravelly soil, forming heath, with Pines in the background, which are often co-dominant on such barren soils. True heath plants, Heather, Heath, &c., replace these under similar conditions.

In Northants it is said:

"When Gorse is out of bloom
Kissing is out of season".

A spray of Gorse was inserted in the bridal bouquet in allusion to this. According to Pliny, Furze was used in the collection of gold, the plant being laid down in water to catch any gold-dust brought down by the water. Furze was used for fuel in bakers' ovens and in soap-making, when burnt containing much alkali. It was also crushed and given to horses as fodder, as also to cows and sheep.

Essential Specific Characters:—

74. *Ulex europæus*, L.—Shrub branched, spreading, with close thorns or spines, leaves small, lanceolate, few, calyx hairy, bracts ovate, flowers yellow, borne on spines, calyx teeth united.

Broom (Cytisus scoparius, Link.)

As with Furze, commonly distributed as it is this shrub is not found in any early deposits. Its present range is from Gothland southward, but it is absent from Greece and Turkey, occurring in N. Asia, Canaries, and the Azores. In Great Britain it is found in every county except Cardigan, Flint, and the Northern Isles, from Caithness southward, up to a height of 1000 ft. in the Highlands. It is found in Ireland and the Channel Islands.

Broom is everywhere a sign of heath-land or common-land, equally as much as Furze; but to-day Broom bears much more evidence of having been planted than Furze does, being much employed for forming fox-coverts and plantations, where Furze is used in its natural state. Railway embankments are frequently lined with clumps of Broom, and it grows in many recent woods.

Broom is a typical switch plant, with the shrub habit. The plant is more or less hairy, but not spinose, as in Furze, to the habit of which it more or less conforms, both being dry-soil heath plants. The stems are erect, much branched, bright- or dark-green, angular, and furrowed, the branches silky. The leaves are shortly stalked, ternate, 3 in a group, or solitary. They are small or absent, and the stems perform their function to a great extent. The leaflets are inversely egg-shaped, silky.

The flowers are papilionaceous, large, bright-yellow or white, the flower-stalks short, in the axils, solitary or paired. The styles are spiral. The pod is black, with hairs along the borders, and many seeds. After opening, the valves are twisted.

The height of a Broom plant is about 6 ft. It is in flower in April, May, and June. The plant is an evergreen shrub, increasing by seed.

The flowers are, as in *Genista*, explosive. There is no honey. The 5 short stamens first explode and dust the insect's abdomen, the 5 longer stamens then dust it above, and the pollination of the stigmas not covered up ensues. When bees settle they grasp the alæ with their mid and hind legs, and thrust their forelegs and head below the middle of the vexillum or standard.

The alæ and carina are forcibly pressed down, and the united upper margin of the keel splits from behind forwards by the pressure of an insect's foot. A fold catching in the angle between the upper edge of the carina and the sharp pouched protuberance at its mouth connects the alæ with the carina. When the split extends to the middle the shorter stamens spring out. They open in the bud and now press the pollen against the closed upper edge of the carina, and force the pollen against the bee's abdomen. The shock is not sufficient to drive off the bee, which only pauses and resumes its work. The split extends still further, and has barely reached the tip of the style, closely pressed against the keel, when a second more violent explosion takes place. Before this the style lay along the side of the carina, and the flattened end lies in the apex of the carina above the longer anthers, which have already opened. It curls inwards being now rendered free, and forms more than one complete spiral turn. As soon as it extends to the end of the carina the style springs up, and strikes the bee's back with the stigmatic tip, and the bulk of the pollen carried away by the enlarged style falls on the bee's back. The long stamens curl inward and emerge from the flower. When the bee is held, and the stigma cannot slip sideways, it remains as if stunned, and then, turning round, forces itself away from the style, and begins to gather pollen from the anthers. When the vexillum is erect, and the alæ are still enclosed by it, humble bees force it open and cross-fertilize it. The visitors are Hymenoptera (Apidæ), Diptera (Syrphidæ), Coleoptera (Staphylinidæ, Nitidulidæ).

Broom is dispersed by its own agency. The fruit is a dry pod, which jerks its seeds by an elastic movement, to a distance, opening suddenly with a jerk. It is also myrmecochorous, or dispersed by ants, which find nutriment in the elaiosomes.

Broom is a heath plant requiring a sand soil, and is thus a sand-lover, but some degree of humus soil is also a necessity, and it is likewise partly a humus-lover.

It is galled by *Asphondylia sarothamni.* Other insects infesting it are *Placophthorus rhododactylus*, a beetle, and also the beetles *Sitones regens*, *Philorhinium sordidum*, *Exochomus quadripustulatus*, *Meligethes lumbaris*, *Læmophlœus ater*, *Micrambe vini*, *Dryophilus anobioides*, *Bruchus villosus*, *Phytodecta olivacea*, *Luperus nigro-fasciatus*;

Photo. H. Irving

BROOM (*Cytisus scoparius*, Link.)

the moths, &c., Long-tailed Blue Butterfly (*Polyommatus bœticus*), Pale-shouldered Brocade (*Mamestra thalassina*), Straw Belle (*Aspilates gilvaria*), The Streak (*Chesias spartiata*), *Depressaria assimilella*; the Homoptera, *Gargara genistæ*, *Psylla spartii*; the Heteroptera, *Piezodorus lituratus*, *Dictyonota strichnocera*, *Anthocoris sarothamni*, *Orthotylus adenocarpi*, *O. concolor*, *O. chloropterus*, *Heterocordylus genistæ*,

H. tibialis, *Ascodema obsoletum*, and *Megachile versicolor*, a Hymenopterous insect.

Cytisus, Pliny, is an old Greek name for a kind of clover. *Scoparius* is from the Latin *scopæ*, a broom.

Broom has been named Banadle, Bannal, Basam, Beesom, Bisom, Bizzom, Breeam, Greem Broom, Green Broom, Browme, Brum, Genest. Basam, Bassam, or Bisom were names given in reference to the habit of making brooms from it. Breeam tea was an infusion used as a diuretic.

If Broom has many flowers it is a sign of plenty. In Germany it is used in decorating at Whitsuntide. When Joseph and Mary were fleeing into Egypt it bristled and cracked.

> "If you sweep the house with blossomed Broom in May,
> You are sure to sweep the head of the house away."

The water from Broom flowers was drunk by Henry VIII to prevent disease from surfeits. The bark shaved was used to stanch blood in the fourteenth century. An unguent was made from the blossoms. It was the badge of the Plantagenets.

The tops of Broom were put in beer to give it a bitter taste. The stem is fibrous, like Spanish Broom. The seeds have been used to adulterate coffee. Containing much alkali, it is the *Sal genistæ* of the pharmacopeia. It has been used successfully for thatching, and is planted for fences and coverts. It serves also as food for cattle. The flowers in bud are pickled like capers. The woody part was once used for tanning leather, and the old wood for veneering. Cloth has been manufactured with the fibre. It is cathartic, and the seeds emetic.

Essential Specific Characters:—

75. *Cytisus scoparius*, Link.—Shrub, branches slender, erect, angular, leaflets small, scattered, ternate, upper simple, flowers yellow, large, pods hairy, black, styles coiled.

Tormentil (Potentilla erecta, Hampe = P. Tormentilla, Scop.)

This is one of the Arctic plants which have been detected in early deposits, e.g. Interglacial, Late Glacial, Neolithic, and Roman deposits. The range to-day is Arctic Europe, West Siberia, the Azores, or the Northern and Arctic Temperate Zones. Commonly dispersed throughout Great Britain, it is found as far north as the Shetlands. In the Highlands it is found at the height of 3300 ft. It is a native of Ireland and the Channel Islands.

Tormentil is essentially an ericetal plant, being found on most of

our commons and heaths, where Furze or Broom occurs along with Tussock Grass, and Grassy Stitchwort, Lesser Spearwort, &c. It is xerophilous, loving best dry pastures, where Milkwort, Heath Bedstraw, Heath, Whortleberry, Eyebright, Woodrushes, Heath Hair Grass, and Matweed are usually found.

All herbalists know the red woody rootstock of Tormentil, for it is a favourite plant with them, and those who study botany will not neglect to collect it in preserving their specimen of it. The stems, which are numerous, are suberect, the lower leaves being quinate,

Photo. B. Hanley

TORMENTIL (*Potentilla erecta*, Hampe)

divided into five, and stalked, the others stalkless, the leaflets being wedge-shaped, lance-shaped, coarsely toothed at the end, clasping the stem, and downy both sides.

The flowers are smaller than in most of the Cinquefoils, and there are 4, not 5, petals, drooping at first, then erect (hence the second Latin name, applying equally to the stem). There are 8 sepals, which are downy. The seeds are naked, yellow, and net-veined. The receptacle is not fleshy as in *Fragaria*.

The plant is usually 6 in. high. It flowers during June and the intervening months up to September. Tormentil is like other deciduous, herbaceous plants, reproduced by seeds.

The floral arrangements are similar to those in *P. verna*, but the secretion of the honey is more evident, and as a thin layer. The

anthers spread out in a flat disk and open along their margins as in *Fragaria*, and they are coated with pollen only along their edges. The plant is visited by Apidæ, *Andrena*, Bombylidæ, *Systœchus*, Syrphidæ, *Chrysotoxium*, *Melithreptes*, *Cheilosia*. The anthers and stigma ripen at the same time.

The fruit consists of achenes, which are dispersed when dry by falling away from the parent plant, and so the plant is dispersed by its own agency.

Tormentil requires a sandy soil, and is therefore a sand-loving plant. It is also found commonly on rock soils derived from granitic and older aqueous rocks, which are more or less barren.

A fungus, *Phragmidium tormentillæ*, infests it, and it is galled by *Xestophanes brevitarsis*. A beetle, *Meligethes erythropus*, a Hymenopterous insect, *Andrena analis*, a moth, *Teras caspersana*, feed upon it.

The second Latin name refers to its relatively erect habit. It is called Biscuit, Blood-root, Earthbark, Ewe Daisy, Five-fingers, Flesh-and-blood, Sheep's Knapperty, Sept-foil, Set-foil, Seven-leaves, Shepherd's Knot, Shepherd's Root, Thormantle, Tormentil, Turnmentille. Sept-foil refers to the seven leaves, though there are often only five. It is called Earthbark in the Shetlands. As it is very astringent it is used for oak-bark in tanning. The name Blood-root arose from its red root, and by Doctrine of Signatures it was used for dysentery. Flesh-and-blood has the same origin.

The plant was an old cure for ague. Because it was used to cure toothache it was called Tormentil. It was also early used for stone. The rootstock is woody, and yields a red colour to leather and wood in Lapland. For tanning leather the roots have been boiled in water, and the leather steeped in the liquid when cold. A dye of a red colour has been obtained from it. It is used for a gargle, and lotion for ulcerated mouths and for sores.

Essential Specific Characters:—

99. *Potentilla erecta*, Hampe.—Rootstock woody, stem ascending, radical leaves quinate, petiolate, leaflets acute, 3–5, flowers small, cymose, yellow, petals 4, carpels wrinkled.

Heath Bedstraw (Galium saxatile, L.)

This lowly but widespread plant is found in the North Temperate Zone in Europe and West Siberia, but not in any early deposits. In Great Britain it is found in all parts except in Hunts, Cardigan, Mid Lancs, Stirling, and it ascends to a height of 3700 ft. in the Highlands.

No. 1. Heath Bedstraw
(*Galium saxatile*, L.)

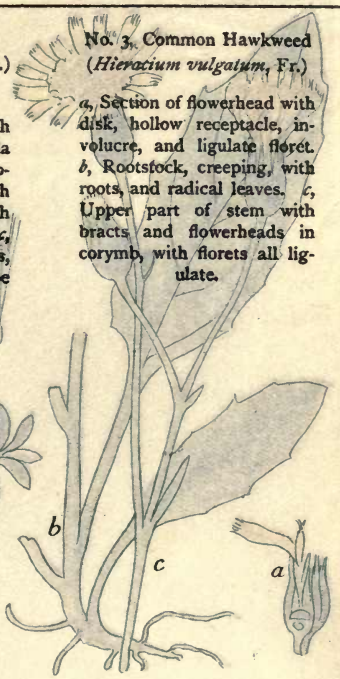
a, Flower (enlarged), with 4 petals and 4 sepals, alternating, 4 epipetalous stamens and pistil with 2 styles. *b*, Fruit, didymous, with rough surfaces. *c*, Upper part of plant, with leaves 5–6 in a whorl, and flowers, in axillary and terminal cymes, with some in fruit.

No. 2. Cat's Foot
(*Antennaria dioica*, Gaert.)
(Plant dioecious)

a, Female tubular floret with style, and with filiform corolla limb, and achene with pappus. *b*, Tubular floret, with dilated limb, and achene with pappus, undivided styles. *c*, Plant, with barren shoots, leaves cottony below, scape with flowerheads

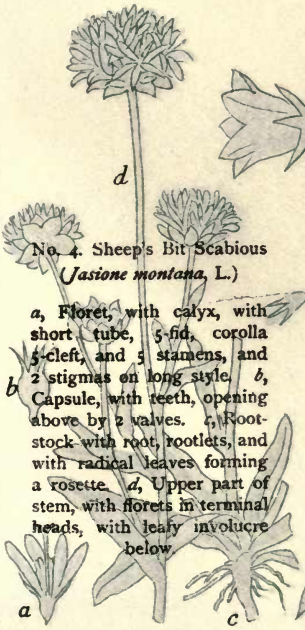
No. 3. Common Hawkweed
(*Hieracium vulgatum*, Fr.)

a, Section of flowerhead with disk, hollow receptacle, involucre, and ligulate floret. *b*, Rootstock, creeping, with roots, and radical leaves. *c*, Upper part of stem with bracts and flowerheads in corymb, with florets all ligulate.



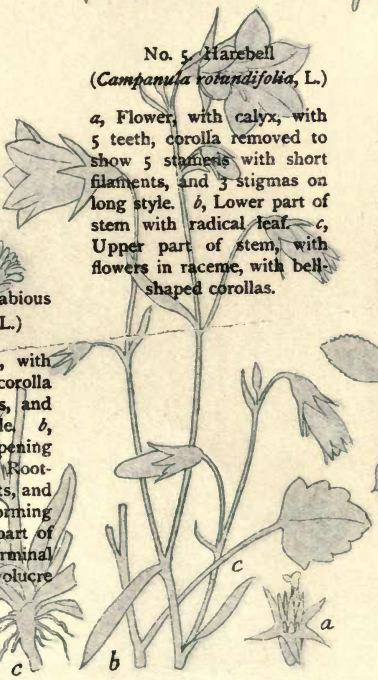
No. 4. Sheep's Bit Scabious
(*Jasione montana*, L.)

a, Floret, with calyx, with short tube, 5-fid, corolla 5-cleft, and 5 stamens, and 2 stigmas on long style. *b*, Capsule, with teeth, opening above by 2 valves. *c*, Rootstock with root, rootlets, and with radical leaves forming a rosette. *d*, Upper part of stem, with florets in terminal heads, with leafy involucre below.



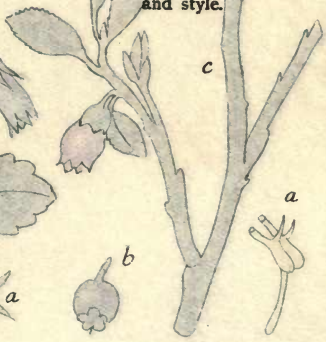
No. 5. Harebell
(*Campanula rotundifolia*, L.)

a, Flower, with calyx, with 5 teeth, corolla removed to show 5 stamens with short filaments, and 3 stigmas on long style. *b*, Lower part of stem with radical leaf. *c*, Upper part of stem, with flowers in raceme, with bell-shaped corollas.



No. 6. Whortleberry
(*Vaccinium Myrtillus*, L.)

a, Stamen, with long filament, and anthers with tubular tip and awns. *b*, Berry, with areola at the top and persistent style. *c*, Upper part of plant, showing stem-leaves, and flowers, solitary, drooping, with pink bell-shaped corolla, and one in fruit with persistent calyx and style.



No. 1. Heath Bedstraw
(Galium saxatile, L.)

a, Flower (enlarged), with 4 petals and 4 sepals, alternating; *b*, corpuscles stamens and pistil with 2 styles; *c*, Fruit, didymous, with rough surface; *d*, Upper part of plant, with leaves 5–6 in a whorl, and flowers in axillary and terminal cymes, with some in fruit.

No. 2. Cut-leaved Crane's-bill
(Geranium dissectum, L.)

a, Flower, with calyx of 5 sepals, 5 petals, 10 stamens, and pistil with 5 styles; *b*, Fruit, with 5 beaks; *c*, Upper part of plant, with dissected leaves, and flowers in axillary cymes.

No. 3. Cut's Foot
(Antennaria dioica, Gaert.)
(Plant dioecious)

a, Female tubular floret with style, and with filiform corolla limb, and achene with pappus; *b*, Tubular floret, with dilated limb, and achene with pappus, undivided style; *c*, Plant, with barren shoots, leaves contorty below, scape with flowerheads.

No. 4. Sheep's-bit Scabious
(Jasione montana, L.)

a, Flower, with calyx, with short tube, 5-fid, corolla 5-cleft, and 5 stamens, and 2 stigmas on long style; *b*, Capsule, with teeth opening above by 2 valves; *c*, Rootstock with root fibrils, and with radical leaves forming a rosette; *d*, Upper part of stem, with florets in terminal heads, with leafy involucre below.

No. 5. Harebell
(Campanula rotundifolia, L.)

a, Flower, with calyx, with 5 teeth, corolla removed to show 5 stamens, with short filaments, and 3 stigmas on long style; *b*, Lower part of stem with radical leaf; *c*, Upper part of stem, with flowers in racemes, with bell-shaped corollas.

No. 6. Whortleberry
(Vaccinium Myrtillus, L.)

a, Stamen, with long filament, and anthers with tubular tip and awns; *b*, Berry, with areola at the top and persistent style; *c*, Upper part of plant, showing stem-leaves, and flowers, solitary, drooping, with pink bell-shaped corolla, and one in fruit with persistent calyx and style.

No. 7. Common Hawkweed
(Hieracium vulgatum, Fr.)

a, Section of flowerhead with calyx, hollow receptacle, involucre, and ligulate florets; *b*, Rootstock, creeping, with roots, and radical leaves; *c*, Upper part of stem with bracts and flowerheads in corymb, with florets all ligulate.

1. Heath Bedstraw (*Galium saxatile*, L.). 2. Cat's Foot (*Antennaria dioica*, Gærtn.). 3. Common Hawkweed (*Hieracium vulgatum*, Fr.). 4. Sheep's Bit Scabious (*Jasione montana*, L.). 5. Harebell (*Campanula rotundifolia*, L.). 6. Whortleberry (*Vaccinium Myrtillus*, L.).

Heath Bedstraw is a plant which is more or less confined to open heaths and moors, or high ground of a rocky, stony character, being a typical moorland plant. It is associated with Grassy Stitchwort,

Photo Flatters & Garnett

HEATH BEDSTRAW (*Galium saxatile*, L.)

Tormentil, Harebell, Whortleberry, various Heaths, Ling, Red Rattle, Cow-wheat, and other heath and moor plants.

Unlike most of the Bedstraws, which are more or less erect, climbing up stronger stems in the hedgerow, this species is usually prostrate,

and covers the ground in a matted manner. The stems grow in tufts, but are short and weak. They are quite smooth, and angular. The leaves are whorled, 4–6, inversely egg-shaped, acute, blunt with a sharp point, rough at the margin, with prickles directed forward, flat, with a slender midrib.

The flowers, which are white, numerous, and closely associated, are in a cyme, and rather small. The petals are acute. The fruit is granular, not stiffly hairy, and the flower-stalks are erect to spreading. When dried the plant turns black, unlike the Rough Marsh Bedstraw, which retains its colour when dried, and has bristles at the angles of the stem turned back. The plant is 6 in. high at most. It flowers freely from April to September. Heath Bedstraw is a deciduous, herbaceous perennial increasing by division.

The flowers, though small, are white and conspicuous, growing in a compact cyme, and contain honey, which is not concealed. There are 4 stamens and 2 short styles close together. The stigmas are capitate. Being sweet-scented and growing in the open, the plant is accessible to insects, and liable to be cross-pollinated.

The fruit is rough, and adapted to dispersal by animals, clinging to the wool of sheep.

This Bedstraw is a humus-loving plant to some extent, growing on heaths where there is humus, or on rocks where, though the rock soil is stony, humus has collected.

On its leaves one may find a diminutive fungus, *Æcidium valantiæ*. Beetles such as *Meligethes coracinus*, *Timarcha tenebricosa*, *T. violaceo-nigra*, *Sermyle helensis*; Lepidoptera such as Beech Green Carpet (*Larentia olivata*), Satyr Pug (*Eupithecia satyrata*), Small Argent and Sable (*Melanippe tristata*), Wood Carpet (*M. rivata*), *M. biriviata*, Royal Mantle (*Anticlea sinuata*), *Eubolia*, *Lygris*, &c.; a Homopteron, *Trioza galii*; and the Heteroptera *Pœcilocytus gyllenhelii*, *P. nigritus*, *P. unifasciatus*, and the Hymenopterous insect *Halictus luteicollis* feed upon Bedstraws generally.

Galium, Dioscorides, is from the Greek *gala*, milk, referring to the property of coagulating milk characteristic of another species; and the second Latin name refers to its habitat, rocky places.

This species is also called Lady's Bedstraw, Our Lady's Bedstraw, a name which refers to the habit of using dried plants as bedding, and is associated with the Blessed Virgin from her having given birth to our Saviour in a stable.

Heath Bedstraw was said to induce love. It was reputed to have filled the manger in which the infant Jesus was laid.

Essential Specific Characters:—

Galium saxatile, L.—Stem prostrate, twisted, smooth, without reflexed bristles, leaves obovate, 6 in a whorl, flowers white, in a dense panicle, fruit granular.

Cat's-foot (Antennaria dioica, Gaertn.)

The Cat's Foot is found at the present day in the North Temperate and Arctic Zones in Arctic Europe, N. and W. Asia, East and West North America, and so far this is all our knowledge of its age and dispersal. In Great Britain it is absent in North Devon and Somerset in the Peninsular province, but is found in N. Hants, Surrey, Herts, Berks, Oxford; throughout Anglia, except in E. Suffolk and Bedford; only in E. Gloucs, Stafford, Salop in the Severn province; while in N. Wales it does not occur in East Radnor, and in S. Wales not in Montgomery; and in the Trent province it is not found in Rutland, but in the Mersey province generally (though not in S.E. Yorks); in the Humber, Tyne, and Lakes provinces. In Scotland it is found in the Lowlands, but not in Selkirk or Linlithgow in East Lowlands; elsewhere it is found in every part of Scotland, ascending to 2000 ft.

Photo. Dr. Somerville Hastings

Cat's-foot (*Antennaria dioica*, Gaertn.)

The Cat's-foot is a local plant, found, however, on most sandy heaths in the counties north of the Thames, and throughout Scotland. It is also found on dry sandy pastures, as well as true heaths and moors. With it one may find Furze, Ling, Penny Royal, Creeping Willow, Small Bent Grass, &c.

The aerial stems are flowering stems, and erect and simple, the shoots are prostrate or procumbent, with inversely egg-shaped, spoon-

shaped, radical leaves which are dark-green, and smooth above, cottony below. The stem is woody, and the leaves are in dense tufts.

The flowerheads are male or female, the plant being diœcious, the different sexes being in separate involucres, or whorls of bracts, on separate plants. The first Latin name was given in allusion to the awns of the pappus (like Antennæ). The flowerheads are pink. The inner scales of the involucre are blunt and coloured. The pappus hairs are silky.

Since it is a prostrate plant it is scarcely more than 3 in. high. Cat's-foot flowers in June and July. It is perennial, and multiplied by division.

The plant is diœcious, the flowers tubular, the female ones narrow and thread-like, the male tubular and dilated above. The anthers slightly project, and the style is simple. The flowers are adapted to cross-pollination if insects visit them.

The achenes are provided with a pappus, being 1-seriate, and adapted for wind dispersal.

Cat's-foot is addicted to a sand soil in which some humus occurs, and is partly a sand-lover or arenophilous, partly a humus-loving plant.

Neither fungal nor insect pests are known in connection with this rather uncommon plant.

The name *Antennaria* is from the Latin *antenna*, because the pappus hairs of the barren florets resemble the antennæ of an insect. The second Latin name refers to its diœcious nature. It is called Cat's-ear, Cat's-foot, Moor Everlasting.

Essential Specific Characters:—

153. *Antennaria dioica*, Gaertn.—Plant diœcious, stem prostrate, woody, with procumbent shoots, leaves tufted, radical leaves woolly below, spathulate, stem-leaves appressed, linear-lanceolate, flowerheads white or rose, in a corymb.

Common Hawkweed (Hieracium vulgatum, Fr.)

The present distribution of this Hawkweed is Arctic Europe, N. Asia, and N. America, or the Northern Temperate and Arctic Zones. It is found in every county in Great Britain except E. Cornwall, West Kent, Suffolk, Bedford, Hunts, Pembroke, Flint, Mid Lancs, Isle of Man, Dumfries, Linlithgow, Stirling, N. Aberdeen, Orkneys, that is from Ross southwards, and it ascends to 3500 ft. in the Highlands. In Ireland it is rare.

The Common Hawkweed is a plant of the heaths and moors, growing at a high altitude, and being ericetal it is also more or less

a xerophyte. It is, moreover, found on banks and in copses, usually in hilly country, like the majority of species, and in this case where the ground is rocky or covered with a debris of loose stones.

Unlike the Mouse-ear Hawkweed this has a tall stem. The leaves are green or bluish-green, and oblong, the radical leaves stalked, in a rosette, toothed in the middle or lower half, the stem-leaves stalkless. The leaves are often spotted.

The flowers are yellow, as in all Hawkweeds, and arranged in a corymb, or panicled, with ascending flower-stalks, with few hairs. The phyllaries or scales are equally narrowed, and the involucre or whorl of bracts cylindrical and subacute. The styles are livid.

The stem varies in height from 18 in. to 2 ft. Flowers are to be sought between June and September. This plant is perennial, and can be propagated by division.

The flowers are rather larger than in *Hieracium Pilosella*, and the flower-stalks are not prostrate, but the flowerheads borne on erect and longer scapes. They usually occur in shaded districts, so that the visitors to the flowers are different. They are *Bombus*, *B. terrestris*, *B. silvarum*, *Andrena*, *A. denticulata*, *Halictus cylindricus*, *Panurgus*, Lepidoptera, *Rhopalocera*, *Lycæna*.

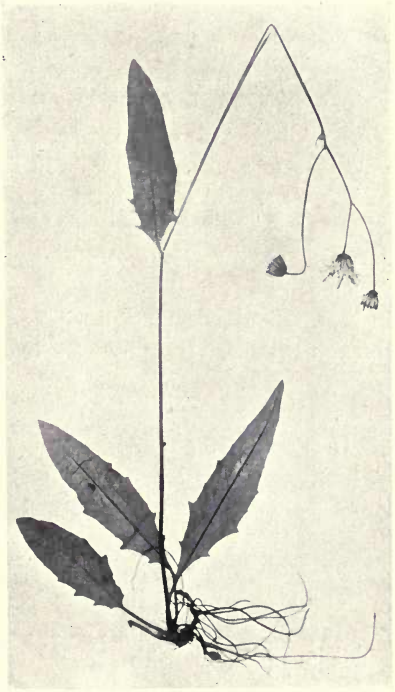


Photo. Horwood

COMMON HAWKWEED (*Hieracium vulgatum*, Fr.)

The achenes are provided with a pappus of simple hairs, and dispersed by the wind when the seeds are ripe.

This handsome Hawkweed is a peat-loving plant, living on soils in which there is a fair amount of humus, or the plant may be a rock plant and grow on rock soil of different types.

Two fungi, *Puccinia hieracii*, *Entyloma calendulæ*, attack the leaves.

The second Latin name refers to its wide distribution, but the name refers to an aggregate which has since been split up.

Essential Specific Characters:—

180. *Hieracium vulgatum*, Fr.—Stem erect, tall, leaves oblong-lanceolate, radical leaves alternate, with forward teeth, purplish below, flower-heads large, yellow, in a panicle or corymb, peduncles straight, phyllaries attenuate.

Sheep's Bit Scabious (Jasione montana, L.)

This plant is known only from its present distribution in the North Temperate Zone in Europe, N. Africa, and W. Asia. In Great Britain it is not found in W. Kent, Hunts, Glouc, Mid Lancs, S.E. Yorks, Cheviotland, E. Lowlands, except in Peebles and Selkirk, and only in Kincardine and Elgin in the E. Highlands. It is not found in Westerness, Mid or N. Ebudes, nor in the W. Highlands, and only in Shetland in the Northern Isles. It is found in Ireland and the Channel Islands.

Sheep's Bit Scabious grows on heaths and moors at a high elevation in rocky districts, cliff sides or quarries, or natural escarpments where the soil is light. It is indeed a rupestral species, or rock plant, occurring where Hawkweeds of various kinds and Wall Lettuce, as well as heaths and ericetal species, grow.

It is a dwarf plant, with suberect stems, branching near the base, and tufted. The leaves are linear-lance-shaped, narrow at the base, wavy or sinuate, curled, crisped, hispid, stiffly hairy, numerous, the radical leaves forming a rosette. The plant may be smooth or roughly downy, with long stiff hairs.

The blue flowers are small, in small heads, terminal, on the smaller branches. The bracts are smooth or hairy, the inner narrower. The petals meet below with narrow lobes. There are 5 anthers, oblong, which meet below at the base, forming a tube, a feature which separates it from the Scabious. The corolla is regular.

The plant may be 1–1½ ft. in height. It is in bloom in July. Sheep's Bit Scabious is annual, and propagated by seeds.

Having 100–200 large blue florets, it is attractive to many insects, and the plant is cross-pollinated simultaneously in the case of the main stigmas. The honey is easily reached by insects, being secreted in the upper part of the ovary. It is fully exposed, and surrounded by the flat limb of the calyx. The corolla is cleft down to the base, where it meets together into 5 narrow linear lobes, so that insects with short proboscis can penetrate the tube. The stamens meet together at the base, forming a ring round the style, and protect the honey from the rain, allowing

insects to insert their tongues between the anther-stalks. The hairs are excluded from the base of the flowers by the shrivelled anthers, which point obliquely upwards, and the anther-stalks. Pollination of many flowers by large insects is possible because the flowers are small and crowded, and an insect touches several flowers together. The styles lengthen till they are longer than the corolla lobes, and the flower is proterandrous, the anthers ripening first. Self-pollination is rendered difficult. The style at first bears a brush covered with pollen, and after the pollen and hairs have disappeared displays a 2-lobed stigma. The small size of the florets is counterbalanced by the number of insect visitors. It is visited by some 50 Hymenoptera, 30 Diptera, 30 Lepidoptera, including Hawkmoths, and Beetles.

The capsule is 2-valved at the top, and contains numerous seeds, being aided in dispersal by the wind, the seeds falling out above.

Sheep's Bit Scabious is a sand-loving plant growing on sand soil, and is a rock plant also, growing on granitic and slaty rocks.

Photo. Dr. Somerville Hastings

SHEEP'S BIT SCABIOUS (*Jasione montana*, L.)

A moth, *Homœosoma nimbella*, and a Heteropterous insect, *Strongylocoris luridus*, are found upon it.

Jasione, Theophrastus, was a Greek name applied to one of the Campanulas; and the second Latin name indicates its montane habit.

Sheep's Bit Scabious is called Blue Bonnets, Blue Buttons, Blue Daisy, Iron Flower, Sheep's Scabious, Sheep's Bit.

ESSENTIAL SPECIFIC CHARACTERS:—

186. *Jasione montana*, L.—Stem short, branched, leaves radical, in a rosette, oblong, hairy, alternate, flowerheads lilac-blue, in a terminal stalked head, anthers united, corolla 5-fid.

Harebell (Campanula rotundifolia, L.)

The Harebell is known to us as a plant of the Northern Temperate and Arctic Zones, found in Arctic Europe, North Africa, N. Asia, N. America. It is found in every part of Great Britain, except the Orkneys, as far north as the Shetlands, and ascends to 3500 ft. in the Highlands. It is native in Ireland.

The Harebell is the Bluebell of Scotland, and is a typical ericetal plant, indicative of heath or moorland generally. Barren, dry upland tracts are made gay with its delicate bluebell-like flowers in autumn, and it is one of our commonest hill-side wild flowers, growing side by side with Furze, Broom, Heaths, Ling, and Heather.

The leaves are smooth, the radical leaves oblong, kidney-shaped, seen at their best before the plant matures. They are usually coarsely toothed. The stem-leaves are linear-lance-shaped, and entire.

The flowers are blue or rarely white, bell-shaped, on spreading flower-stalks, drooping, and the flower-stalks may be simple or branched. The arrangement of the flowers is racemose, the corolla regular (or almost), and the calyx is 5-fid, the calyx segments linear, awl-shaped, and remain with the fruit. The anther-stalks are swollen below, concealing and protecting the honey. The anthers are quite distinct. There may be 2, 3, or 5 styles.

The plant may be 6–9 in. or 1 ft. high. The blooming of the Harebell takes place between June and August. The plant is perennial, and propagated by division. It is, and ought more generally to be, cultivated.

When the flower opens, the anthers and upper part of the stalks wither, the lower swell and partly cover the honey. The hairs on the pistil are drawn in, and the honey then lies more or less exposed, and is accessible to honey-seeking insects. When the hairs are withdrawn the stigmas open out and are dusted with pollen. If insects do not visit the flower, the stigmas bend over and are dusted with pollen from the anthers.

The flowers are large, blue, bell-shaped, tubular, with 5 lobes, bent back. The anthers are distinct and not united into a tube, the anther-stalks being expanded at the base to form triangular valves, dilated and broad, which protect the honey. The style is club-shaped, divided into 2 or 3 or 5 thread-like stigmatic lobes crowned with hairs. The anthers shed pollen on the stigma before the flower is even open, and are close to the pistil. The honey is abundant, and the plant is much

visited by insects, viz. Honey-bee, *Bombus*, *Cilissa*, *Andrena*, *Halictus*, *Halictoides*, *Chelostoma*, Diptera, Bombylidæ, *Systœchus*, Empidæ.

Photo. Flatters & Garnett

HAREBELL (*Campanula rotundifolia*, L.)

Rhamphomyia, Lepidoptera, *Ino statices*, Staphylinidæ, *Anthobium*, Curculionidæ, *Gymnetron*, *Otiorhynchus*.

The capsules open at the base, being pendent. The seeds remain in the capsules and are blown out by the wind. The inner face of such

hanging capsules is thick and woody, the thick part is egg-shaped and drawn into a blunt neck, with a long sharp point which extends into the capsule, the broader end being at the base, constituting the outline of the valve. There is a shallow groove in the centre, and, when ripe, this is convex on the inner face, hollow on the outer, breaking away from the rest of the capsule, and the thin edges turn outwards.

The seeds are large, oblong, broader at the end opposite the hilum, biconvex, with a thin narrow margin. The testa is bright brown, polished, and smooth.

The capsule is perforated at the bottom or base, so that the seeds are scattered by the wind. It is 3-celled.

The Bluebell is a peat-loving plant, luxuriating in a humus soil on moor, heath, and wayside, on various rock soils.

The fungi *Puccinia campanulæ*, *Coleosporium campanulæ* occur on it, and it is galled by *Cecidomyia campanulæ* and *Miarus campanulæ*.

Two Hymenoptera, *Cilissa hæmorrhoidalis*, *Cheilostoma campanularum*, and the moths Large Ranunculus (*Hadena flavocincta*), Ashworth's Rustic (*Agrotis ashworthii*), are found upon it.

Campanula, Dodonæus, is from the mediæval Latin *campana*, church bell (a diminutive of it), and the second Latin name refers to the round radical leaves.

It is called Air-bell, Aulman's, Hare or Hare's, Heath Bell, Bell-flower, Witch Bells, Blawort, Blue-bell, Blue Blauers or Blue-blowers, Blue-bottle, Gowks Thumbs, Milkwort, Lady's Witches, Thunble, Thimble. Aulman's Bell is a Scottish name, the plant being regarded with a sort of dread and commonly left unpulled. The name Lady's Thimble was bestowed because of the bell-shaped corolla which children gather and fit on their fingers. It was called Witches' Thimble, because it was commonly supposed witches decorated their fingers with it.

The Harebell was dedicated to St. George (April 23), people wearing blue coats.

> "On St. George's Day, when blue is worn,
> The blue harebells the fields adorn."

This, no doubt, refers to the Bluebell, *Scilla nutans*. Our Lady's Thimble was another name. It was a plant of ill-omen in Scotland (see Aulman's Bell). The roots have a milky acrid juice, and the plant has been used in dietetics. Linnæus says a blue pigment is prepared from the flowers. It is an ornamental flower and has been, and is, used in gardens.

Essential Specific Characters:—

187. *Campanula rotundifolia*, L.—Stem erect, slender, smooth, radical leaves ovate-cordate, shorter than the petioles, stem-leaves linear-lanceolate, flowers 1 or more, blue or white, campanulate, in a raceme, lobes of the corolla turbinate.

Whortleberry (Vaccinium Myrtillus, L.)

Seeds and other parts of this plant are known from Neolithic deposits in Renfrewshire. Hence it is a fairly ancient species. It is found in Arctic Europe, N. and W. Asia, and N.W. America. In Great Britain it is absent from N. Wilts, N. Essex, Bucks, Suffolk, W. Norfolk, Cambridge, Mid Lancs, Main Argyle, northward to the Shetland Islands, but is general elsewhere. It ascends to an altitude of 4000 feet. It is native in Ireland.

Whortleberry is a typical heath plant, growing as a rule at a considerable altitude, but always under ericetal conditions. Hill-sides, woods, and copses are similar stations for this plant, which loves a subsoil or soil rich in humus, like that of a wood or heath. Whole botanical districts are made up of this species, so that it gives its name to a certain type of association.

This is a short, shrubby plant, with the stem at first prostrate, then ascending and branched. The stem is smooth, angular, green, rigid. The leaves are egg-shaped, coarsely toothed, falling in autumn, the nerves net-veined. The stems as well as the leaves are capable of assimilation.

The leafless flower-stalks are 1-flowered, the flowers solitary, and pinkish, waxy, greenish, nodding or drooping. The corolla is swollen below, narrow above, with a narrow entrance. The anthers have two bristles or horns on the back. The fruit is a berry, nearly black or dark-blue, with a greyish bloom, or bluish-green. The calyx-tube is conical.

The height of the plant is at most 18 in. It is flowering in April, May, and June. The plant is a shrub increased by layers, and worth cultivating.

It is slightly proterandrous, the anthers ripening first. The pollen is dry and dust-like. Honey is secreted by an annular ridge resting on the ovary which surrounds the style, which is never moist, and not so smooth as most honey-glands. Honey drops are found on the outside of the base of each stamen, passing between the anther-stalks and the wall of the corolla. The honey is secreted in abundance in the

Photo. Flatters & Garnett

WHORTLEBERRY (*Vaccinium Myrtillus*, L.)

globular corolla by the epigynous disk. The aperture is so small that only long-lipped insects are able to reach it, such as hive-bees and humble-bees. The flowers resemble those of the Heath; but the anther-cells are close to the style, resting against the openings, and so retained until the insect visitors disturb it, when pollen falls on the back. The stigma is slightly projecting, and each visitor touches the stigma before it receives the pollen with which the anthers cover it. It is visited by the honey-bee, *Bombus agrorum*, *B. lapidarius*, *B. terrestris*, *B. scrimshiranus*, and *Andrena*. *Vespa rufa* is a frequent visitor also.

Photo. H. Irving

WHORTLEBERRY (*Vaccinium Myrtillus*, L.)

The berry is blue or bluish-green or black, and is eaten by birds, and the seeds are thus dispersed.

No. 1. Ling

(*Calluna vulgaris*, Hull.)

a, Flower, with calyx, 4-fid, corolla 4-lobed, urceolate, stamens and style (exserted). *b*, Stamen, with awned anthers, the cells opening by slits. *c*, Pistil, with 4-celled ovary, long style, and swollen stigma. *d*, Upper part of plant, with stem, with linear leaves, gibbous below, and 3-angled, and flowers in 1-sided racemes.

No. 2. Cross-leaved Heath

(*Erica Tetralix*, L.)

a, Stamen, with tailed anthers. *b*, Pistil, with 4-celled ovary, long style, and capitate stigma. *c*, Leaf, with revolute margin, and glands. *d*, Upper part of plant, with leaves, 4 in a whorl, and flowers in terminal umbels, with bell-shaped corollas, with 4-fid lobes, and 4-fid calyx.

No. 3. Crimson Heath

(*Erica cinerea*, L.)

a, Flower, with 4-fid calyx, and tubular or bell-shaped corolla, 4-lobed at the tip. *b*, Stamen, with long filament, and tailed anthers. *c*, Pistil, with 4-celled ovary, long style, and capitate stigma. *d*, Upper part of plant, with linear leaves, 3 in a whorl, irregular, and flowers in drooping whorled racemes, the styles exserted.

No. 4. Dodder

(*Cuscuta europæa*, L.)

(Leafless parasite)

a, Corolla, opened out, showing 4-fid limb, 4 epipetalous stamens, and pistil with 2-celled ovary with 2 styles. *b*, Corolla (pitcher-shaped), in 4-fid calyx. *c*, Pistil, in calyx with ovary, and 2 styles. *d*, Section of stem of host-plant, with pegs from stem entering it. *e*, Dodder plant, with twining stems and flower clusters, on grass and thistle, some with fruit.

No. 5. Eyebright

(*Euphrasia nemorosa*, H. Mart.)

a, Flower, showing corolla and calyx, the former labiate, the latter gamosepalous and 4-fid, bell-shaped. *b*, Pistil, with ovary, incurved style, with swollen stigma. *c*, Part of corolla tube, with 2 long, 2 short stamens. *d*, Capsule opening by 2 valves, and seed. *e*, Plant with roots (parasitic on grass), square stem, glandular, opposite leaves, and flowers in spike with bracts.

No. 6. Red Rattle

(*Pedicularis sylvatica*, L.)

a, Section of corolla, showing 4 epipetalous stamens, pistil, with ovary, long style, and stigma. *b*, Posterior stamen enlarged, with hairy filament, and blunt anther cells. *c*, Transverse section of capsule (compressed), with seeds. *d*, Seed. *e*, Capsule showing 2 lobes and oblique tip. *f*, Plant, with rootstock, root, and rootlets, radical and stem-leaves (pinnate), and flowers with labiate corolla in axils, with bell-shaped calyx, with unequal teeth and crested.

1. Ling (*Calluna vulgaris*, Hull). 2. Cross-leaved Heath (*Erica Tetralix*, L.). 3. Crimson Heath (*Erica cinerea*, L.). 4. Dodder (*Cuscuta europæa*, L.). 5. Eyebright (*Euphrasia nemorosa*, H. Mart.). 6. Red Rattle (*Pedicularis sylvatica*, L.).

No. 1. Ling
(Calluna vulgaris, Hull.)

a, Flower, with calyx, 4-cleft corolla, 4-lobed stigma, 8 stamens and style (or serrated). b, Stamen, with awned anther opening by slits. c, Pistil, with 4-celled ovary, long style and swollen stigma. d, Upper part of plant, with stem, with linear leaves, ribbons below, and 3-angled and flowers in terminal racemes.

No. 2. Cross-leaved Heath
(Erica tetralix, L.)

a, Stamen, with tailed anthers. b, Pistil, with 4-celled ovary, long style, and capitate stigma. c, Leaf, with revolute margin, and clumps of hairs in the axils, and d, Upper part of plant, with flowers in terminal umbels, with bell-shaped corollas, with 4-cleft lobes, and 4-fid calyx.

No. 3. Crimson Heath
(Erica cinerea, L.)

a, Flower, with 4-fid calyx, and tubular or bell-shaped corolla, 4-lobed at the tip. b, Stamen, with long filament, and tailed anthers. c, Pistil, with 4-celled ovary, long style, and capitate stigma. d, Upper part of plant, with linear leaves, 3 in a whorl, revolute, and flowers in drooping whorled racemes, the styles exserted.

No. 4. Dodder
(Cuscuta europæa, L.)
(Leafless parasite)

a, Corolla, opened out, showing 4-fid limb, 4 epipetalous stamens, and pistil with 2-celled ovary with 2 styles. b, Corolla (picture-shaped), in 4-fid calyx. c, Pistil, in calyx with ovary, and 2 styles. d, Section of stem of host-plant, with peg from stem entering it. e, Dodder plant with twining stems and flowers-clusters, on grass and thistle, some with fruit.

No. 5. Primrose
(Primula vulgaris, Huds.)
Mar.

a, Flower, showing corolla and calyx, the tomentellate and the latter exaggerated and 4-fid, bell-shaped. b, Pistil, with ovary, incurved style, with swollen stigma. c, Part of corolla tube, with 2 long, and short stamens. d, Capsule opening by 2 valves and seed. e, Plant with roots (parasitic on grass) square stem, glandular, opposite leaves, and flowers in spike with bracts.

No. 6. Red Rattle
(Pedicularis sylvatica, L.)

a, Section of corolla, showing 4 epipetalous stamens, pistil, with ovary, long style and stigmata. b, Posterior stamen, enlarged with hairy filament, and blunt anther cells. c, Transverse section of capsule (compressed), with seeds. d, Capsule, e, Capsule showing 2 lobes and oblique tip. f, Plant, with roots, root, and rootlets, radical and stem-leaves (pinnate), and flowers with labiate corolla in axils, with bell-shaped calyx, with unequal teeth and crested.

1. Ling (*Calluna vulgaris*, Hull). 2. Cross-leaved Heath (*Erica Tetralix*, L.). 3. Crimson Heath (*Erica cinerea*, L.). 4. Dodder (*Cuscuta europæa*, L.). 5. Eyebright (*Euphrasia nemorosa*, H. Mart.). 6. Red Rattle (*Pedicularis sylvatica*, L.).

Like other heath plants it is a peat-loving plant, and limited largely to hills where humus soil abounds, or woods.

The fungi *Guignardia vaccinii*, *Calyptospora gœppertiana*, Conifer cluster-cup disease, *Exobasidium vaccinii*, Vaccinium leaf blister, and *Melampsora vacciniorum* attack Whortleberry. It is a food plant for many moths, amongst which are Small Lappet (*Gastropacha ilicifolia*), Beautiful Yellow Underwing (*Anarta myrtilli*), *Grapholitha vaccinicum*, Scarce Dagger (*Acronycta auricoma*), Golden-rod Brindle (*Cloantha solidaginis*), and many others.

Vaccinium, Pliny, is the Latin name for the plant. *Myrtillus* is from the Latin *myrtus*, myrtle, because of the form of the leaves.

This upland shrub is called Bilberry, Bilberry Whortle, Blackberry, Blackheart, Black Whort, Black Whortle, Blaeberry, Bleaberry, Blueberry, Brylocks, Bullberries, Crow-berry, Fayberry, Fraghan, Hartberries, Horts, Huckle-berry, Hurtle-berry, Hurts, Whinberry, Whortleberry, Whorts, Winberry, Windberry. Blaeberry is bestowed on it because blae or blea refers to the blue colour of the fruit, hence "you're blae with cowl". Under the name Fraghan the berries are gathered in autumn, and women cry them out for sale.

The berries were used as "rob" and boiled till thick, honey and sugar being added. They have been used to make tarts in Scotland and the North. Grouse feed largely on the berries. They are eaten in Devonshire with clotted cream. A purple stain for paper or linen is derived from the juice. The berries are astringent. They are used in cases of dysentery. In the Highlands they are eaten with milk and used for jellies, and in the latter are mixed with whisky to give it a good flavour.

Essential Specific Characters:—

190. *Vaccinium Myrtillus*, L.—Shrub, stem angular, woody, leaves ovate, serrate, deciduous, flowers greenish-red, drooping, globular, waxy, solitary, corolla globose, berries black, with grey bloom.

Ling (Calluna vulgaris, Hull)

Though it is so widespread to-day Ling is not known from any early deposits. It is found in the North Temperate and Arctic Zones in Arctic Europe, not in Greece or Turkey, W. Siberia, Azores, Greenland, N. America. It is found also in all vice-counties of Great Britain as far north as the Shetlands, ascending to 3300 ft. in the Highlands. It is native in Ireland and the Channel Islands.

Ling is essentially a heath and moorland plant, contributing so

largely to those formations as to constitute, like Whortleberry, an association of its own. With it one finds Whortleberry, various Heaths, Furze, and Broom, and it is more widely distributed upon the high ground or hills in the British Isles, but in the south and elsewhere covers as well many lowland moors and heaths over wide areas.

Heather is a low-branched shrub, erect, downy, with reddish stems, with small, threadlike, stalkless, opposite, erect leaves, overlapping,[1] in 4 rows, and arrow-shaped. The leaves are smooth, small, and hoary, and hollow below. The stem is woody. A variety with downy stems and leaves occurs.

The flowers are purple, and are more or less turned one way, in racemes, numerous, drooping, bell-shaped, on very short flower-stalks, and the calyx is double, erect, i.e. in an inverted position, hairy on the margin, red or green and purple. The corolla is small, enclosed in the inflated calyx, persistent, with 4 lance-shaped bracts at the base giving the red colour. There are 8 anther-stalks, the anthers nearly united, being orange, and bearing two horn-like projections covered with rough hairs.

The plant is from 1–2 ft. high. The flowers bloom from February to July. Ling is an evergreen shrub propagated by cuttings, and worthy of cultivation.

The flower is bell-shaped and horizontal, the stamens and pistil are curved upwards, and insects press the proboscis under them, so that less pollen is wasted than if they were in the middle. The corolla is 2–3 mm. long, cleft, 4-fid near the base. Alternating with the stamens are 8 black glands which contain honey, and can be reached by short-lipped insects. When large bees cling to the flower with the foreleg they weigh it down until it is vertical, and hanging on below they suck the honey and dust themselves with pollen on the back. Small bees thrust their head or proboscis down from the front, and the upward bend of the stamens causes them to enter the lower half, and thus dust themselves also with pollen. As the bud opens, the anthers open, and the appendages, set with spreading hairs at right angles, are so far apart that they are sure to be touched by the insect's proboscis, and when the anthers are touched pollen falls. After the flower is open the style, which is longer than the stamens, grows, and only completes its growth after the anthers have opened. Then the 4-fid stigma is mature. The projection of the stigma before the opening of the anthers ensures cross-pollination. It is not self-pollinated. The visitors are Honey-bee, *Bombus*, *Diphysis*, *Saropoda*, *Andrena*, *Vespa*,

[1] In damp places they are more spreading.

Chrysotoxum, *Melithreptus*, *Syritta*, *Sericomyia*, *Cheilosia*, *Syrphus*, Thysanoptera, *Thrips*.

The capsule is divided into septa, and when dry these break off and the seeds fall out or are blown away.

Ling is essentially a peat-loving plant growing on a humus soil.

Three beetles, *Ceuthorhynchus ericæ*, *Stenus lustrator*, *Luperus flavipes*; *Thrips ericæ*, a Thysanopterous insect; Lepidoptera, Emperor

Photo. B. Hanley

LING (*Calluna vulgaris*, Hull)

Moth (*Saturnia carpini*), True Lover's Knot (*Agrotis porphyrea*), Narrow-winged Pug (*Eupithecia nanata*), Feathered Footman (*Eulepia grammica*), Speckled Footman (*E. cribrum*), Light Knot-grass (*Acronycta menyanthidis*), Beautiful Yellow Underwing (*Anarta myrtilli*); Heteroptera, *Camptobrochis pustulatus*, *Eroticoris rufescens*, *Sehirus biguttatus*, *Capsus scutellaris*; Homoptera, *Alopa reticulata*, *Thamnotettix strictulella*, *Dicraneura aureola*, feed on Heather.

Calluna is from the Greek *calluno*, I cleanse, as with the brooms made of it; and the second Latin name refers to its common occurrence.

Ling is also called Basam, Bend, Bent, Bream, Broom, Cat-heather, Dog-heather, Gowlins, Grig, Griglans, Hadder, Hather, Heath, Dog, Long, Red, and Small Heath, Heather, He Heather, Heth, Black

or Crow Ling, Ling-berry, Moor. It is called Broom from its use in making brooms. There was an Act of Parliament, 4 and 5 William and Mary, Cap. 23, which forbade anyone to burn on any common or waste between Candlemas and Midsummer any Grigg, heath, &c., and if they did they would be punishable with whipping and imprisonment. In modern times Ling is protected, as at Croydon. Laws still exist as to when moors may be burnt. It was called Ling Heath to distinguish it (as being taller) from the shorter heaths. The name He Heather was bestowed from its superiority as a fodder, for sheep have an aversion to other heaths because of their bitter taste.

It covers a great part of the North, and affords good fodder, when there is nothing else, for sheep. The milk of cows is supposed to be coloured red by it. It is used with earth to make Highland cottages, and for thatching and bedding. Leather was formerly tanned with it, and it was used for yellow and orange dyes. Brooms, brushes, and baskets are made from the shoots. Ale was brewed from the young tops. It was used for mending roads and heating ovens. The honey from the flowers is dark in colour.

Essential Specific Characters:—

193. *Calluna vulgaris*, Hull.—Shrub, tufted, stem wiry, procumbent or ascending, leaves imbricate, small, downy, sessile, in 4 opposite rows, flowers lilac, rose, in drooping racemes, corolla bell-shaped, calyx rose-coloured, with 4 bracts.

Cross-leaved Heath (Erica Tetralix, L.)

This common heath is found to-day (we have no earlier records) in the North Temperate Zone in N. and W. Europe, as far east as Russia. It is common in all parts of Great Britain, except E. Glouc, as far north as the Shetlands, and ascends to 2400 ft. in the Highlands. It is a native of Ireland and the Channel Islands.

The Cross-leaved Heath is nearly as widely dispersed as Ling, growing in the same habitats, but does not form such extensive patches as the latter. It does not reach so high an altitude as Ling, but occurs generally in the same districts, and principally on high ground.

The Cross-leaved Heath is a shrub, and has the typical heath habit. The plant is often downy and glandular. The stems are branched below, and again just above the middle, simple above, densely leafy below, with more distant whorls above, with a leafless space just below the flower. The stem is wiry, the branches irregular, slender. The young shoots are green at the tip, and much eaten by

game. The leaves are in whorls of 4, and are lance-shaped, linear, spreading, blunt, the old leaves hairless, the young leaves fringed with hairs, downy above and on the midrib below, the margins rolled back to the midrib—an adaptation to drought.

The flowers are in a sort of terminal umbel, drooping, rose-coloured, darker above, the parts in fours. The sepals are linear, oblong-lance-shaped, downy. The corolla is regular, egg-shaped, the mouth scarcely oblique. The flower-stalks are short, with bracteoles in the middle.

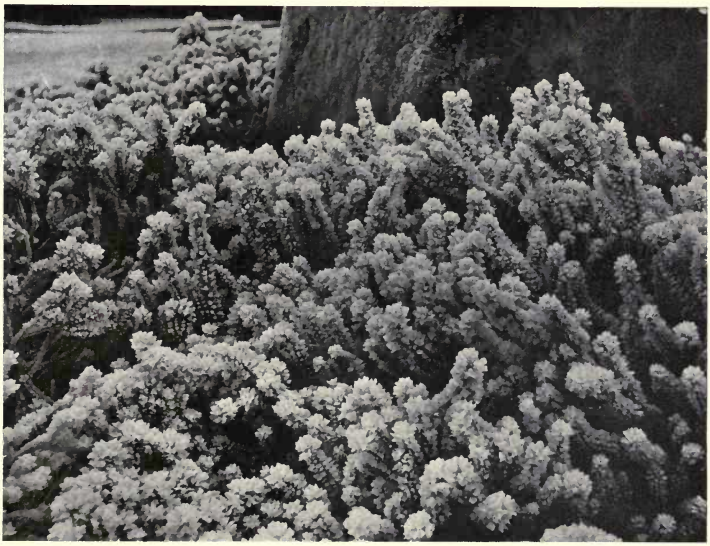


Photo. J. H. Crabtree

CROSS-LEAVED HEATH (*Erica Tetralix*, L.)

The anthers are spurred, with awl-like awns, and are included. The ovary is downy, with hairs tipped with glands.

The height of this Heath is about 1 ft. It flowers in June up till August. It is an evergreen shrub, propagated by cuttings, and worth cultivating.

The flower is bell-like in form and drooping, so that honey and pollen are amply protected from rain. The mouth of the clapper is 2 mm. wide, nearly taken up by the long style and stigma, and the tube is contracted in the middle, and 1 mm. wide. A dark glandular honey-ring surrounds the base of the ovary, and the style stands in the centre and fills up the mouth, bearing a black, moist, sticky stigma which is slightly exserted. An insect clinging to the flower touches it and is covered with a sticky secretion.

There are 8 anthers on long filaments springing from the base of the ovary. At the end of each are two cells, which are spreading, with an oval aperture below, which, however, does not allow the pollen to escape, as each cell at the aperture rests against the next anther cell, which acts as a sort of cap, the whole series forming a ring round the corolla. The anther-cells are also armed with two horn-like processes which stick out like the spokes of a wheel. The anthers reach just below the sticky stigma. When an insect visits the flower for the honey it rubs against the stigma first with its head, which in a previous flower was dusted with pollen, and it also, in pushing its proboscis down the tube, pierces the *chevaux de frise* of anther processes, and these release the pollen in the boxes and shower it upon the visitor's head, ready for the next visit as it were. But if insects do not visit the flower the pollen, when discharged from these boxes, falls on the stigma, which is in the fall line.

Amongst the insect visitors are Honey-bees, *Bombus*, *Nomada*, *Volucella*.

The capsule splits open from above, allowing the seeds to fall out or be blown away by the wind.

Cross-leaved Heath is a humus-loving plant, and almost confined to a humus soil.

Several beetles live upon it, *Harpalus discoideus*, *Coccinella hieroglyphica*, *C. distincta*, *Byrrhus murinus*, *Elater sanguinolenta*, *Haltica cricetí*, and several Hymenoptera, *Miscophus concolor*, *Colletes succincti*, *Halictus punctatissimus*, *Andrena fuscipes*, *A. argentata*, *A. lucens*; Lepidoptera, Fox Moth (*Lasiocampa rubi*), *Saturnia pavonia*, Heath Rustic (*Agrotis agathina*), True Lover's Knot (*A. porphyrea*), Gray Rustic (*Noctua neglecta*), &c.; several Heteroptera, *Myrmus miriformis*, *Berytus crassipes*, *Nysius lineatus*, *Ischnorhynchus geminatus*, *Ischnocoris angustulus*, *Macrodema micropterum*, *Scolopostethus decoratus*, &c.; Homoptera, *Cixius similis*, *Ulopa reticulata*, *Athysanus russeolus*, *Rhinocola ericæ*.

Erica, Dioscorides, is from the Greek *ereike*, heath, and *Tetralix* from the arrangement of the leaves in fours.

The Cross-leaved Heath is called Bell-heath, Bell-heather, Broom-heath, Cat-heather, Crow Ling, Grig, Hather, Heath, Bell, Besom, Broom, Father-of-Heath, Heather Bell, Carlin, Ringe Heather, Honey Bottle, Ling. This plant was called Ringe Heather because it was used for making rings or wisps made of Heather. Though called Besom Heather in Ray's day it was not used for besoms, "that ever I saw, nor is fit for such a use".

It was especially burnt on the eve of All Saints' Day as a bonfire.

> "On All Saints' Day bare is the place where the heath is burnt,
> The plough is in the furrow, the ox at work."

Essential Specific Characters:—

194. *Erica Tetralix*, L.—Shrub, stem branched below, simple above, leaves 4 in a whorl, fringed, lanceolate, downy above and on the midrib, flowers rose colour, drooping, umbellate, terminal, sepals linear, downy, ovary downy.

Crimson Heath (Erica cinerea, L.)

Generally distributed throughout Western Europe as far east as Germany and N. Italy in the North Temperate Zone, there are no records of the occurrence of this plant in any ancient deposits up to the present. In Great Britain it is absent from Bedford, Hunts, Northampton, E. Gloucs, Mid Lancs, S.E. Yorks, as far north as the Shetlands. It is found at a height of 2200 ft. in the Highlands, and is native in Ireland and the Channel Islands.

Crimson Heath is an ericetal species like the Cross-leaved Heath and Ling, and more widely distributed than the former. Both extend sufficiently to give their name to the Heath formation, which is to some extent of lower elevation than that of Ling, which reaches generally a higher altitude. Both Cross-leaved Heath and Crimson Heath are found on commons, heaths, and moors in the south as well as the far north.

The Fine-leaved Heath has a similar habit to the Cross-leaved Heath and Ling. But in this species the leaves are three in a whorl not four. The stem is shrubby, the plant as a whole bushy, with woody, wiry stems, the bark being ash-coloured, and branched. The branches are opposite, bearing linear, spreading leaves, smooth above, transversely wrinkled, with a keel below and a furrow beneath, and smooth.

The flowers are deep purple, in dense racemes, in verticillate or whorled clusters, and terminal. There are 4 sepals, lance-shaped acute, and keeled, spurred. The corolla is monopetalous or tubular. It is remarkable for the fineness and smooth green of the leaves, and the deep purple spikes of flowers.

The Crimson Heath is about 1 ft. high, and is in flower from June to September. It is an evergreen shrub increased by means of layers.

The flower is similar to that of *E. Tetralix*, but sometimes horizontal, and the anthers have toothed appendages and not awl-shaped awns. The flowers are normally whorled.

The capsule splits open along the 4 valves, and contains many small seeds which fall out or are dispersed by the wind.

As a heath plant it is a humus-loving plant, and grows only on humus soil.

A moth, *Gelechia longicornis*, and several other Heteroptera, besides those that visit *E. Tetralix*, are found on *E. cinerea*, such as *Seranthia*

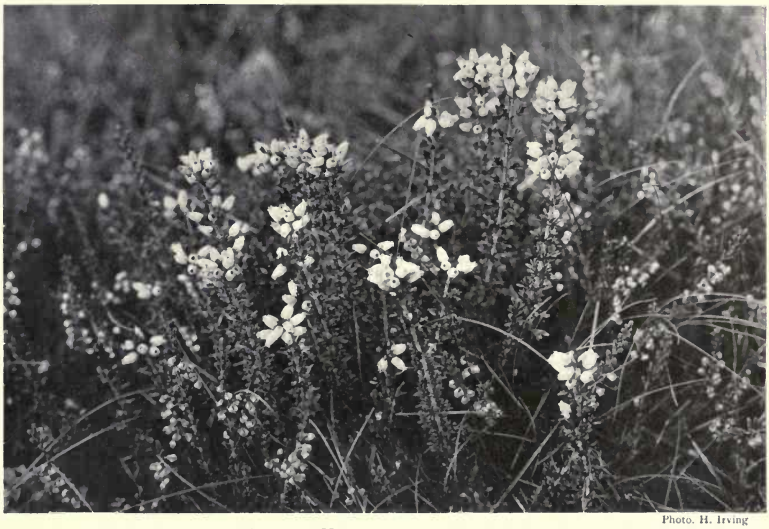


Photo. H. Irving

CRIMSON HEATH (*Erica cinerea*, L.)

læta, *Nabis boops*, *N. ericetorum*, *Allodapus rufescens*, *Orthotylus ericetorum*.

The second Latin name refers to its greyish appearance. The names Bell-ling, Bent, Carlin-heather, Cat-heather, Crow-ling, Hather, Heath, Black Heath, Heather, She Heather, and Ling are applied to this plant.

As to the name She Heather, it is said, "This is the She Heather of the herds, who thus ungallantly indicate their opinion of its inferiority to the Ling".

It is much sought by bees for honey, which is of a peculiar flavour. Beer is made from it in the Hebrides, and malt is added to the heath-tops. It is astringent, but is not now used in medicine.

Essential Specific Characters:—

195. *Erica cinerea*, L.—Shrub, bushy, stem wiry, upright, branched, leaves 3 in a whorl, keeled below with glabrous furrows, flowers crimson in dense whorls, raceme irregular, ovate, ovary glabrous.

Dodder (Cuscuta europæa, L.)

A parasite and sporadic in its occurrence, this curious form of plant life has left no trace of its occurrence in ancient deposits. Its present distribution in the North Temperate Zone is Europe, N. Africa, and Siberia. In Great Britain it is found in S. Devon, Somerset, N. Wilts, Dorset, the Isle of Wight, N. Hants, Sussex, the Thames province except E. Kent, Middlesex, Anglia, E. Gloucs, Worcester, Warwick, Leicester, Chester, Westmorland.

Dodder is a parasitic plant which grows on nettles and vetches and other plants, and is as a rule found on heaths and commons, being frequently found upon Furze. But its occurrence is extremely sporadic, and it cannot be said to be common anywhere, though it is more especially characteristic of ericetal tracts in the south of England.

Interesting in its mode of subsistence, aerial, and not issuing from the ground, adhering to the upper parts of other plants, from which it draws its support, as in the case of *Bartsia*, *Euphrasia*, *Orobanche*, &c., it is also remarkable in not turning like most climbing plants from right to left with the sun. If planted in earth it will not grow.

The seeds after falling on the ground germinate in the soil, develop a slender root and a thread-like stem. There are no cotyledons. By the aid of the twining habit or circumnutation it later twines itself upon a furze stem, which forms its host, and tendril-like twines round it. Suckers are developed, and these bore into the woody layers of the stem of the host plant, and henceforward serve as the organs of absorption. The root no longer necessary dies, and the plant is therefore now a true parasite. The stems are thread-like, reddish, branched, leafless, twining.

The flowers are white, streaked with red, clustered, stalkless, with an erect calyx, shorter than the corolla, with spreading, blunt segments, fleshy at the base. At first cylindric the tube of the corolla, which equals the short, broad lobes, is spreading and swollen, with closely-pressed scales within. The seed does not open by lobes, but the embryo is spirally coiled.

The plant grows to a length of 2 ft. It flowers in August and September, and is annual.

The anthers and stigma ripen simultaneously, self-pollinating the plant. The flowers are cleistogamic. The corolla is spreading, with a ring of appressed scales below the stamens, which are included, and inserted on the corolla tube. The styles are also included. The flowers are small and globular, and unattractive to insects. Honey is secreted at the base of the ovary, protected by 4 scales.

Photo. Flatters & Garnett

DODDER (*Cuscuta Epithymum*, L.), to show the habit of *C. europæa*

The capsule splits open, allowing the seeds to fall around the parent plant.

Dodder is a parasitic plant growing on heath plants after the seed has germinated in the soil, usually a humus-loving plant and rich in humus.

A beetle, *Smicronyx jungermanniæ*, is found on it.

Cuscuta, Mathiolus, is from the Arabic *Chasuth*, and the second Latin name indicates the distribution of the plant.

It goes by the name of Beggarweed, Bind, Devil's Guts, Hailweed, Hairweed, Hale, Hell, or Hairy-bind, Hale-weed, Podder, Scald, Scald-

weed, Strangle Tare. The name Scald is from the scalded appearance it gives to bean crops. The name Devil's Guts is derived from the thread-like stems which wind round other plants and strangle them. "Hellweed grows upon tares more abundantly in some places, where it destroyeth the pulse or at least maketh it much worse, and is called of the country people Hellweed because they know not how to destroy it."

Essential Specific Characters:—

222. *Cuscuta europæa*, L.—Stem yellow, filiform, branched, leafless, flowers whitish-yellow, clustered, corolla longer than the calyx, scales appressed, stamens included.

Eyebright (Euphrasia nemorosa, H. Mart. = E. officinalis, L., in part)

There are no traces of Eyebright, which is a northern type, in any ancient deposits. It is found in the Arctic and N. Temperate Zones in Arctic Europe, N. and W. Asia, the Himalayas, and N. America. As an aggregate the old *E. officinalis* occurs in every county except Cardigan, Stirling, Main Argyle, but the segregate is found in only 47 vice-counties. It ranges as far north as the Shetlands, and in the Highlands up to 3600 ft. It is native in Ireland and the Channel Islands.

Eyebright is an upland species as a rule, and is found in meadows, as well as frequent on heaths, moors, and commons. It is a xerophyte. Associated with it are Milkwort, Grassy Stitchwort, Furze, Broom, Tormentil, Heath Bedstraw, Harebell, Red Rattle, and many other ericetal and pratal species.

The stem is large, robust, without any glands, branched, with deeply coarsely-toothed and folded leaves, spreading, egg-shaped to lance-shaped, acute, with curved teeth, the bracts spreading, curved back, with broad and short and acute teeth.

The flowers are white, with a blue upper lip, and yellow on the lower lip, borne on a long spike, terminal, with triangular sepals. The corolla is small. The fruit is inversely egg-shaped, notched at the end, fringed with hairs, and longer than the calyx.

This plant may be 1 ft. high, but is usually about 6 in. It flowers in July up till September. The plant is annual, propagated by seeds.

It is a hemi-parasite on the roots of grasses, penetrating by nodular suckers into the host. Possibly some nutriment is returned to the latter on the death of the Eyebright.

The honey is secreted by the lower part of the ovary, which is

smooth and swollen in front, concealing the honey, and hairy above, and so protecting it. The corolla tube is 4–6 mm., and enlarged below. Short-lipped insects can get at the honey by thrusting their heads into the wider part. The upper lip is a vaulted roof which shelters the honey and pollen from the rain, and an insect's proboscis cannot be thrust in above the 4 stamens (with 8 anthers). The lower lip is 3-lobed, and small insects alight on it, while larger ones place their fore-legs on it. There is an orange spot or honey-guide on the inner lip and at the entrance, and the violet lines converging to the centre also

Photo. J. H. Crabtree

EYEBRIGHT (*Euphrasia nemorosa*, H. Mart.)

serve the same purpose. The lengthening of the corolla brings the stigma and anthers closer. The anthers are behind at first in some flowers. The anthers meet together, the 2 lower chambers of each upper or outer pair uniting with the upper of the inner or lower stamens on the same side. The lower surface of the anther is produced into a sharp point, which the bee touches with its proboscis as it passes down the tube, and it serves as a lever, shaking the pollen from the anthers upon the insect. It is visited by Honey-bees, *Bombus*, *Nomada*; Diptera, *Systœchus*, *Syrphus*, *Melithreptus*. This large-flowered form is proterandrous and cross-pollinated. There are forms in which the stigma matures first. The smaller-flowered plants are self-pollinated.

The lower chambers of the upper anthers, which are outer, unite firmly with the inner and lower anthers. There is a stiff-pointed process on the lower surface. The lower points exceed the upper,

projecting into the mouth, the upper terminating in a brush of hairs, and these prevent the pollen from being scattered at the side. A bee touching them disperses the hairs, and pollen falls upon the insect.

The capsule opens above, and the seeds are dispersed around the parent plant.

Eyebright is a humus-loving plant, a heath plant, parasitic on grasses, and requires a humus soil.

The leaves are attacked by the fungus *Plasmopora densa* and *Coleosporium euphrasiæ*.

A moth, the Pretty Pinion (*Emmelesia blandiata*), feeds upon it.

Euphrasia, Fuchs, is Greek for gladness. It was formerly called Euphrosyne from its reputed cure for eyes. The second Latin name indicates the woodland habitat. It grows on grassy slopes. Eyebright is also called Adhib, Euphrasy, Ewfras.

Coles says: "Divers authors write that goldfinches, linnets, and some other birds, make use of this herb for the repairing of their own and their young ones' sight. . . . The purple and yellow spots and stripes, which are upon the flowers of Eyebright, doth very much resemble the diseases of the eyes as bloodshot, by which signature it hath been found that this herb is very affectual for the curing of the same." It was supposed (and is now) to be good for the eye, owing to the black pupil-like spot in its corolla, by Doctrine of Signatures. Milton represents the Archangel clearing the vision of Adam and Eve by its means:

> "Then purged with euphrasy and rue
> His visual orbs, for he had much to see";

and Spenser writes:

> "Yet Euphrasie may not be left unsung,
> That gives dim eyes to wander leagues around";

and Thomson also:

> "If she, whom I implore Urania, deign,
> With Euphrasy, to purge away the mists
> Which humid dim the mirror of the mind".

In Chaucer's day it was held a cure for all eye diseases, and described as

> "Precious water to clear a man's sight and destroy the pin" (a sty).

Essential Specific Characters:—

238. *Euphrasia nemorosa*, H. Mart.—Stem branched, without glands,

leaves ovate-lanceolate, dentate, upper with recurved teeth, flowers white or blue with yellow spots, small, fruit obovate, exceeding the calyx teeth.

Red Rattle (Pedicularis sylvatica, L.)

Unlike the Marsh Red Rattle this is not an Arctic plant, and does not occur in any ancient deposits. The range is throughout Europe,

Photo. Flatters & Garnett

RED RATTLE (*Pedicularis sylvatica*, L.)

except Greece and Turkey or the N. Temperate Zone. It is found in every part of Great Britain, as far north as the Shetlands, up to 2000 ft. in the Highlands. It is native in Ireland and the Channel Islands,

Red Rattle is an extremely local plant, though uniformly dispersed. It is an ericetal species, few heaths being without it. It aiso grows on commons, moors, and upland slopes of hills. It is associated with Tormentil, Heath Bedstraw, Harebell, Ling, Eyebright, Cow-wheat, and a hundred other upland wild flowers.

The stems are smooth, tufted, clustered, unbranched except at the

base, decumbent or prostrate, so differing markedly in habit from the Marsh Lousewort. It has a low, tufted, leafy stem. The leaves have lobes each side of a common stalk, with acute pinnæ, and are divided nearly to the base.

The flowers are rose-colour, irregular, large, with an oblong, inflated, smooth calyx, which is unequal, 5-cleft, with leaflike lobes. The corolla has a slender tube (10–14 mm.), flattened lengthwise, and the upper lip is 2-dentate. The capsule exceeds the calyx, and is blunt.

Red Rattle is not more than 3 in. in height, being prostrate. The flowers bloom in May, June, and July. The plant is perennial and propagated by division.

Opposite pairs of the 4 anthers are contiguous along the inner edge, forming a box, and their outer edges adhere to the top of the tube or hood. The honey lies at the base of the ovary, 10–14 mm. from the mouth of the corolla, and the latter is compressed or flattened lengthwise, hence a humble-bee can only insert part of its head. To reach the honey the insect has to stretch the lips, and so opens the anther-cavity, and releases a shower of pollen on the fringe of hairs on the lower edge of the anthers, which thus falls on the head of the bee, when it has but just touched the projecting stigma, and is ready to be applied to the stigma in the next flower. The edge of the upper lip is rolled back, the inner armed with projecting teeth.

The flowers are visited by the Hymenoptera, *Anthophora* and *Bombus*.

The capsule splits open and allows the seed to fall out, or be blown by the wind, around the parent plant.

This pretty little heath and marsh plant is a humus-loving, parasitic plant, and grows only on heaths on humus soil.

The second Latin name suggests a woodland habitat, but it is addicted to open heathland or wet spongy tracts on hill-sides.

Red Rattle is also called Cock's-comb, Dead Men's Bellows, Honeysuckles.

Essential Specific Characters:—

241. *Pedicularis sylvatica*, L.—Stem prostrate, branched below only, leaves pinnatifid, segments ovate. flowers rose-colour, calyx glabrous, oblong, angular. 5-fid.

Cow-wheat (Melampyrum pratense, L.)

Another of those Arctic plants not found in early deposits is Cow-wheat. To-day it is found in the Arctic and N. Temperate Zones in Europe (except Spain, Italy, Greece, Turkey), and in Siberia. Cow-wheat is widespread in distribution, growing in all the counties (except Hunts, Cardigan, Isle of Man, Shetlands), as far north as the Orkneys, and up to 3000 ft. in the Highlands. It is a native also of Ireland.

One has to look in the exact habitat of Cow-wheat to come across it, a remark almost a truism and applicable to every other plant in some degree, but especially here. That is to say it is local, choosing a peculiar type of station. Common Sylvan Cow-wheat, while an ericetal species, is more often to be found in damp localities occurring in woods and copses, and sometimes on ground surrounding streams or other tracts of water.

Cow-wheat has a sub-erect, square, weak, wavy stem, which is provided with more or less spreading branches issuing from the base. The leaves are narrowly lance-shaped, in opposite pairs, stalkless, smooth, or downy with two rows of hairs, dark-green, the base heart-shaped sometimes, the margin entire.

The flowers are pale-yellow, large, and spreading. They are borne in the axils of the leaves and in pairs turned all one way. The bracts are toothed below, spear-shaped. The corolla is irregular, four times the length of the calyx, and closed, with a projecting lower lip. The calyx is smooth, and the teeth equal the tube. The capsule is egg-shaped and depressed, like wheat, hence the first Greek name. It is said to turn bread black.

Cow-wheat is about 1 ft. to 18 in. high. The flowers bloom in June and up to September. The plant is annual, propagated by seeds.

The four anthers lie close together, and form a pollen reservoir, which is opened by touching the pointed appendages or teeth at the lower end of each anther-lobe, unlocking the reservoir. The honey lies at the base of the ovary, opposite the lip, which is expanded into a round, fleshy body with grooves each side. The honey rises 2–3 mm. in the tube, which is 14–15 mm. long, and is protected by hairs from the rain. Without inserting its head an insect needs a proboscis 14–15 mm. long, but at the anterior end the corolla is expanded and admits a bee's head, except the hive-bee, *Bombus terrestris*, and a few others.

The flowers are visited by Honey-bees, *Bombus*, *Megachile*, *Oxycera*.

No. 1. Cow Wheat
(*Melampyrum pratense*, L.)

a, Corolla, opened out to show epipetalous stamens, (filaments cut). *b*, Pistil, with ovary, style, and stigma. *c*, Four stamens, meeting together. *d*, Rootstock of Cow Wheat, with root and rootlets parasitic on grass, the rootlets of former being attached to the latter. *e*, Junction of rootlet of Cow Wheat with rootlet of grass. *f*, Upper part of plant, with square stem, leaves in opposite pairs, and flowers with toothed bracts, bell-shaped calyx, and labiate corolla, in spike.

No. 2. Pennyroyal
(*Mentha Pulegium*, L.)

a, Flower, showing tubular calyx 5-fid, bell-shaped, 4-lobed corolla, 4 stamens and pistil exserted. *b*, Pistil, with ovary with 4 cells, style, and 2-fid stigma. *c*, Upper part of plant, with leaves in opposite pairs, flowers in spikes.

No. 3. Creeping Willow
(*Salix repens*, L.)

a, Staminate flower, with scale, and 2 stamens. *b*, Capsule opening, showing seeds within. *c*, Seed, with tuft of hairs. *d*, Pistillate flower, with ovary and 2 2-fid stigmas. *e*, Branch, with pistillate catkins. *f*, Branch, with leaves, and pistillate catkin with capsules ripe, and others opening. *g*, Creeping rootstock, with rootlets, and branch with staminate catkins—anthers ripe.

No. 4. Great Wood Rush
(*Luzula sylvatica*, Gaud.)

a, Flower, with 6 perianth-segments, 6 stamens, anthers exceeding the filaments, and pistil with 1-celled ovary, style, and 3 stigmas. *b*, Capsule, enclosed in perianth-segments with bracts below. *c*, Leaf, with ciliate surface (channelled). *d*, Flowering scape, with upper leaves, and flowers in compound cymes; with bracts below, some cymes bearing fruit.

No. 5. Meadow Wood Rush
(*Luzula campestris*, D.C.)

a, Flower, with 6 perianth-segments, 6 stamens, and pistil with 3 stigmas. *b*, Capsule enclosed in perianth-segments, with bracts below. *c*, Rootstock with rootlets, radical leaves and barren shoot. *d*, Flowering stem, with upper hairy stem-leaves, and flowers in short cyme.

No. 6. Early Sedge
(*Carex caryophyllea*, Latour = *C. præcox*, Jacq.)

a, Staminate flower, with 3 stamens and glume. *b*, Pistillate flower, with pistil with hairy ovary, short style, 3 stigmas, and glume. *c*, Nut, with short notched beak, and hairy perigynium. *d*, Plant, with tufted stem and leaves (radical), scape with bract and flowers in cyme, 1 male spikelet erect, 2 female inclined, shorter. *e*, Flowering stem, with bract and spikelets, 2 female in fruit—male spikelet terminal.

1. Cow Wheat (*Melampyrum pratense*, L.). 2. Pennyroyal (*Mentha Pulegium*, L.). 3. Creeping Willow (*Salix repens*, L.). 4. Great Wood Rush (*Luzula sylvatica*, Gaud.). 5. Meadow Wood Rush (*Luzula campestris*, D.C.). 6. Early Sedge (*Carex caryophyllea*, Latour).

No. 1. Cow Wheat
(*Melampyrum pratense*, L.)

a, Corolla, opened out to show epipetalous stamens, (filaments cut). *b*, Pistil, with ovary, style, and stigma. *c*, Four stamens, meeting together. *d*, Rootstock of Cow Wheat, with root and rootlets parasitic on grass, the rootlets of correct being attached to the latter. *e*, Junction of rootlet of Cow Wheat with rootlet of grass. *f*, Upper part of plant, with square stem, leaves in opposite pairs, and flowers with toothed bracts, bell-shaped calyx, and labiate corolla, in spike.

No. 2. Pennyroyal
(*Mentha Pulegium*, L.)

a, Flower, showing tubular calyx 5-fid, bell-shaped, 4 lobed corolla, 4 stamens and pistil exserted. *b*, Pistil, with ovary with 4 cells, style, and 2-fid stigma. *c*, Upper part of plant, with leaves in opposite pairs, flowers in spikes.

No. 3. Creeping Willow
(*Salix repens*, L.)

a, Staminate flower, with scale, and 2 stamens. *b*, Capsule opening, showing seeds within. *c*, Seed, with tuft of hairs. *d*, Pistillate flower, with ovary and 2-fid stigmas. *e*, Branch, with pistillate catkins. *f*, Branch, with leaves, and pistillate catkin with capsule ripe and others opening. *g*, Creeping rootstock with roots, and branch with staminate catkins, anthers ripe.

No. 4. Great Wood Rush
(*Luzula sylvatica*, Link.)

a, Flower, with 6 perianth-segments, 6 stamens, anthers exceeding the filaments, and pistil with 1-celled ovary, style, and 3 stigmas. *b*, Capsule, enclosed in perianth-segments, with bracts below. *c*, Rootstock with rootlets, radical leaves and barren shoot. *d*, Flowering stem, with upper bary stem-leaves, and flowers in short cyme.

No. 5. Meadow Wood Rush
(*Luzula campestris*, DC.)

a, Flower, with 6 perianth-segments, 6 stamens, and pistil with 3 stigmas. *b*, Capsule enclosed in perianth-segments, with bracts below. *c*, Rootstock with rootlets, radical leaves and barren shoot. *d*, Flowering stem, with upper bary stem-leaves, and flowers in short cyme; with bracts below, some cymes bearing fruit.

No. 6. Bay) Sedge
(*Carex riparia*, Lafonte.
C. arenaria, Jacq.)

a, Staminate flower, with 3 stamens and glume. *b*, Pistillate flower, with pistil with bary ovary, short style, 3 stigmas and glume. *c*, Nut, with short notched beak, and bary pericynium. *d*, Plant, with tufted stem and leavys (radical) scape with bract, and flowers in cyme. *e*, male spikelet, erect. *f*, female spikelets, 3 female to male spikelet ornament.

1. Cow Wheat (*Melampyrum pratense*, L.). 2. Pennyroyal (*Mentha Pulegium*, L.). 3. Creeping Willow (*Salix repens*, L.). 4. Great Wood Rush (*Luzula sylvatica*, Gaud.). 5. Meadow Wood Rush (*Luzula campestris*, D.C.). 6. Early Sedge (*Carex caryophyllea*, Latour).

Large bees have to push into the upper part of the corolla to insert the proboscis between the anther-stalks above and touch the hairs. The latter catch the pollen on the way. The bees touch the stigma, and cross-pollination may result. Bees bite the base of the tube to get at the honey. When they do not visit the flowers the anther-stalks become limp, the anthers separate, and the style now bent down is touched with pollen. Ants cause honey to be secreted after the flower fades, contrary to the usual rule.

Photo. Flatters & Garnett

COW-WHEAT (*Melampyrum pratense*, L.)

The capsule when ripe splits open, allowing the 4 seeds to fall out, and to be blown by the wind a short distance, but the plant usually grows in patches. The seeds mimic the chrysalis of the ant in size and colour, having a black spot at the end. The ants disperse the seeds, considering them to be chrysalises.

Cow-wheat is fond of peat, requiring a peaty soil. A moth, Lead-coloured Pug (*Eupithecia plumbeolata*), and two beetles, *Meligethes cervinus*, *M. kunzei*, feed on it.

Melampyrum, Theophrastus, is Greek for black wheat, because it resembles wheat, and the second name refers to its habitat, moist meadows. Black Corn is another name for Cow-wheat.

The seeds when used for bread (as they have been) colour it black. The plant affords good fodder for cattle, and Linnæus says butter from cows fed on it is very rich and deep yellow. It used formerly to be cultivated in Holland and by the Flemish.

Essential Specific Characters:—

243. *Melampyrum pratense*, L.—Stem erect, branched, leaves lanceolate, paired, flowers yellow, distant, paired, axillary, lower lip of the corolla projecting, corolla four times as long as the calyx.

Pennyroyal (Mentha Pulegium, L.)

As a southern type we have no record of the occurrence of Pennyroyal in early deposits. Its present distribution is Europe, N. Africa, and N. and W. Asia, or the North Temperate Zone. In Great Britain it grows in the Peninsula and Channel provinces, except in E. Sussex; in the Thames province, Anglia, except in Bedford; in the Severn province, except in Monmouth and Hereford; in S. Wales only in Glamorgan; in N. Wales in Carnarvon, Flint, and Anglesea; in the Trent province, except in S. Lincs; in S.E. Yorks, S.W. Yorks, N.W. Yorks, Durham in the Tyne province, and Lakes district. In Scotland it is found only in Ayr and Berwick, south of which it is general. It is a native of Ireland and the Channel Islands. In some counties it is only an escape.

Photo. Dr. Somerville Hastings

Pennyroyal (*Mentha Pulegium*, L.)

Careful search upon a stretch of heath-land or common-land, in which are scattered numerous little ponds and pools, will reward the botanist who is searching for Pennyroyal. It is rather local, but a common constituent of ericetal formations, and is usually to be found by pools in such areas.

It is a much smaller, less erect, terrestrial form of mint. The stem is more or less prostrate. The leaves are egg-shaped, acute, notched,

bent back, with no flowers in the upper axils, smooth in England, in S. Europe densely hairy, a protection against too rapid transpiration.

The flowers are lilac, in the axils, round, distant, many in a whorl. The regular calyx and the flower-stalks are downy each side, and the teeth are fringed with hairs, the throat being defended by hairs, and tubular. The nearly regular corolla is smooth inside. Complete flowers are less numerous than small female flowers.

Pennyroyal is 6 in. to 1 ft. high. It flowers late in August and September. The plant is perennial, propagated by division.

The flower is arranged on much the same plan as *M. arvensis*, and it is likewise prostrate, and less visited by insects. The flowers are proterandrous or proterogynous the anthers or stigma ripening first. The corolla is smooth within and hairy on the exterior. The throat is closed with hairs. The equal stamens are erect.

The nutlets are free, and are dispersed when ripe around the parent plant. It is a humus-loving plant, and requires a peaty soil.

The name *Pulegium*, Pliny, is from *pulex*, a flea. Pliny says that fleas are killed by the odour of the burnt blossoms.

Pennyroyal is called Brotherwort, Churchwort, Pudding Grass, Hill-wort, Lillie-riall, Lurkey Dish, Flea Mint, Organ, Organy, Pudding Herb, Pulicall. It is called Pudding Herb because it was used for flavouring black-puddings, and Pudding Grass because it was used in hogs' puddings. Coles says: "Penniroyall chopped and put into a bag-pudding giveth it a savoury relish".

Pennyroyal is aromatic and pungent in taste, and flavoured like camphor. It contains a volatile essential oil, obtained by distilling it. It was used as an expectorant and diaphoretic, for hysteria, whooping-cough, asthma, and is in use now. It was used as smelling salts in cases of fainting by the Romans. The blossoms, according to Pliny, killed fleas, as above. The use of it in puddings has not entirely ceased. In Chaucer's day it formed an ingredient of the almighty drug "save", and was employed to sharpen the eyes.

Essential Specific Characters:—

247. *Mentha Pulegium*, L.—Stem prostrate, leaves ovate, subglabrous, crenate, flowers purple, in distant whorls, throat of corolla closed with hairs, calyx tubular.

Creeping Willow (Salix repens, L.)

A typical upland plant, Creeping Willow is found in Late Glacial beds at Edinburgh and in Perth, and in Neolithic deposits at Cambridge and in Renfrew. It is found in the N. Temperate Zone in Europe, Siberia. The Creeping Willow occurs in Great Britain generally, except in Somerset, N. Wilts, W. Kent, Northants, Monmouth, Hereford, Cardigan, Flint, Derby, Mid Lancs, Isle of Man, Dumfries,

Photo. H. Irving

CREEPING WILLOW (*Salix repens*, L.)

Roxburgh, Haddington, Linlithgow, Stirling, Main Argyle, Dumbarton, E. Ross, but elsewhere, or from Shetland southwards. It grows at 2500 ft. in the Highlands, and is a native of Ireland and the Channel Islands.

One of the peculiar signs of a heath or moor, especially in upland, barren, stony regions, is the occurrence of the Creeping Willow, which grows profusely on wide open commons and heaths. It also occurs on the sides of stony slopes of hills and mountains, usually in a dry situation, being ericetal rather than paludal.

As the second Latin name suggests (and the English also), this willow has a creeping habit, seldom attaining any height, but is branched and bushy. The leaves are loosely and softly hairy, small,

elliptic, lance-shaped, straight, subacute, subentire, nearly naked above, bluish-white, and below silky.

The catkins are cylindrical, oblong, with spoon-shaped scales. The ovary is egg-shaped, stalked, smooth, or even silky. The anthers becoming black at length, are at first golden.

The plant is 2 ft. high. It flowers in May. The Creeping Willow is deciduous, propagated by seeds.

Photo. Dr. Somerville Hastings

CREEPING WILLOW (*Salix repens*, L.)

The flowers are unisexual; the plant being dicœcious, pollinated by the wind, and also adapted to the visit of bees, which cause cross-pollination. Creeping Willow is visited by the Honey-bee, *Bombus terrestris*, *Andrena*, Tenthredinidæ, *Dolerus*, Diptera, *Bombylius*, *Myopa*, Lepidoptera, *Vanessa*. The honey is half-concealed and abundant.

The seeds are fringed with hairs, which assist in dispersing them by the wind.

This Willow is a humus-loving plant, and requires a peat soil or humus soil.

A fungus, *Melampsora repentis*, attacks the Creeping Willow.

Several Lepidoptera are found upon it. *Tortrix viburnana*, *T. dumetana*, *Gelechia lentiginosella*, *Lithocolletis quinqueguttata*.

The second Latin name refers to its creeping habit.

ESSENTIAL SPECIFIC CHARACTERS:—

286. *Salix repens*, L.—Shrub, straggly, branches upright, leaves lanceolate, with recurved margin, glaucous, silky below, catkins sessile, style short.

Great Wood Rush (Luzula sylvatica, Gaud. = L. *maxima*, D.C.)

This is a woodland arctic type which is known to us only from its present distribution in N. Temperate and Arctic Europe (except Greece) and Russia. In Great Britain it is found in every county except Suffolk and Hunts, both lowland districts; as far north as the Shetlands, up to 2300 ft. in the Highlands, and in Ireland and the Channel Islands.

Photo. Flatters & Garnett

GREAT WOOD RUSH (*Luzula sylvatica*, Gaud.)

The Wood Rush, that is to say, here, the largest of the species, is a typical woodland plant, forming a definite feature in certain types of wood, oak woods, growing in the shade, which it loves more than all the other wood rushes, and forming big clumps over a wide area, but it also grows on heaths.

This plant is a tall, graceful wood rush with a grass-like habit. The leaves are clothed and fringed with hairs, which spring from the sides of the long, flat leaves, which taper to a graceful point, and are mainly radical. They are channelled. The few stem-leaves towards the top of the stem are short, drooping, and bract-like.

The flowers are in clusters of three in a densely compound cyme, with long flower-stalks; the perianth-segments are awned or bristle-like and as long as the capsule, with small anther-stalks. The capsule is tuberculate, beaked, egg-shaped, acute, and 3-seeded.

The stem towers gracefully to a height of 18 in. Flowers may be found in May. The plant is a perennial, propagated by seeds, and is suited to plantation in woods and shrubberies.

As in the case of the Rushes the flowers are pollinated by the wind, and self-pollination is rendered impossible as the stigma matures first, this condition lasting 4–5 days. The perianth is only partly open, and then expands for a few hours. The flowers are in clusters of 3–4,

pale, like *Juncoides* generally, but the anthers are longer than the anther-stalks.

The capsule splits open, allowing the seeds to fall around the parent plant, which is dispersed by its own agency.

The Great Wood Rush is a humus-loving plant, and confined to a humus soil.

The leaves are attacked by a cluster-cup fungus, *Puccinia oblongata.*

Luzula, Smith, is from the Latin *luceo*, I shine, from the shining leaves and fruits (it was spelt *Luciola* at first); *sylvatica* refers to the woodland habitat.

Wood Rush is called Wood Grass, Shadow Grass, Wood Blades.

Essential Specific Characters:—

307. *Luzula sylvatica*, Gaud.—Rhizome woody, stem tall, leaves radical, lanceolate, hairy, flowers 3, in a compound cymose panicle.

Meadow Wood Rush (Luzula campestris, D.C.)

Widespread and growing at high elevations, the only knowledge we have so far of this common meadow plant is to be gained from its present distribution in the North Temperate Zone in Europe (except Greece), and all temperate and cold regions in general. It is found in every part of Great Britain, except Glamorgan, Cardigan, Selkirk, as far north as the Shetlands, and up to 3200 ft. in the Highlands and Wales, being found also in Ireland and the Channel Islands.

The Meadow Wood Rush is a very common component of our higher pastures and meadows, growing usually at high elevations, and is common to heaths and common-land, where it is very abundant. It is also found in rides in woods, and in meadows which slope down from the hills, and even in valleys.

Like the tall Wood Rush on a smaller scale in habit, having the grass habit, it has several simple stems, which are erect, leafy, smooth, and thickened below. The leaves are hairy, linear, not so long as the stems, and flat, with hairs on the margin. The tips are reddish, not membranous. The bracts below the spikes are unequal.

The brown flowers are apetalous, without a corolla, in terminal cymes, in compact heads or close clusters, 3–4, dense, the spikelets egg-shaped, and stalkless or stalked, the flower-stalks arising from a sheath, edged with hairs. The perianth-segments exceed the capsule, which is blunt, beaked, 3-sided. The anthers are light-yellow.

The Meadow Wood Rush is about 6–8 in. high. It flowers in April and May. This common plant is perennial, and propagated by seeds.

The flowers, as in all the Wood Rushes, are pollinated by the wind. There are 6 stamens with very short anther-stalks. The style is short. The 3 stigmas are wavy, and softly and loosely hairy. When the flower-bud expands the 3 stigmas elongate and wither very quickly. After five to nine days the flower is completely expanded, and after a further interval of a day the anthers are ripe. The flower is open for a day and a half. The plant is thus incapable of self-pollination.

Photo. Flatters & Garnett

MEADOW WOOD RUSH (*Luzula campestris*, D.C.)

The capsule splits open, the seeds when ripe falling out to the ground.

This little Wood Rush is a humus-loving plant growing in a humus soil, but also able to grow in sand soil.

The plant is attacked by two cluster-cup fungi, *Puccinia obscura*, *P. oblongata*. The Lepidoptera Double-line (*Leucania turca*), *Coleophora cæspitella*, *C. murinipennella*, are found on it.

The second Latin name indicates that it is found on pastures usually dry and heath-like.

The names by which it is known are Sweet Bent, Blackcaps, Chimney-sweeps, Crow-feet, Cuckoo-grass, Davie-drap, God's Grace, Good Friday Grass, Black-head Grass, Peeseweep, Hair-beard, Smuts, Sweeps, Sweep's Brushes. The name Smuts was applied in reference to the black appearance of the flower-heads, and the name Chimney-sweeps has the same origin, and children on first seeing it in spring say:

"Chimney-sweeper, all in black,
Go to the brook and wash your back;
Wash it clean or wash it none,
Chimney sweeper, have you done?"

In the North they are called "ewe-knots". When it appears the ewes are likely to have plenty of milk for the lambs, as it indicates that the new grass is growing.

Chambers relates that the children of Galloway play at hide-and-seek with a little black-topped flower which they call Davie-drap, saying:

"Within the bounds of this I hap
My black and bonny Davie drap;
Wha is he, the cunning yin[1],
To me my Davie drap will fin'?"

Peeseweep-grass is applied because it grows where lapwings resort (peesweep).

As it is one of the harbingers of spring, and generally making its appearance in mild, genial weather, it has originated in the following prophetic adage:

"When the hair beard appear
The shepherd need not fear".

It is usually indicative of a dry and not very luxuriant pasture, but when growing in boggy ground of moist and rich soil.

Essential Specific Characters:—

308. *Luzula campestris*, D.C.—Stem short, leaves linear-lanceolate, downy, pilose, flowers in a dense panicle, of 3–4 clusters, anthers longer than the filaments.

Early Sedge (Carex caryophyllea, Latour. = *C. verna*, Chaix)

The Early Sedge is found in Europe, N. Asia, in the N. Temperate Zone, and has been introduced into N. America. It is unknown in Glacial beds. In Great Britain it is absent in N. Devon, Pembroke, Cardigan, Mid Lancs, Roxburgh, Stirling, Banff; in W. Highlands it only occurs in Main Argyle, Dumbarton, Clyde Islands; but it does not occur in N. Highlands, nor Hebrides in the Northern Isles. Elsewhere it ranges as far N. as the Shetlands, and up to 2300 ft. in the Highlands, as well as in Ireland and the Channel Islands.

The Early Sedge is a local but widely dispersed ericetal species which grows on elevated ground, such as upland pastures, where it seeks the highest parts, heaths and moors. It may also be found

[1] One.

in meadows in more lowland districts in less dry situations, but it is usually xerophilous.

This is a short, leafy sedge, with an erect stem, with many leaves, three-angled, usually smooth, dark-green, and shiny, leafless above. The leaves are large for the size of the plant, tufted, keeled, curved backwards. The bracts are leafy and clasping.

The spikes of the flower are of different sexes, 1 male, 1–3 female, the latter stalkless or nearly so, oblong egg-shaped. The male are erect. The glumes are spreading, with a green midrib, egg-shaped with a long point. The perigynia are inversely egg-shaped, 3-sided, acute, and downy. The nut or utricle is obovoid, inversely egg-shaped, narrow below.

Photo. A. R. Horwood

EARLY SEDGE (*Carex caryophyllea*, Latour.)

This sedge is 6 in. high. The flowers are early, appearing in April. The plant is perennial, propagated by roots.

The floral mechanism is similar to that of sedges generally, the male spikelets are slender and erect, the female inclined, oblong, crowded. The flowers are pollinated by the wind.

The nut is 3-sided, and when it is ripe it falls close to the parent clump, being dispersed to no distance.

The Early Sedge is a humus-loving plant, growing on humus soil.

The fungi, *Puccinia sylvatica* and *Ustilago caricis*, are found to infest it.

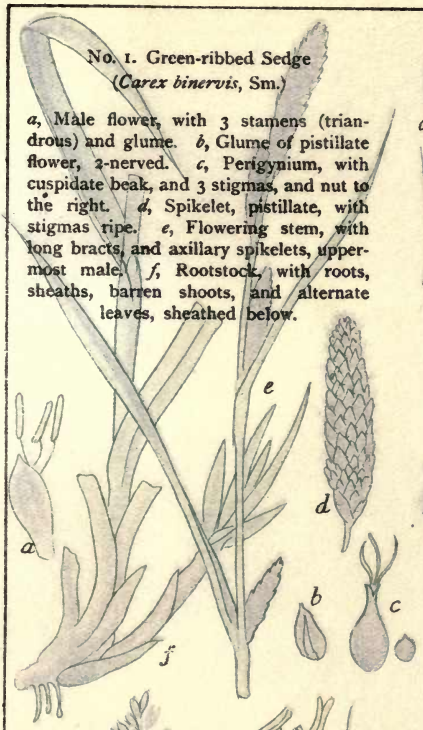
The second Latin name refers to the scent, which is like cloves. Early Sedge is called Pink Grass and Iron Grass.

ESSENTIAL SPECIFIC CHARACTERS:—

328. *Carex caryophyllea*, Latour.—Stem short, leaves flat, curved, 1 male spikelet, 1–3 female, oblong, glumes ovate, fruit obovoid.

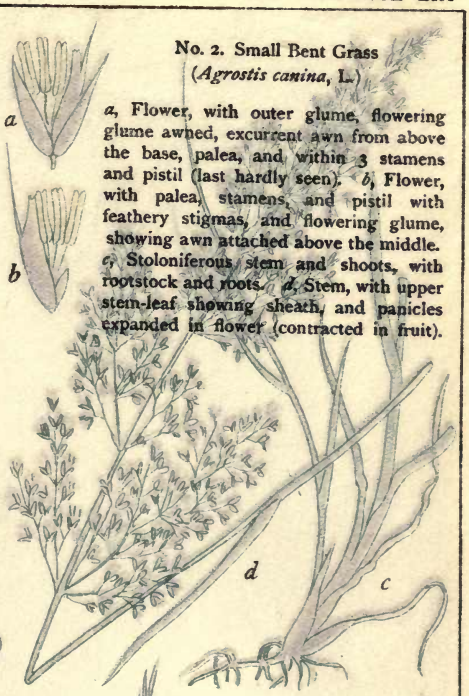
No. 1. Green-ribbed Sedge
(*Carex binervis*, Sm.)

a, Male flower, with 3 stamens (triandrous) and glume. *b*, Glume of pistillate flower, 2-nerved. *c*, Perigynium, with cuspidate beak, and 3 stigmas, and nut to the right. *d*, Spikelet, pistillate, with stigmas ripe. *e*, Flowering stem, with long bracts, and axillary spikelets, uppermost male. *f*, Rootstock, with roots, sheaths, barren shoots, and alternate leaves, sheathed below.



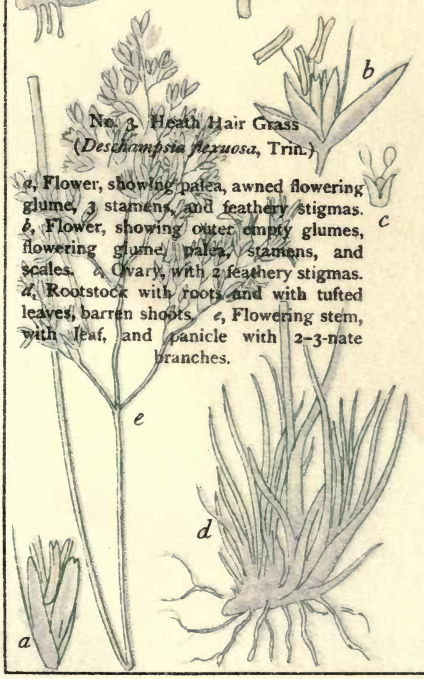
No. 2. Small Bent Grass
(*Agrostis canina*, L.)

a, Flower, with outer glume, flowering glume awned, excurrent awn from above the base, palea, and within 3 stamens and pistil (last hardly seen). *b*, Flower, with palea, stamens, and pistil with feathery stigmas, and flowering glume, showing awn attached above the middle. *c*, Stoloniferous stem and shoots, with rootstock and roots. *d*, Stem, with upper stem-leaf showing sheath, and panicles expanded in flower (contracted in fruit).



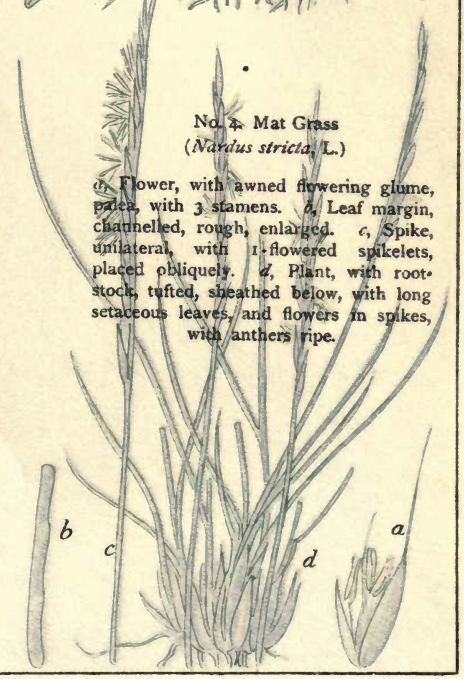
No. 3. Heath Hair Grass
(*Deschampsia flexuosa*, Trin.)

a, Flower, showing palea, awned flowering glume, 3 stamens, and feathery stigmas. *b*, Flower, showing outer empty glumes, flowering glume, palea, stamens, and scales. *c*, Ovary, with 2 feathery stigmas. *d*, Rootstock with roots and with tufted leaves, barren shoots. *e*, Flowering stem, with leaf, and panicle with 2-3-nate branches.



No. 4. Mat Grass
(*Nardus stricta*, L.)

a, Flower, with awned flowering glume, palea, with 3 stamens. *b*, Leaf margin, channelled, rough, enlarged. *c*, Spike, unilateral, with 1-flowered spikelets, placed obliquely. *d*, Plant, with rootstock, tufted, sheathed below, with long setaceous leaves, and flowers in spikes, with anthers ripe.



No. 1. Green-ribbed Sedge
(*Carex binervis*, Sm.)

a, Male flower, with 3 stamens; (triangular) and glume. *b*, Glume of pistillate flower, 2-nerved. *c*, Perigynium, with cuspidate beak, and 3 stigmas, and nut in the right. *d*, Spikelet, pistillate, with stigmas ripe. *e*, Flowering stem, with long bracts, and axillary spikelets, upper most male. *f*, Rootstock, with roots, sheaths, barren shoots, and alternate leaves, sheathed below.

No. 2. Small Heat Grass
(*Agrostis canina*, L.)

a, Flower, with outer glume, flowering glume awned, excurrent awn from above the base, palea, and within 3 stamens and pistil (last hardly seen). *b*, Flower, with palea, stamens, and pistil with feathery stigmas, and flowering glume, showing awn attached above the middle. *c*, Stoloniferous stem and shoots, with rootstock and roots. *d*, Stem, with upper stem-leaf sheathing sheath, and panicles expanded in flower (contracted in fruit).

No. 3. Mat Grass
(*Nardus stricta*, L.)

a, Flower, with awned flowering glume, palea, with 3 stamens. *b*, Leaf margin, channelled, rough, enlarged. *c*, Spike, unilateral, with 1-flowered spikelets, placed obliquely. *d*, Plant, with rootstock, tufted, sheathed below, with long setaceous leaves, and flowers in spikes, with anthers ripe.

1. Green-ribbed Sedge (*Carex binervis*, Sm.). 2. Small Bent Grass (*Agrostis canina*, L.). 3. Heath Hair Grass (*Deschampsia flexuosa*, Trin.). 4. Mat Grass (*Nardus stricta*, L.).

Green-ribbed Sedge (Carex binervis, Sm.)

This tall, graceful sedge is found in the North Temperate Zone in W. Europe, N. Asia, and N. Africa. It is not found in any early plant-beds. It is found in all parts of Great Britain, except Northants, Glamorgan, Notts, S.E. Yorks, Linlithgow; as far north as the Shetlands, up to 3200 ft. in the Highlands, and in Ireland.

The Green-ribbed Sedge is an ericetal species found in dry habitats, and it grows in upland stations on the borders of woods, on stony hills, on heaths and moors, as well as in fields, in woodland districts, and on sandy soil by the roadside, up to high elevations.

Photo. Horwood

GREEN-RIBBED SEDGE (*Carex binervis*, Sm.)

This is a tall, erect, finally drooping plant, with a slender, graceful stem, with a creeping rootstock. The stems are 3-angled, smooth, with numerous leaves, which are not very long, rigid, keeled, and curved back, flat. The bracts are leaflike.

The spikes are stalked, cylindrical, distant, and the male and female are on different stems. The male flowers are solitary, the female are short, stalkless, or nearly so, distant, the lower ones stalked, the upper included. The sheaths are not so long as the flower-stalk. The spikes are cylindrical, with perigynia with green ribs, and 3-angled, longer than the glumes, which are oblong and compound. The beak is rough along the margin, and divided into two nearly to the base. The nut is rough and inversely egg-shaped.

This sedge is 1–2 ft. high. The flowers are in bloom in June. The plant is a perennial, propagated by division of the rootstock.

The floral mechanism is that typical of sedges with more numerous

and longer female spikelets. There is no doubt that some of the sedges can be pollinated by insects, though usually, as here, by the agency of the wind.

The nut is indehiscent and falls to the ground close to the plant, or it may be swung on the slender drooping flower-stalks by the wind to a short distance.

Green-ribbed Sedge is a humus-loving plant, and grows in a rich humus soil on heaths or woodland tracts.

The second Latin name refers to the ribbed perigynia.

The plant is often infested by a fungus, *Puccinia caricis*, one of the "rusts".

Essential Specific Characters:—

329. *Carex binervis*, Sm.—Stem tall, triangular, slender, leaves flat, female spikelets brown, remote, perigynia with two green ribs, nut obovoid.

Small Bent Grass (Agrostis canina, L.)

Seeds of grasses are so small that they are liable to be overlooked in plant beds, and so far this plant has not been found. It grows to-day in N. Temperate and Arctic Europe, N. and W. Asia, Himalaya, N. and S. America, Australasia. It is found in every county of Great Britain, except Salop, Mid Lancs, S.E. Yorks, as far north as the Shetlands, up to 1500 ft. in Derby, and in Ireland and the Channel Islands.

The Small Bent Grass is strictly an arenophilous species, growing where *Aira præcox* and Sheep's Sorrel are found. It is mainly ericetal, being frequent on commons, heaths, and moorland, where also Furze, Broom, Tormentil, Harebell, and other heath plants grow.

This is a tall, erect grass with a slender stem, unbranched, often putting forth stolons or trailing shoots, with the lower part of the stem prostrate at first. The leaves are mainly radical, and narrow, with inrolled flat margins. The lower leaves are bristle-like and tufted. The shoots are leafy and trailing. The ligule is oblong and acute. The sheaths are smooth.

The flowers are in a long panicle, which is narrow before it opens, then spreading almost at right angles, slender and wavy, with rough flower-stalks, and purple to green in flower, and contracted in fruit. The branches are slender and hair-like.

The glumes above are empty, shorter than those below, which are blunt. The awn is bent like a knee, twisted, and above the base of

the spikelet. The lower palea is jagged above, the upper absent or very small.

This graceful grass is 18 in. high. The flower is in bloom in July and August. The plant is perennial, and may be propagated by division.

The flowers are bisexual, and pollinated by the wind. The flowers open at 11 a.m. There are 3 stamens, the styles are short, and the stigma is feathery.

The seed is a caryopsis or achene, united to the pericarp, and the

Photo. H. Irving

SMALL BENT GRASS (*Agrostis canina*, L.)

fruit is enclosed in a glume, which assists it in being blown to a distance by the wind.

Small Bent Grass is a sand-lover, and addicted to a sand soil.

Agrostis, Theophrastus, is from the Greek *agros*, field, and *canina*, Latin, refers to the silvery-whitish appearance.

It is attacked by a fungus, *Tilletia decipiens*, which dwarfs the host-plant, and such plants were once known as *A. pumila.*

ESSENTIAL SPECIFIC CHARACTERS:—

330. *Agrostis canina*, L.—Stem tall, leaves narrow, involute below, sheaths glabrous, panicle erect, diffuse in flower, glumes 2, unequal, no inner palea.

Heath Hair Grass (Deschampsia flexuosa, Trin.)

This Arctic plant is found in the North Temperate and Arctic regions in Arctic Europe, N. and W. Asia, N. America, Fuegia. It is unknown in early plant beds. In Great Britain it is found in every county except in Hunts, Mid Lancs, Haddington, as far north as the Shetlands, and up to 3700 ft. in the Highlands, as well as in Ireland and the Channel Islands.

Photo. Flatters & Garnett

HEATH HAIR GRASS (*Deschampsia flexuosa*, Trin.)

Heath Hair Grass is commonly distributed in the upland regions of the country, especially in dry stations, the borders, for instance, of rocky woods, where on sandy knolls it is a common plant. It is characteristic again of heath and common-land, as well as moors, up to very high elevations.

This plant is similar in general habit to the Silvery Hair Grass. The stem is erect, slender, glossy, and leafless above. The leaves are bristle-like, short, curved, blunt, grooved, and glossy. The upper leaves have long sheaths, and are rough. The ligule is short and blunt, or truncate.

The flowers are apetalous (without a corolla), in panicles which are spreading, wavy, or flexuose (hence the second Latin name), divided into three branches. The spikelets are purple, glossy, with long-pointed empty glumes, and long-twisted awn, half as long as the rounded spikelet, and coming from the base of the palea.

The plant is 6–8 in. or even 2 ft. high. The flowers may be found between June and August. Heath Hair Grass is a perennial, propagated by division.

There are 2 flowers in a spikelet, and sometimes a male flower is

produced on the rachilla. There are 3 stamens, with bluish-black anthers, distinct styles, and feathery stigmas. The flowers are pollinated by the wind. The stigma and anthers ripen together. The flower opens between 5 and 6 a.m.

The fruit is light and easily blown away by the wind.

The Heath Hair Grass is turfophilous, growing on humus soil. The name *Deschampsia*, Beauv., is in commemoration of a French chemist, M. H. Deschamps. The second Latin name refers to the wavy panicle.

Essential Specific Characters:—

334. *Deschampsia flexuosa*, Trin.—Stem smooth, erect, leaves filiform, solid, terete, upper sheaths roughish, panicle spreading, wavy, the spikelets exceeding the awn.

Mat-grass (Nardus stricta, L.)

Though an Arctic type of grass this species is not met with in early deposits, but is found in Temperate and Arctic Europe, the Azores, and Greenland. In Great Britain it is found in every county except Hunts, Northampton, E. Gloucs, as far north as the Shetlands, and up to 3300 ft. in the Highlands, as well as in Ireland and the Channel Islands.

Mat-grass is one of the most typical of heath grasses. It forms patches, as the English name suggests, of wide extent, to the exclusion of all else, on heaths and commons, in the south as well as the north, and on various formations. It grows also at different elevations, and is prevalent not only on stony but also on sandy and even peaty formations.

The plant is densely cæspitose, or tufted, with a cushion of close, rigid, radical leaves, and stems which are erect, rigid, finely furrowed, angular, with long sheaths. The leaves below are nearly horizontal. The sheaths are smooth, and the ligule is short.

The spike is bristle-like, solitary, straight, and turned one way, with a slender rachis. The spikelets are distant, the flowering glume is purple and slender, the lower palea has a rough awn, and is short. The flowering glume is rough after flowering.

Mat-grass is 6–8 in. in height. The flowers are at their best in July. The grass is perennial, propagated by roots.

The spikelets are arranged in a single row, and turned one way. There are 3 stamens, the stigma is hairy and does not fall, slender and thread-like, and the spikelets somewhat distant. The plant is anemo-

philous, pollinated by the wind. The flowers open between 12 and 1 a.m. The stigma is mature first. The spikelets open at the top for the stigma and the stamens to protrude.

The fruit, slightly attached to the panicle and adhering to the palea, is readily blown away by the wind.

This grass is a peat-loving plant growing in a humus soil.

Photo. Flatters & Garnett

MAT-GRASS (*Nardus stricta*, L.)

Nardus, Theophrastus, is a Greek name *nardos*, for sweet-smelling ointment, and it is unknown why it is applied to this grass. Mat-grass is known by the names of Black, White, or Wire Bent, Ling, Mat-reed, Nard.

ESSENTIAL SPECIFIC CHARACTERS:—

344. *Nardus stricta*, L.—Cæspitose, stem erect, rigid, leaves the same, slender, spike unilateral, close, awn short, palea purple.

Section XII

FLOWERS OF THE ROCKS, WALLS, STONY AND GRAVELLY PLACES

FLOWERS OF THE ROCKS, WALLS, STONY AND GRAVELLY PLACES

We have already alluded, under Section VI on Mountains, Hills, and Dry Places, to certain Lithophytes, chiefly surface plants, which were grouped together primarily on a physical basis—their altitude. In this section we include not only the surface plants (Exochomophytes) but true Lithophytes. Rock plants may be called Petrophytes, and include Lithophytes and Chomophytes. Here, also, as a subdivision of the latter, are some crevice plants growing in vertical fissures in rocks, or Chasmophytes.

As the group is kindred in character to, but diverse in origin from, the plants found on walls with the rupestral plants, a number of purely mural plants are included, and a few found on sandy or gravelly fields, of a local character, allied to those growing on rubble or shingle, but not identical. Several features characterize the existence of vegetation on rocks.

The plants are lovers of dry soil, and may be called in general rupestral or saxicolous. There are about 180 of these, and of that number 120 are alpine, 60 lowland species. Those here alluded to chiefly belong to the latter. About a dozen prefer wet rocks, and twenty are distinctly calciphilous or lime-lovers, and so on. Much depends on how far the rocks are exposed in relation to sunlight.

The slope of the surface is of importance, as horizontal surfaces accumulate detritus, whilst vertical rocks do not. Of paramount importance is the composition of the rock chemically, or looked at in a different way, to what geological formation it belongs. If it is siliceous and hard, it nourishes a certain flora quite distinct from that found on calcareous rocks. The porosity, again, is of great importance.

The true Lithophytes are chiefly Cryptogams, such as Algæ, Lichens, and Mosses, which are all typically Xerophytes. Upon the same rocks, where humus has accumulated, grow Biting Stone Crop and Ling. Chasmophytes are those plants that grow with their roots

attached to humus, such as collects in the vertical or horizontal clefts in exposed rocks. The clefts caused naturally by alternate heat and cold, frost, disintegration, rain or chemical action are not inconsiderable, and support a typical plant formation, which varies according to the exposure, size of cleft, position, &c. Chasmophytic vegetation may be found in other situations, as where Orpine grows under hedge-banks, though its true position is in the clefts of rocks.

Chasmophytes develop rhizoids, and have flattened rootlets and tap-roots. They are usually tufted, and many are rosette plants.

They are xerophylous as a whole, such as Sedum or Stone Crop, Saxifrages, Sempervivum, and Draba. Many species of Chickweed, Sandwort, Speedwell, Lady's Mantle, Saxifrage are white and woolly. Most of them are perennials, and while most are Xerophytes, some are Mesophytes, and along the shore Halophytes.

If we take the flowers that grow on older rocks we have here an example in Sandwort Spurrey, which is found on granitic and slaty or schistose rocks, where also, if there is some detritus, another Chomophyte, Bird's-foot, grows. The Field Mouse-ear and Silvery Hair Grass grow on similar sand-rock soil, and may also be found on marlstone on little detritus; and in the hollows of the slopes from the escarpment of the latter one finds the White Meadow Saxifrage, which prefers clay soil derived from the Middle Lias clays. Limestone rocks with little soil are the only habitat on which Cheddar Pink grows. The chalk, which forms but a thin rubble, or has otherwise a sandy, gravelly subsoil, affords support for Horseshoe Vetch, with its pretty horseshoe-like pods, and Yellow Centaury is found there or on limestone, but usually in wetter stations.

The Chasmophytes include such rupestrals as Navelwort, Orpine, Golden-rod, the last growing in tufts, tall and graceful, with rich golden blooms. Golden-rod is either a Chasmophyte or a Mesophyte, growing in chalky districts along the roadside in hedge bottoms.

Mouse-ear Hawkweed sometimes covers exposed rocks growing in the crannies on the faces of exposures, and extends above vertically on a sand-rock soil or a lime-rock soil, or it may also be found on wall-tops. Out of the crevices in the Marlstone Rock-bed, or on older detrital rocks such as slate, one may see Wall Lettuce growing in the shade sheltered by overhanging herbage.

Walls have a typical flora, but this mural habitat is an entirely artificial one, originated within the historic era. Here, in towns and villages throughout the country from Land's End to John o' Groats, one may find the Yellow Fumitory in gardens or on greenhouse walls

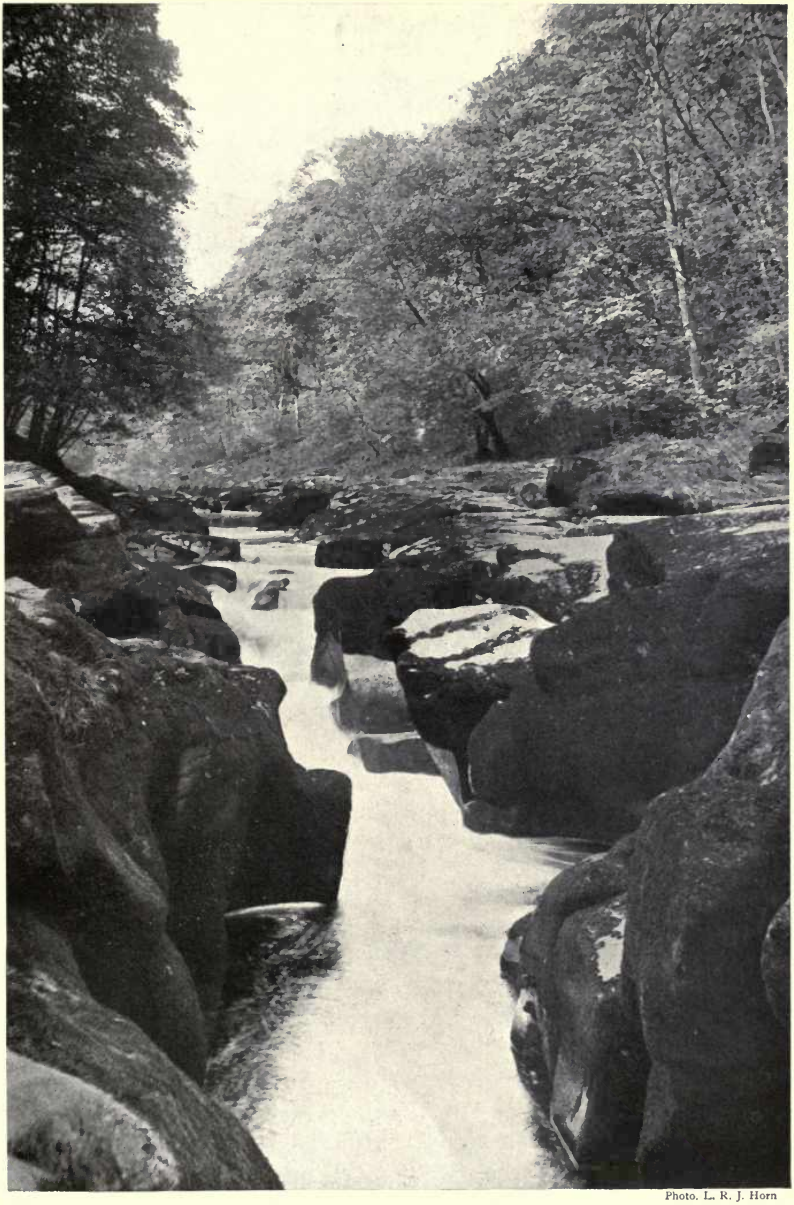


Photo. L. R. J. Horn

GULLY IN THE R. WHARFE AT BOLTON (THE STRID)

Natural rock-habitats for rupestral plants.

or terraces, wallflowers on ruins of castles or old houses, on a mud-wall top, and Rue-leaved Saxifrage, which also grows on mole-heaps, its natural habitat. Then on thatched roofs there is Live-long, and as a Chasmophyte rooted in crevices (but artificially introduced) Ivy-leaved Toadflax, while other mural plants are Great Snapdragon, Field Speedwell, Pellitory, especially on church towers, castles, and Flat-stalked Poa on mud-walls. The luscious-rooted Rampion is fond of gravel, while Silky Wind Grass and Sand Fescue love sandy fields.

Yellow Wall Fumitory (Corydalis lutea, D.C.)

No trace of this plant has occurred in ancient deposits. It is found south of Belgium throughout Western Europe. The Yellow Fumitory is found throughout England, Wales, and Scotland, where it is naturalized, and without exception an escape from cultivation. Almost entirely an escape from gardens it is likely to be found wherever it is grown in or near gardens. Its actual distribution as a naturalized plant has not been ascertained.

This plant has a predilection for walls, and is usually grown with other rock or mural plants in a garden or on the stone walls of a glass-house, or at the foot of the wall of a house. But it flourishes best, like the Ivy-leaved Toadflax, with which it grows, in old moated enclosures, where the bricks have fallen into decay, and a suitable substratum has thus been created for it. This is also the case with the Wallflower, Stock, and other mural denizens.

Unlike the Earth Smoke, Yellow Fumitory is a compact, many-branched, spreading plant, whose stems are less tall, and clustered together in a fastigiate manner, giving the plant, with its luxuriant foliage and rather abundant flowers, an ornamental character lacking in the latter.

The yellow, rarely white, flowers are in racemes, with a leaf opposite each, and the seeds are in 2-valved pods and numerous, while the bracts are small, oblong, shorter than the flower-stalks, and the seeds, which are granular, have a crest. The upper of the 4 petals has a short, thick, incurved spur. The foliage is more like that of an *Adiantum*, with inversely egg-shaped leaflets on long petioles. The whole plant is less bluish-green than Earth Smoke, but equally tender and brittle. The base of the stem and roots is yellow.

The stem is not more than 1 ft. high. Flowers extend from May to August. The plant is a deciduous, herbaceous perennial, increased by division.

When the hood is bent down it does not rise again, but the stamens and pistil fly upwards, becoming concealed in the hollow of the upper petal, and the flower can only be visited once. The under side of the bee is dusted with pollen, heaped upon the stigma. Pollen is brought to the stigma if the bee comes from another flower. *Bombus agrorum*, with proboscis 12–15 mm., is the main visitor.

In *Corydalis cava* the flowers are larger and more conspicuous than in *Fumaria*, and have no power to self-pollinate, being sterile with their own pollen, and not perfectly fertile with pollen from another flower,

Photo. Flatters & Garnett

YELLOW WALL FUMITORY (*Corydalis lutea*, D.C.)

but only so with pollen from a different plant. The tube is 12 mm. long, and hive-bees with proboscis 6 mm. cannot get at the honey, but only the humble-bee with proboscis 7–10 mm., though even they cannot easily get at it. The insect bites a hole at the base of the tube to reach the honey, and the visitors are *Andrena*, *Sphecodes*, *Nomada*, and Hive-bees (pollen-seekers).

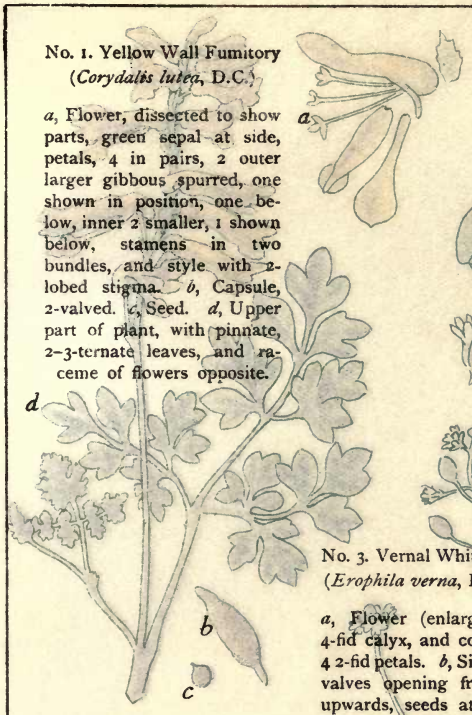
The plant is dispersed by its own agency. The capsule is oblong, 2-valved, and swollen, and disperses the seeds, which are small, around the plant.

This is a humus-loving plant, requiring a mild humus soil, which it obtains in the habitats it frequents in woods and shaded spots.

The name *Corydalis* given by Galen is the Greek *Corydalis* for

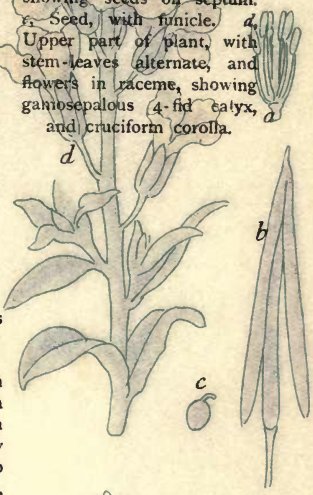
No. 1. Yellow Wall Fumitory
(*Corydalis lutea*, D.C.)

a, Flower, dissected to show parts, green sepal at side, petals, 4 in pairs, 2 outer larger gibbous spurred, one shown in position, one below, inner 2 smaller, 1 shown below, stamens in two bundles, and style with 2-lobed stigma. *b*, Capsule, 2-valved. *c*, Seed. *d*, Upper part of plant, with pinnate, 2–3-ternate leaves, and raceme of flowers opposite.



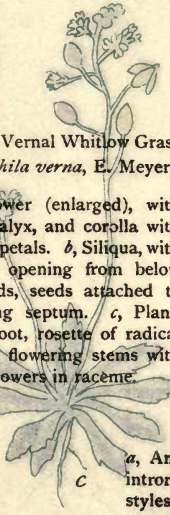
No. 2. Wallflower
(*Cheiranthus Cheiri*, L.)

a, Androecium, with 6 stamens, 4 long, 2 short, honey-glands at base, gynæcium with long ovary and 2-fid stigma. *b*, Pod, with valves opening from below upwards, showing seeds on septum. *c*, Seed, with funicle. *d*, Upper part of plant, with stem-leaves alternate, and flowers in raceme, showing gamosepalous 4-fid calyx, and cruciform corolla.



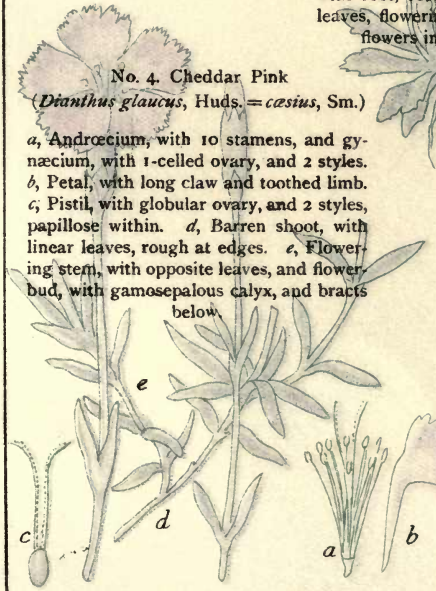
No. 3. Vernal Whitlow Grass
(*Erophila verna*, E. Meyer)

a, Flower (enlarged), with 4-fid calyx, and corolla with 4 2-fid petals. *b*, Siliqua, with valves opening from below upwards, seeds attached to dividing septum. *c*, Plant, with root, rosette of radical leaves, flowering stems with flowers in raceme.



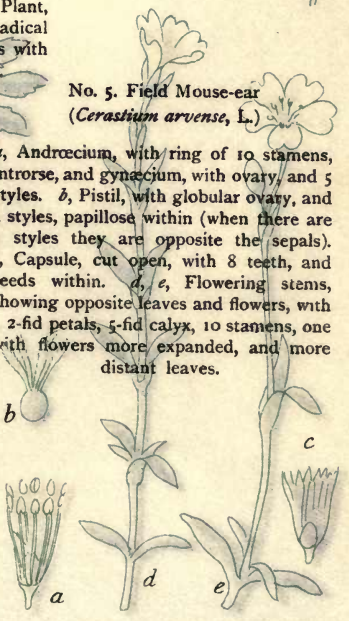
No. 4. Cheddar Pink
(*Dianthus glaucus*, Huds. = *cæsius*, Sm.)

a, Androecium, with 10 stamens, and gynæcium, with 1-celled ovary, and 2 styles. *b*, Petal, with long claw and toothed limb. *c*, Pistil, with globular ovary, and 2 styles, papillose within. *d*, Barren shoot, with linear leaves, rough at edges. *e*, Flowering stem, with opposite leaves, and flower-bud, with gamosepalous calyx, and bracts below.



No. 5. Field Mouse-ear
(*Cerastium arvense*, L.)

a, Androecium, with ring of 10 stamens, introrse, and gynæcium, with ovary, and 5 styles. *b*, Pistil, with globular ovary, and 5 styles, papillose within (when there are 5 styles they are opposite the sepals). *c*, Capsule, cut open, with 8 teeth, and seeds within. *d*, *e*, Flowering stems, showing opposite leaves and flowers, with 5 2-fid petals, 5-fid calyx, 10 stamens, one with flowers more expanded, and more distant leaves.



No. 1. Yellow Wall Pimpernel
(*Corydalis lutea*, D.C.)

a, Flower, dissected to show parts, green sepal at side, petals, 4 in pairs, 2 outer larger ribbons spurred, one shown in position, one below, inner 2 smaller, 1 shown below. stamens in two bundles, and style with 2-lobed stigma. *b*, Capsule, 2-valved. *c*, Seed. *d*, Upper part of plant, with simple, 2–3-ternate leaves, and racemose of flowers opposite.

No. 2. Wallflower
(*Cheiranthus Cheiri*, L.)

a, Andrœcium, with 6 stamens, 4 long, 2 short, honey-glands at base, gynœcium with long ovary and 2-fid stigma. *b*, Pod, with valves opening from below upwards showing seeds on septum. *c*, Seed, with funicle. *d*, Upper part of plant, with stem-leaves alternate, and flowers in racems, showing cauline position. *e*, Bud. *f*, calyx, and contorta corolla.

No. 3. Vernal Whitlow Grass
(*Erophila verna*, E. Meyer)

a, Flower (enlarged), with 4-fid calyx, and corolla with 4 2-fid petals. *b*, Siliqua, with valves opening from below upwards, seeds attached to dividing septum. *c*, Plant, with root, rosette of radical leaves, flowering stems with flowers in racems.

No. 4. Cheddar Pink
(*Dianthus plumarius, Hlads. = caesius*, Sm.)

a, Andrœcium, with 10 stamens, and gynœcium, with 1-celled ovary, and 2 styles. *b*, Petal, with long claw and toothed limb. *c*, Pistil, with globular ovary, and 2 styles, papillose within. *d*, Barren shoot, with linear leaves, rough at edges. *e*, Flowering stem, with opposite leaves, and flower-bud, with gamosepalous calyx, and bracts below.

No. 5. Field Mouse-ear
(*Cerastium arvense*, L.)

a, Andrœcium, with ring of 10 stamens, intorse, and gynœcium, with ovary, and 5 styles. *b*, Pistil, with globular ovary, and 5 styles, papillosed within (when there are 5 styles they are opposite the sepals). *c*, Capsule, cut open, with 8 teeth, and seeds within. *d*, *e*, Flowering stems, showing opposite leaves and flowers, with 5 2-fid petals, 5-fid calyx, 10 stamens, one with flowers more expanded, and more distant leaves.

1. Yellow Wall Fumitory (*Corydalis lutea*, D.C.). 2. Wallflower (*Cheiranthus Cheiri*, L.).
3. Vernal Whitlow Grass (*Erophila verna*, E. Meyer). 4. Cheddar Pink (*Dianthus glaucus*, Huds.).
5. Field Mouse-ear (*Cerastium arvense*, L.).

Fumitory, and *lutea* is Latin for yellow, in allusion to the colour of the flowers. The English names are Lady's Pincushion, Mother of Thousands, Pincushion.

The plant is commonly grown in gardens, being an easily-cultivated plant, covering bare walls, and very prolific, the ordinary loamy garden soil being suited to it.

Essential Specific Characters:—

21. *Corydalis lutea*, D.C.—Stems erect, angular, leaves 3-ternate, lobed, bracts oblong, flowers large, in racemes, spur incurved, short, pods compressed, many-seeded.

Wallflower (Cheiranthus Cheiri, L.)

Long cultivated as it has been no seeds of the Wallflower have been discovered in early beds. It is confined to the North Temperate Zone in Central and North Europe. Everywhere it is only naturalized, being an alien plant which has become established solely on account of being a garden plant, easily propagated by seed, the amount of which, as in most Cruciferæ, is enormous.

Like the yellow-flowered Wall Fumitory, the Wallflower, too, is a rock plant. Its occurrence on old ruins may sometimes mark the only remnants of a former domestic use of such buildings. Castle walls and enclosures are a frequent stronghold of the so-called Wild Wallflower. With it one may find the Martagon Lily and the Star-of-Bethlehem, these last being fond of humus but not rock habitats.

The plant is shrubby, having a smooth, stout main stem, or with a few hairs, with numerous ascending branches forked from the base. The leaves, which are entire, lance-shaped, and having appressed forked hairs, which are numerous, help to give it this shrub-like character. The hairs protect the plant from loss of moisture or from the sun.

The flowers are large, in racemes, the sepals erect, 1 in. across, fragrant, and in cultivation many-coloured. The stigma is bilobed with bent-back lobes, the pods are long and not transversely divided, but square. The pod opens by 2 valves all the way, and is divided by narrow compartments. The seeds are oblong, have a membranous oval border, and are in a single row in each cell. The valve of each pod has a rib in the centre. The embryo fills the seed, and the cotyledons are egg-shaped, flat, and pressed face to face.

The Wallflower reaches a height of 1–1½ ft. It is in flower from April to June or July. It is an evergreen undershrub, perennial, and propagated by seed.

The flowers are large and conspicuous, sweet-scented and attractive to insects, and the stigma is provided with spreading lobes to assist insects to alight upon it and cause cross-pollination. There are 2 honey-glands at the base of the 2 stamens.

The seeds are dispersed by the wind or the plant's own mechanism. The seeds are flattened, and this assists in their dispersal by the wind when the pod has opened or dehisced lengthwise.

The Wallflower is largely a rock plant or saxicolous, and grows on a variety of rocks—granite, sandstone, and oolite. It is also a sand plant, favouring a sand soil derived from sandy formations.

Photo. J. H. Crabtree

WALLFLOWER (*Cheiranthus Cheiri*, L.)

It is infested by a fungus, *Peronospora parasitica*. The beetle *Baridius laticollis*, and the Lepidoptera Large Yellow Underwing (*Triphæna pronuba*), Angle Shades (*Phlogophora meticulosa*), *Plutella cruciferarum*, *P. porrectella*, visit it.

The name *Cheiri*, or *Keir* in Arabic, was adopted by Linnæus, who added *anthos*, Greek for flower. *Cheiros* means a man's hand, and it was called hand-flower. Gerarde (1597) called it Well Gilloflower.

The English names are Banwort, Bee Flower, Bleeding Heart, Blood Wall, Bloody Warrior, Chevisaunce, Churl, Geraflour, Gilliflower, Heartsease, Jacks, Jeroffleris, Jilliver, July Flower, Keyry, Sweet William. It was called Winter Flower and July Flower because it flowers in winter and is more or less dead in summer. In Palestine it was called "Blood-drops of Christ". A legend is told of a maiden held captive on the Tweed banks, having plighted her troth with a member of a hostile clan. The rival chiefs fought and shed blood between each other. The lover at last gained admission as a troubadour and planned escape, he agreeing to wait for her:

"Up she got upon a wall,
Attempted down to slide withal;
She fell, and bruised, she died.
Love in pity to the deed,
And her loving luckless speed,
Turned her to this plant we call
Now the Flower of the Wall."

The Wallflower is much cultivated, and many varieties of colour—yellow, white, orange, blue, purple flowers—are produced, both double and single. It has been grown in pastures with parsley, thyme, &c., for its acrid properties as a remedy for sheep rot.

Essential Specific Characters:—

23. *Cheiranthus Cheiri*, L.—Stem shrubby, leaves linear-lanceolate, acute, with appressed hairs, flower yellow or red, calyx spreading, pod tetragonal, stigma 2-lobed.

Vernal Whitlow Grass (Erophila verna, E. Meyer)

There is no record of this in beds containing fossil remains of recent plants. It is distributed throughout temperate Europe, Asia as far as the Himalayas, North Africa. This little plant is known in every district in Great Britain except Cardigan, Mid Lancashire, Stirling, N. Hebrides, Orkneys, ranging from the west of England to the Orkneys and throughout the south. It is found also in Ireland and the Channel Islands.

Vernal Whitlow Grass, as the name implies, is a spring flower which adorns our mud walls or stone walls and roofs in the majority of English and Scottish counties. It is also found on mole-heaps and other dry spots which are raised above the general level at a distance from houses in the open fields. It is a xerophyte, and occurs also on gravel-walks, cinder-paths, terraces, in the cracks of walls and similar spots.

The habitat of this plant is associated with its habit. For its leaves, which are lance-shaped, acute, and are hairy and narrowed below, are arranged in a regular rosette at the base of the plant, which in its usually exposed position help to prevent it from being uprooted. The short aerial stem is a scape, leafless, and bears few flowers. Many of these little plants grow together like little mats scattered over the surface.

The petals of the flower are deeply cloven, white. The pods are oblong, rounded, and the flower-stalks are longer, spreading, alternate.

The style is not marked, the stigma pin-headed. There are numerous seeds. When it is wet and at night the flowers hang down.

This is a diminutive plant, the scape not being more than 3–5 in. high. The first Latin name was given in allusion to its early flowering, viz. March to April. It is an annual.

Between the base of the short and long stamens, which are adjacent, there are 4 small, fleshy, green honey-glands. Anthers and stigma ripen together. The longer stamens reach the level of the stigma, and closely surround it, opening towards it and dusting it with pollen, and the shortest stamens also, but they are below it. The

Photo. Flatters & Garnett

VERNAL WHITLOW GRASS (*Erophila verna*, E. Meyer)

insect's head is placed between the stigma and shorter stamens, and is covered with pollen, and in transferring it to another flower cross-pollination follows. Cross-pollination is brought about by the short stamens, and the four longer regularly cause self-pollination, which is effective. The flowers are not conspicuous, and insects seldom visit it. The visitors are the Honey-bee, *Andrena parvula*, *Halictus*.

The plant is dispersed by its own agency. The pods when dry become tense, and disperse the numerous small seeds to no great distance.

Vernal Grass is a sand-loving plant, and requires a sand soil with no humus.

A beetle, *Ceuthorhynchus hirtulus*, causes galls, but there are no other insect pests.

Erophila is derived from *er*, spring, *phileo*, I love; and *verna* is Latin for vernal or spring.

The English names are Faverel, Whitlow Grass, Nailwort, White Blow. The flowers droop at night and in wet weather. In Sweden they sow their rye when the Whitlow Grass is in flower.

Essential Specific Characters:—

28. *Erophila verna*, E. Meyer.—Stem (flowering) leafless, leaves radical, lanceolate, acute, dentate, hairy, petals white, deeply cloven, capsule a compressed oval pouch, many-seeded.

Cheddar Pink (Dianthus glaucus, Huds.)

This plant is quite unknown except from its present-day distribution, which is from Belgium southwards to Lombardy and Hungary. It is native in these islands only at its single locality in North Somersets, on the rocks of Cheddar Gorge, and it is only introduced in Oxford and Edinburgh; and in Northampton, West Gloucester, South Lincs, and Westmorland it is erroneously recorded as native.

Cheddar Gorge, which is a valley cut through Carboniferous rocks and calcareous, is the only locality for this charming pink, called from its single British station the Cheddar Pink. In the minds of the country traveller and the botanist this locality is thus rendered doubly famous, first for the reputed Cheddar Cheese, and last, but not least, for the Cheddar Pink. Over the limestone rocks at this place it grows in patches like Thrift at the seaside; but this plant is eminently a lime-loving plant, the other sand-loving.

Like other pinks and carnations, e.g. the Common Clove, the Cheddar Pink grows in tufts on the rocks, having a woody rootstock and numerous stems. The leaves are linear, blunt, with rough edges, bluish-green, and the barren stems are much branched.

The flower-stalks are usually single, in panicles or solitary. The petals are rosy, inversely egg-shaped, notched, downy. The calyx scales are roundish, blunt, only $\frac{1}{4}$ as long as the calyx and pressed close together, and the flower is scented.

The plant is not more than 3 in. high when barren, the flowering stems are 6–8 in. It is in bloom in June and July. Like others of the group it is perennial, and increased by cuttings.

Honey-glands in *D. deltoides*, the pollination of which is similar to that of this plant, are formed by the union of petals and stamens at the base. The stamens and pistil nearly close the narrow tube, making it impossible for any but moths to get at the honey. Other insects, such as flies, are pollen-seekers. The flower is conspicuous, being flattened above. There are 10 stamens. Five project, and

the anthers open when the flower opens, and ripen, and after the pollen is shed the other five do so. After they have all opened, the pistil, previously concealed, emerges, and the 2 long stigmas elongate. In this way it is necessary for Lepidoptera to convey pollen from anthers of young to the stigmas of old flowers. The plant is not self-pollinated. It is sweet-scented. Some plants produce only female flowers.

The seeds of the Cheddar Pink are dispersed by the wind. The capsule opens to form a series of apical teeth and allows the seeds to be dispersed by the wind, the stem swaying backwards and forwards.

Photo. Flatters & Garnett

CHEDDAR PINK (*Dianthus glaucus*, Huds.)

A fungus, *Ascochyta dianthi*, infests several members of the Clove and Pink tribe. The beetle *Phytonomus polygoni* feeds on it.

This is a lime-loving plant, and saxicolous, requiring a lime soil and growing on rocks.

Dianthus is the name given by Linnæus, Greek *Dios anthos*, Flower of Jove, and *glaucus* means bluish-grey or glaucous, in allusion to its colour.

Cheddar Pink is called Cleve-pink, Cliff-pink. Cleve-pink is given in the same sense as Cliff-pink, both indicating its habitat, and the first its only locality.

It has been cultivated as a flower in the garden for the rock-border.

ESSENTIAL SPECIFIC CHARACTERS:—

46. *Dianthus glaucus*, Huds.—Leaves linear, with rough margins, flowers solitary, rose-pink, petals bearded, jagged, bracts shorter than the calyx.

Field Mouse-ear (Cerastium arvense, L.)

This plant has not been discovered in any early deposits containing seeds. It is distributed at the present time throughout Arctic Europe, North Africa, Siberia, West Asia to the Himalayas, North America, Fuegia, Chili. In Great Britain it is absent from Cornwall, North

Devon, N. Somersets, Dorset, I. of Wight, Monmouth, Worcester, from S. Wales; and it occurs in N. Wales only in Carnarvon, Denbigh, Flint, Anglesea; and is absent from S. Lancs, Westmorland, Ayr, Renfrew, Peebles, Selkirk, Mid and N. Perth. In England it is not uncommon, in Scotland it is rarer in the West and N. Highlands.

The Field Mouse-ear turns up here and there over a wide area in England upon the stony heights of the Midlands, and on sandy fields and waste places in the south and east. It is a saxicolar xerophyte, and may be found, on walls and rocks, in situations similar to the

Photo. Rev. C. A. Hall

FIELD MOUSE-EAR (*Cerastium arvense*, L.)

Cheddar Pink, Sandwort, Bird's-foot, White Meadow Saxifrage, Mouse-ear Hawkweed, Musk Thistle, and other dry-soil-loving species.

This plant is very rigid, and generally prostrate, with numerous barren shoots which make a kind of turf where they grow, but the flowering shoots are ascending. The leaves are deep-green, linear-lance-shaped, blunt, and fringed with hairs at the base. The stem is brittle owing to jointing.

The flowers are larger than in the Common Mouse-ear, the petals being twice as long as the calyx, which has membranous margins and tips. The capsule is longer than the calyx, and the seeds are acutely tubercled, numerous, and reddish-brown.

The plant in flower is usually at most 6 in. in height. It flowers from April and May till August. It is perennial, increasing by division.

The honey-glands are situated as in the Greater Stitchwort. The stamens and pistil develop in the same manner. A similar opportunity for cross-pollination is presented when insects visit it, and of self-pollination in their absence. The flowers are large and widely open and conspicuous. The insects that visit it are numerous: Diptera, Stratiomyidæ, Empidæ, Pepidæ, Syrphidæ *Eristalis*, *Syritta*, *Platycheirus*, *Syrphus*, *Melanostoma*, Muscidæ, Hymenoptera, Apidæ, Coleoptera, Staphylinidæ, Thysanoptera, *Thrips*, Lepidoptera, *Polyommatus phlœas*. Besides complete flowers there are some with more or less rudimentary stamens.

Field Mouse-ear is mainly dispersed by the wind. The seeds (acutely tuberculate) are blown out of the capsule, the plant growing in exposed positions.

It is a sand-loving plant growing on a sand soil, but is also lime-loving, and will subsist on a lime soil.

A fungus, *Melampsora cerastii*, lives upon it. It is galled by *Cecidomyia cerastii*. The beetle *Adimonia tanaceti*, and the moths, *Coleophora chalcogrammella*, *C. olivacella*, (Small Yellow Underwing), *Heliodes arbuti*, *Heliaca tenebrata*, feed on it.

The second name, *arvense*, refers to a reputed prevalence for cultivated land.

Though found in the eastern counties in cornfields, it is found on dry banks, sand-banks, and on walls, as well as on hilly ground. It is distinguished from all other species by its large flowers, prostrate habit, the deep-green, not light or yellow leaves, its brittle-jointed stem, and its powerful creeping root.

Essential Specific Characters:—

53. *Cerastium arvense*, L.—Stem prostrate, wiry, tufted, leaves linear-lanceolate, downy, petals longer than the calyx, white, bracts membranous on the margin and at the tip.

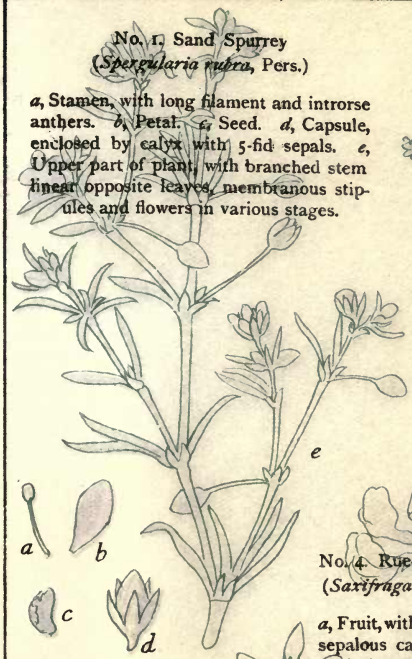
Sand Spurrey (Spergularia rubra, Pers.)

No instance of the occurrence of this plant in Glacial, earlier or later, beds is known at present. To-day it is found in the Temperate Northern Zone in Europe, North Africa, Siberia, Western Asia to India, North America. In Great Britain it is common, but absent in West Suffolk, Montgomery, Flint, Roxburgh, Westerness, Cantire, South Ebudes, Mid Ebudes, North Ebudes, Sutherland, Caithness, and the Northern Isles. In Ireland it is quite rare.

Sand Spurrey is a plant of rocky districts where there are accumu-

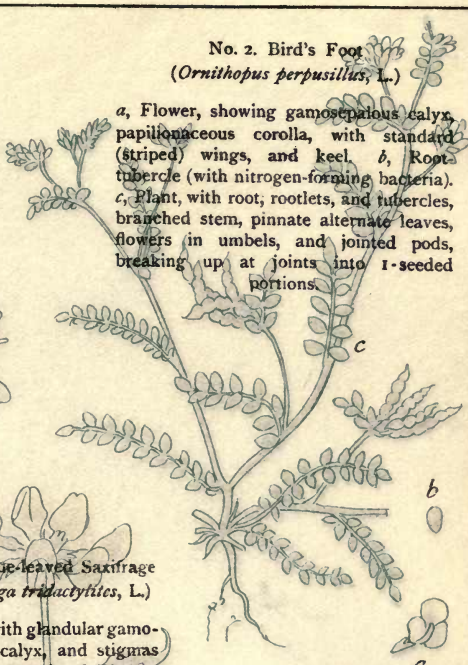
No. 1. Sand Spurrey
(*Spergularia rubra*, Pers.)

a, Stamen, with long filament and introrse anthers. *b*, Petal. *c*, Seed. *d*, Capsule, enclosed by calyx with 5-fid sepals. *e*, Upper part of plant, with branched stem linear opposite leaves, membranous stipules and flowers in various stages.



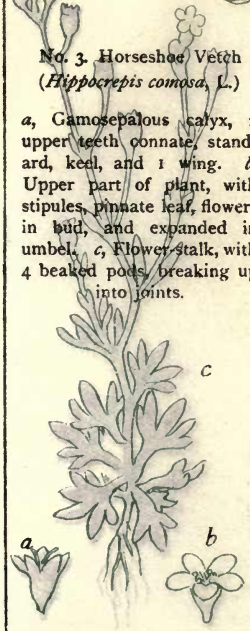
No. 2. Bird's Foot
(*Ornithopus perpusillus*, L.)

a, Flower, showing gamosepalous calyx, papilionaceous corolla, with standard (striped) wings, and keel. *b*, Root-tubercle (with nitrogen-forming bacteria). *c*, Plant, with root, rootlets, and tubercles, branched stem, pinnate alternate leaves, flowers in umbels, and jointed pods, breaking up at joints into 1-seeded portions.



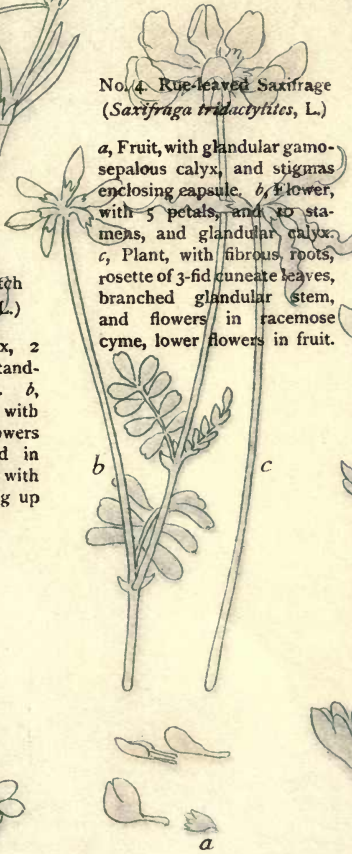
No. 3. Horseshoe Vetch
(*Hippocrepis comosa*, L.)

a, Gamosepalous calyx, 2 upper teeth connate, standard, keel, and 1 wing. *b*, Upper part of plant, with stipules, pinnate leaf, flowers in bud, and expanded in umbel. *c*, Flower-stalk, with 4 beaked pods, breaking up into joints.



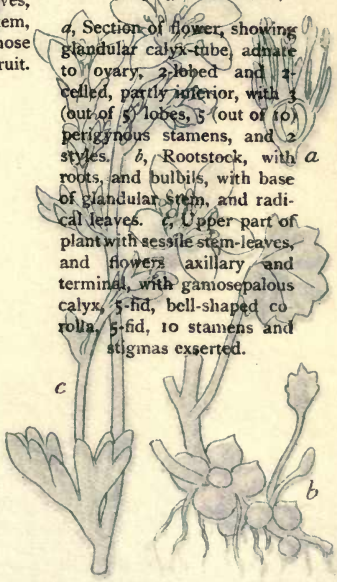
No. 4. Rue-leaved Saxifrage
(*Saxifraga tridactylites*, L.)

a, Fruit, with glandular gamosepalous calyx, and stigmas enclosing capsule. *b*, Flower, with 5 petals, and 10 stamens, and glandular calyx. *c*, Plant, with fibrous roots, rosette of 3-fid cuneate leaves, branched glandular stem, and flowers in racemose cyme, lower flowers in fruit.



No. 5. Meadow Saxifrage
(*Saxifraga granulata*, L.)

a, Section of flower, showing glandular calyx-tube, adnate to ovary, 2-lobed and 2-celled, partly inferior, with 5 (out of 5) lobes, 5 (out of 10) perigynous stamens, and 2 styles. *b*, Rootstock, with roots, and bulbils, with base of glandular stem, and radical leaves. *c*, Upper part of plant with sessile stem-leaves, and flowers axillary and terminal, with gamosepalous calyx, 5-fid, bell-shaped corolla, 5-fid, 10 stamens and stigmas exserted.



No. 1. Sand Spurrey
(Spergularia rubra, Pers.)

a, Stamen, with long filament and introrse anthers. b, Pistil. c, Seed. d, Capsule, enclosed by calyx with 5-fid sepals. e, Upper part of plant with branched stem, linear opposite leaves, membranous stipules and flower in various stages.

No. 2. Horsetail Vetch
(Hippocrepis comosa, L.)

a, Compressed calyx, 2 upper teeth connate, stand-ard, keel, and 1 wing. b, Upper part of plant, with stipules, pinnate leaf, flowers in bud, and expanded in umbel. c, Flower-stalk, with 4 bealed pods, dehiscing up into joints.

No. 3. Bird's Foot
(Ornithopus perpusillus, L.)

a, Flower, showing gamopetalous calyx, papilionaceous corolla, with standard (striped) wings, and keel. b, Monadelphous tube (with nitrogen-forming bacteria). c, Plant, with root, rootlets, and tubercles, branched stem, pinnate alternate leaves, flowers in umbels, and jointed pods, breaking up at joints into 1-seeded portions.

No. 4. Rue-leaved Saxifrage
(Saxifraga tridactylites, L.)

a, Fruit, with glandular gamosepalous calyx, and stigmas enclosing capsule. b, Flower, with 5 petals, and 10 stamens, and glandular calyx. c, Plant, with fibrous roots, rosette of 3-fid cuneate leaves, branched glandular stem, and flowers in racemose cyme, lower flowers in fruit.

No. 5. Meadow Saxifrage
(Saxifraga granulata, L.)

a, Section of flower, showing glandular calyx-tube adnate to ovary, 5-lobed and 5-celled, partly inferior, with 5 (out of 6) notches, 5 (out of 10) perigynous stamens, and 2 styles. b, Rootstock, with roots, and bulbils, with basal leaves. c, Upper part of plant with sessile stem-leaves, and flowers axillary and terminal, with gamosepalous calyx, 5-fid, bell-shaped corolla, 5-fid, 10 stamens and 2 stigmas exserted.

1. Sand Spurrey (*Spergularia rubra*, Pers.). 2. Bird's-foot (*Ornithopus perpusillus*, L.). 3. Horseshoe Vetch (*Hippocrepis comosa*, L.). 4. Rue-leaved Saxifrage (*Saxifraga tridactylites*, L.). 5. Meadow Saxifrage (*Saxifraga granulata*, L.).

lations of sand or gravel. Thus it will grow in the Midlands on the Pennines, where igneous and volcanic rocks have by disintegration produced an arenaceous subsoil, or on rocks and walls. Along the maritime tracts of the coast counties it will be found where there are wide stretches of sandy heath.

No plant could be more prostrate in habit than this humble species, which spreads its flexible stems over the surface in the manner of a club moss on land or some stalkless seaweeds in the water. The stems are hairy and numerous, nearly round, with linear, flat, or thread-like

Photo. A. R. Horwood

SAND SPURREY (*Spergularia rubra*, Pers.)

leaves, shorter than the joints of the stem; and the stipules are large, united at the base, silvery and torn, membranous at the margin, not falling, inserted just below the leaves, enclosing them entirely in bud, covering the base when fully developed.

The flowers are like those of Common Spurrey, but pink or purple, the petals equalling the calyx, and the capsule is the same length, shorter than the fruit-stalk, the seeds egg-shaped, wedge-shaped, and bordered.

The plant never rises to a height of more than 2 in. It can be seen in flower from June to September. It is annual or biennial.

The flowers are like those of *Spergula*, but are more conspicuous, and the plant is not hidden away amongst corn, but is prostrate on rocky soils. It is in this way less driven to self-pollination than Spurrey.

The seeds of Sand Spurrey are dispersed by its own agency. The capsule is split into valves, and the seeds are scattered when ripe close to the plant; but they may be wind-scattered, the bordered margin facilitating this.

The plant is saxicolous or a rock plant, and requires a rock soil, growing on volcanic, igneous, and granite rocks which are more or less barren.

The fungus *Uromyces sparsus* infests it.

From the general similarity between it and Spurrey the Latin name is a diminutive of *Spergula*, and *rubra*, red, refers to the flowers.

This is one of those plants that serve to make up a floral index, flowering only at certain hours of the day.

Essential Specific Characters:—

59. *Spergularia rubra*, Pers.—Stem branched, prostrate, leaves linear, flat, with a bristle, stipules triangular, chaffy, flowers purple, capsule not exceeding the calyx, shorter than the pedicels, seeds not winged.

Bird's-foot (Ornithopus perpusillus, L.)

Nothing is known of the distribution of this plant except from its distribution to-day in the Northern Temperate Zone in Europe and North Africa. In Great Britain it is absent from Radnor, Carmarthen, Montgomery, Merioneth, Northumberland, Cheviotland, Renfrew, occurring in the East Lowlands only in Edinburgh, not in Kincardine or Aberdeen or Easterness in the E. Highlands, and elsewhere only in Dumbarton. From Moray and Dumbarton it ranges, however, to the extreme south elsewhere. It is very rare only in S.E. Ireland. It occurs in the Channel Islands.

Bird's-foot is found on bare sandy or gravelly places, which may form parts of mountainous or hilly districts, or the lowlands, or parts of heaths or commons, where it is most frequent along the side of wide alluvial river valleys. But it may also be found on stony ground in wooded tracts, and also on walls and rocks generally.

The stems are numerous, prostrate, simple, downy, with leaves with lobes each side of a common stalk, the radical leaves prostrate, from 6–12, with a terminal larger leaflet.

The flowers are white with red veins, in a capitate head, on short flower-stalks, the calyx tubular, hairy, with 5 teeth. The pods are jointed, with curved valves, and the first name is given in allusion to the resemblance of the clustered pods to a bird's foot, hence the English and generic names.

Bird's-foot is at most about 3 in. high. Flowers may be seen in May up till August. The plant is perennial.

The type of flower is like the general Leguminous flower, but is very small, and the plant is prostrate, so that insect visits are restricted to smaller insects. The upper stamens are free. The stigma is pin-headed, with an inbent style, while the keel is very short, so that self-pollination is more frequent or possible. There is moreover no honey.

As in *Lotus* the pod, a schizocarp, breaks up into single joints of 1 cell each, and the seeds are thus dispersed separately around the

Photo. Dr. Somerville Hastings

BIRD'S-FOOT (*Ornithopus perpusillus*, L.)

plant, or blown by the wind when half-loose. They are also liable to be fractured by animals underfoot.

The Bird's-foot requires a sand soil, and is a sand-loving plant. It also favours barren and stony ground, and can be found on many of the older Precambrian, schistose, and granitic formations.

No fungi or insects infest this plant.

Ornithopus, Gesner, from the Greek *ornis*, bird, *pous*, foot, is so named from the similarity of the fruits to a bird's foot, and the second name refers to its diminutive character. The plant goes by two names, Bird's-foot, Fowl-foot.

ESSENTIAL SPECIFIC CHARACTERS:—

86. *Ornithopus perpusillus*, L.—Stem decumbent, spreading, leaves

downy, pinnate, leaflets elliptic, in 5–12 pairs, flower white, veins crimson, with a small leaf at the base, pods jointed, curved, moniliform.

Horseshoe Vetch (Hippocrepis comosa, L.)

This plant is found at the present day (not in any earlier beds) in Western and Southern Europe and North Asia in the North Temperate Zone. In Great Britain it is found in South Devon and Somerset in the Peninsula province; in the whole of the Channel province, except in S. Hants; and in the Thames province, except in Middlesex; in Anglia, except in Hunts; in the Severn province, except Monmouth; only in Glamorgan and Carnarvon in Wales; and in the Trent province; in Mid Lancs; in the Humber province, not in N.E. York; elsewhere northward in Western Ireland, Ayr, and Kincardine, and it ascends in Yorkshire to 1800 ft.

The Horseshoe Vetch is especially prevalent in the chalk districts, where it is a conspicuous hill-side plant, growing on stony and rocky pastures. It is accompanied by Mountain Flax, Rock Rose, Man Orchis, Pyramidal Orchis, *Viola calcarea*, *Polygala serpyllacea* and *P. calcarea*, Field Mouse-ear, Snapdragon, &c.

This plant has the *Lotus* habit, not growing very tall, but suberect or prostrate, then ascending, with inversely egg-shaped, blunt leaflets, 4–13, the leaves with lobes each side of a common stalk, with an odd one.

The flowers are yellow on short stalks, and the slender flower-stalks exceed the leaves. The 2 upper teeth of the calyx are united below, and the petals have a long claw or stalk. The pods are stalked in clusters, bent in a circle, and in shape like a horseshoe (hence the names, *Hippocrepis* and English name above), the hollow margin continuous, the convex margin wavy. The pod does not break up at the narrow part, but across the middle of the broader part. Each segment contains two seeds, but one is sterile.

The plant is usually about 6 in. high. The flowers are in bloom from April to August. Horseshoe Vetch is a perennial, deciduous, herbaceous plant.

The Horseshoe Vetch has a flower in general like that of *Lotus*, in so far as the method of pumping out the pollen is concerned. The vexillum or standard has a narrow stalk or claw, and is curved, enabling one to distinguish it between the vexillum and the stamens. Underneath it bears a flat, irregular process which fits exactly upon the nectaries, and serves to close them very effectually. The vexillum is employed by

a bee visitor as a long lever by which to raise this lid and then insert its head beneath the vexillum, a procedure which leads to effectual cross-pollination. It is visited by bees and Lepidoptera.

The pod breaks up into several joints, which are dispersed with the contained seeds to a short distance, aided by the wind, as the plant is semi-erect in habit.

It is one of the typical chalk plants needing a lime soil, which

Photo. A. R. Horwood

HORSESHOE VETCH (*Hippocrepis comosa*, L.)

it obtains also from oolitic rocks. No fungi or insect pests infest this plant.

Hippocrepis, Linnæus, is from the Greek *hippos*, horse, and *crepis*, shoe, from the form of the joint, and *comosa* means hairy.

The only common name is Horseshoe. It is called also "Unshoe the Horse", because its seeds resemble a horseshoe, and by Doctrine of Signatures (!) it was therefore said to unshoe horses.

ESSENTIAL SPECIFIC CHARACTERS:—

87. *Hippocrepis comosa*, L.—Stem branched, woody below, procumbent, leaves pinnate, leaflets narrow, obovate, 6–12, flowers yellow, in umbels, 5–8, pod jointed, curved, like a horseshoe.

Rue-leaved Saxifrage (Saxifraga tridactylites, L.)

Small-seeded as it is there is nothing to prevent its occurrence in Glacial beds, but the minuteness of the seeds would seem to prevent their detection. The Northern Temperate Zone of Europe, N. Africa, N. and W. Asia, is the region in which this little plant is found. In Great Britain it is present throughout the Peninsula, Channel, Thames, Anglia, and Severn provinces; but not in Radnor or Cardigan in S. Wales, Montgomery, or in N. Wales; in the Trent province; not in Mid Lancs in the Mersey province; generally in the Humber and Tyne provinces; not in the Isle of Man; in the Lakes province; and only in Haddington, Edinburgh, and Linlithgow in the East Lowlands; in Fife, W. and Mid Perth, Forfar, Aberdeen, in the E. Highlands, and in Easterness, N. Ebudes, E. Ross, E. Sutherland, and Caithness; elsewhere from E. Scotland, that is from Caithness, to Cornwall and Kent, it is otherwise general. It is found in Yorkshire at 1800 ft. It is native in Ireland and the Channel Islands.

Photo. Flatters & Garnett

RUE-LEAVED SAXIFRAGE (*Saxifraga tridactylites*, L.)

The Rue-leaved Saxifrage is a familiar wall plant, growing abundantly on the tops of mud walls or on rocks, rarely on the ground, with Whitlow Grass, and Stonecrop of various kinds. Thale Cress is similarly addicted to this same type of habitat.

This pretty little Saxifrage, so familiar on wall tops, is an erect plant, with usually a reddish single-branched stem, and with leaves wedge-shaped, 3–5-lobed or divided, alternate. The stem-leaves are covered, like many other xerophytes, with absorbent, stalked, sticky glands, which capture insects. The plant may be insectivorous. The lower leaves are entire and spoon-shaped.

The single white flowers are borne on flower-stalks, with 2 bracts at the base, and longer than the fruit. The petals are only slightly longer than the calyx. The capsule is 2-chambered, with numerous, minute, blackish-brown seeds.

This plant is about 3–6 in. in height. The flowers follow on after Whitlow Grass, from April till July. Rue-leaved Saxifrage is annual.

The flowers yield honey and are proterandrous. The stamens move singly in succession towards the centre of the flower, which, however, is proterogynous, the stigma ripening first. The male flowers are larger and more conspicuous than the female. The anthers ripen one after another and bend inwards towards the centre. After they open they bend out again and cross-pollinate the flower. It is visited by bees, flies, and beetles.

The capsule is many-seeded and opens above, and having short spreading beaks the seeds are scattered around, being aided by the wind which sways the rigid stems, or by being touched by passing animals.

Rue-leaved Saxifrage is a sand-loving plant loving sand soil, but will also grow on lime found in the mortar of walls, calcareous rocks, and elsewhere.

The only fungus that infests it is *Puccinia saxifraga*, one of the cluster-cups.

No insects feed upon it.

Saxifraga, Pliny, is from the Latin *saxum*, stone, *frango*, break, meaning stone-breaker; and the second Latin name means three-fingered in Greek, alluding to the trifid lobes of the upper leaves.

The plant is called Whitlow Grass, Nailwort, White Blow. Gerarde uses the first name in allusion to a supposed property it had of healing disease of the nails called Whitlow, and the same reason explains the second name. The Saxifrage was said to reveal witches.

Essential Specific Characters:—

109. *Saxifraga tridactylites*, L.—Stem leafy, branched, leaves cuneate, trifid, flowers small, white, terminal on a separate stalk, with 2 bracts below.

Meadow Saxifrage (Saxifraga granulata, L.)

As with the Rue-leaved Saxifrage, we have no evidence as to the antiquity of this plant. It is found in the North Temperate Zone in Europe, W. Africa, Western Asia as far east as the Himalayas. It is found in Great Britain in Somersets; in the Channel province,

except in the Isle of Wight; in the Thames province, Anglia; in the Severn province, except in Monmouth and W. Gloucs; in Wales, only in Brecon, Denbigh, Carnarvon, Flint, and Anglesea; in the Trent, Mersey, Tyne, and Lakes provinces, except in the Isle of Man; in W.

Photo, Flatters & Garnett

MEADOW SAXIFRAGE (*Saxifraga granulata*, L.)

Lowlands; in E. Lowlands, except in Easterness; and in E. Ross, from Elgin to Somerset and Kent, ascending to 1500 ft. in Yorkshire; and it is rare in Ireland.

The White Meadow Saxifrage grows on the sides of hills in moist, shady hollows, where in the earlier part of the year it looks like Grass

of Parnassus at a distance, when numerous plants grow together in association. It is a pelophilous plant.

Common enough, this has the habit of a bulbous plant with granulate tuberous roots. The stems are erect, the lower radical leaves kidney-shaped, with stalked, rounded lobes, scalloped, the leaf-stalks channelled. The stem-leaves are nearly stalkless, divided nearly to the base into 3 or 5 lobes, and the bulbs are downy and reddish.

Panicles of flowers of this plant have a pearly silvery effect. The petals are white, at right angles, rounded externally, narrowed below. The 10 anther-stalks bear awl-shaped yellow anthers. The seeds are numerous, small, black, in inversely egg-shaped, pale-brown capsules.

The Meadow Saxifrage is 1 ft. high. It flowers in May. This plant is a perennial, increasing by division.

The flowers contain honey, and the anthers mature before the stigmas. The general form of the flower and its chances of self- or cross-pollination are precisely the same as in *S. tridactylites* (which see).

The short-beaked capsule opening above causes the numerous seeds to be upset around the parent plant by the jerking caused by the wind or by browsing animals.

This is a clay-loving plant which subsists on a clay soil, or rarely a sandy loam.

It is found on many different rock soils of Triassic and Liassic age, as well as on earlier granitic or volcanic rocks.

The only fungi that infest it are *Puccinia saxifragæ* or *Cæoma saxifragæ.*

The Yellow-winged Carpet feeds on it.

The second Latin name has reference to the small granular knobs of the roots or bulbs.

It is called Billy Button, Cuckoo-flower, Fair Maid of France, First of May, Thirlestane Grass, Lady's Pincushion, Pretty Maids, Sassifax, Saxifer, Saxifrage, White Saxifrage, Sen-green, Stonebreak. Pretty Maids refers to the double garden form, which may be:

> "Mary! Mary! quite contrary,
> How does your garden grow?
> Cockle shells and silver bells,
> And pretty maids all of a row."

The First of May refers to its time of growing. By the Doctrine of Signatures it was formerly used for stone, because the plant growing on rocks was thought to break them. It is cultivated and forms a pretty garden flower, especially when double.

Essential Specific Characters:—

110. *Saxifraga granulata*, L.—Stem erect, leafy below, roots bearing granular bulbs, radical leaves stalked, reniform, crenate, lobed, stem-leaves sessile, lobed, flowers large, white, in a cyme, calyx half-inferior.

Pennywort (Cotyledon Umbilicus-Veneris, L.)

Known only from its distribution to-day in the North Temperate Zone, Pennywort is found in Europe from France southwards, W. Asia, the mountains of N. and Tropical Africa. It is found in Great Britain throughout the Peninsula province, and in the Channel province except in N. Hants, in Kent; in S. Wales except Radnor; N. Wales; in the Trent province only in Leicester and Derby; in S. Lancs, S.W. and N.W. Yorks, the whole of the Lakes; in Scotland in Kirkcudbright, Ayr, Renfrew, Argyle, Clyde Islands, Cantire, Mid Ebudes, especially on the west coast. It ascends to 1000 ft. in Wales. It is native in Ireland.

Moist, dripping, flat-surfaced, perpendicular walls, intersected by numerous crannies and fissures, are the special habitat of Navelwort, which is a shade-loving rock plant, found wherever Orpine, Stone Crops, Goldenrod, Wall Lettuce, and many ferns, such as Wall Spleenwort and others, grow.

Pennywort has much the same habit as Grass of Parnassus, but the stems are more numerous and prostrate at the base, while the flowers, too, are in a raceme. The stems are succulent, stout, rounded. The leaves are thick, shield-like, the leaf-stalk being central below the leaf, which is hollow (hence the first Greek name and the second Latin name), scalloped at the margin, smooth, fleshy, and shiny. All the leaves are stalked, and chiefly radical. From the round, flat nature of the leaves they are known as pennies, hence the English name.

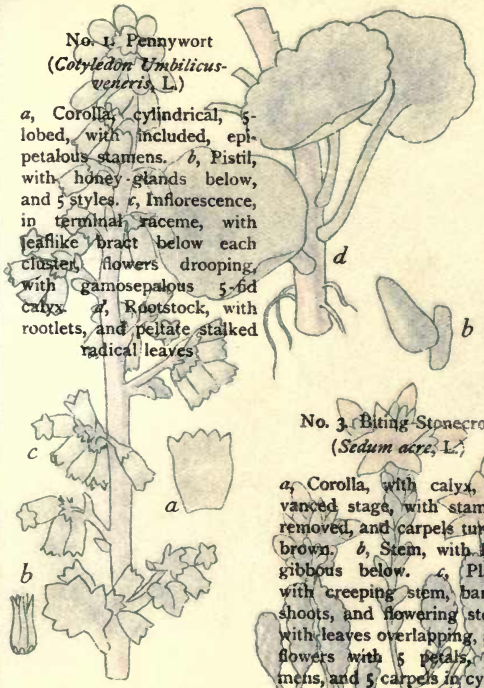
The bracts are simple, towering gracefully above the characteristic leaves. The greenish-yellow drooping flowers are arranged in a simple raceme, alternate. The flower-stalks are very short. The corolla is cylindrical. The seeds are contained in follicles.

Pennywort reaches a height of 6 in. to 1 ft. or more. The flowers are in bloom in June and July. The plant is a perennial plant, which may be propagated by cuttings.

The green flowers are not attractive to beetles, and though large and bell-shaped they grow in situations where insects are not likely to reach them readily, and from the adnate stamens, which are included

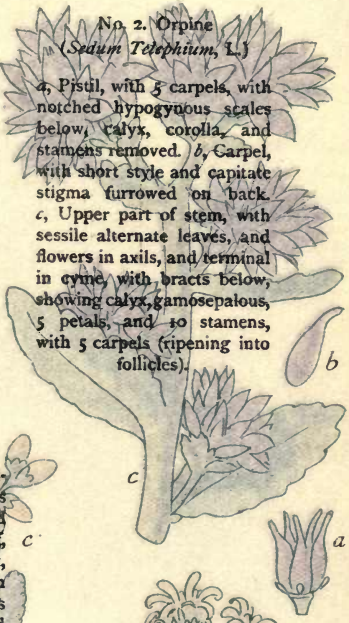
No. 1. Pennywort
(*Cotyledon Umbilicus-veneris*, L.)

a, Corolla, cylindrical, 5-lobed, with included, epipetalous stamens. *b*, Pistil, with honey-glands below, and 5 styles. *c*, Inflorescence, in terminal raceme, with leaflike bract below each cluster, flowers drooping, with gamosepalous 5-fid calyx. *d*, Rootstock, with rootlets, and peltate stalked radical leaves.



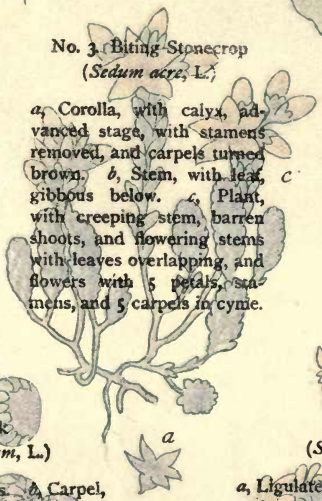
No. 2. Orpine
(*Sedum Telephium*, L.)

a, Pistil, with 5 carpels, with notched hypogynous scales below, calyx, corolla, and stamens removed. *b*, Carpel, with short style and capitate stigma furrowed on back. *c*, Upper part of stem, with sessile alternate leaves, and flowers in axils, and terminal in cyme, with bracts below, showing calyx, gamosepalous, 5 petals, and 10 stamens, with 5 carpels (ripening into follicles).



No. 3. Biting Stonecrop
(*Sedum acre*, L.)

a, Corolla, with calyx, advanced stage, with stamens removed, and carpels turned brown. *b*, Stem, with leaf, gibbous below. *c*, Plant, with creeping stem, barren shoots, and flowering stems with leaves overlapping, and flowers with 5 petals, stamens, and 5 carpels in cyme.

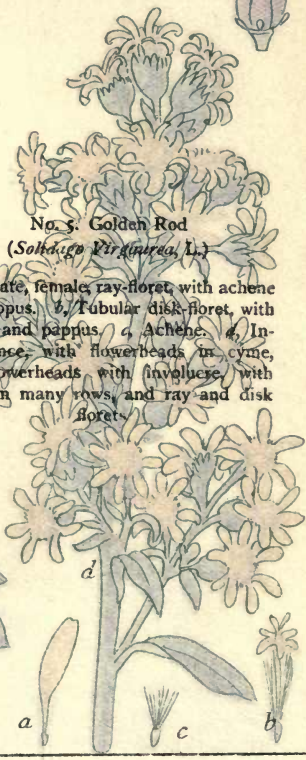


No. 4. Houseleek
(*Sempervivum tectorum*, L.)

a, Gynæcium, with 12 carpels. *b*, Carpel, with slender style. *c*, Upper part of plant, with alternate sessile stem-leaves, and flowers in corymbose cyme, with calyx, with 12 sepals, 12 petals, 12 stamens, and carpels. *d*, Basal rosette of radical leaves, fringed with hairs.

No. 5. Golden Rod
(*Solidago Virgaurea*, L.)

a, Ligulate, female, ray-floret, with achene and pappus. *b*, Tubular disk-floret, with achene and pappus. *c*, Achene. *d*, Inflorescence, with flowerheads in cyme, with flowerheads with involucre, with bracts in many rows, and ray and disk florets.



No. 1. Feverwort
(Chrysanthemum Parthenium, Pers.)

a, Corolla, cylindrical, 5-lobed, with included, epipetalous stamens. b, Pistil, with honey-glands below, and 2 styles. c, Inflorescence, in terminal racemes, with peltate bracts below each cluster. d, flowers drooping, with pentagonal 5-ribbed calyx. e, Rootstock, with rootlets, and pellate stalked radical leaves.

No. 2. Orpine
(Sedum Telephium, L.)

a, Pistil, with 5 carpels, with notched hypogynous scales below. Calyx, corolla, and stamens removed. b, Carpel, with short style and capitate stigma furrowed on back. c, Upper part of stem, with sessile alternate leaves, and flowers in axils, and terminal in cyme, with bracts below, spreading calyx, pentapetalous, 5 petals, and 10 stamens, with 5 carpels (ripening into follicles).

No. 3. Biting Stonecrop
(Sedum acre, L.)

a, Corolla, with calyx, advanced stage, with stamens removed, and carpels turned brown. b, Stem, with leaf, ribbous below. c, Plant, with creeping stem, barren shoots, and flowering stems with leaves overlapping, and flowers with 5 petals, stamens, and 5 carpels in cyme.

No. 4. Houseleek
(Sempervivum tectorum, L.)

a, Cyme-rosin, with 12 carpels. b, Carpel, with slender style. c, Upper part of plant, with alternate sessile stem-leaves, and flowers in cymbuses cyme, with calyx with 12 petals, 12 stamens, and carpels. d, Basal rosette of radical leaves, fringed with hairs.

No. 5. Golden Rod
(Solidago Virgaurea, L.)

a, Ligulate, female ray-floret with achene and pappus. b, Tubular disk-floret, with achene and pappus. c, Achene. d, Involucre, with flowerheads in cyme, with flowerheads with involucre, with bracts in many rows and ray and disk florets.

1. Pennywort (*Cotyledon Umbilicus, veneris*, L.). 2. Orpine (*Sedum Telephium*, L.). 3. Biting Stonecrop (*Sedum acre*, L.). 4. Houseleek (*Sempervivum tectorum*, L.). 5. Golden Rod (*Solidago Virgaurea*, L.).

in the corolla, and the many short ovules, the plant is more liable to be self- than cross-pollinated. *Thrips* visits but does not pollinate the flowers. The anthers ripen first.

The follicle when ripe contains many seeds, which are shaken out by the wind, and this causes dispersal over a wide area.

Pennywort is entirely a rock plant, growing on rocks, largely harder granitic or siliceous rocks, and slates and hornstones. Rarely it is found in the hedgerow.

A cluster-cup fungus, *Puccinia umbilici*, is to be found upon it.

Cotyledon, Dioscorides, is from the Greek *cotule*, cup, in allusion to the hollow form of the leaves, and the Latin *umbilicus* also refers to their shape and character.

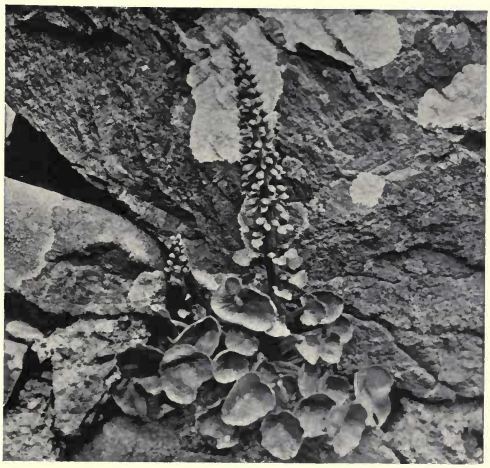


Photo. Flatters & Garnett

PENNYWORT (*Cotyledon Umbilicus-Veneris*, L.)

Pennywort is also called Bachelor's Buttons, Corn-leaves, Cups-and-saucers, Cut-finger, Penny Grass, Wall-penny Grass, Hipwort, Jack-in-the-bush, Kidney-wort, Lady's Navel, Lover's Links, Maid-in-the-Mist, Milk-the-cows, Money-pennies, Navelwort, Venus Navelwort, Pancakes, Penny Caps, Penny-cake, Penny Hat, Penny Leaves, Penny Pies, Penny-plates, Penny Wall, Great Stonecrop, Wallwort. The plant is called Corn-leaves because it was once applied to corns and warts, and Hipwort "for that it easeth the paines of the hippes", and Kidney-wort "because it helpeth the kidneys".

ESSENTIAL SPECIFIC CHARACTERS:—

112. *Cotyledon Umbilicus-Veneris*, L.—Stem succulent, erect, short, leaves radical, peltate, crenate, orbicular, flowers greenish-yellow, pendulous, in clusters or simple racemes.

Orpine (Sedum Telephium, L.)

Orpine is known entirely, as far as age and distribution go, from its occurrence to-day in the North Temperate Zone in Europe, Siberia, as far as Kamschatka, W. Asia. It is found throughout the Peninsula province, except in S. Somerset; throughout the Channel and Thames provinces, except Hants and in Anglia; in the Severn province, except in E. Gloucs. In Wales it is found in Glamorgan, Carnarvon, Denbigh, Flint, and Anglesea. In the Trent province it occurs in Leicester and Derby; not in Mid Lancs in the Mersey province; throughout the Humber, Tyne provinces; in the Lakes district, except in the Isle of Man. In Scotland, in the West Lowlands, except Wigtown; the E. Lowlands, except in Peebles, Selkirk, Forfar, Kincardine, and S. Aberdeen. In Yorks it is found at a height of 1200 ft. It is found in Ireland in Derry. Orpine is often a garden escape.

Photo. J. J. Ward

ORPINE (*Sedum Telephium*, L.)

Orpine has doubtless been planted in many districts, but in the western counties is quite native, growing in glens and dales, on rocks and walls, or even in stony hedge-banks and woods. For it is a lover of the shade, and may be found most luxuriantly in the same station as the Navelwort and the Spleenworts.

The tufted growth of the erect, unbranched stems of the Orpine, with flat, coarsely-toothed leaves, egg-shaped, oblong, nearly stalkless, give it a characteristic appearance.

The second name has reference to the long period during which

the plant can subsist removed from the soil. Its root is large and tuberous, not fibrous. The purple colour is also characteristic. The calyx and corolla have the parts in fives, the former acute, the petals white below. The ovaries are furrowed.

Cultivated, this plant may reach 3 ft. in height, but is usually less, or about 2 ft. The period of flowering is between July and September. The plant is perennial.

The flowers are proterandrous, small, but bright and conspicuous, and visited by numerous insects. The flower possesses honey, which can be obtained by short-lipped insects. The stamens open inwards. The first five alternate with the petals, and the inner series is soon covered with pollen. The styles are acute, and stigmatic papillæ are developed upon them after the stamens have withered. The petals and the stamens become widespread. Self-pollination does not occur without insects' visits, even when the anthers are stored with pollen when the stigmas ripen. The nectaries are at the points of the long scales, hidden under the ovaries at the base of the petals. Insects touch either the stamens or stigmas of many flowers, and cross-pollinate them by their proterandrous condition.

Self-pollination occurs only in old flowers with pollen on the anthers when the stigmas ripen. Owing to the flowers being closely packed the plant can dispense with self-pollination. It is visited by *Bombus campestris*, *B. sylvarum*, *B. agrorum*, *B. tapidarius*, *Halictus zonatus*, *Allantus*, *Echinomyia*.

The follicle is many-seeded, and the seeds are dispersed by the wind when the fruit is dry and opens above.

This plant grows on rocky slopes, and is partly rupestral like Cotyledon, but is also a sand-loving plant, and flourishes on a sand soil.

A moth, *Hyponomeuta viginti-punctatus*, and abroad *Parnassius Apollo* feed on it.

Sedum, Pliny, is from the Latin *sedeo*, I sit, from its squatting on rocks. *Telephium*, Dioscorides, is from *Telephus*, son of Hercules, King of Mysia. Orpine is a contraction of orpiment, a yellow mineral.

Orpine is also called Alpine Broklimbe, Arpent or Arpent-weed, Harping Johnny, Jacob's Ladder, Lib-long, Livelong, Midsummer Men, Orphan John, Orpies, Orall, Solomon's Puzzles. Arpent, &c., is a variant of Orpine, and Harping is probably a corruption of the same. As to the name Livelong, Lyte says: "The people of the country delight much to set it in pots and shelles on Midsomer even, or

upon timber slates or trenchers daubed with clay, and so to set or hang it up in their houses, whereas it remayneth greene a long season, and groweth if it be sometimes over sprinckled with water". And hence the name Midsummer Men. Orpies is a contraction for Orpine, and Orpy leaves were said to be good for wounds. The name Orpine was given first of all to yellow-flowered species, hence its origin. In Chaucer's day they called it Ornal.

Orpine was used as a charm against lightning. With St. John's Wort it was hung over the doorways to scare away witches. Formerly, too, it was employed as a love-charm.

This plant is astringent, and was used for intestinal disorders. It is also mucilaginous. It is cultivated and highly suited to rockery or rock-gardens, growing to a height of 3 ft. when well grown.

Essential Specific Characters:—

113. *Sedum Telephium*, L.—Stem tall, erect, green, with red spots, leaves large, ovate, oblong, upper sessile, rounded below, lower narrow below, flowers purple, in a corymbose cyme, dense, ovaries furrowed dorsally.

Biting Stonecrop (Sedum acre, L. = *S. Drucei* (British plant))

Stonecrop is found in the North Temperate Zone in Europe, North Africa, Siberia, but only at the present day. In Great Britain it is absent in Hunts, Cardigan, Mid Perth, Shetlands. It grows in Yorkshire at a height of 1500 ft.

Biting Stonecrop, or Wall Pepper, occurs wherever there are suitable ledges of rock, natural or otherwise. In wild hilly regions it grows on the shelving ledges of steep precipices, covering their angular edges like a green carpet turned golden-yellow in flower. It is also common on walls near villages, &c., being often planted, and on the ground where sandy stretches occur, being rather prevalent near the sea.

Rather dwarf compared with Orpine, this Stonecrop differs in other ways. It is a straggling plant with a small root, and several prostrate then ascending stems branching from a central one, with thick fleshy, cylindric leaves, egg-shaped, with a spur below, closely overlapping, alternate, swollen, and stalkless or sessile. The leaves are very numerous, and the second Latin name means bitter in reference to their taste, while the first has reference to their squat habit, seated as it were cushion-like on a rock.

Wall Pepper is distinct, in having yellow flowers, from the purple- and white-flowered Stonecrops. They are in 3-fid cymes, with blunt, swollen sepals, and petals twice as long, and spreading.

Three to six inches is the usual height for this pretty but diminutive species, which flowers in June and July. It is perennial, attractive, and suited for cultivation, and can be increased by division.

The plant is short, but the flowers are conspicuous on barren ground where it grows. It is proterandrous and contains honey, accessible to short-lipped insects, whence it is much visited. The honey is secreted in 5 yellow scales at the base of the flowers between the anthers and carpels. The flowers are cross-pollinated. When the flower opens and the petals spread into a star, 5 outer stamens alter-

Photo. J. H. Crabtree

BITING STONECROP (*Sedum acre*, L.)

nate with the petals, and are erect, and now open in the middle of the flowers, and the 5 others are inclined outwards while the petals remain closed, and the stigmas are still immature. As the first stamens wither and turn outwards, the others rise up into the centre and open. Before the second ring withers and turns outwards, the stigmas ripen and stand in the centre. Insects remove the pollen before the stigmas are mature, but in dull weather the anthers are stored with pollen till the stigmas are ripe and may self-pollinate the flower.

Insects touch the stamens and stigmas whether they settle in the centre or on the edge of the flowers. The flowers are visited by *Bombus*, *Cilissa*, *Andrena*, *Sphecodes*, *Nomada*, *Prosopis*, *Megachile*, *Ammophila*, *Oxybelus*, *Eristalis*, *Pyrellia*.

The follicle is many-seeded and opens above, and the seeds are dispersed by the wind.

Biting Stonecrop is a rock plant growing on barren rocky soil, or where there are stretches of sand or gravel derived from the more ancient granitic or schistose rocks.

A moth, *Glyphypteryx equitella*, is the only insect which feeds upon it, and no fungus attacks it, perhaps from its acrimonious properties.

The second Latin name refers to its bitter taste.

The plant is called Bird's Bread, Creeping Charlie, Creeping Jack, Creeping Jenny, Creeping Sailor, Crowdy Kit o' the Wall, Ginger, Gold Chain, Gold Dust, Golden Moss, Houseleek, Little Houseleek, Jack-of-the-Buttery, Moss, French Moss, Mouse-tail, Country Pepper, Poor Man's Pepper, Wall Pepper, Pepper Crop, Pig's Ears, Pricket, Prick Madam, Rock Crop, Rock Plant, Stancroppes, Stonecrop, Stone-hot, Stonnord, Wall Grass, Wall Moss, Wallwort. It was called Country Pepper and Ginger from its pungent flavour.

Biting Stonecrop was planted in gardens and used as a pot-herb.

Pliny said it produced sleep, for which purpose it was wrapped in a black cloth, and put under the pillow unawares. In the early days of herbals it was considered good for dropsy. It is emetic and has been used in scorbutic complaints.

Essential Specific Characters:—

114. *Sedum acre*, L.—Stems in tufts, leaves blunt, imbricate, fleshy, sessile, spurred or gibbous at the base, flowers yellow, in a 3-cleft cyme, sepals gibbous below.

Houseleek (Sempervivum tectorum, L.)

Europe and Western Asia are the regions in the North Temperate Zone in which alone to-day this plant is known. The Houseleek is not a native, and its existence depends largely on the former use to which it was put as a source of ointment. In every village where there still remain old-fashioned thatched cottages, especially in the west, one may be sure to find one or more with some traces of a roof-garden, made up of Houseleek or Stonecrop. Indeed it is quite a feature of the village community, and affords evidence of the picturesque nature of our country places, in spite of many drawbacks, caused by poverty or the lack of an artistic sense in constructing the dwelling of the labourer.

The perennial nature of this plant is indicated by the first, and the usual roof habitat by its second Latin name. It is an erect plant, very succulent (assisting water storage), with thick, fleshy leaves, fringed with a ring of hairs, of a reddish tint, the radical leaves arranged in

a rosette, stalkless, wedge-shaped, flat above, white below, and smooth or glabrous.

The flowers are numerous and close, turned all one way, usually erect, and reddish or pink. The calyx is 12-partite, sticky, fringed with hairs, purple above. The corolla has 12 petals, which are twice as long as the calyx, of a purplish colour. There are 12 stamens with purple anthers. The capsules are numerous, flattened at the border, and open inwards, in the form of follicles with many seeds.

The plant is tall, reaching a height of 12 in. or more. It flowers from June to August. Houseleek is perennial or biennial, and reproduced by division.

The colour of the flowers, which are purple, depends on their adaptation to a narrow or wide circle of visitors. The honey lies hidden, and the flowers are visited by bees, Lepidoptera, and long-tongued flies. Whilst there are 10 stamens in *Sedum*, in *Sempervivum* there are 12–40. The anthers open first, but self-pollination is not impossible.

Photo, J. H. Crabtree

HOUSELEEK (*Sempervivum tectorum*, L.)

The follicle splitting open allows the numerous seeds to fall over a wide compass around the parent plant when shaken out by the wind.

Houseleek is a mural or roof plant, and requires for its growth a certain amount of humus.

Endophyllum sempervivi, a cluster-cup fungus, noteworthy since it is sunk in the surface of the leaf, is found upon Houseleek, and also a mould *Phytophthora omnivora*. No insect makes a food-plant of it.

Sempervivum, Pliny, is Latin for livelong, and *tectorum* alludes to its roof habitat.

Houseleek goes by the following names: Aye-green, Bullock's-eye,

Cyphel, Fews, Foos, Fouets, Fow, Fuit, Full, Healing Blade, Hockerie-topner, Homewort, House-green, Huslock, Imbreke, Jobarbe, Jubard, Jupiter's Beard, Jupiter's Eye, Poor Jan's Leaf, Selgreen, Sengreen, Sigrim, Sil-green, Simgreen, Singreen, Sinna-green, Sungreen, Suphelt, Thunder-plant. Homewort was the Saxon name for it. Cockayne says planted on a roof it protected from thunder and lightning. Because associated with the evil one it was called Devil's Beard.

Houseleek was used in Italy as a love charm. There are locally antipathies against uprooting and even allowing it to bloom. It was used in heny greyne, i.e. megrim, used for neuralgia. An ointment for scalds and burns is prepared from it. The plant is astringent. It is planted on roofs and walls as an ornament.

Essential Specific Characters:—

115. *Sempervivum tectorum*, L.—Leaves fleshy, succulent, fringed at the margin, tufted, flowers purple, petals 12, ciliate.

Golden Rod (Solidago Virgaurea, L.)

This common rupestral plant is found in the North Temperate and Arctic Zones to-day in N. Temperate and Arctic Europe generally. It is unknown earlier than this, and is found in Asia eastward to the Himalayas, and America. In Great Britain it is absent from East Suffolk, Hunts, Carmarthen, S. Lancs, Mid Lancs, Stirling, North Aberdeen, and ascends to 2800 ft. in the Highlands.

Golden Rod is confined to wooded districts where there are perpendicular faces constantly covered with a stream of running water. This is its special stronghold, but it is to be found in the south in ditches by the roadside.

Golden Rod is a tall, graceful plant, erect, with few branches, with angular edges, rather rough. The leaves are lance-shaped, those at the base shortly stalked, elliptic, coarsely-toothed, with acute or blunt tips. Several stems grow in a clump, forming a fair sight when in bloom.

The beauteous golden bloom is abundant with the flowers arranged in panicled racemes, which are crowded and upright. The involucre is oblong, with several rows of bracts overlapping, with lance-shaped phyllaries. In the ray there are 10–12 florets, 10–20 in the disk—the former ligulate, the latter tubular. The bracts are linear-acute with membranous margins. The fruit is downy, with numerous ribs, and the pappus hairs in more than one row, rough.

Tall and slender, Golden Rod reaches a height of 2 ft. The flowers are in bloom in July up to September. It is a deciduous, herbaceous, perennial plant, propagated by division of the roots.

The disk florets are like those of *Chrysocoma*, in which several capitula combine to form one surface, and so do not need ligulate marginal florets. Here they are placed on an elongated axis. The disk of each capitulum is 4–5 mm., and 5–7 golden marginal florets render it conspicuous, making it broader, or 14–19 mm.

Photo. Matson

GOLDEN ROD (*Solidago Virgaurea*, L.)

The marginal florets have an enormously developed corolla, while the stamens are reduced or absent. The branches of the style have the sweeping hairs also reduced as useless, bearing stigmatic papillæ on the inner surface along each margin throughout. There are female and complete flowers on the same plant. Pollen may drop from the upper flowers on those below. The Golden Rod is pollinated by *Apis mellifica*, *Bombus rupestris*, *B. campestris*, *B. terrestris*, *Andrena*, *Eristalis arbustorum*, *E. nemorum*, *Thecla*.

The fruit is provided with pappus, and the achenes are downy and many-ribbed, and adapted for wind dispersal.

Golden Rod is a rock plant, which may be found growing on

granitic or schistose rocks with little soil, or it may be found growing on lime soil in the south, upon chalk or Oolite.

A little fungus, *Puccinia virgaureæ*, infests it. Lepidoptera frequent it, such as The Cudweed (*Cucullia gnaphilii*) and The Starwort (*C. Asteris*), The Golden-rod Brindle (*Cloantha Solidaginis*), *Botys terrealis*, *Homœosoma nimbella*, *Coleophora virgaureæ*, *Lycæna virgaureæ*, Guenée's Pug (*Eupithecia pernotata*), Common Pug (*E. vulgata*), Wormwood Pug (*E. absynthiata*), *Pterophora tetradactylus*, Dark Brocade (*Hadena adusta*).

Solidago, Brunfels, is from the Latin *solidare*, make whole or sound. *Virgaurea*, Mathiolus, is from the Latin *virga*, stem, *aurea*, golden.

Golden Rod has a few other names, such as Aaron's-rod, Banwort, Woundwort. The first was bestowed because it has a tall, straight stem, and is connected with Aaron because his rod, like his beard, is familiar from its mention in Scripture history.

This plant was formerly employed as a vulnerary. It is now planted in our gardens.

Essential Specific Characters:—

151. *Solidago Virgaurea*, L.—Stem erect, sub-simple, sub-angular, leaves lanceolate, lower petiolate, serrate, flowerheads yellow, in terminal racemes, small, disk florets tubular, ray florets ligulate, fruit downy.

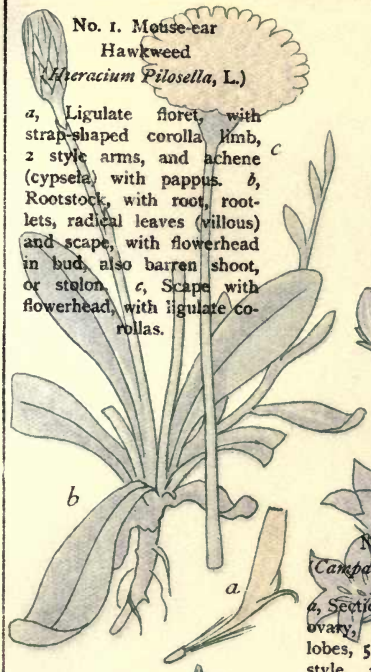
Mouse-ear Hawkweed (Hieracium Pilosella, L.)

Widely dispersed on hilly ground this pretty Hawkweed was quite an old-established species in the British Islands in the Glacial period. It is found in Interglacial beds at West Wittering, Sussex, and it is the only species of this large and polymorphic genus found in Britain so early. At the present day it occurs in the North Temperate Zone in Europe, N. Africa, North and West Asia. Mouse-ear Hawkweed occurs in all parts of Great Britain except the Shetlands, ranging elsewhere as far north as the Orkneys, and ascends to 2400 ft. in Yorkshire. It is native in Ireland and the Channel Islands.

This common Hawkweed is a xerophilous plant, growing usually on dry ground, at a more or less high altitude on hills and mountains, on sandy soil. It is fond of growing on rocky ledges, or where rocks crop out at the surface and are exposed by denudation. Similarly, walls are another suitable and frequent habitat. This Hawkweed is associated with Bird's Foot, Vernal Grass, and other rupestral types.

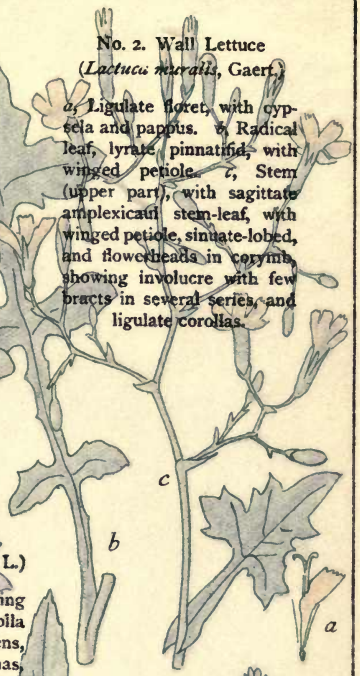
No. 1. Mouse-ear Hawkweed
(*Hieracium Pilosella*, L.)

a, Ligulate floret, with strap-shaped corolla, limb, 2 style arms, and achene (cypsela) with pappus. *b*, Rootstock, with root, rootlets, radical leaves (villous) and scape, with flowerhead in bud, also barren shoot, or stolon. *c*, Scape with flowerhead, with ligulate corollas.



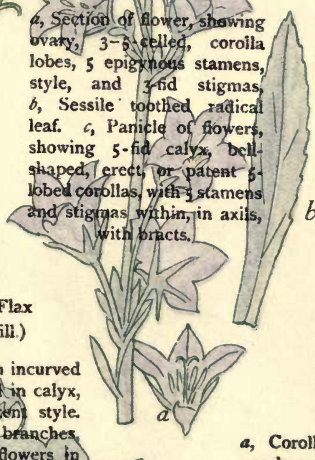
No. 2. Wall Lettuce
(*Lactuca muralis*, Gaert.)

a, Ligulate floret, with cypsela and pappus. *b*, Radical leaf, lyrate pinnatifid, with winged petiole. *c*, Stem (upper part), with sagittate amplexicaul stem-leaf, with winged petiole, sinuate-lobed, and flowerheads in corymb, showing involucre with few bracts in several series, and ligulate corollas.



No. 3. Rampion
(*Campanula Rapunculus*, L.)

a, Section of flower, showing ovary, 3–5-celled, corolla lobes, 5 epigynous stamens, style, and 3-fid stigmas. *b*, Sessile toothed radical leaf. *c*, Panicle of flowers, showing 5-fid calyx, bell-shaped, erect, or patent 5-lobed corollas, with 5 stamens and stigmas within, in axils, with bracts.

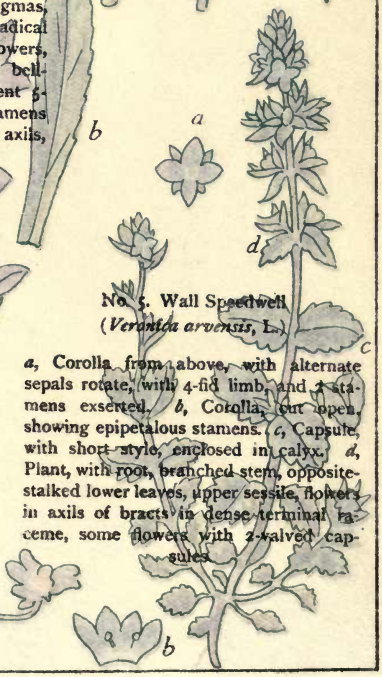


No. 4. Ivy-leaved Toad Flax
(*Linaria Cymbalaria*, Mill.)

a, Stamens, 2 long, 2 short, with incurved filaments. *b*, Capsule, enclosed in calyx, opening by pores, with persistent style. *c*, Upper part of plant, with branches, long-stalked uniform leaves, flowers in axillary racemes, with bracts long-stalked, showing personate, spurred corolla.

No. 5. Wall Speedwell
(*Veronica arvensis*, L.)

a, Corolla from above, with alternate sepals rotate, with 4-fid limb, and 2 stamens exserted. *b*, Corolla, cut open, showing epipetalous stamens. *c*, Capsule, with short style, enclosed in calyx. *d*, Plant, with root, branched stem, opposite-stalked lower leaves, upper sessile, flowers in axils of bracts in dense terminal raceme, some flowers with 2-valved capsules.



No. 1. Mouse-ear Hawkweed
(*Hieracium Pilosella*, L.)

a, Ligulate floret, with strap-shaped corolla limb, 5 style arms, and anthers (cypsela) with pappus. *b*, Rootstock, with root, rootlets, radical leaves (Willows) and scape, with flowerhead in bud, also barren shoot, or stolon. *c*, Scape with flowerhead, with ligulate corollas

No. 2. Hairy Tare
(*Vicia hirsuta*, Koch)

a, Ligulate floret, with corolla and papillæ. *b* Radical leaf, lyrate, pinnatifid, with winged petiole. *c*, Stem (upper part), with sagittate amplexicaul stem-leaf, with winged petiole, simple-lobed, and flowerheads in corymb, showing involucre with few bracts in several series and ligulate corollas.

No. 3. Hampion
(*Calepina Corvini*, L.)

a, Section of flower, showing ovary, 2-celled, corolla lobes, 5 spreading stamens, style, and 2-fid stigmas. *b*, Sessile toothed radical leaf. *c*, Panicle of flowers, showing 5-fid calyx, bell-shaped, erect, or patent 4-lobed corollas with 4 stamens and stigmas within in axils, with bracts.

No. 4. Wall Lettuce
(*Lactuca muralis*, Gaert.)

a, Ligulate floret, with corolla, with 5 stamens, 5 style arms, and 2 stigmas, and cypsela, with pappus. *b*, Capitate flowerhead, with involucre of imbricated bracts, and receptacle, with ligulate corollas. *c*, Stem-leaf, with auricled base, and sessile lobes. *d*, Radical leaf, with petiole, and lyrate lobes.

No. 5. Wall Speedwell
(*Veronica arvensis*, L.)

a, Corolla (top view), with alternate sepals rotate, with 4-fid limb, and 2 stamens exserted. *b*, Corolla (lateral view), showing epipetalous stamens. *c*, Capsule, with short style, enclosed in calyx. *d*, Plant, with ripe, branched stem, opposite, stalked lower leaves, upper sessile, flowers in axils of bracts in dense terminal raceme, some flowers with 2-valved capsules.

No. 6. Ivy-leaved Toad Flax
(*Linaria Cymbalaria*, Mill.)

a, Stamens, 5 only, short, with incurred filaments. *b*, Ovary, enclosed in calyx, opening by pores, with persistent style. *c*, Upper part of plant, with branches, long-stalked radicinary leaves, flowers in axillary racemes with bracts long-stalked, showing peloriate, spurred corolla.

1. Mouse-ear Hawkweed (*Hieracium Pilosella*, L.). 2. Wall Lettuce (*Lactuca muralis*, Gaertn.). 3. Rampion (*Campanula Rapunculus*, L.). 4. Ivy-leaved Toad Flax (*Linaria Cymbalaria*, Mill.). 5. Wall Speedwell (*Veronica arvensis*, L.).

This wild flower has no real aerial stem, the flowering stems being scapes. It is stoloniferous, and except for the scapes prostrate or decumbent. The leaves are stalked, entire, egg-shaped, downy beneath, dark-green, rough, hairy both sides, the offsets branching out from the centre of the leaves and creeping, leafy and stiffly hairy, or with a felt of long stiff hairs, and stellately downy below. In dry weather the leaf rolls up, the downy under side being uppermost.

The flowerheads are pale or sulphur-yellow, the outer ones purple below, the petals fringed and reddish-flecked. The phyllaries are unequal and imbricating. The scapes are one-flowered.

Photo. Flatters & Garnett

MOUSE-EAR HAWKWEED (*Hieracium Pilosella*, L.)

The plant is rarely more than 6 in. high (the scapes). It is in flower from May to July and even later. It is a perennial propagated by division, and worth cultivating.

The flowers open in fine weather between 7 and 8. The capitulum is made up of 42–64 florets, which increase in size centrifugally. The tube is 3–6 mm., and the limb 4–8 mm. The capitulum opens in the sun and measures 20 mm., and being bright lemon-yellow is, though small, conspicuous and attractive to insects. When it is wet the petals close up. Insects' visits are not so abundant, and by means of the involution of the stigmas the plant is self-fertilized. It is visited by *Panurgus*, *Andrena*, *Halictus*, *Ceratina*, *Diphysis*, *Nomada*, *Cephus*, *Bombylius*, *Helophilus*, Hollyblue (*Cyaniris argiolus*), The Mother Shipton (*Pieris brassicæ*), Large White Butterfly (*Euclidia mi*); Coleoptera, *Leptura livida*, *Cryptocephalus*.

The pappus is slender, but assists in the dispersal of the fruits by the wind.

Mouse-ear Hawkweed is a rock plant, and is addicted to a sand

soil when it is a sand-loving plant, or a lime soil and is a lime-loving plant.

The plant is common on the Marlstone and Oolitic rocks.

A cluster-cup fungus *Puccinia hieracii* attacks the leaves, and it is galled by *Cecidomyia pilosella.*

Several beetles feed on Hieracia, e.g. *Olibrus liquidus, Meligethes umbrosus, M. exilis, Psilothrix nobilis, Cryptocephalus aureolus, C. hypocharidis*; two Hymenoptera, *Prosopis masoni, Andrena angustior*; Lepidoptera, *Pterophora parvidactylus, P. pilosellæ,* Broad-barred White (*Hecatera serena*), *Melitæa cinxia,* Six-spotted Burnet (*Zygæna filipendulæ*); a Heteropterous insect, *Hoplomachus thunbergii*; and a fly, *Pephritis ruralis* also feed on it.

Hieracium, Dioscorides, is from the Greek *hierax,* hawk, because birds of prey were said to improve their sight by its means. *Pilosella,* Mathiolus, is a diminutive of *pilosus,* hairy.

This pretty plant has been named Erswort, Fellon-herb, Ling Gowlands, Mouse Ear. The name Spear Hawk is like Hawkweed, of which Gerarde says: "These herbes tooke their name from a Hawke, for they are reported to cleere their sight by conveying the juice heere of into their eies". (See *ante.*) Another name for it is Devil's Bit. The plant is astringent and was used medicinally in former days.

Essential Specific Characters:—

179. *Hieracium Pilosella,* L.—Stoloniferous, creeping, leaves hairy, entire, scape 1-flowered, leafless, flowerheads yellow or lemon, fruit striate, pappus hairs equal, styles yellow.

Wall Lettuce (Lactuca muralis, Gaertn.)

There is no trace of Wall Lettuce in ancient deposits. It is found in the North Temperate Zone in Europe and Western Asia. In Great Britain it is found in the Peninsula, Channel, Anglia provinces, except in Bedford, and Hunts in the Severn province; in S. Wales, except in Radnor; in N. Wales, except in Merioneth and Montgomery; in the Trent province; in the Mersey province, except in Mid Lancs; the Humber and Tyne provinces, except in Cheviotland; the Lakes province, except in the Isle of Man; in Scotland, in Ayr, E. and W. Perth, Easterness, Westerness, Argyle. In England it is rare, ascending to 1300 ft. in Yorks. It occurs in Wicklow and Louth in Ireland.

Wall Lettuce, as implied by the name, is a mural species which

grows on walls and rock ledges. It is found in the crevices of perpendicular faces of damp rocks in woods, well sheltered by overhanging trees or vegetation, or on stony banks. It has an erect stem, with peculiarly delicate leaves, with lobes larger upwards, runcinate, with lobes each side of a common stalk, with a channelled leaf-stalk clasping the stem, with angles and fine teeth, the terminal lobe the largest, five-angled. The keel is smooth.

The flowerheads are pale-yellow, and very small, having only 5 florets growing in erect panicles, which are spreading. The beak of the fruit is shorter than the fruit.

The plant is about 2 ft. high. It is in bloom in July. Perennial it can be propagated by division, and is really worth growing in a garden.

The flowerheads are yellow, rather small and distant, and the plant grows in the shade, and is little likely to be visited very largely by insects. The florets are few and hermaphrodite. The stamens are hair-like and short, and the anthers, which are yellow, form a cylinder. The style, longer than the stamens, is thread-like, with a stigma with 2 lobes, which is turned back. Thus the structure is quite like that in most Composites, but self-pollination is more likely to occur.

Photo. J. H. Crabtree

WALL LETTUCE (*Lactuca muralis*, Gaertn.)

The silky, simple, white pappus is light, and the achenes are dispersed by the wind.

Wall Lettuce is a rock plant growing on rock soil. The type of rock varies, but is largely sandy, and not usually calcareous. Thus it grows on Precambrian slate and on arenaceous marlstone of the Middle Lias.

The plant is infested by a fungus, *Puccinia prenanthis*.

Photo. H. Irving

RAMPION (*Campanula Rapunculus*, L.)

Lactuca, Pliny, is from *lac*, milk, in allusion to the milky juice it secretes. Wall Lettuce is the only name by which it is known.

The eagle was said to pluck the Wild Lettuce, with the juice of which it smeared its eyes.

ESSENTIAL SPECIFIC CHARACTERS:—

183. *Lactuca muralis*, Gaertn. — Stem slender, branched, smooth, leaves lyrate, dentate, terminal lobe larger, 3-angular, panicle diffuse, flowerheads yellow, 5 florets, equal, fruit black, compressed beak shorter, pappus pilose.

Rampion (Campanula Rapunculus, L.)

This plant is known entirely from its distribution at the present day in the North Temperate Zone, where it ranges from Denmark southward (except in Greece), in Europe generally, N. Africa, W. Siberia. In Great Britain, Rampion is hardly native in every county in which it is found, but it occurs in W. Cornwall, S. Somerset, N. Hants, W. Sussex, the Thames except in East Kent, Oxford, E. Suffolk, Norfolk, Cambridge, Northampton, Hereford, Worcester, Warwick, Stafford, Carnarvon, Denbigh, Anglesea, Notts, S.E. Yorks,

N. and E. Yorks, S.W. Yorks, Durham, Fife, Kinross. It is doubtfully wild.

Rampion is found on gravelly pastures, on roadsides, and along hedge-banks, especially in the south of England. While not confined to chalky districts it is more common in such areas.

The name Rampion and the second Latin name (from *rapum*, turnip) refers to the character of the root. The stem is simple or branched, tough. The leaves are stalkless, smooth or hairy, wavy, the radical leaves lance-shaped, oval, scalloped, having a narrow leaf-stalk.

The small pale-blue flowers are in an erect, long, terminal raceme, or clustered panicle, which is narrowed, with awl-shaped calyx segments which are entire. The capsules are erect, stalked. Pores occur just below the calyx segments.

The stem is 3 ft. high. The flowers are at their best in July and August. The plant is biennial, cultivated for the roots. It is sown in the spring for autumn gathering.

The flower is similar to that of the Harebell, but is much larger, and the plant is more local. It is quite adapted to cross-pollination. A doubt as to its being native deprives it of some interest in this connection (but cf. Bluebell or Harebell).

The capsule is perforated at the top, and the seed is scattered by the wind.

Rampion is largely a sand-loving plant growing on sand soil, but it flourishes best on gravelly soil.

It is infested by the fungi *Pseudopeziza radians* and *Puccinia campanulæ*. A moth, The Shark (*Cucullia umbratica*), feeds upon it.

Rapunculus, Lonicerus, is from Latin *rapum*, turnip, a diminutive of it, from the shape of the roots.

This beautiful bell-flower is called Rampion and Ramps. By Gerarde it was called *Rapuntium paruum.*

The root was once eaten as a salad, and the plant cultivated. The root was eaten raw or boiled. In France and Italy it has been much cultivated. It may be eaten hot with sauce or cold with vinegar or pepper.

Essential Specific Characters:—

188. *Campanula Rapunculus*, L.—Stem tall, rough, angular, leaves crenate, radical leaves lanceolate, elliptic, stem-leaves linear-lanceolate, flowers pale-blue, erect, clustered, in a small panicle, calyx-segments 5, subulate.

Ivy-leaved Toad Flax (Linaria Cymbalaria, Mill.)

The comparatively recent introduction of this plant into the British Isles precludes its being ancient in this region. It is found to-day in the N. Temperate Zone from Holland southwards, except in Turkey. It was introduced into England from abroad to the Chelsea Botanic Gardens, whence it has spread all over the kingdom. As an alien its distribution is uncertain, but the plant is generally distributed.

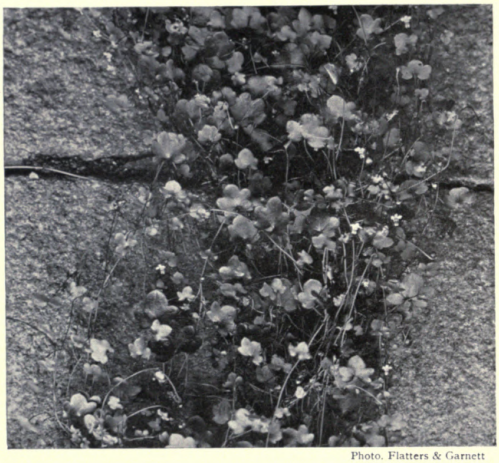


Photo. Flatters & Garnett

IVY-LEAVED TOAD FLAX (*Linaria Cymbalaria*, Mill.)

Ivy-leaved Toad Flax has now been introduced long enough to have established itself in many places. It is fond of growing on walls, especially garden walls or terraces. It hangs down from the interstices between the stones of church towers, and covers the sides of houses, often trailing over the ground but always near houses.

The root is thin and fibrous, with a knack of finding its way into the crevices of walls and other inaccessible places. The stem is very characteristic, being trailing, tufted, limp, purple and stringy, rooting at intervals. The leaves are ivy-shaped, round, on long terete leaf-stalks.

The flowers are light-blue, axillary, and solitary, on long, smooth flower-stalks. The lobes of the calyx are lance-shaped, and do not fall. The corolla is gaping, with a short tube, and yellow palate which closes the tube. The mouth is yellow and hairy. The nectary is purple, as long as the calyx. There are 4 anther-stalks, with white anthers. The capsule is globose, with black, ridged, wrinkled seeds.

The plant grows to a length of 2–3 ft., but is only some 3 in. high. It flowers in May right up till November. The plant is perennial, freely multiplying spontaneously by division of the root.

The stamens and pistil mature at the same time. The corolla-tube is spurred. There are four fertile stamens, one absent or abortive. The anthers are oblong. The stigma is notched. The flowers are often cleistogamic. It is visited only by bees. The palate nearly closes the throat and does not project. The nectary is purple and as long as the calyx. When in flower it pushes itself out into the light and sun, but when the seeds are mature it buries the capsules in the cracks between stones on which it grows, so that the seed is dispersed by an automatic psychic motion of the plant itself.

Ivy-leaved Toad Flax is a rock plant growing usually on an artificial rock soil or wall, being a modern introduction, not native.

Linaria, Tournefort, is from the flax-like foliage, *Linum*. The application of toad arose from the name *bubonium* being changed to *bufonium*. *Cymbalaria*, Mathiolus, is from the Latin *cymbalum*, cymbal.

This graceful plant is called Aaron's Beard, Climbing Sailor, Creeping Jenny, Ivy-wort, Mother of Millions, Mother of Thousands, Oxford Weed, Pedlar's Basket, Penny Wort, Rabbits, Rambling Sailor, Roving Jenny or Roving Sailor, Thousand Flower, Wandering Jew, Wandering Sailor. Parkinson's reason for calling it Ivywort is stated thus: "We may call it in English either Iviewort or the Ivie-like leaf as it is in the title".

It is eaten as a salad, being acrid or pungent like Cress, and it was endowed with antiscorbutic properties. It is a common garden flower planted on rockeries, &c.

Essential Specific Characters:—

227. *Linaria Cymbalaria*, Mill.—Stem long, trailing, purplish, leaves cordate, lobed, glabrous, flowers blue, axillary, on long peduncles.

Wall Speedwell (Veronica arvensis, L.)

A Southern plant, Wall Speedwell is found in the N. Temperate Zone in Europe, N. Africa, N. and W. Asia, Himalayas, and has been introduced into America. It is unknown in early deposits. This plant is found in all parts of Great Britain as far north as the Shetlands, and ascends to nearly 2000 ft. in Yorks. It is found in Ireland and the Channel Islands.

Wall Speedwell is an arenophilous plant, which grows on wall-tops, at the sides of paths, on sandy, open ground, as at the seaside, on gravel drives, and other dry habitats, being xerophilous. With it

grows Vernal Grass, Sandwort Spurrey, Rue-leaved Saxifrage, Mouse-ear Hawkweed, and other plants,

A small, erect, sometimes branched plant, Wall Speedwell has a rigid habit which marks it off from others of the group. It is a downy plant with the lower 5 leaves stalked, heart-shaped, purplish below, blunt, flat, notched. The upper leaves are stalkless and twisted. When it grows on walls the leaves at the base are purple. The hairs are jointed, and arranged on the lower part of the stem in two rows.

The numerous flowers are slightly stalked, in a spiked raceme, with

Photo. Dr. Somerville Hastings

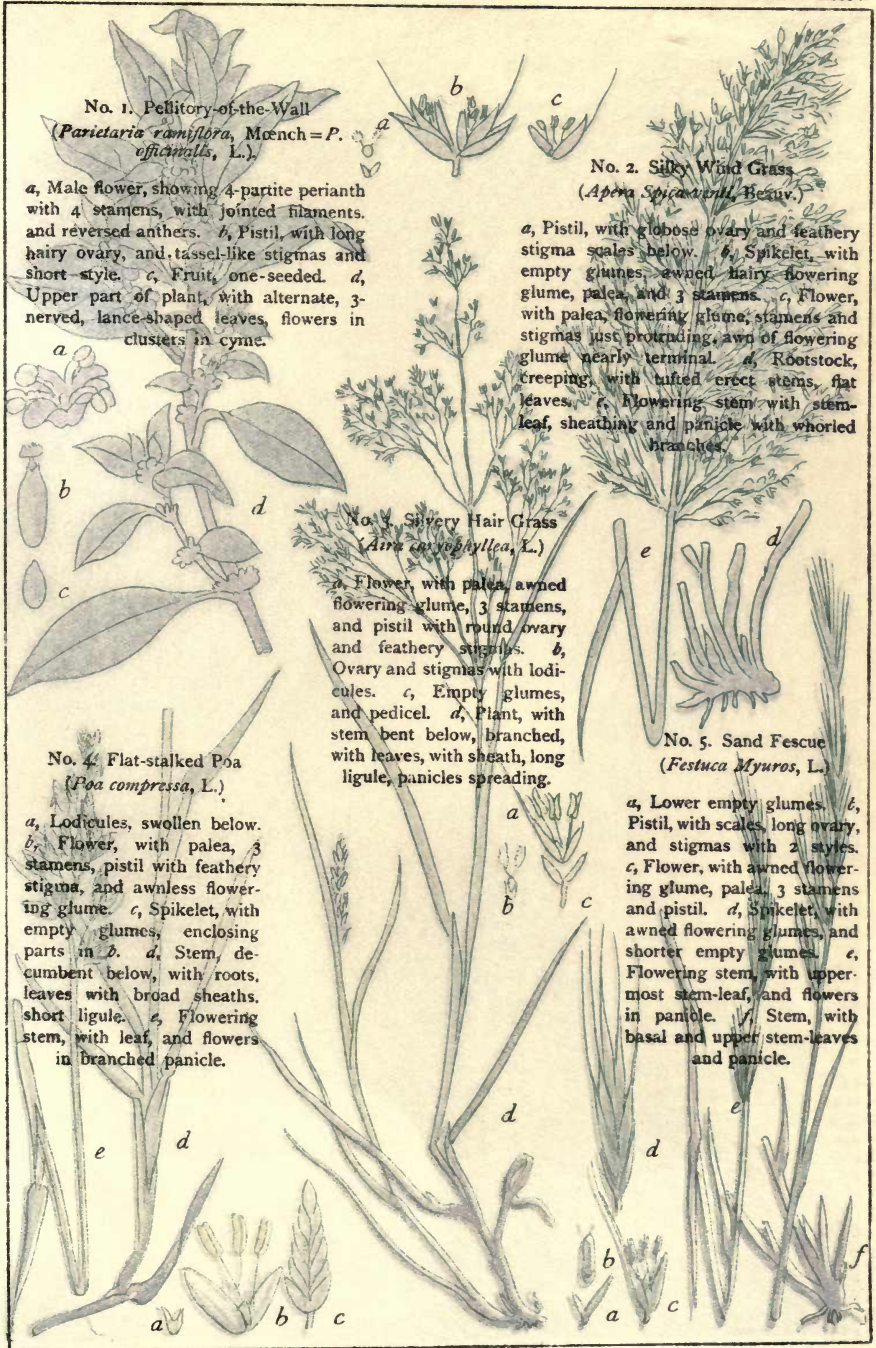
WALL SPEEDWELL (*Veronica arvensis*, L.)

long, linear bracts exceeding the flowers. The flowers are deep blue, and fall at the least touch. The calyx has lance-shaped sepals, oval, hairy, covered with glands; the corolla is wheel-like, with a short white tube. The limb is divided into 4 segments. The capsule is flat, inversely heart-shaped, pale-brown, and the seeds are oval, flattened at the border, with a depression down the middle.

The stem may be 3–9 in. high. The flowers open in April, and flowering continues till July. The plant is annual, propagated by seeds.

The floral mechanism is closely similar to that of *V. hederæfolia*, but the corolla is very small and pale-blue with a white eye. The style is very short, and the flowers are in a terminal raceme.

The capsule is winged, and dispersed by the wind, and the seeds, being flat, are also adapted for this.



No. 1. Pellitory-of-the-Wall
(*Parietaria ramiflora*, Mœnch = *P. officinalis*, L.).

a, Male flower, showing 4-partite perianth with 4 stamens, with jointed filaments, and reversed anthers. *b*, Pistil, with long hairy ovary, and tassel-like stigmas and short style. *c*, Fruit, one-seeded. *d*, Upper part of plant, with alternate, 3-nerved, lance-shaped leaves, flowers in clusters in cyme.

No. 2. Silky Wind Grass
(*Apera Spica-venti*, Beauv.)

a, Pistil, with globose ovary and feathery stigma scales below. *b*, Spikelet, with empty glumes, awned hairy flowering glume, palea, and 3 stamens. *c*, Flower, with palea, flowering glume, stamens and stigmas just protruding, awn of flowering glume nearly terminal. *d*, Rootstock, creeping, with tufted erect stems, flat leaves. *e*, Flowering stem with stem-leaf, sheathing and panicle with whorled branches.

No. 3. Silvery Hair Grass
(*Aira caryophyllea*, L.)

a, Flower, with palea, awned flowering glume, 3 stamens, and pistil with round ovary and feathery stigmas. *b*, Ovary and stigmas with lodicules. *c*, Empty glumes, and pedicel. *d*, Plant, with stem bent below, branched, with leaves, with sheath, long ligule, panicles spreading.

No. 4. Flat-stalked Poa
(*Poa compressa*, L.)

a, Lodicules, swollen below. *b*, Flower, with palea, 3 stamens, pistil with feathery stigma, and awnless flowering glume. *c*, Spikelet, with empty glumes, enclosing parts in *b*. *d*, Stem, decumbent below, with roots, leaves with broad sheaths, short ligule. *e*, Flowering stem, with leaf, and flowers in branched panicle.

No. 5. Sand Fescue
(*Festuca Myuros*, L.)

a, Lower empty glumes. *b*, Pistil, with scales, long ovary, and stigmas with 2 styles. *c*, Flower, with awned flowering glume, palea, 3 stamens and pistil. *d*, Spikelet, with awned flowering glumes, and shorter empty glumes. *e*, Flowering stem, with uppermost stem-leaf, and flowers in panicle. *f*, Stem, with basal and upper stem-leaves and panicle.

FLOWERS ON ROCKS, WALLS, ETC.

No. 1. Pellitory-of-the-Wall.
(Parietaria ramiflora, Moench = P. officinalis, L.)

a, Male flower, showing 4-partite perianth with 4 stamens, with jointed filaments, and reversed anthers. b, Fruit with long hairy ovary, and tassel-like stigmas and short style. c, Fruit, one seeded. d, Upper part of plant, with alternate, 3-nerved, lance-shaped leaves, flowers in clusters in cyme.

No. 2. Sea-Wind Grass.
(Agrostis pungens, Schrad.)

a, Pistil, with 2 loose ovary and feathery stigma scales below. b, Spikelet, with empty glumes, awned hairy flowering glume, palea, and 3 stamens. c, Flower, with palea, flowering glume, stamens and stigmas just protruding. d, Top of flowering plant, panicle. e, Rootstock, creeping, with matted root stems, flat leaves, and flowering stem with stem-leaf, sheathing and pointed with whorled

No. 3. Sand Fescue.
(Festuca [Vulpia] myuros, L.)

a, Lower empty glumes. b, Pistil, with scales, long ovary and stigmas with 2 styles. c, Flower, with awned glume, palea, 3 stamens, and awnless flowering glume. d, Spikelet, with awned flowering glumes, and shorter empty glumes. e, Flowering stem, with upper most stem-leaf, and flowers in panicle. f, Stem, with basal and upper stem-leaves and panicle.

No. 4. Flat-stalked Pea.
(Pea complexa, L.)

a, Leaflet-tendrils, swollen below. b, Flower, with palea, 3 stamens, pistil with feathery stigma, and awnless flowering glume. c, Spikelet, with empty glumes enclosing pistil and stamens. d, Stem, dwarf, lower with broad sheaths, short ligule. e, Flowering stem, with leaf, and flowers in branched panicle.

1. Pellitory-of-the-Wall (*Parietaria ramiflora*, Mœnch). 2. Silky Wind Grass (*Apera Spica-venti*, Beauv.). 3. Silvery Hair Grass (*Aira caryophyllea*, L.). 4. Flat-stalked Poa (*Poa compressa*, L.). 5. Sand Fescue (*Festuca Myuros*, L.).

Wall Speedwell is strictly a sand-loving plant, growing on sand soil, on walls, and on gravel.

The second Latin name refers to a supposed preference for arable land, but this should be applied rather to *V. agrestis.*

The plant is called Corn Speedwell, which is equally a misnomer.

This species is distinguished from *V. agrestis* by its erect stem, nearly stalkless flowers, smaller seed capsules, forming a spike when ripe.

Essential Specific Characters:—

235. *Veronica arvensis*, L.—Stem erect, leaves cordate, crenate, lower petioled, upper bract-like, flowers in a terminal, lax, spiked raceme, pale-blue, tube of corolla short, capsule obcordate, seeds flat.

Pellitory-of-the-Wall (Parietaria ramiflora, Mœnch)

This is a rupestral plant, not found earlier than the present day, ranging in the N. Temperate Zone in Europe, N. Africa, and Western Asia. In Great Britain it is not found in the Isle of Man or the following Scottish counties: Dumfries, Kirkcudbright, Roxburgh, Linlithgow, and in the E. Highlands, not in Fife or S. Perth, Forfar, not in W. Highlands, N. Highlands, Northern Isles, except as an escape, but from Ross southward elsewhere. It is a native of Ireland and the Channel Islands.

Pellitory-of-the-Wall is fond of growing on old walls, such as those of ruins, or on walls generally. A favourite habitat is the tower of a church. It may be found also in hedge-banks, but it is largely rupestral. Clustering round the base of a tower in clumps the stems are numerous, erect, brittle, herbaceous, reddish, branched, downy, rounded, finely furrowed, with curled hairs, the branches alternate, spreading. The leaves are hairy, oblong, lance-shaped, with a long point each end, with transparent dots on slender leaf-stalks.

The flowers are in the axils of the leaves, small, bisexual, in an involucre of 3–6 lobes, and stiffly hairy and stalkless. The calyx is flat or bell-shaped, or tubular, hairy, erect. There is no corolla. The fruit is small and enclosed in the perianth, the seed being single.

Pellitory-of-the-Wall is 1–2 ft. high. Flowers may be found any time between July and September. This is a deciduous, herbaceous, perennial plant, propagated by division.

The flowers are generally proterogynous, and when so mainly hermaphrodite, or of three forms—complete, male, and female—the stamens develop after the stigma has protruded from the bud, and they explode as in the Nettle, when the stigma cannot be pollinated,

and the style has dropped. The flowers are anemophilous. The male flowers are like those of the Nettle, the female with a brush-like stigma and 4-lobed.

The fruits are small, and fall when ripe at once to the ground, or are blown away to a distance by the wind.

This is a rock plant, growing on rocks or walls, or arenophilous on a sand soil.

Two beetles, *Throscus carinifrons* and *T. elateroides*, and a moth, *Simæthis fabriciana*, feed on it.

Parietaria, Pliny, is from the Latin *paries*, a wall, from which came

Photo. Dr. Somerville Hastings

PELLITORY-OF-THE-WALL (*Parietaria ramiflora*, Mœnch)

perritory, the *r*'s being changed into *l*'s, and the old second Latin name *officinalis* refers to its use as a medicine; *ramiflora* refers to the flowers being on the stem or branches.

Pellitory-of-the-Wall is also called Billie Beatie, Hammerwort, Lichwort, Parietary, Peletir, Peniterry, Wallwort. As to the name Peniterry, we read of "a weed called locally at least, Peniterry, to which the suddenly terrified (schoolboy) idler might run in his need, grasping it hard and threateningly and repeating the following 'Words of Power':

> "'Peniterry, Peniterry, that grows by the wall,
> Save me from a whipping, or I pull you roots and all.'"

The name Lichwort was applied because "it grows neere to old wals

in the moist corners of churches and stone buildings", according to Gerarde. The plant was used in mediæval times for broken limbs and tightness of the chest. It was considered diuretic and used for dropsy. It was laid in corn in granaries to drive away weevils.

ESSENTIAL SPECIFIC CHARACTERS:—

280. *Parietaria ramiflora*, Mœnch. — Stem erect, pinkish, hairy, tufted, leaves lanceolate, elliptic, flowers green or red, in clusters in the axils, filaments elastic.

Silky Wind Grass (Apera Spica-venti, Beauv.)

This graceful but rare grass is found in the N. Temperate Zone in Europe, N. Africa, Siberia, but not in any early beds. In Great Britain it is found in W. Cornwall, N. Hants, W. Sussex, throughout the Thames province, Anglia, except in Hants and Northants in Salop, N. Lincoln, Derby, S.E. York, or from York to Kent, and Hants in S.E. England.

The Silky Wind Grass grows in the lowlands, in fields liable to inundation at no considerable distance from the sea. It is arenophilous, preferring a sandy habitat, and is a submaritime ericetal species. It is also common to rocky mural habitats in the same way as some other sand-loving grasses.

This is a tall, graceful, elegant plant, with a slender stem which is

Photo. H. Irving

SILKY WIND GRASS (*Apera Spica-venti*, Beauv.)

prostrate at the base, and then erect and tufted. The leaves are rough along the margin and below, flat, and either smooth or downy. The ligule is short and torn.

The flowers are in whorls, in a large spreading pyramidal panicle, which is both light (hence the Latin name since every wind sets it blowing) and graceful, with branches at right angles. The slender awn is long, being 3–4 times as long as the palea, which is surrounded by a tuft of hairs below, and silky, giving the plant the English name. The anthers are linear and oblong, and the glume is hairy.

Silky Wind Grass is 2–3 ft. high. The plant flowers in June and July, and is annual, propagated by seeds.

This graceful grass is bisexual and anemophilous. There are 3 stamens in the male flowers, and the anthers are linear. The styles are short and distinct, and as in other grasses the stigmas are feathery. The flowers open about 6 a.m.

The fruit, which is a caryopsis, is light and blown to a distance by the wind, or falls to the ground close to the parent plant.

This grass is a sand-loving plant growing on sand or loam.

Apera, Adanson, is from the Greek *aperos*, undivided, in allusion to the flowering glume; *Spica-venti*, Lobel, is Latin for spike of wind, because the panicle is constantly agitated by the wind.

Silky Wind Grass is also called Corn Grass and Windlestraws. Gerarde explains the second name thus: "Some in English, much agreeable to the Latine name, call these windle straws. Now I take this to be the grasse with which we in London do usually adorne our chimneys in summer time. And we commonly call the bundle of it handsomely made up for use by the name of Bents." Corn Grass he explains thus: "*Gramen segetale*, either of the likenes it hath with corne, or that it groweth among corne".

Essential Specific Characters:—

331. *Apera Spica-venti*, Beauv.—Stem tall, flowers in spreading panicle, slender, awn three times as long as the palea, with hairs on each side.

Silvery Hair Grass (Aira caryophyllea, L.)

This slender, graceful grass is found throughout the North Temperate Zone in Europe, N. Africa, and has been introduced into N. America. It is unknown in early plant beds. It is absent in Great Britain only in S.E. Yorks, and ranges as far as the Shetlands, up to 1400 ft., in the Highlands. It is native in Ireland and the Channel Islands.

The Silvery Hair Grass is a rupestral species, growing on rocky pastures or barren moorlands, being a xerophyte, and partly ericetal. With it one will find Harebells, Eyebright, and other lovers of dry soil.

It has a very loosely-rooted fibrous root. The stem is erect, terete, striate, with 2–3 joints, tufted, decumbent at the base, rough above. The leaves are bristle-like, short, blunt, rough, rigid, the edges involute and narrow. The ligule is long, rough, and striate, with a white membrane.

The flowers are in a panicle, which is widely branched, with single

Photo, A. R. Horwood

SILVERY HAIR GRASS (*Aira caryophyllea*, L.)

flower-stalks, and divided into three parts. The spikelets are small, egg-shaped, shining, rounded, purple below, the lower empty, egg-shaped, and longer than the flowering glume. The awn is longer than the glume, jointed, dorsal, twisted, originating from the middle of the palea, which is divided into two nearly to the base.

This grass is 6–8 in. high. The flower is in bloom in May, June, and July. It is annual, propagated by seed.

The flowers are anemophilous. There are 3 stamens, and the stigmas are feathery, as in other wind-fertilized flowers. The anther-stalks are capillary. The anthers are oblong and forked at each end. There are 2 styles. The fruit is light and attached to the glume and palea, and is blown away readily by the wind.

Silvery Hair Grass is a sand-loving plant and requires a sand soil.

The Butterfly, The Grayling (*Satyrus semele*), and two moths, The Slender Clouded Brindle (*Xylophasia scolopasina*), *Elachista eleochar-ella*, are found on it.

Aira, Theophrastus, from Greek *airo*, I destroy, was the name of a grass—probably Darnel—which was poisonous. The second Latin name is given in allusion to the scent of cloves, which makes it attractive to Lepidoptera. It is called Mouse-grass.

Essential Specific Characters:—

333. *Aira caryophyllea*, L.—Stem erect, leaves setaceous, short, narrow, sheaths rough below, panicle spreading, awn silvery, twisted.

Flat-stalked Poa (Poa compressa, L.)

This more or less local mural grass is found in the N. Temperate Zone in Europe, N. and W. Asia, and is possibly native in America, there being no trace of it in early plant beds. In Great Britain it does not grow in the Peninsular province in W. Cornwall, but throughout the Channel and Thames, Anglia, and Severn provinces, except in Stafford; in S. Wales, only in Carmarthen and Pembroke; in N. Wales, in Denbigh, Anglesea; in the Trent province; in the Mersey, not in Chester; throughout the Humber, Tyne, and Lakes provinces, except in the Isle of Man; and in the W. Lowlands, only in Renfrew and Lanark; in the E. Lowlands, only in Roxburgh, Berwick, Edinburgh; in the E. Highlands, in Fife and Forfar; in N. Highlands, in E. Ross. From Ross it ranges southward, but it is rare in Ireland and the Channel Islands.

The Flat-stalked Poa is not so common as some others, on account of its restricted habitat. It prefers a dry soil, and largely affects a mural habitat. Thus it grows commonly on walls with Vernal Grass, Mouse-ear Hawkweed, &c., and its natural habitat is a dry bank.

Slightly prostrate at the base, the stem is finally erect, oblique, flattened (hence the second Latin name), from a creeping rhizome which produces long soboles. The leaves are flat, rough or smooth. The upper leaf is longer than the sheath, with the upper knot near the middle of the stem. The ligule is short and blunt.

The flowers are in a secund (one-sided) branched panicle, which is narrowed. The spikelets have 5–7 flowers, and are oblong, egg-shaped, bluish-purple, with hyaline flowering glumes, with 3 hairy veins, and webbed, blunt, and smooth.

Flat-stalked Poa is 1–2 ft. high. The flowers are in bloom in June and July. The plant is perennial, propagated by division.

There are from two to many flowers in the spikelet. The lowest glumes are empty, the rest flowering. There are 3 stamens and 2 styles, which are short and terminal, and the stigmas are feathery. The flowers are anemophilous.

The fruits are enveloped in the glume, and may be partially wind-borne or fall to the ground.

This grass is a sand plant and addicted to a sand soil.

Poa, Theophrastus, is the Greek for grass, and the second Latin name refers to the contracted panicle. The plant is called Squitch Grass.

ESSENTIAL SPECIFIC CHARACTERS:—

338. *Poa compressa*, L.—Stem compressed, geniculate, leaves involute, panicle secund, ligule prominent, palea downy-veined.

Sand Fescue (Festuca Myuros, L.)

The distribution of Sand Fescue to-day is the N. Temperate Zone in Europe, and N. Africa, and it has been introduced into N. America. In Great Britain it is found in the Peninsula province, except in N. Devon; the Channel province, except in N. Hants; Thames, Anglia provinces, except in W. Suffolk; Severn province; in S. Wales, only in Glamorgan, Radnor, Carmarthen; in N. Wales, in Carnarvon, Denbigh, Anglesea;

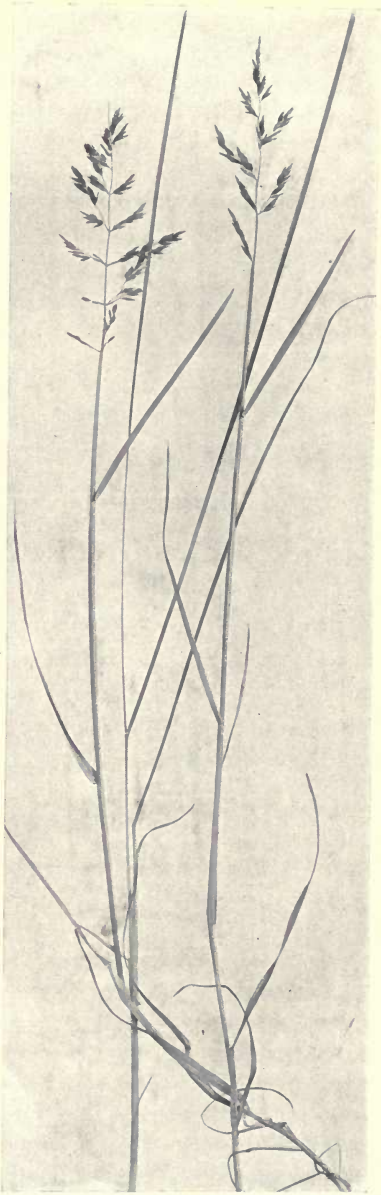


Photo. H. Irving.

FLAT-STALKED POA (*Poa compressa*, L.)

Photo. H. Irving

SAND FESCUE (*Festuca Myuros*, L.)

in the Trent province, in Lincs; in the Mersey province, only in Chester; in the Humber province, in N.E. and N.W. Yorks; and in the Lakes province, only in the Isle of Man. In Scotland it is only found in Dumfries and Kirkcudbright. It is a native in Mid and S. Ireland and the Channel Islands.

Sand Fescue is so essentially arenophilous that its distribution is limited to some inland and many maritime counties where sand is a dominant formation. It is found where Silky Wind Grass and Flat-stalked Poa are prevailing grasses.

The stems are slender, smooth, with many bristle-like leaves below, keeled, very short, with long upper sheaths, which are furrowed, rounded, smooth, and almost or more than reaching the panicle. The ligule is short, with round auricles or lobes.

The panicle is one-sided, nodding, elongate, interrupted, the lowest branch a quarter of the whole, and is either straight or wavy, glossy. The lower glume is one-third less than the upper. The spikelets have awns which are wedge-shaped when expanded. The awn is slender.

This plant is 12–18 in. in height. It flowers in June and July. Sand Fescue is annual, propagated by seeds.

The spikelets contain three or more flowers, there is 1 stamen, the terminal style is short, and the stigma is feathery. Here, again, the flower is anemophilous and proterogynous.

The long, light fruit is enclosed in the glume, and is admirably adapted for wind dispersal.

This is a sand plant, growing on sand soil and gravel.

Festuca, Dodonæus, is from the Latin *festuca*, which means a stalk, stem, or strand, and *Myuros* is from the Greek *mus*, a mouse.

Fescue is from the Celtic *fest*, food or pasturage. This grass is also called Capon's-tail Grass.

ESSENTIAL SPECIFIC CHARACTERS:—

340. *Festuca Myuros*, L.—Stem slender, tall, leaves setaceous, panicle long, unilateral, nodding, compressed, awn longer than the palea, terminal, slender, glumes unequal.

SOME GENERAL HINTS AND NOTES

SECTION X

FLOWERS OF THE BOGS AND MARSHES

Bogs and Moors.[1]—Bog and moor both owe their origin to the clearing of forests from regions which became waterlogged, and thus established conditions suitable for the formation of peat. A fen resembles a bog, but includes marsh, with lowland vegetation, and contains very little peat. In the case of bogs and moors the peat is thick. They are developed upon the higher parts of the hilly tracts in the north and west; but a bog is essentially a wetter type of formation than a moor. Moors occupy in fact more convex portions of highlands than the bog or fen, which have a concave basis, or lie in hollows.

The moor also is similar in some respects to a heath in being drier, and the peat is the subsoil for similar types of Ericaceous plants. But the subsoil of the moors does not, as in the case of heaths, affect the vegetation, the sand and gravel underlying a heath with thin peat or humus being confined to particular districts. The moor and the bog or fen then are characteristic of the more humid parts of the British Isles.

Local Character of Bogs and Moors.—Owing to the necessity for the development of peat on a large scale and the dependence on more or less moist conditions, bogs and moors are not widely dispersed in the British Isles; and indeed the plants which are characteristic of these types of formation are of very rare occurrence for the most part. This is partly due to the universal cultivation and drainage of the country after the cutting down of trees. But it is also due to more natural causes. These are the requirement of a considerable altitude, and the constant replenishment of the peat, which is normally developed only in regions of great rainfall.

[1] See also Section IX, where dry moors are treated with heaths. The two divisions overlap to some extent.

Bogs and moors are, in fact, confined to the lofty mountains or hilly regions which are based upon the distribution of the older rocks in this country. These are found for the most part in the west of England, in Wales, in the Lake District, and in Scotland generally. Yorkshire also is mainly composed of lofty hills, covered by moorland vegetation. In Ireland peat is widespread in the whole of the north-west, and along the western half of the country. Thus moorland and fen are developed in the regions of the greatest rainfall and altitude.

Marsh Plants and Aquatic Plants.—Since marshes are areas where plants are in various stages of submergence, it is not unnatural that they should show various degrees of connection with plants that are entirely submerged, or aquatic plants. Marsh vegetation and aquatic vegetation are, in fact, intimately connected. The former is often marginal to the latter, and the plants of the one are frequently common to the other; thus a river or lake with aquatic vegetation may give rise to a marsh at its edge. The difference again between marsh formations and fen or carr vegetation is less marked than the difference between the former and moorland vegetation, the alkaline nature of the water of the second resembling that of a marsh. Marsh vegetation may, on the other hand, become transitional to wet meadows by drainage. Marsh plants are also largely common to salt marshes where the conditions are suitable.

Peat and its Characteristics.—Peat is the result of the accumulation of vegetable matter in such a state that it has preserved its original character to a very great extent. It is relatively dry at the surface, and owing to oxidation browner, whilst below it is much wetter and black. The lowest layers may be amorphous, and exhibit no traces of the original

types of plants. Thus it is similar in character to coal, but much younger, and therefore physically different.

Peat is formed in stagnant water, and is charged with humous acids, which tend to preserve the constituent plants. There is very little foreign matter (3 per cent) in it.

Generally speaking there is upland peat and lowland peat, or hill peat and bog or marsh peat. The plants that respectively make up each layer, form distinctive types of peat, and from sections it is possible to determine the origin of the different peat beds, and to denote the changes in the flora.

Thus in the Lake District one may find the following succession, above lacustrine ooze and shell marl, viz.: amorphous peat; *Hypnum* peat, made up of moss stems; lower sedge and reed peat, with drifted tree stumps occasionally; upper sedge and reed peat; wood peat, with Birch; a mixed brown peat, with Cotton Grass, Sedges, and bog moss (*Sphagnum*); and finally an upper grey spongy *Sphagnum* peat.

Peat beds vary from a few feet to as much as 30 ft. or more. In Ireland peat is cut into turves and used for fuel, paper-making, &c.

Ancient Peat Deposits.—As a whole peat deposits are not older than the Glacial epoch, and a great proportion of them belong to the Recent or present period coeval with the formation of the alluvium of our modern rivers. But the upland peat formed upon the highlands of England and Scotland, as shown by F. J. Lewis, may be said to be older, or of Glacial age. Thus in Kirkcudbrightshire and Ayrshire the succession is as follows: Recent peat, chiefly with *Scirpus* and *Sphagnum*, an Upper Turbarian or Sixth Glacial stage, an Upper Forestian bed with *Pinus sylvestris*, then *Sphagnum*, then *Eriophorum*, Lower Turbarian or Fifth Glacial stage, Arctic Willow and *Empetrum*, then *Eriophorum*, followed by *Sphagnum*, a Lower Forestian bed with White Birch, and below Willow and Ling, the *Mecklenburgian* or Fourth Glacial stage with coarse sand and morainic material.

Thus forest beds alternate with peat beds. This is similar to the sequence of Pine, Oak, and Spruce in Sweden. The plants of the peat beds are arctic plants, and have travelled southward with the ice.

Lowland and Upland Moors.—Moors as a whole, being based upon a peat soil, are developed in regions that are humid, and it is natural that they occur most frequently in the uplands. But there are lowland moors also, which usually occur in association with estuaries or lakes, where they are formed above silt or alluvium or lacustrine mud. When there is much lime the first stage has been a bog.

The estuarine lowland moors are formed upon extensive beds of silt, as in North Lancashire, and are called Mosses, and occupied old filled-up upland valleys. Cotton Grasses, Tufted Bulrush, Ling, Cross-leaved Heath, Rosemary, Bog Mosses, Beak Sedge, Cranberry, Bog Asphodel, and Sundews are characteristic of these estuarine moors. In the lacustrine moors there are in the peat successive layers with Bog Mosses, Cotton Grasses, Prickly Twig Rush, Reed, Birch, Ling, &c. The valley moors of the New Forest show Bog Moss, Purple Moor Grass, Reed Swamp associations, and Alder thickets.

The upland moors lie on the slope of the hills, e.g. Pennines, between 1000 and 2000 ft., and in Scotland are found up to 3000 ft. They are distinctly drier, and trees are absent as in the original condition. The following associations occur: Bog Moss, Cotton Grass (1200–2200 ft.), Tufted Bulrush (1250–2000 ft.), Bilberry Moor (up to 3000 ft. in Scotland), Heather Moor (700 ft. or 1000 ft. to 2200 ft.). Elsewhere Rush societies and others of stagnant hollows occur. Grass Moor takes the place of these associations in some parts of Scotland.

Lowland and Upland Bogs.—As there are lowland and upland moors, so there are lowland and upland bogs or tracts of fen. But the greater portion of the fen formation, which is made up of fen and carr (or wooded fen), is lowland, being developed chiefly in East Anglia. There the fen is very little above sea-level along the coast, and in fact may be continuous with salt marshes at the margin.

The plants that are most distinctive of the fen are Grasses and Sedges, such as Reed, Prickly Twig Rush, and *Juncus obtusiflorus*; Purple Moor Grass also occurs on a wide scale, and *Sphagnum* and Cotton Grass, whilst other plants are Sweet Gale, Bog Orchis, Sundew, Winter Green, and elsewhere *Glyceria aquatica*, Reed Grass, Rough Meadow Grass, Ragged Robin, &c.

Fen associations pass into moorland, and where the peat rises above alkaline waters, moor with acid water may occur. The upland fen tracts are probably akin to lowland moors, and consist of Cotton Grass, Sedges, Rushes, &c., with Ragged Robin, *Œnanthe Lachenalii*, *Orchis incarnata*, *Scirpus rufus*, &c. These have been so far little investigated, and a field lies open for their special study.

Xerophytic Types.—The submerged parts of bog and marsh plants are exposed to the same conditions as aquatic plants, but the water in which they grow is deficient in some salts, especially nitrates, though rich in lime. Their

aerial parts above water are also exposed to drought, and the bog plants have xerophilous adaptations, absorption of water being difficult.

Marsh plants are similarly protected and enabled to withstand drought, though less liable to alternations of wet and dry conditions than bog plants. Moorland plants show the most marked contrivances for resisting drought, and the vegetation is almost entirely xerophytic.

Vestiges.—Many causes have contributed to the disappearance of the wet-soil types of vegetation such as bogs and marshes. The moorlands, which are drier, and situated mainly above the zone of cultivation, have, however, largely escaped, and they are probably of far greater extent than the bog or fen type and marshes.

The fen type, since it is largely lowland, and developed upon soil which is valuable for agricultural purposes, has been most largely affected. But in spite of this there is a good deal of country in the original state of the Fens.

Bogs, lowland or upland, however, have been greatly reduced in extent. The lowland types now only survive in an altered condition, having by artificial agency been transformed into marsh or wet meadow. In some cases they are to be discovered only by a careful survey of the country yard by yard, or field by field. The same applies also in a great measure to heaths and similar vegetation developed upon peat or ground with stagnant water, liable to be removed. When wet peat is drained it may become a moor, or a wet or dry meadow or grass heath.

We have ventured to call such traces of former bog or heath "vestiges", since they are now merely an indication of natural vegetation almost obliterated. Marshes are similarly liable to become lost or completely altered by kindred causes.

Drainage and its Effects.—For agricultural purposes a soil must be drained of superfluous moisture. Hence practically all land below the altitude of 1000 ft. has been subjected to repeated drainage, after tree-felling, followed by cultivation and the enclosure of land.

All the causes at work too, in diminishing rare plants, accentuate this effect of drainage. The Fens are an illustration of the extent to which drainage has gone on within the last two centuries. All the tract from Peterborough and parts of Lincoln to Bedford and Huntingdon, and most of East Anglia, has undergone the most radical alteration. Where the Bittern boomed and the Ruff once bred, will be found acres and acres of potato fields. The reed swamps are gone, and so too is the marsh and bog vegetation.

The Lowland Character of Marshes.—The marsh plants as a whole are of Arctic origin, a large proportion of them being of northern type. They are ascending species, which, owing to the milder conditions since the Glacial epoch, have gradually tended to reach a higher altitude more suited to their primitive or original requirements.

The marsh flora in its unaltered phase demands a lowland habitat, where water of a stagnant character may rise to a certain level, so that the plants may be more or less submerged. The water is, however, not as in aquatic vegetation able to circulate freely. The marsh vegetation is thus largely above the river level, and may rest upon a certain amount of peat.

Tree Associations of Marshes.—That the marsh vegetation is a more or less natural formation is shown by the usual occurrence of a certain tree association, which gives it a distinctive character. The tree flora of the moors is deficient in this country, and only the Pine and Birch are found at high altitudes in peaty soils. In a marsh formation the Alder is usually the dominant tree. The fen or fen carr is also made up of Weeping Willow and Sweet Gale forming a scrub, which merges into an Alder and Willow wood; Ash, the pedunculate Oak, the hoary and black Poplars, and the small-leaved Elm also occur frequently.

The shrubs forming the scrub layer are made up of the smaller Willows, Guelder Rose, Birch, Field Maple, Hawthorn, Sloe, Elder, Gooseberry, Currant, and Brambles and Roses, with such climbers as Honeysuckle and Ivy.

But trees may be absent, in which case marsh approaches the bog formation more closely.

Marshes and Wet Meadows.—The margin of a marsh usually shows the wet-meadow type of vegetation that results when marshes are drained. The characteristic tree association may remain to some extent, and Alders and Willows are often found bordering streams and rivers, or growing in hedges with deep or wide ditches, flanked by meadows, which have lost their most characteristic herbaceous marsh flora.

There may be in such wet meadows relics of the former marsh flora, denoted by the general distribution of Marsh Marigold, Lady's Smock (*Cardamine amara*), Ragged Robin, Great Water Stitchwort, Meadow Sweet, Golden Saxifrage, Marsh Willow Herb, Marsh Bedstraw, Valerian, Marsh Thistle, Money-

wort, Scorpion Grass, Water Figwort, Skullcap, Marsh Woundwort, Great Water Dock, Marsh Orchid, Yellow Flag, Hummock Sedge, Tussock Grass (*Catabrosa aquatica*), Manna Grass, Horsetail, &c.

Wet and Submerged Character of Marshes.—Marsh vegetation is distinctly hygrophilous, or made up of plants that require a considerable amount of moisture; in the marsh the soil is saturated with water, but owing to the close association of the plants and the absence of channels, the water is stagnant, and peat is formed on a small scale.

Relatively the same conditions are thus obtained by the marsh plants in the lowlands that are seized upon by bog or moorland plants in the uplands. But there is an essential difference in the resulting soil conditions or water content. In the marsh the soil may be peat or silt, the water if rich in mineral salts is alkaline. In the bog the water is also alkaline, but more so, and the peat thick, and in the moor the water is acid, whilst the water is derived from aerial sources.

A marsh is an aquatic formation of a closed character in which there is not a free circulation of water. In aquatic vegetation the plants are submerged beneath the water-table, and as a rule 80 per cent of their surface is covered. In a marsh the percentage may be between 5 and 20 per cent.

Habitats of Bog and Marsh Plants.—A common characteristic of both bog and marsh plants is the moist nature of the habitat. The flora of a bog is exposed to wind and insolation, and sunshine for long periods, and it shows adaptation to these conditions. Little shade is afforded for the bog plants, except by the few shrubby types for the smaller plants, e.g. trailers.

The bog or fen vegetation may be extensive, and afford habitats for a number of different plants; or consist of a few plants, as Cotton Grass, making up a wide association.

Trees and scrub are much more frequent in a marsh than in an upland bog, and the marsh flora in any case exhibits a greater diversity as it merges into aquatic vegetation, which is very diversified.

The Habits of Bog and Marsh Plants.—Bog plants as a whole are strikingly homogeneous in their habit of growth. The dominant habit is the grass habit, as in the case of the Sedges, Cotton Grass, &c. But the rosette habit is also not uncommon, as in Butterwort, Grass of Parnassus, &c. The trailing habit is met with in the case of the Bog Pimpernel, common also to the marsh flora. The shrub habit is found in the case of Cranberry, Wild Rosemary, and Bog Myrtle. In all cases there is a marked reduction in leaf and stem owing to the xerophytic adaptations which the bog plants have acquired.

The marsh flora is more or less similar in general characteristics to the bog flora, as far as the dominance of the grass type is concerned, but contains numerous other types less usual in the bog flora.

Some plants are procumbent types, such as the Bog Bean. Non-glumaceous plants adopt the grass habit when associated with Grasses, e.g. Bog Speedwell, Bog Asphodel, and Great and Lesser Spearworts. The inversely pyramidal habit is found in Marsh Marigold and Marsh Lousewort.

Height of Bog and Marsh Plants. — Bog plants are perpetually exposed to wind, and are as a whole not tall. The development of the grass habit, in fact, establishes a more or less uniform height, which is from 9 in. to 1 ft. or 18 in. The necessity for adaptation to dry conditions also prevents upward growth.

The marsh flora containing tree types consists of much loftier types, and again, wind is less influential in a marsh than in an upland bog. The marsh flora is altogether less subject to dry conditions, hence the ground flora is more luxuriant, and the plants are generally more robust.

The Flowering Seasons of Bog and Marsh Plants.—As might be expected in the case of plants which flourish only where there is some degree of moisture, the flowering seasons of bog and marsh plants are as a whole rather late.

The earliest plant to flower amongst those especially selected for description is the Marsh Marigold, which blooms in March. The White Willow comes next, and flowers with others in April.

In May, Valerian, Rosemary, Butterwort, Bog Myrtle, Cotton Grass, and Great Prickly Sedge, with other Sedges, commence to bloom.

The plants that flower for the first time in June are Great Spearwort, Cranberry, Bog Speedwell, Marsh Red Rattle, Bladderwort, Jointed Rush, and Hummock Sedge.

When July opens, a number of others just commence to flower, and but few plants linger till August and September before they bloom, such as Sundew, Water Violet, Bog Bean, Golden Dock, Marsh Helleborine, Bog Asphodel, Galingale, Common Spike Rush, Prickly Twig Rush, Bog Pimpernel, and Grass of Parnassus.

The Duration of Bog and Marsh Plants.—Bog and marsh plants are amongst the most truly native of our wild plants. The vegetation they make up is essentially primitive, derived very largely from arctic or northern

regions, where few or no annual plants are known. As has been seen the period of flowering is indeed very late, and the interval between this period and winter is relatively very short; the uniformly perennial character of bog and marsh vegetation is therefore a natural characteristic. A few, as Cranberry, Rosemary, Bog Myrtle, are shrubs, and the Alder and the Willows are trees. The only annual is Marsh Lousewort, a hemi-parasite on Grass roots.

The Pollination of Bog and Marsh Plants.—As might naturally be expected in the case of habitats so essentially moist as bogs and marshes, insects that get their livelihood in the imago stage are not conspicuously abundant. None the less many bog- and marsh-plants rely upon insect agency for effective crossing.

Such are Great Spearwort, Marsh Marigold, Grass of Parnassus, the Sundew, Water Dropwort, Valerian, Cranberry, Rosemary, Water Violet, Bog Bean, Bog Speedwell, Marsh Red Rattle, Bladderwort, Butterwort, Marsh Helleborine, Bog Asphodel; the Bog Pimpernel, which grows almost covered up by other plants, making it difficult to discover it, is normally self-pollinated.

Golden Dock and Bog Myrtle are pollinated by the agency of the wind, as are all the Rush, Sedge, and Grass types that occur.

The Dispersal of Seeds of Bog and Marsh Plants.—The uniformity of the bogs and marshes as a whole is a factor in the mode of dispersal of the seeds, the wind playing an important part generally.

The Great Spearwort, Sundew, Bog Pimpernel, Marsh Red Rattle (in part), Butterwort, Jointed Rush, Galingale, Common Spike Rush, Great Prickly Twig Rush, Hummock Sedge, Great Prickly Sedge rely upon their own special mechanisms for the dispersal of the seeds at no great distance from the plant.

Animals, especially birds, disperse the berries of the Cranberry and the Bog Myrtle. Water is responsible for the dispersal of the seeds of the Water Violet and the Bladderwort.

The Fungal Pests of Bogs and Marshes.—As has been noted elsewhere, a damp habitat is not, as a whole, conducive to attack by fungi. There are some few paludal types of fungi, but they are not of frequent occurrence; and though moulds attack the tissues of plants in moist situations, when they have been already subjected to adverse conditions, plants in a healthy state are not usually infected. The fungi that infest bog and marsh plants belong chiefly to the smaller parasitic types, mainly rusts, smuts, mildews, and moulds.

Methods of Survey.—In some respects the bog and marsh are difficult to study on a systematic plan; for the peaty soil and wet conditions render both inaccessible for a large part of the year, and the vegetation is so close and tall, that anything like the detailed survey recommended for meadows, woods, the cornfield, coast, &c., is rendered difficult. But the frequent arrangement of the plants in wide associations is a feature which renders the survey less formidable than at first appears.

Attention ought to be paid especially to the soil, depth of peat, nature of the water, &c., and these conditions should be correlated with the adaptations of the plants to xeromorphic conditions. Otherwise surveys may be made as in the case of a meadow.

In the marsh the tree associations may be noted first, and then the scrub. The dominant types and larger associations should be mapped out on a broad basis.

SECTION XI

FLOWERS OF THE HEATHS AND MOORS

Heaths and Moors.—In Section VIII some remarks have been made as to the similar character of Bogs, Heaths, and Moors, and the natural passage of one of them into the others has been pointed out in Sections I–III and V–VIII. Heaths in the usual sense are lowland, and drier than moors, and are usually developed upon a sandy or gravelly soil. Even in the uplands a heath only merges into moorland vegetation where the surface forms hollows and thick peat accumulates. A moor requires no surface soil of a particular character, but it does demand a certain sort of water, acid in character.

The peat of a heath is also acid, but relatively dry. Occasionally there is a thick impervious layer of sand and gravel (moor pan), which is cemented together by mineral solutions derived from the peaty soil. In the case of a wet heath there is a deeper layer of peat,

often associated with a bog, where there is a resemblance to the moor formation. On the other hand, heathland, as will be seen, often passes into grassland.

Dry and Wet Heaths.—Though heaths, as a rule, are dry compared with moors or bogs, they vary sufficiently to cause a difference in the flora according as they are dry or wet, relatively speaking.

On the typically dry acid peaty soil, in the lowlands of England especially, the dry heath is characterized by the predominance of the Heather or Ling, Bell Heather, and in some parts by Cross-leaved Heath and Cornish Heath. The Whortleberry is also a common constituent. These plants form wide associations, and make up a large proportion of the vegetation altogether. But with them may also be found Milkwort, Pretty St. John's Wort, Purging Flax, Broom, Furze, Tormentil, Heath Bedstraw, Saw Wort, Harebell, Dodder, Red Rattle, Eyebright, Cow Wheat, Wood Sage, Juniper, various Sedges (e.g. Early Sedge), Bent Grasses, Matweed, Purple Hair Grass, &c.

The wet heath developed in hollows, where water lies, may closely resemble the moor, and the peat is then usually thicker. In such places may be found Marsh Violet, Sundew, Cranberry, Ling, Cross-leaved Heath, Butterwort, Lesser Skullcap, Gentian, Creeping Willow, Sweet Gale, Bog Orchid, Heath Rush, Spike Rushes, Bulrush, Cotton Grass, Beak Sedge, Flea Sedge, Purple Hair Grass, Matweed, Royal Fern, Club Moss, and Bog Mosses.

Ericaceous Plants and Heaths.—One of the chief characteristics of the heath is the predominance of the plant which gives its name to this type of formation. Such plants as Ling, Bell Heather, Cross-leaved Heath, Ciliate Heath, Cornish Heath, Mediterranean Heath, all have the characteristic Heath habit. They are all adapted to resist the effects of drought, to which heaths, especially on stony or gravelly soils, are much subject.

In some cases Ling itself is the principal plant; on damper soils the Cross-leaved Heath may take its place, or the Whortleberry, which is also adapted to dry-soil conditions. The dominance of the Heath plants excludes all but a few plants that in the main have the grass habit, and so can exist side by side with the Heaths, and maintain their struggle successfully where others would be crowded out. Where there are a good number of other species present, the heath merges into a grass heath. One reason for the dominance of the heath plants is the periodic burning of Ling and Heath each spring to encourage the growth of new shoots, largely done where grouse are preserved. This destroys the other plants. A few, however, recover, even before the Ling, as Whortleberry, Sheep's Fescue, Matweed, Cotton Grass, &c.

Distribution of Heaths.—The heaths of the British Islands occupy certain well-defined areas, where there is a considerable rainfall, on more or less sandy or gravelly soils. Thus they occur in the south and west of England, and in Scotland, and in the Midlands, and elsewhere on a lesser scale. The rainfall in Scotland, which may amount to 40 or more inches of rain annually, exceeds that in the English areas named by at least 15 in.

The heaths of the Eastern Counties have not more than 25 in. of rain per annum, and peat is not formed to any great extent. In the south of England it is much less. In Norfolk and Suffolk the Ling-covered areas may be transitional to grass heath, and also develop the flora of the chalk pasture.

In the Cornish area the Cornish Heath, Dwarf Furze, Ciliate Heath are characteristic. In the Midlands the heaths are ill developed. Yorkshire has great regions of heather, called moors. There is 35 in. of rain per annum, and both wet and dry heaths occur.

Degenerate Woods and Heaths.—From the frequent association of certain tree associations with heaths, it is probable that in some cases, at any rate, the heath is a degenerate type of woodland, as where Oak, Birch, and Pine occur, and form a scrub with heath plants. But in many cases, especially on coarse sandstones and sands, the heath was itself originally developed.

In any case, when a heath occurs it transforms the soil characteristics, for a layer of peat is formed, which at once affords a home for certain types of plants, and excludes others that cannot grow in humus. It has been found on the Continent that the cause of the degeneration of woodland into heath is due to the leaching out of the sand from the soil. It is probable that in the same way the leaching out of humus from a soil originally rich in this has been responsible for the disappearance from certain districts of such humus-loving plants as Dog's Mercury and Lords and Ladies. In place of the mild humus of a woodland required by such plants, an acid humus is formed suitable for heath types. The consolidation of sandy, gravelly soil by humus acids similarly affects the growth of trees, and renders the persistence of woodland impossible and the formation of heaths possible.

Grass Heath.—Where the soil is sandy there are frequently wide tracts of uniform so-called

heath which are made up of a characteristic type of vegetation. They are more or less ancient pastures that have not, owing to the sandy, rather sterile nature of the soil, been cultivated or turned into arable land. Consequently they are distinguishable from ordinary pasture or meadow.

Though typical heath plants are found upon the grass heath, they may be entirely absent. As the name denotes, this type of association is largely characterized by the predominance of Grasses. The following plants are also typical of the grass heath: Climbing Fumitory, Whitlow Grass, Teesdale's Cress, Dog Violet, Milkwort, Field Chickweed, Sand Spurrey, Pearlwort, Grassy Stitchwort, Pretty St. John's Wort, Perforate St. John's Wort, Purging Flax, Jagged-leaved Crane's Bill, Stork's Bill, Furze, Broom, Creeping Rest-harrow, Subterranean Trefoil, Hare's Foot Trefoil, Bird's Foot, Narrow-leaved Vetch, Silvery-leaved Tormentil, Parsley Piert, Burnet Saxifrage, Ladies' Bedstraw, Heath Bedstraw, Least Cudweed, Heath Ragwort, Hawkweeds, Autumnal Hawkbit, Carline Thistle, Sheep's Bit Scabious, Harebell, Ling, Bell Heather, Centaury, Dwarf Forget-me-not, Eyebright, Wood Sage, Wild Thyme, Knawel, Sheep's Sorrel, Field Spike Rush, Vernal Grass, Bent Grass, Sheep's Fescue, &c.

Vestiges of Heaths.—Indications of heath or grass heath are occasionally to be found amidst meadow and pasture of a less special type, or purely neutral grassland. It may be that the one has invaded or obliterated the other owing to induced or artificial conditions. This is an interesting problem for the pupil, and will show how one type of formation may influence another.

The flowering plants that may be found as vestiges of former heathland or grass heath are more likely to be discovered, and are easier to distinguish than cryptogams. Such vestiges may, however, as in the case of bogs, be indicated by the occurrence of certain ericetal mosses or other cryptogams that are perhaps the only indication that is left of the former occurrence of a heath flora.

Furze itself, may in some cases indicate heath conditions, especially when associated with Grassy Stitchwort, Heath Bedstraw, Water Pepper, Procumbent St. John's Wort, *Sieglingia decumbens*, &c.

Commonland, Furze, and Heaths.—A feature that may be pointed out in studying the conditions of heath vegetation is the association of commonland with a certain type of soil which is suitable for the latter, and which is largely colonized by Furze, and the plants that usually grow with it.

Commonland is not only land that has been devoted to the general needs of the community, but has other characteristics which cause it to be left uncultivated and unenclosed. It is usually poor, sandy, or gravelly soil, which is suitable only for grazing. Commonland is also largely developed upon the slopes or summits of hills, where the ground is littered with stones, and unfit for cultivation. In this way it is especially favourable to the type of heath vegetation where Ling, Furze, Pine, and the usual ericetal plants occur.

Furze frequently grows on the sides of paths, where also ants may be found. Indeed, it is an interesting fact that ants to a great extent disperse the Gorse, finding nutriment in the elaiosomes or oily appendages of the seeds. Amongst the Furze will be found many plants common to the grass heath, and a common may, in fact, be made up largely of grass heath.

Wooded Heathland.—Though heaths most often are open treeless tracts, they may be wooded, or have a scrub association. Much of the heathland in the south-east of England in fact is wooded, and elsewhere wood and heath are found to alternate.

The type of wood associated with heath conditions is the dry Oak Wood, and a scrub may also develop made up of Sloe, Gorse, Hawthorn, Rose, Bramble, &c. The heath flora occurs in open parts of the dry Oak woods, with Whortleberry, Ling, and Heath Hair Grass.

Oak and Birch are the prevalent trees, but sometimes Beech or Pine, associated with Bracken and Ling, or White Beam, may be dominant. There is generally a good deal of light, so that the ground flora may be rich and made up of large associations, as *Holcus mollis*, Bluebell, Wood Sorrel, Wood Anemone.

The ground flora in the dry Oak wood consists of heath plants, in addition to members of the true dry Oak wood formations, many Grasses, and plants of the grass heath. There may elsewhere be a Birch heath characterized by a dominance of Birch with Bracken.

Open Character of Heaths.—The heath, except where dominated by trees, is, as a rule, a very open association. The wide stretches of Ling, Heath, or Whortleberry are frequently unvaried by a single bush or tree over wide areas. The same may be said relatively of a Furze common, but it is often studded here and there with a scrub of taller shrubs or trees, as Hawthorn, &c. The grass heath also is of a very uniform open type.

This openness of the heath exposes it to severe conditions, which cause the ericetal plants to be modified accordingly. In the first

place, the absence of shade causes the plants to adapt themselves to dry conditions. The leaves are leathery, rigid, narrow or linear, the margins inrolled, and the plants are often hairy. The exposure of heath plants to the wind is also a characteristic feature, and they have a typical habit correlated with this factor.

The open heath again lends itself to the successful pollination of the chief ericaceous types by insects. In the case of grass heath, on the other hand, the dominant Grasses are enabled to disperse their pollen, and later their seed, by the aid of the wind.

Dry-soil Types.—The heath flora is especially exposed to dry-soil conditions. The conditions upon a heath further involve dry air, intense illumination, heat, and wind exposure. As a consequence, heath plants display very marked xerophytic adaptations.

Extensiveness of Heath Plants.—A special feature of heaths is the well-marked continuity of the association of such dominant plants as Furze, Broom, Ling, Heath, Whortleberry, &c. This is partly due to the uniformity of the conditions. The heath is developed upon a particular kind of soil, hence it is natural that certain plant types, as Ling, &c., are characteristic of such a soil. Heath is a stable association, and as such not liable to invasion by or migration into other types.

Where Ericaceous types cover wide areas, other plants cannot grow, or become dwarfed. If the formation is open, however, grass heath develops, and the grass type becomes equally prevalent or even entirely dominant.

Game and Moors and Heaths.—An interesting feature of the moorlands and the heaths is the close association between gamebirds and Ericaceous types of plants. It is the gamebirds, of course, that are dependent, and there is no reason to think that Ericaceous plants are in any way dependent upon the agency of game for their dominance, unless it be that in modern times the popularity of sport has tended to conserve heaths and moors as the special habitat of game.

Upland Heaths and Lowland Heaths.—As intimated in Section XII, there are two altitudes at which Ling and Heath, or the chief components of a heath, occur. Though these two levels are not uniform, they serve to indicate the particular zones at which the heaths in different areas are found.

The English heaths of the South of England and the East Counties are more or less of the lowland type, and the same may be said of the Irish heaths, excluding the west coast moors and heaths. Of this type are Exmoor, Dartmoor, and numerous heath-clad commons. Such heaths normally occur between 300 and 500 ft. above sea-level, but many of them come right down to the sea.

The upland heaths are developed in the hilliest parts of the country in the west, Wales, Gloucestershire, the Pennines, Lake District, Yorkshire, Scotland. They go by the name of moors in many districts, especially in Yorkshire. The height to which *Calluna* and *Erica* extend, respectively, differs, and upon this fact zones have been based. Ling ascends the highest (2000 ft.), and the Cross-leaved Heath next, Purple Heath the least of the three.

Transition to Pasture.—The similarity between the true heath and the grass heath suggests that a heath may ultimately pass into pasture. Heaths may, in fact, at their margin, grade into dry pastures without Ling or other heath plants. This is merely the illustration of a natural law of succession. The transition of heath into pasture in this manner, however, must not be confused with the existence of vestiges of true heath or grass heath amongst neutral grassland, for in this case cultivation has been the determining factor. It is true that the result is largely the same, but the originating cause (and process) is dissimilar. This fact may be illustrated by the study of a heath locally and its *marginal* transition to pasture or grass heath, and the comparison between this type and the possible representation of a vestigial heath in the same area.

In the transition from heath to pasture it is interesting to note the elimination of the Ericaceous dry-soil types, and the persistence or appearance of ordinary meadow types. Once the Ling and Heath, or Furze, or Oak, or Pine are removed, a new flora comes into existence. The transition from grass heath which thus results is very easy, into a normal, dry pasture. Indeed, many dry pastures may be found to retain a few traces of their former condition, including some dry-soil types, as Mountain Everlasting, &c. By drainage, the wet-heath types also disappear, and there may then be little left to indicate the former character of the vegetation.

The Habitats of Heath Plants.—Owing to the uniform type of soil, rich in acid humus, demanded, heath plants as a whole exhibit a marked similarity in their choice of habitat. In this connection must be considered the relation between the true heath, grass heath, and pasture, on the one hand, and the moister types of habitat of the wet heath, moor, and bog on the other.

There are thus dry habitats and wet habitats, depending upon the altitude to some extent. Wet heaths may also be developed upon

a thin peaty or humus soil in hollows in lowland areas, so that the lie of the ground must be considered. Except where pools occur, the heath is more or less homogeneous; but where it is wooded, new conditions are introduced, and shade and sun plants both find a foothold in such areas.

The Habit of Heath Plants.—No type of natural vegetation, perhaps, exhibits so marked a habit of growth on a wide scale as ericetal vegetation.

The most obvious character in open association, where trees are absent, is the dwarfing of the vegetation. This is due not only to the necessity of a reduction of parts such as leaves, &c., and a certain stem habit, but also to the need for meeting the exposure to the wind. An inland heath in this respect is similar to the vegetation of the sea-coast where wind plays a constant and important part. The type of growth is typically ericoid, as in the heath plants, with whorls of linear, erect leaves, and fastigiate or closely grouped branches, developed much on the lines of the tufted foliage and stems of grasses. Owing to this close habit of the dominant types of heath plants other plants have to adapt themselves accordingly, and even where Ling, &c., is discontinuous, and where there is an alteration of conditions, there are few types except the grass type. But amongst the heath types a few others manage to survive in locally open spots, and these have usually the trailing habit, or else they have the erect rigid habit of St. John's Wort, with few branches and short, not very broad, leaves. Some are rosette plants, as Hawkweeds, Sheep's-bit Scabious. Here and there on rocks or ledges plants having a mat or cushion habit occur. Many others have a sort of grass habit, as Harebell, Cow-wheat, &c.

The Height of Heath Plants.—There is so little variation in the height of the dominant heath plants that the whole flora might be considered to range between a few inches and 2 ft. in height on the average. But in some places the Ling itself is abnormally developed, whilst elsewhere it is equally dwarf and prostrate.

The chief factor regulating the height of the heath plants is the wind. The heath formation is open, as a whole, and exposed to strong air-currents, hence, as on the sea-coast, the plants adapt themselves to this in their stunted growth. Furze and Broom first, then Ling and the Heaths may be said to form the next highest type of association. There are plants of intermediate height that struggle upwards amidst the closely branched Ling or Furze, as Heath Bedstraw and Grassy Stitchwort, whilst, as a rule, the Milkwort and the Tormentil, both grass-heath types also, are trailers that form a third or lowest zone.

The trees are stunted, and the Birch has on the Birch heath often a more erect habit with reduction of the branches. The Creeping Willow is a dwarfed type also, stunted or bent over owing to the wind.

The Flowering of Heath Plants.—The exceptionally dry conditions of most heath vegetation have a noticeable effect upon the flowering seasons of the plants. A heath is exposed to intense illumination, a dry atmosphere, and hot sun, with little shade. Hence the thermal constants of the plants that grow on the sandy soil or acid humus of a typical heath are attained more quickly in the main, and the plants are not so backward as those that grow upon hills or in wet places. Here, again, however, altitude plays its part, and when Ling and Heath grow at high altitudes, the plants flower later.

A considerable number of the plants described in detail in Section IX commence to flower as early as April, as Grassy Stitchwort, Furze (which blooms more or less all the year round), Broom, Heath Bedstraw, Whortleberry, Meadow Rush, Early Sedge. In May, Milkwort, Red Rattle, Creeping Willow, and Wood Rush are first found in flower. Tormentil, Cat's Foot, Common Hawkweed, Harebell, Cross-leaved Heath, Crimson Heath, Cow-wheat, Green-ribbed Sedge, and Heath Hair Grass first bloom in June. Not until July do Pretty St. John's Wort, Sheep's-bit Scabious, Eyebright, Small Bent Grass, or Matweed bloom. Dodder and Pennyroyal linger till August before they open their flowers.

The Duration of Heath Plants.—It is of advantage to plants that are exposed to dry-soil conditions to continue their activities from year to year. By this means, with a rest period in winter, they are enabled with the renewal of their vigour in spring to cope with the more disadvantageous conditions of the summer. The possibility of the germination, growth, and development of an annual is remote, as a rule, upon heath land. It is, of course, necessary that such hemi-parasites as Eyebright and Cow-wheat should come up from seed each year and attach themselves to the Grasses upon which they grow.

It is also of advantage to the dominant types of heath vegetation that they are shrubs and evergreen in many cases. This enables them to cope the more easily with the conditions, as they have not to renew the shoots each year.

The Pollination of Heath Plants.—Heath vegetation may be either open or closed in character, woodland in the latter case alter-

nating with more open conditions. But everywhere it is never so protected or sheltered as in a true woodland.

In the first case the heath is exposed to the full glare of the sun. The flowers that bloom in the open association are not usually large and conspicuous, but they are frequently sweet-scented, e.g. Furze and Broom, and Ling, Heather, Hawkweed, Sheep's-bit Scabious, and Harebell are also attractive to insects. The masses of Ling and Heath, Broom or Furze together form a conspicuous feature; hence by association they attain the same end that individually conspicuous flowers do in the matter of attracting insects. On a small scale the Blue Milk Wort, Starry White Grassy Stitchwort, Pretty St. John's Wort, Tormentil, Heath Bedstraw, Eyebright, Red Rattle, Cow-wheat, are also attractive.

In the case of the tree types and the Spike Rushes, Sedges, and Grasses, as a rule the flowers are proterogynous, the stigma is feathery, and the plants are pollinated by aid of the wind. The flowers of the Creeping Willow are also resorted to by bees. Thus the vegetation of the heath is adapted equally to cross-pollination by insects and to wind pollination, its open character being advantageous in both respects.

The Dispersal of Seed of Heath Plants.—Undoubtedly wind plays a great part generally in the dispersal of the seeds of ericetal plants, on account presumably of the extensiveness of the dominant types, and of the need for dispersal to a distance. Thus Ling, Heath, Milkwort, Cat's Foot, Hawkweed, Sheep's-bit Scabious, Harebell, Red Rattle, Cow-wheat, Creeping Willow, in addition to the Spike Rushes, Sedges, and Grasses, have their small seeds scattered by the agency of the wind.

Two plants have an interesting mode of dispersal, viz. Furze and Broom. The elaiosomes afford an attraction to ants, which carry them away, and feed upon the nutritive matter they contain. The seeds are also dispersed by an elastic movement, the crackling of the gorse being a well-known feature in spring and early summer. Some of the heath plants rely on other animals for dispersal, as Heath Bedstraw, the fruit bearing hooks; Whortleberry, the fruit being edible and eaten by birds.

The Soil.—There is one feature of heath vegetation which makes it more uniform than most formations; this is the nature of the soil, which is always of the same character. The plants that grow upon heaths are thus unable to grow elsewhere, and attempts to transplant them without a considerable thickness of the soil, as the gardener well knows, are usually fruitless. This is largely due to the association of a mycorhiza or fungal mycelium with the roots of the plants, especially in the case of the Heath proper.

Peat is an organic soil derived from the remains of plants which accumulate and form a thick deposit above the subsoil. It differs from the mild humus found in woods—which is neutral or alkaline, and well aerated and dry—in being acid or deficient in lime, more or less damp, and poorly ventilated. The passage from humus to peat is largely regulated by the water-content, or state of humidity, and the depth of the deposit. In the last stage a heath passes into a moor.

The soil upon which this organic deposit is formed is usually sandy or gravelly, or of a similar nature. Moorpan is formed by the cementing of gravel by humous acids, and where this is the case trees will not grow. The type of soil of a common or grass heath is usually sandy, and there is at most a very thin layer of humus.

Method of Survey.—A heath presents a more or less uniform type of formation. There is no zonation, save at the periphery of a region of wood (or scrub), and except where it is wooded it presents a series of dominant associations or societies, which can be studied on a broad basis, and mapped as in the case of moors and bogs. Apart from the lines formed by the extent of the Ling, Heaths, Furze, Broom, Whortleberry, &c., there are the lesser societies that endeavour in more open spots to maintain an existence. These should be carefully studied, as in the case of meadows and pastures, by staking out squares, and the plants counted, or put down on squared paper. The dominant plants in these cases should be noted, and their percentage estimated.

Where there is woodland, this should be studied as in the case of woods (Section IV). The influence of the tree growth on the heath types should be noted, as also the form of the wood or the alternation of wood and heath.

The openness and extensiveness of a heath makes it especially adapted to the study of the plants from the ecological point of view; for there are no barriers, and a base line for the squares to be studied can be laid down almost anywhere.

The particular conditions of soil, the effect of light, wind, &c., should all be studied in relation to the adaptations of the plants to meet the special conditions in each case. Advanced students may make pot cultures, make observations on the rainfall or light intensity, water-content, &c.

SECTION XII

FLOWERS OF THE ROCKS AND WALLS

Lithophytes.—The plant formations hitherto considered have been either aquatic or terrestrial, and in the latter case made up of plants that grow upon soil derived from underlying rocks, often of considerable thickness.

The rupestral or rock plants differ in growing upon the rock itself or in clefts. In general they are called lithophytes. One condition affecting such lithophytes is the slope of the surface, which when steep has no loose soil or detritus, but when little inclined is covered with the latter. The composition of the rock is important, determining the distribution of plants that prefer lime or not, and so on. The hardness, cleavage, specific heat, and water-bearing capacity or porosity are also important factors. Owing to the irregularity of the surface, lithophilous plants are of variable character as regards their adaptation to dry or moist conditions. The formations are thus not generally continuous, but like a patchwork quilt, occurring in small societies or florulas.

The plants included in this section, which embraces artificial habitats such as walls, sandy and gravelly fields, &c., are also found upon soils derived from rock surfaces in some cases.

Chomophytes and Chasmophytes.—Lithophytes (or petrophytes) form the vegetation, including cryptogams, on the surface of rocks or stones, which can colonize steeply inclined or *bare* rock.

Chomophytes are plants that can colonize rocks *where detritus has accumulated*, whether on the surface or in crevices. In this country chomophytes are developed upon the detritus formed at high altitudes, in Scotland and elsewhere, at altitudes of 2000–3000 ft. or more, and in ravines or corries at 3000 ft. or more, where arctic-alpine vegetation occurs. The plants are generally the highland species of Watson. The mountain-top detritus is largely of Glacial origin, and the plants are northern, perhaps Preglacial. The rocks vary in different districts in composition. Owing to the frequent displacement of rock the surface is continually being recolonized. It is in the corries that the chomophytes occur, such as many arctic Saxifrages, *Saussurea*, *Gentiana nivalis*, *Erigeron alpinum*, *Veronica saxatilis*, *Arenaria rubella*, *Draba rupestris*, *Carex atrata*, &c. Others not arctic-alpine occur, as Globe Flower, Hairy Bitter Cress, Wood Sorrel, Northern Bedstraw, &c.

Chasmophytes are crevice plants in fine sand, &c., which accumulates, with particular conditions depending on water content. The true chomophyte vegetation is thus almost entirely upland, though lowland plants occur at high elevations amongst the others. Some of these have already been mentioned in discussing the flora of hills and dry places, including Silky Mountain Vetch, Oak-leaved Mountain Avens, Wild Thyme. There are certain other types that at lower elevations may be considered as chomophytes or chasmophytes of the more lowland rocks, as Biting Stonecrop and Mouse-ear Hawkweed (chomophytes), Navelwort, Orpine, Golden Rod, Wall Lettuce, and Ivy-leaved Toad-flax (chasmophytes).

Walls.—Walls are the artificial counterparts of rock habitats, and are dispersed uniformly over the country in the lowlands, as well as at higher altitudes. In the neighbourhood of villages and towns they are composed of a variety of materials. Where natural exposures of hard rocks do not occur, walls are largely composed of brick. The upper surface forms a habitat for a number of plants, where some detritus has accumulated, and here one may find Rue-leaved Saxifrage; but as it is a lime-loving plant to a great extent, it is more frequent in the interstices of the mortar, where Ivy-leaved Toadflax also grows.

There were formerly a large number of mud walls in differents parts of the country, a survival from the days when houses were similarly constructed of mud; barns and outhouses are frequently built of mud to-day, having in many cases a top or roof of thatch. This latter is a favourite habitat for Vernal Grass, Rue-leaved Saxifrage, Thale Cress, Biting Stonecrop, Houseleek, Field Speedwell, and Flat-stalked Poa.

Whilst walls vary in composition, the habitat is resorted to by the plants that occur upon it, not so much because of such differences, but because it is uniformly a dry habitat. Upon old walls, especially in less-frequented districts, a large number of plants may be found. Sometimes Furze establishes itself, whilst in sheltered, moist spots Navelwort may grow in the crevices, Shining Crane's Bill, Wall Rue, and many ferns.

Artificial Character of Walls, &c.—The

artificial character of walls requires emphasis in the recording of the rarer plants that are found upon them. The Wallflower is a plant which is seldom found anywhere but on walls outside gardens, and was certainly introduced in comparatively recent times. But its persistence on certain places upon old ruins, &c., is an interesting feature biologically. The part played by walls in the retention of seeds or spores is of importance. The direction of the prevailing winds and the orientation of the walls are points that should be studied in this connection.

The influence of walls, and of boulders which are dispersed by glacial action up and down the country north of the Thames, as well as of the numerous blocks of stone used to mark the boundaries of roads, is responsible in many areas for the sole persistence of some interesting plants. There are some doubtfully native British plants, as the Oxford Ragwort, which in this country are to be found as a rule only upon walls.

Conditions of Alpine Rock Habitats.—Alpine plants, as has been seen, are largely confined to regions where there are accumulations of mountain-top detritus, or where, as in the case of chomophytes, corries or ravines occur; they are generally found above the limits of tree-growth at altitudes of 2000 ft. and upwards.

As a rule there is a decrease in temperature as one ascends, and this is the reason presumably for the retreat of the alpines to the mountains of this area; in the Ice Age they occurred at lower levels, owing to the lowering of the level of the snow-line, &c. The conditions are therefore much colder, and though the rainfall may be excessive, as at Satterthwaite, in the Lake District, the plants suffer from physiological drought, or in many cases transpiration is easy, so that the conditions are similar to those of dry soil.

The exposure of such elevated tracts to the wind also demands a rosette habit, or a grass habit, whilst other plants form mats or cushions, approximating to the habits of lichens, mosses, &c. The viviparous condition, a vegetative mode of reproduction, is frequent amongst such forms.

It is extraordinary that amongst the numerous rare specialized alpine forms growing at very high altitudes many lowland plants occur, and these must be regarded as descending species. The upright Meadow Crowfoot is found at 3980 ft., Marsh Marigold, Red Campion, Coltsfoot, and Hogweed at about 3500 ft., Bird's-foot Trefoil at 2800 ft., and Bog Violet ranges to 4000 ft.

In more lowland areas similar dry-soil conditions are encountered by plants growing upon sub-alpine hills, such as Rock Cress, Alpine Thale Cress, Rue-leaved Saxifrage, Orpine, Rock Rose, Wall Lettuce, &c.

Siliceous Rocks and Soils.—The type of rock termed siliceous is characterized by the closeness of the texture, as opposed to the openness and porosity of sandstones. The rock is denser, in fact, and when wet is pasty. Though plants do not favour bare rock surfaces, yet some are to be found upon siliceous rocks where there is but little soil formed, or nothing but detritus, and in the clefts of siliceous rocks some crevice plants do grow, such as the Rowan Tree, Holly, Ash, Birch, Oak, and occasionally even Willow.

Many shrubs, especially Brambles, Roses, Hawthorn, Hazel, may be found growing also on siliceous rocks in damp situations, as around slate pits or natural exposures. Of other types may be mentioned such plants in the ground vegetation as Columbine, *Cardamine impatiens*, which I have observed on talus slopes of older Palæozoic rocks in Shropshire, Bush Vetch, Wild Strawberry, Enchanter's Nightshade, Woodruff, Wall Lettuce, Wood Loosestrife, *Epipactis latifolia*, *Luzula maxima*, *Carex pendula*, and many ferns in the clefts.

Where the conditions are drier, Heath Bedstraw, Mouse-ear Hawkweed, Foxglove, Wood Sage, Sheep's Sorrel, Bluebell, &c., are found. Navelwort, Orpine, grow as crevice plants, and so does Golden Rod, and on slopes with little soil Field Mouse-ear (the latter also on marlstone).

Sandstones.[1]—Siliceous soils are fine-grained, whereas sands and sandstones are much coarser and looser, more porous. They are consequently drier than the former. Very little humus is formed upon them, and the soil is deficient in mineral salts as a rule. Such soils are characterized by woodland and heath formations. The woodland is dominated by the Oak, both pedunculate and sessile types. The occurrence of Rowan and Birch is characteristic, and also of Bluebell, Bracken, Yorkshire Fog, Tormentil, Foxglove, &c. This is the typical succession where a sandy soil is developed, but frequently such areas may exhibit the rocks themselves in natural exposures, and some plants may be found to grow on the all but bare surfaces, or in crevices, as Orpine, Golden Rod, Sheep's Sorrel. Where flowering plants do not colonize such bare rocks, cryptogams are abundant.

Limestones.—Limestones, as a rule, form bold massifs or hills, and they are not covered

[1] Cf. also Section IV.

by a great thickness of soil. Indeed, large areas are denuded of soil, forming pavements, and upon these plants grow as upon the slopes where detritus has accumulated.

The natural type of woodland upon limestones is Ash wood, which ranges up to an altitude of 1000 ft. Associated with the Ash are the Wych Elm and Hawthorn, the former at lower elevations in damp situations, the latter higher up in dry situations, and either may replace the Ash locally.

Juniper and Yew are also found on calcareous soils. The Hazel is common, but the Alder is local. In some areas the Birch is found. Other members of tree or scrub zones are Lime, Buckthorn, Spindle Tree, Scotch Rose, Eglantine, White Beam (as on chalk), Cornel, Wayfaring Tree, Privet, Spurge Laurel. Heaths and Ling are absent. In damp spots the herbaceous types are Marsh Marigold, Meadow-sweet, Water Avens, Valerian, Butterbur, Melancholy Thistle, Jacob's Ladder, Scorpion Grass, Bur Reed, Reed, &c.

On dry soils Dog's Mercury and Moschatel are very characteristic types, and in damper places Yellow Archangel, Ransoms, Bellflower. Ground Ivy, and, where the ground is stony, Hairy St. John's Wort, Nettle, Wood Sage, Lily-of-the-Valley, Melic Grass.

Rocky knolls occur where there is little or no soil and bare rock, with cryptogams, Sandwort, Whitlow Grass, Rue-leaved Saxifrage, Biting Stonecrop, Thyme. The woodland ceases where the rocks outcrop, except on the pavements. The screes and cliffs, when damp, are colonized by the vegetation of the Ash wood itself.

Chalk.—Limestone, in the last section, refers to the Palæozoic limestones, which are developed in the moister west and north of England. The chalk and oolites, also limestones, which are not so compact or altered, are more porous, and, being confined to the southern and eastern parts of the country, are drier, and many of the chalk plants are therefore xerophiles.

The typical woodland is Beech, but Ash woods also occur. They occur on the slopes or hangers (a name familar to readers of White's *Selborne*), growing often on the rock itself, or where the soil is merely a shallow layer of mild humus. With the Beech grow Ash and White Beam, and, locally, Box (as on Boxhill) and Cherry. The Yew is also a characteristic tree, native here. In the Beech wood there is little scrub, but on calcareous pastures or the margins of the chalk, White Beam, Cornel, Buckthorn, Wayfaring Tree, Spindle Tree, &c., are found.

The scanty ground flora consists of Wood and other Violets, Wild Strawberry, Enchanter's Nightshade, Sanicle, many Orchids, Bird's-foot, Belladonna, Butcher's Broom.

In addition to Beech, Ash, and Yew woods upon the chalk, there is a scrub association and a chalk pasture. In the last case the soil is often not more than 1 in. in depth, but an extensive flora occurs upon it, with a turf of Sheep's Fescue, or, in other cases, of *Bromus erectus*, *Trisetum flavescens*, *Brachypodium sylvaticum*. Occasionally the soil disappears, and here the plants are subjected to intensely dry conditions in a hot summer.

These gradations of soil thickness, again, show that between rocks pure and simple and rock soils there is very little difference, especially in this case. But where a non-calcareous soil is formed above the chalk, as frequently happens, this is not the case.

Other Rocks (Maritime).—In addition to inland rocks and rock soils there are the rocks along the coast, forming cliffs of some height, with bare faces and surfaces covered by grass or heath, &c. The proximity of the sea and the regular occurrence of sea breezes, gales, mists, &c., tend to obliterate the effect of the chemical composition of the rocks themselves, and to transform the vegetation into a halophytic type of formation. And the conditions upon the cliff face resemble those of mountain-tops, the sides of the cliffs being often spray-covered and moist; whilst innumerable caverns exist where moisture-loving ferns are especially at home, and, fortunately for their existence, inaccessible.

On such rocks (cf. Section VII) occur many maritime species, as Wild Pæony (Steep Holmes), Welsh Poppy, Wild Cabbage, Woad (Severn estuary), Sea Stock, Tree Mallow, Scurvy Grass*, Sand Spurrey, Pearlwort, Stonecrop, Samphire, Lovage, Golden Samphire, Sea Plantain*, Buckshorn Plantain*, Cotoneaster (Great Orme's Head, now protected), Thrift*, Sea Lavender, &c. It is a noticeable fact that some of these (marked with an asterisk) occur also upon inland rocks at high altitudes, thus showing the influence of a rupestral habitat.

Sandy Fields.—In many areas there are tracts of sandy ground, derived from sandstones or sands, especially in the east and south of England, where the rainfall is small (under 25 in.). Reference has already been made to the probable occurrence of steppe conditions in this country following the glacial phase. The following plants are found on sandy areas at Mildenhall: *Silene Otites*, *S. conica*, *Holosteum umbellatum* (on walls, becoming rare), *Medicago falcata*, *M. sylvestris*,

Artemisia campestris, *Veronica verna*, *V. triphyllos*, *Muscari racemosum*, *Ornithogalum umbellatum*, *Carex ericetorum*.

F. Arnold Lees, in a delightful old volume, was one of the first to recognize the importance of soils in determining the distribution of plants, and enumerates the following among others as being especially confined to sandy strata: *Tillæa muscosa*, *Turritis glabra*, *Teesdalia nudicaulis*, *Silene anglica*. *Arenaria peploides* (maritime), *A.* (*Spergularia*) *rubra*, *Radiola millegrana*, *Erodium cicutarium*, *Trifolium suffocatum*, *Jasione montana*, *Centunculus minimus*, *Lamium amplexicaule*, *Scleranthus annuus*, *Phleum arenarium* (maritime), *Festuca Myurus*, *Elymus arenarius*, *Carex arenaria* (the last two maritime).

Sandy fields generally are characterized by such plants as Little Bur Medick, Rough Clover, Rigid Hare's Ear, French Cudweed, Cut-leaved Speedwell, Biennial Knawel. The connection between such tracts and rocks of a sandy composition is shown by the occurrence of plants common to both. Other plants found here are Silky Wind Grass, Silvery Hair Grass, Sand Fescue.

Gravelly and Stony Places.—Gravelly soil is in general characteristic of heaths in the north and west of England, but in the south may be replaced by sand or clay. It is connected in the first case with the formation of moorpan, and trees will not grow on such tracts; but the Pine grows, where the gravel is not cemented together in this manner, on gravelly heaths in East Anglia and elsewhere in the south of England.

Gravelly commons, as indicated by F. A. Lees, have a characteristic flora, which is common also to trap, serpentine, syenitic and granitic rocks, including *Trifolium repens*, *T. fragiferum*, *T. minus*, *T. filiforme*, *Ornithopus perpusillus*, *Plantago coronopus* (also maritime). He points out that similar species occur whatever be the age of the gravel, the same plants occurring even to the Chamomile (*Anthemis nobilis*) and *Bupleurum tenuissimum*. And much depends on the relative moisture or occurrence of pools. Here are found Starwort, Forget-me-not, Bur Marigold (*Bidens cernua*), and *Pulicaria vulgaris*, like the Chamomile now very rare, and more or less confined to commons in the south of England.

In marshy spots occur *Ranunculus flammula*, *R. hederaceus*, *Nasturtium terrestre*, *Cardamine hirsuta*, *Montia fontana*, *Peplis Portula*, *Epilobium palustre*, *Helosciadium nodiflorum*, *H. repens*, *Pedicularis sylvatica*, *Lycopus europæus*, *Mentha hirsuta*, *M. piperita*, *M. Pulegium* (the two latter now very local or rare), *Polygonum minus*, *Blysmus compressus*, *Heleocharis*, *Carices*.

Others on village greens and dry commons are *Polygonum aviculare*, *Nardus stricta*, *Chenopodium*, *Atriplex* (in waste places), *Cerastium*, *Sagina*, *Filago*, *Polygala vulgaris*, *Hypericum humifusum*, *Linum catharticum*, *Potentilla anserina*, *P. tormentilla*, *Carlina vulgaris*, *Chrysanthemum inodorum* (*Matricaria inodora*). Rampion, described here, is also a characteristic plant of gravelly soil.

Altitudes of Arctic-alpine or Boreal Plants.—The lowest limit of the arctic-alpine vegetation in Scotland is the 2000-ft. contour, but in Ireland and elsewhere it is not so high. It is above the tree limit in this country. Ling and Whortleberry, or moorland vegetation, disappears, and a sort of grassland, with dwarf vegetation, takes its place at higher levels, made up of *Alchemilla*, Grasses (often viviparous), *Carex*, *Juncus*, *Luzula*, *Draba*, *Cerastium*, *Potentilla*, *Saxifraga*, *Sedum*.

The types of plants are Scottish, or Highland at higher altitudes, the latter chiefly in Scotland. On Highland hills, e.g. on Ben Muic Dhui (4300 ft.) the following occur: *Silene acaulis*, *Saxifraga stellaris*, *Salix herbacea* (typically arctic), *Luzula spicata*, *L. arcuata*, *Carex rigida*, *Festuca ovina* (viviparous form). Elsewhere these plants occur on alpine rocks in arctic and sub-arctic latitudes.

The altitudes attained by some of these arctic-alpine plants is illustrated by the following list of plants on high mountain-tops, many of which are rare or restricted to certain localities, viz.: *Draba rupestris* (3000–3980 ft.), *Saxifraga cernua* (3800 ft.), *S. rivularis* (3500–3900 ft.), *Arenaria rubella* (2700–3800 ft.), *Sagina nivalis* (3100–3900 ft.), *Astragalus alpinus*, *Oxytropis campestris*, *Erigeron alpinum* (2500–3500 ft.), *Gnaphalium norvegicum*, *Menzesia cærulea* (2350–2460 ft.), *Gentiana nivalis* (2400–3450 ft.), *Myosotis pyrenaica* (2400–3450 ft.), *Veronica fruticans* (1200–3600 ft.), *Salix arbuscula*, *S. lanata* (dwarf willows), *Juncus biglumis*, *Carex alpina*, *C. rupestris*, *C. atrofusca* (2600 ft.) A number of lowland types also occur at high altitudes (see *ante*). In this group of arctic plants we see the influence of altitude and insolation in a marked degree.

Talus Slopes or Mountain-top Detritus.—The accumulation of talus slopes on sloping hillsides forms a transition between bare rock and rock with a thick layer of soil, the limestone pavement, and sandy and gravelly soils, being other transitions between them.

In the case of arctic-alpine vegetation, disintegration owing to alternation of heat and cold, landslips, erosion by water or by sand,

&c.. play a considerable part in the accumulation of talus, as does rain-wash against vertical cliffs, whilst in the past glacial action has produced a considerable scree or detritus at higher elevations.

Rock debris is formed and is colonized by lichens and mosses, which provide a layer of humus and pulverized grit or sand, &c., for higher plants. Indeed, a large part of it is colonized by *Rhacomitrium*, forming an open association with bare patches of rock between, which lower down becomes closed and includes higher plants, and still lower is succeeded by heath.

It is exposed to wind, to intense heat, and drought, owing to the thin soil and steepness of the slopes, and is subjected, also, to insolation and the prolonged influence of a snow covering. The intensity of the struggle for existence under such conditions is shown by the paucity of species.

Habitats of Plants of Walls and Rocks.—Rock plants are affected by a variety of factors, which in different areas and circumstances help to render the habitat diverse. The vegetation of the arctic-alpine rocks is typically of a dwarf habit, owing to altitude and exposure and the poverty or thinness of the soil layer. It varies in respect of the derivation of the latter. The mountain-top detritus forms layers on the surface. Elsewhere, in corries, &c., there are crevices with deeper soil and wetter conditions. At lower altitudes the rocks and soils vary in composition.

There are siliceous soils with a characteristic vegetation which is found in some cases on bare rocks of this type or in crevices. Sandstones and sands have an equally characteristic flora.

On limestone the soil is thin, and the flora may be regarded as petrophilous to a great extent, limestone pavements in particular illustrating this point. The soil of the chalk is markedly deficient, and many chalk plants are petrophytes. Along the coasts on cliffs and rocks a halophytic rupestral flora is found. Sandy fields and gravelly commons are special types of sandstone or loose sand formations, but of newer date. Walls have a particular flora of their own, and many plants are confined to them and to old ruins. The plants found upon rocks are also common to mural habitats, owing to the occurrence in both cases of dry conditions and a thin soil layer.

Habits of Plants on Rocks and Walls.—The outstanding feature of plants growing in these habitats is the adaptation (generally speaking) to dry conditions. Practically all of them are xerophytes. Mural plants are in other habitats largely mesophilous, but on walls develop xerophytic adaptations.

Upon the summits of lofty mountains the main feature of the vegetation is the dwarfed nature of all the plants. This is more or less what might be expected, since the vegetation merges into, or follows upon, the lichen and moss zone, which is dwarf in an extreme degree. Many of the plants have the cushion habit, e.g. *Silene acaulis*, *Arenaria sedoides*, *Saxifraga hypnoides*. Others form mats, as *Azalea procumbens*, *Potentilla Sibbaldi*, *Empetrum nigrum*, *Saxifraga umbrosa*, *S. oppositifolia*, *Luzula spicata*, *Carex rigida*, *Vaccinium myrtillus*, *Salix herbacea*. The rosette habit is exhibited by *Ranunculus acris*, &c. Many plants are viviparous.

The trees that occur are mere bushes. The Juniper on Snowdon is only an inch or two in height, and on Great Orme's Head the Cotoneaster is similarly dwarfed, owing to the exposure to wind. Hairs, &c., are developed which act as screens from the wind, and help to retain moisture. The dwarf character may be assigned to the effect of intense sunlight. The mat, cushion, and rosette habits are largely due to wind exposure, and to the ready evaporation, and generally dry conditions.

The Height of Rock and Wall Vegetation.—Altitude is largely responsible for the dwarf habit of alpine plants. When these are found at lower altitudes, or in moist situations, they are taller. The plants that grow on rocks are in general not very tall, nor are the crevice plants in exposed situations, but in lowland districts in wooded areas Orpine may be luxuriant and grow to a height of 2 ft. The habit of the plants is intimately connected with their height; and mat, cushion, or rosette plants are consequently more or less dwarf. Thus Vernal Whitlow Grass is rarely more than 5 in. in height even in flower; Cheddar Pink, 8 in.; Field Mouse-ear and Sandwort Spurrey, both trailers, are 6 in. and 2 in. respectively; Bird's-foot is 2 in.; Horse-shoe Vetch, 6 in.; Rue-leaved Saxifrage 6 in.; Meadow Saxifrage and Navelwort, growing in more sheltered situations, reach a foot or more in height.

Dry conditions limit not only the height but also the extent of the branching or size of leaves.

The Flowering of Rock and Wall Plants.—The principal factors that regulate flowering are, in the case of terrestrial plants, excessive rainfall, increased altitude, exposure to wind, insolation, or interrupted sunlight. The duration of the plant also influences the flowering, and to some extent size enters into these

factors. The lying of snow upon alpine heights, which are also wind-swept, poor in soil, and subject to insolation, retards the flowering of alpine plants.

The effect of size upon flowering is shown by the earliest months of flowering of some of the plants here included. Thus Vernal Whitlow Grass, an annual, blooms in March. Field Mouse-ear, Horseshoe Vetch, and Field Speedwell bloom in April. Bird's-foot, also prostrate and perennial, blooms in May. The annual Rue-leaved Saxifrage, a mural plant, also found on thin calcareous soils, flowers early in April, whilst its taller relative, Meadow Saxifrage, blooms in May, on colder clay soils. Mouse-ear Hawkweed, Mother of Thousands, and Silvery Hair Grass flower in May.

June is the month when numerous flowers first open, viz. Cheddar Pink, Sandwort Spurrey, Navelwort, Biting Stonecrop, Houseleek, Silky Wind Grass, Flat-stalked Poa, Sand Fescue. Not a few, however, defer their flowering till July, e.g. Orpine, Golden Rod, Wall Lettuce, Rampion, Pellitory-of-the-wall, and these are largely plants that grow in crevices or walls, where the soil is poor or thin, and nutrition a slow process.

The Duration of Rock and Wall Plants.—The duration of plants that are found upon rocks and walls is regulated by various causes. The arctic-alpine vegetation is exposed to such adverse conditions that it is normally perennial. But a few annuals are found even amongst this group of plants, or of those that range as high, e.g. Vernal Whitlow Grass and Rue-leaved Saxifrage. Sandwort Spurrey may be either annual or biennial, and Houseleek is perennial or biennial. The Rampion is also a biennial. Grasses are usually perennial, but some are annual, e.g. Silky Wind Grass, Silvery Hair Grass, Sand Fescue.

The remainder of the plants here considered are perennial. This corresponds largely with an increased stature or size, or with a diurnal habit or late flowering period.

The Pollination of Rock and Wall Plants.—Growing in exposed areas, the arctic-alpine chomophytes and chasmophytes are not characterized by large or conspicuous or brilliant flowers. But in sheltered positions the alpine flora of Switzerland at much greater altitudes, as is well known, is characterized by the wealth and beauty of the flowers. It is true that in such sheltered habitats in Scotland, upon a small scale, the same thing is to be noticed, but the hills are not blue with the flowers of *Gentiana acaulis* (erroneously recorded for Britain), or yellow with alpine Wood Anemones, &c. Still, the arctic types of Pinks, Stitchworts, Saxifrages, Primulas, &c., reflect in a lesser degree the grandeur of the alpine flower garden.

As a whole the flowers of the plants here enumerated are not large or conspicuous. The bulk are cross-pollinated by insect agency, but, as is inevitable with small-flowered plants, many are equally adapted to self-pollination. Some, indeed, such as Vernal Whitlow Grass and Ivy-leaved Toad-flax are specially fitted for the latter, the stigma and anthers ripening together. In the case of Cheddar Pink, Rue-leaved Saxifrage, and Orpine the anthers mature before the stigma, and in the case of Pellitory-of-the-wall, Sand Fescue, &c., the stigma is developed and receptive beforehand.

Cleistogamy occurs in the case of Ivy-leaved Toadflax. Pollination by the assistance of the wind is exemplified by such Grasses as Silky Wind Grass, Silvery Hair Grass, Flat-stalked Poa, and Sand Fescue, and by the Pellitory-of-the-wall.

Dispersal of Fruits and Seeds of Rock and Wall Plants.—Amongst the rock and wall plants there are few if any plants, at least amongst those enumerated here, that are adapted to dispersal of fruit or seed by the agency of animals. The absence of aquatic conditions, also, is marked by the entire absence of water-dispersed fruits or seeds.

In the exposed habitats in which a large bulk of this class of plants grow, it is, moreover, quite natural that the majority of plants growing upon rocks and walls should be adapted to dispersal by aid of the wind. It must be remembered, however, that it is necessary for plants, growing upon such limited areas as the specially suitable rocks or walls usually are, to be dispersed at no very great distance from the plant. The following are wholly or partly dispersed by the agency of the wind, viz.: Wallflower, Cheddar Pink, Field Mouse-ear, Bird's-foot, Horsevetch, Rue-leaved Saxifrage, Meadow Saxifrage (censer fruits), Navelwort, Orpine, Stonecrop, Houseleek (small seeds), Golden Rod, Mouse-ear Hawkweed, Wall Lettuce (with hairy pappus), Rampion (censer fruits), Field Speedwell, Pellitory-of-the-wall, Silky Wind Grass, Silvery Hair Grass, Flat-stalked Poa, Sand Fescue.

The rest, e.g. Yellow Fumitory, Whitlow Grass, Sandwort Spurrey, Ivy-leaved Toadflax (which buries its fruits in the crevices of the wall), have mechanisms or methods of dispersal of their own.

The Soil of Rock and Wall Plants.—In the case of petrophytes or plants that grow upon rocks, or rock debris, or in crevices, the composition of the rock is of importance in determining distribution. But since the highest

rocks in this country are as a whole the oldest rocks, and are mainly siliceous or sandy, the factor that plays the greatest part is apparently altitude. There are, in fact, no alpine chalk plants, and limestone plants do not range as high as 2000 ft. Hence the arctic-alpine vegetation more or less monopolizes the most elevated siliceous or sandstone (or volcanic) rocks.

In the more lowland areas the modified petrophytic vegetation is dependent more especially upon soil or rock characters. Thus there are plants that grow on siliceous rocks, sandstones, limestone, chalk, along the coast, where the conditions of soil or rock are modified by halophytic conditions, or on the shallow soils of sandy or gravelly areas.

The characteristic limestone types here described are Rue-leaved Saxifrage, Horseshoe Vetch, Cheddar Pink, Golden Rod (in part), Mouse-ear Hawkweed. A few need clay, as Meadow Saxifrage, whilst some humus is needed by Yellow Fumitory and Houseleek, and gravel is required by Rampion and Field Speedwell. The rest, when not rupestral or crevice plants, are typically found upon sandy or siliceous soils.

The wall plants are found upon rock or brick, or on sandy, loamy, or gravelly soil.

Methods and Objects of Survey.—The progressive or retrogressive character of the vegetation of mountain-tops, where the soil is constantly changing its position, demands a close study of the ground, so that the order of succession of the colonizing plants, whether initially cryptogams or not, may be elucidated. The open or closed nature of the formation requires a similar method in either case, and a survey of the surface in detail is essential. The special adaptations of the plants, owing to the particular conditions, such as wind, slope, soil, depth, sun, rainfall, snow-line, insolation, &c., are only to be determined by such methods.

The exact altitudes attained by each species, and the aspect and extent of the formation, association, or society, are other factors that are of especial interest. As a rule, the study of highland vegetation is open only to the favoured few who live in the vicinity of such areas. But it is suggested that an attempt be made to study a typical area, by visiting one of the mountainous areas in summer or autumn.

In the more generally accessible lowland areas the relation of the vegetation upon bare rocks to the more stable vegetation upon the deeper soils derived from them may be studied in the same way and with greater ease.

The flora of a wall, as it is artificial, requires rather different treatment; it need not be merely a floristic study or enumeration of species upon particular walls, but may also be studied from the wider ecological standpoint. The position of mural plants upon the wall, their relation to aspect, the extent of each society, the adaptations to dry conditions, are some of the points that should be considered.

VOLUME V.—APPENDIX I

ANGIOSPERMÆ

(Summary of Natural Orders)

Seed-plants (Spermatophytes). Ovules enclosed in an ovary. Perianth well-developed.

CLASS I.—DICOTYLEDONS

Embryo containing 2 or more (rarely 1) cotyledons, opposite or in a whorl. Leaves net-veined. Stem perennial, with pith, wood, and bark; with medullary rays, and increased by rings of wood on the outside yearly. Perianth of 4 or 5 or 2 divisions.

SUB-CLASS I.—POLYPETALÆ

Perianth of 2 whorls, calyx and corolla; petals distinct as a rule.

Division A.—Thalamiflorœ

Petals distinct, rarely absent, not united with the sepals, stamens free, hypogynous.

Order 1. **Ranunculaceæ.**—Herbaceous plants, rarely shrubs or woody, a few climbing. Leaves usually alternate, without stipules. Flowers usually regular, sepals 3–6, sometimes petaloid, petals 5 or more, rarely absent. Stamens many, indefinite (rarely 5); anthers adnate, opening longitudinally; carpels numerous, apocarpous or syncarpous; fruit aggregate, achenes, follicles, berries; seeds albuminous.

Order 2. **Berberidaceæ.**—Shrubs, leaves transformed into spines, usually without stipules; sepals in 2 series, 3 or 4; petals 3 or 4 or 6 or 8; stamens 4–6, opposite the petals; anthers valvate; carpels 1, 1-celled; fruit, drupe or berry; seeds fixed by base or on lateral placenta, albuminous.

Order 3. **Nymphæaceæ.**—Aquatic plants; stems submerged; leaves floating, peltate; flowers regular; sepals 4–5; petals many, indefinite, on the disk, surrounding the ovary; stamens indefinite; stigma peltate; ovary syncarpous, 10–20-locular; ovules numerous; seeds many, surrounded by an aril.

Order 4. **Papaveraceæ.**—Herbaceous plants; stems with milky juice; leaves alternate, without stipules; flowers regular; sepals 2, soon falling; petals 4; stamens indefinite, distinct; stigmas simple or lobed, sessile; ovary syncarpous, free, 1-locular; ovules numerous, on parietal placentæ; fruit a capsule; seeds albuminous.

Order 5. **Fumariaceæ.**—Herbaceous plants, slender, often climbing; leaves alternate, pinnatifid with no stipules; flowers irregular; sepals 2, soon falling or wanting; petals 4, one or more spurred below; stamens 2, 3-partite, lateral 1-celled; stigma with one or more points; ovary 1-celled, syncarpous, free; ovules on 2 parietal placentæ or 1 basal ovule; fruit a capsule or nut; seeds albuminous.

Order 6. **Cruciferæ.**—Herbaceous plants; leaves alternate, with no stipules; flowers regular; sepals 4; petals 4, cruciform; stamens 6 (4 long, 2 short) or 4; stigmas 2, alternate with the placentæ; ovary syncarpous; 2 carpels with dividing septum which unites the 2 parietal placentæ; valves opposite shorter stamens; fruit a siliqua or silicule, usually dehiscent.

Order 7. **Resedaceæ.**—Herbaceous plants; flowers irregular; sepals 4–8, persistent; petals 4–8, entire or lobed; stamens indefinite (10–24), seated on a 1-sided hypogynous disk; ovary syncarpous, 1-locular, 3- or 6-lobed; ovules many on 3–6 parietal placentæ; fruit, a capsule.

Order 8. **Cistaceæ.**—Herbaceous plants or undershrubs; leaves opposite, entire; stipules small, or wanting; flowers regular, sepals 5, outer 2 smaller, or wanting; petals 5, crumpled in bud, falling; stamens numerous; stigmas 3; style simple; ovary syncarpous, 3-carpellary, 1-locular; fruit a capsule, 3-, 5-, or 10-valved.

Order 9. **Violaceæ.**—Herbaceous plants; leaves alternate, with persistent stipules; flowers irregular; sepals 5, overlapping; petals 5, irregular, lower spurred; stamens 5, filaments swollen, connective membranous; stigma hooded; ovary syncarpous, 3-carpellary, 1-locular; ovules many, on 3 parietal placentæ; fruit a capsule, 3-valved.

Order 10. **Polygalaceæ.**—Herbaceous plants; leaves simple, alternate, without stipules; flowers irregular, in racemes; sepals 5, irregular, overlapping; 2 interior, larger, petaloid; petals 3, unequal, 1 larger, anterior, united to staminal tube; stamens 8, united below in 2 equal bundles; anthers 1-celled, opening by apical pores; style 1; ovary syncarpous, 2-carpellary, 2-locular; ovules solitary on axile placentæ; fruit a capsule; seeds pendulous, enclosed in an aril below.

Order 11. **Frankeniaceæ.**—Herbaceous, prostrate plants; leaves small, slender, opposite

without stipules, the margins turned back, as in Heaths; flowers regular, axillary, small; sepals 4–6; calyx persistent; petals 4–6, clawed, with limb-appendages; stamens 4–6, distinct, 2-celled, opening by apical pores or longitudinally; style simple or 3-fid; ovary syncarpous, 2–5-carpellary, 1-locular; placentation parietal; fruit a capsule; seeds numerous, very small.

Order 12. **Caryophyllaceæ.**—Herbaceous plants with swollen nodes, leaves opposite, entire; rarely with stipules; flowers regular, in dichasial cymes; sepals 5 or 4, distinct, or tubular below; petals 5 or 4 clawed, or absent; stamens 10 or 8, or 5 or 4, free or united below; anthers opening longitudinally; stigmas 2–5, sessile, slender; styles 2–5; ovary syncarpous, 1-locular; often stalked; ovules on central placenta; fruit a capsule, opening by teeth, or valvular, 1- or 2–5-celled, seeds albuminous.

Order 13. **Portulaceæ.** — Herbaceous plants; leaves succulent, smooth; stipules membranous; flowers regular; sepals 2, or 3–5, united below, overlapping in bud; petals 5, united, or not, below; stamens indefinite, or 3–5; inserted on, or opposite the petals; filaments not united; styles 3; stigmas several; ovary syncarpous, 1-celled; ovules 3, placenta central, basal; fruit a capsule, 3-valved.

Order 14. **Tamaricaceæ.** — Evergreen shrub; branches slender, feathery; leaves very small; flowers regular, in racemes; sepals 4–5, persistent, overlapping in bud; petals 4–5, soon withering; stamens 4–5, or 8–10, on margin of disk (peltate); styles 3–4; ovary syncarpous, 3-carpellary; ovules several; fruit a capsule, rarely developed, 1-locular, 3-valved; seeds many, crowned with tuft of hairs.

Order 15. **Elatinaceæ.**—Plants aquatic; leaves opposite, stipules very small; flowers regular, very small; sepals 3–4, distinct, or united below; petals 3–4; stamens 6–8, free; styles 3–4; stigmas capitate; ovary syncarpous, 3–4-celled; ovules on axile placentæ; fruit a capsule, 3–4-celled, 3–4-valved; seeds many.

Order 16. **Hypericaceæ.**—Herbaceous plants or shrubs; leaves opposite, entire, without stipules, with oil glands; flowers regular, yellow; sepals 5, distinct, persistent, overlapping, with glandular dots; petals 5, twisted in bud; stamens indefinite, in bundles; anthers versatile; styles several, usually distinct; ovary syncarpous, 3–5-locular, ovules on axile placentæ; fruit a capsule or berry, dry or fleshy, many-celled, many-valved; seeds small, many.

Order 17. **Malvaceæ.** — Herbaceous plants; leaves alternate; stipules falling; flowers regular, axillary; sepals 5, valvate, persistent; epicalyx of 3–9 segments; petals 5, twisted in bud; stamens many, connected into a tube below; anthers 1-celled, opening transversely, kidney-shaped; styles free above; ovary syncarpous, many-celled; ovules 1 in each cell; fruit a schizocarp, with numerous 1-seeded cocci.

Order 18. **Tiliaceæ.**—Trees, deciduous; leaves alternate; stipules falling; flowers regular, in cymes; flower-stalk adnate to bract; sepals 5, valvate in bud; petals 5; stamens indefinite, distinct or united; anthers 2-celled; style simple; ovary syncarpous, 5-locular; ovules 2 in each cell; fruit a nut, 1–2-seeded.

Order 19. **Linaceæ.**—Herbaceous plants; leaves alternate, small; no stipules; flowers regular; sepals 4–5, persistent, overlapping; petals 4–5, twisted in bud, falling, with a claw; stamens 8 or 10, on a ring; anthers versatile; styles 4–5; stigmas capitate; ovary syncarpous, 4–5-celled; ovules 2 in a cell, on axile placentæ; fruit a capsule, tipped with hard base of styles; seeds 1 in each spurious cell.

Order 20. **Geraniaceæ.** — Herbaceous plants; leaves simple, with or without stipules; flowers usually regular; sepals 5, persistent, overlapping; petals 5, with a claw, twisted in bud; stamens 5–10; style 1; ovary syncarpous, 5-locular; fruit, a schizocarp, of 5 cocci, beaked, on stylophore; seeds solitary.

Division B.—Calycifloræ

Petals distinct; stamens perigynous or epigynous.

Order 21. **Aquifoliaceæ.** — Shrub, evergreen; leaves spinose, leathery; stipules small, falling; flower regular, unisexual, in cyme, axillary; sepals 4–5, inferior, overlapping; petals 4–8, united below; stamens 4–5, adnate to petals; disk absent; ovary syncarpous, free, 4-locular; ovules solitary; fruit a drupe with four stones, fleshy; seeds stony 2–6.

Order 22. **Celastraceæ.**—Shrub; stipules very small, falling; flowers regular, in cyme, axillary; sepals 4–5, overlapping; petals 4–5 on margin of fleshy disk; stamens alternating with the petals; ovary syncarpous, 3–5-locular; cells 1–2-seeded; ovules erect; fruit a fleshy capsule; seeds enclosed in aril.

Order 23. **Rhamnaceæ.** — Shrubs, deciduous; leaves alternate; stipules minute; flowers regular, small; sepals 4–5; valvate in bud; petals 4–5, distinct, on throat of calyx; stamens 4–5, epipetalous; ovary syncarpous, 3-locular, generally superior; fruit a drupe; seeds erect, 2–4.

Order 24. **Aceraceæ.**—Trees, deciduous; leaves opposite; no stipules; flowers regular, in raceme or corymb; sepals 4–9, overlapping; petals 4–9, on hypogynous disk; stamens 8, on disk; style 1; stigmas 2; ovary syncarpous, 2-lobed; 2-locular; ovules 2 in each cell; fruit a schizocarp; mericarps (samaras) 2, winged, 1-celled, 1–2-seeded.

Order 25. **Leguminosæ.** — Herbaceous plants, or shrubs, some evergreen; leaves alternate, compound; stipules to leaves and leaflets; flowers irregular, papilionaceous; calyx inferior; sepals 5, combined, 1 anterior; petals 5, odd one posterior; stamens in 1 bundle of 10 or 2 bundles of 9 and 1; ovary 1-celled, free; fruit a legume; placenta on upper suture.

Order 26. **Rosaceæ.**—Herbaceous plants, shrubs, trees (deciduous); leaves alternate, simple or compound; with stipules; flowers regular, perigynous as a rule; sepals 4–5 or 8–10 in 2 rows, free or adhering to and enclosing the ovary, odd one

posterior; petals 4–5, equal, perigynous; stamens indefinite, perigynous; styles distinct, often lateral; carpels 1–4, or many, usually apocarpous; ovules 1–2 in each; fruit an achene, drupe, pome, &c.; seeds mainly without albumen.

Order 27. **Saxifragaceæ.**—Herbaceous plants, or shrubs (deciduous); no stipules; flowers regular, epigynous or perigynous; sepals 4–5; petals 4–5 or none; stamens 5 or 10, free, perigynous or hypogynous; styles 2, free, diverging, persistent; ovary superior or inferior; 1-locular, with placentæ 2, parietal, or 2-locular with axile placentæ; fruit a capsule, or berry; seeds many, with fleshy albumen.

Order 28. **Crassulaceæ.**—Herbaceous plants; stem fleshy; leaves fleshy, tufted; no stipules; flowers regular, slightly perigynous; sepals 4–12, united below; petals 4–12, sometimes united, inserted at base of calyx; stamens 8–24, sometimes epipetalous; carpels 5, opposite the petals, free as a rule, 1-celled; fruit aggregate, follicle; seeds with some albumen.

Order 29. **Droseraceæ.**—Herbaceous rosette-plants; leaves insectivorous, glandular, with circinate vernation; flowers regular; sepals 5, overlapping; petals 5; stamens 5, hypogynous or perigynous, free; styles 3 or 5; ovary free, syncarpous, 3–5 carpellary, 1-locular; ovules many on 2–5 parietal placentæ; fruit a capsule, 2–5-valved with seeds on margin of valves; seeds without an aril.

Order 30. **Haloragaceæ.**—Aquatic plants, herbaceous; no stipules; flowers unisexual, apetalous; calyx adnate to ovary, limb minute; sepals 2–4 or none; stamens 8, 4, 2, or 1; styles equal to, or half as many as, cells; ovary inferior, 1-carpellary, or syncarpous and 4-locular; ovule 1 in each loculus; fruit dry, crowned with rim of calyx; seeds pendulous, with fleshy albumen.

Order 31. **Lythraceæ.**—Herbaceous plants; no stipules; flowers regular; calyx tubular; sepals 4–6, valvate in bud; petals 4–6, between sepals, twisted in bud, falling; stamens 8–12, on tube of calyx, below petals; style 1; ovary superior, syncarpous, free, 2-celled; fruit a membranous capsule, 2-valved, 1-celled; seeds many.

Order 32. **Epilobiaceæ** *vĕl* **Onagraceæ.**—Herbaceous plants; leaves alternate or opposite, not dotted; no stipules; flowers regular, epigynous; calyx tubular; sepals 2–4, valvate in bud; petals 2–4, twisted in bud, at top of tube; stamens 2–4, or 8, inserted with petals; style 1; stigma capitate; ovary inferior, syncarpous, 4-locular; placentæ axile; fruit a capsule, many-seeded.

Order 33. **Cucurbitaceæ.**—Herbaceous succulent tendril-climber; plant monœcious or dicœcious; no stipules; calyx 5-partite, tube attached to ovary; corolla 5-partite, bell-shaped, with netted veins; stamens 3, cohering; anthers wavy; style short; stigmas lobed; ovary 3–5-celled; placentæ parietal; fruit a berry; seeds flat, in an aril.

Order 34. **Umbelliferæ.**—Herbaceous plants; leaves much divided, sheathed below; flowers regular, as a rule in a compound umbel; calyx 5-partite, teeth very small, or absent, adhering to the ovary; petals 5, turned inwards; stamens 5, inserted with petals; styles 2, disk fleshy; ovary 2-celled; fruit a schizocarp, of 2 mericarps, adhering by the commissure; seeds solitary, pendulous.

Order 35. **Araliaceæ** *vĕl* **Hederaceæ.**—Shrub, evergreen, root-climber; leaves alternate; stipules none; flowers regular, in simple umbels; sepals 5, adnate to ovary; petals 5, or wanting, valvate in bud; stamens 5, alternate with petals, inserted below disk (epigynous); styles 5; ovary inferior, 5-locular; fruit a drupe, with 5 stones, succulent or dry; seeds solitary, pendulous.

Order 36. **Cornaceæ.**—Herbaceous plants, or shrubs; leaves opposite; stipules none; flowers regular; sepals 4–5, adnate to ovary; petals 4–5 inserted on top of calyx-tube, valvate in bud; stamens 4; style slender; ovary 2-celled; fruit a drupe, with 2 stones, crowned with remains of calyx; seed solitary.

Sub-Class II.—Gamopetalæ (= Corollifloræ).

Perianth, of calyx and corolla, petals united, stamens epipetalous.

Order 37. **Caprifoliaceæ.**—Shrubs (deciduous), twiners, or herbaceous plants; leaves opposite; stipules in some cases; flowers regular or irregular; calyx 4–5-fid, adnate to ovary; corolla 4–5-fid, lobes twisted in bud; stamens 4–5, epipetalous, alternate with corolla-lobes; stigmas 1–3; ovary 1–5-locular, fruit fleshy, 1 or many-celled.

Order 38. **Rubiaceæ.**—Herbaceous plants; stem square; leaves opposite, apparently in a whorl; stipules leafy; flowers regular; calyx very small, superior; corolla lobes 4–6; stamens 4–5, alternate with corolla lobes; style 1, 2-fid sometimes; ovary 1 or 2-locular; fruit indehiscent.

Order 39. **Valerianaceæ.**—Herbaceous plants; leaves opposite; stipules none; flowers usually irregular; calyx superior, rudimentary, like pappus; corolla 5-lobed, tubular, gibbous or spurred; stamens 1 or 3, epipetalous, free; ovary, with 1 fertile cell; ovule solitary, pendulous; fruit dry.

Order 40. **Dipsacaceæ.**—Herbaceous plants; leaves opposite; stipules none; flowers forming a head, each floret with an epicalyx; calyx superior, of 5 bristles surrounded by an outer calyx; corolla 4–5-fid, lobes unequal; stamens 4, epipetalous, free; style 1; stigma simple; ovary 1-celled; ovule pendulous; fruit crowned with pappus-like calyx.

Order 41. **Compositæ** (*Asteraceæ*).—Herbaceous plants, often forming rosettes; no stipules; inflorescence forming a capitulum; flowerheads surrounded by involucre of bracts or phyllaries; calyx superior, absent or hairy pappus; corolla ligulate or tubular, former usually in ray, latter in disk, or either may predominate; stamens 5; anthers united in a cylinder; filaments free; ovary 1-locular; ovule erect; fruit a cypsela, 1-seeded.

Order 42. **Campanulaceæ.**—Herbaceous plants; leaves alternate, entire; no stipules; flowers regular or irregular; calyx superior, entire, or 5-fid; corolla gamopetalous, inserted on calyx; 5-lobed; stamens inserted with corolla, alternate with lobes; anthers distinct or united, 2-celled, opening longitudinally; ovary 2–5-locular; ovules numerous;

placentæ axile; fruit a capsule, opening by valves or fissures, many-seeded.

Order 43. **Vacciniaceæ.**—Shrubs, deciduous or evergreen; leaves alternate; buds clothed with scales; flowers regular, solitary; calyx 4–5 lobed; corolla campanulate, urceolate or rotate; stamens epigynous, 8–10; anthers with appendages; ovary inferior, 4–5-locular; fruit a berry.

Order 44. **Ericaceæ.**—Shrubs and undershrubs, evergreen, rigid; leaves in whorls or scattered, alternate or opposite; buds naked or scaly; flowers regular or irregular; calyx 4–5-fid; corolla campanulate or urceolate, tubular; stamens hypogynous 5, 8 or 10; anthers opening by apical pores; pollen in tetrads; ovary superior; fruit, a berry, drupe or capsule.

Order 45. **Monotropaceæ.**—Saprophyte; leaves scale-like; stem with scales; flowers solitary, in spikes and racemes; sepals 2–6; petals 3–6; stamens hypogynous, 6–12; ovary 4–6 lobed, style simple; capsule membranous; seeds leathery.

Order 46. **Plumbaginaceæ.**—Herbaceous plants; leaves mainly radical, entire; no stipules; flowers regular, in spikes or heads; calyx 5-cleft, inferior; corolla 5-fid; stamens hypogynous, 5, opposite the petals; styles 5, ovary 1-celled; ovule 1, basal; fruit a utricle; seeds inverted.

Order 47. **Primulaceæ.** — Herbaceous plants; leaves radical or cauline; no stipules; flowers regular; calyx inferior, 5-cleft; corolla hypogynous, 4–7-fid; stamens epipetalous; ovary 1-celled, free; ovules numerous; placenta free central; style 1; stigma capitate; capsule 1-celled.

Order 48. **Oleaceæ.** — Trees or shrubs, deciduous; leaves opposite; no stipules; buds scaly; flowers in trichotomous cymes; calyx gamosepalous, inferior, 4-cleft, or absent; corolla 4-partite or absent; stamens 2, hypogynous or epipetalous; ovary 2-celled; style simple or none; ovules 2–3; fruit a berry or samara; seed pendulous.

Order 49. **Apocynaceæ.** — Undershrubs, prostrate, evergreen; leaves opposite or in whorls, entire; flowers regular, solitary; calyx 4–5-fid; corolla hypogynous, 5-cleft; stamens 5, epipetalous; pollen granular; carpels 2, united by styles; stigma 1; fruit 2 follicles.

Order 50. **Gentianaceæ,**—Herbaceous plants; leaves entire, opposite, or whorled, or alternate; no stipules; flowers regular, solitary or in cymes; calyx 4–8-cleft, inferior; corolla 4–8-cleft, hypogynous, rotate, campanulate or funnel-shaped; stamens 4–8, epipetalous; anthers versatile; ovary incompletely 2-locular; placentæ parietal; capsule 1–2-celled; seeds very small.

Order 51. **Polemoniaceæ.**—Herbaceous plants; leaves pinnate, alternate or opposite; no stipules; flowers in terminal cymes; calyx inferior, 5-lobed; corolla hypogynous, 5-lobed; stamens 4–8, unequal, epipetalous; ovary 3-locular; stigma 3-fid; ovules, 1 or more in each cell; fruit, a capsule, 3-celled.

Order 52. **Boraginaceæ.** — Herbaceous plants, rough or hairy; leaves alternate; no stipules; flowers regular or sometimes irregular, in scorpioid cymes; calyx 5-lobed, inferior; corolla hypogynous, 5-lobed, rotate, bell-shaped, tubular or salver-shaped; stamens 5, epipetalous; ovary deeply 4-lobed; style simple; fruit of 4 1-seeded nutlets.

Order 53. **Convolvulaceæ.**—Herbaceous twining plants; leaves alternate (none in *Cuscuta*); no stipules; flowers regular; calyx inferior, 5-lobed; corolla hypogynous, 5-lobed; stamens 5, epipetalous; anthers sagittate; ovary 2-locular, 2 ovules in each cell; style 2–4-fid; capsule 1–4-celled; seeds erect.

Order 54. **Solanaceæ.**—Herbaceous plants or shrubs; leaves alternate, or in unequal pairs; no stipules; flowers regular, in cymes; calyx inferior, 5-cleft; corolla hypogynous, 5-lobed; stamens 5, epipetalous, alternating with corolla lobes; anthers often cohering by tip; ovary 2-locular; ovules numerous; fruit a capsule or berry.

Order 55. **Scrophulariaceæ.**—Herbaceous plants, leaves alternate or opposite, or whorled; with stipules; flowers irregular; calyx inferior, 4–5-lobed; corolla often personate, 4–5-lobed; stamens 4, in pairs, 2 or 5, epipetalous; ovary 2-celled; ovules numerous; placentæ axile; fruit a capsule, many-seeded, 2-celled.

Order 56. **Orobanchaceæ.**—Herbaceous parasitic plants; leafless, with scales; flowers irregular, in terminal spikes or racemes; calyx 4–5-fid, inferior; corolla hypogynous 2-lipped, 4–5-fid, gaping; stamens 4, in pairs, didynamous, epipetalous; ovary 1-locular, of 2 carpels; ovules many; fruit a capsule, 1-celled.

Order 57. **Lentibulariaceæ.**—Herbaceous aquatic or marsh plants; leaves radical, entire, sometimes with bladders on multifid leaf-segments; no stipules; flowers irregular, solitary, in raceme or corymb; calyx inferior, persistent, 2-lobed or 5-partite; stamens 2, hypogynous or epipetalous; anthers 1-celled; ovary 1-celled, of 2 carpels, free; stigma of 2 lamellæ; fruit a capsule, 1-celled; seeds many.

Order 58. **Verbenaceæ.** — Herbaceous plant; leaves opposite or in whorls; no stipules; flowers irregular, in cymes; calyx inferior, tubular, persistent; corolla tubular, hypogynous, 2-lipped; stamens 4, in pairs, unequal, or 2; epipetalous; anthers 2-celled; ovary 4-locular, rounded; style terminal, 1; ovules 4; fruit of 4 nutlets; seeds without albumen.

Order 59. **Labiatæ** (*Lamiaceæ*).—Herbaceous plants; stems square, leaves in opposite pairs, decussate; no stipules; flowers irregular in whorled cymes; calyx inferior, 5-cleft, 2-lipped; corolla 2-lipped, hypogynous, upper lip entire or 2-fid, lower regular or 3-fid; stamens 4, in pairs, unequal, epipetalous; ovary 4-lobed, 4-locular; fruit of 4 nutlets.

Order 60. **Plantaginaceæ.**—Herbaceous plants, scapigerous; leaves radical, forming a rosette, or alternate; flowers regular, in spikes; calyx 4-lobed; corolla hypogynous, membranous; stamens 4, epipetalous, rarely hypogynous; anthers versatile; ovary 2–4-celled, free; style and stigmas slender; fruit a capsule, circumsciss, membranous; seeds peltate.

Sub-class III.—Apetalæ

Perianth in a single whorl, as a rule, corolla, and frequently calyx absent. Flowers in catkins, or not; ovary superior or inferior; stigmas 2–3, or single.

Order 61. **Illecebraceæ.** — Herbaceous plants; stems branched; leaves entire; stipules membranous; flowers in cymes, bisexual; sepals 4–5, persistent, enclosing fruit; petals small or absent; stamens hypogynous or perigynous; ovary 1-celled, free; ovule 1.

Order 62. **Amarantaceæ.**—Herbaceous plants; no stipules; flowers unisexual; perianth 3–5-partite, membranous; stamens 3 – 5, opposite perianth lobes, hypogynous; ovary 1-celled, free; ovule 1; stigmas 3.

Order 63. **Chenopodiaceæ.**—Herbaceous plants; leaves alternate; no stipules or sheaths; flowers 1–2-sexual, with or without bracts, perianth 3–5-partite, persistent; stamens 5 or 3, opposite the perianth lobes; anthers 2-celled; ovary 1-locular; 1 ovule; stigmas 2; fruit a utricle enclosed in perianth.

Order 64. **Polygonaceæ.**—Herbaceous plants; leaves alternate, with sheathing membranous stipules (ochreæ); flowers bisexual; perianth 5–6-partite, petaloid or not; persistent; stamens 5–8, from base of perianth, opposite the perianth lobes; ovary 1-celled, free; styles 1–3; ovule 1, erect; fruit a hard nut.

Order 65. **Aristolochiaceæ.**—Herbaceous plants or shrubs; leaves alternate; no stipules; flowers bisexual, solitary or axillary, regular or irregular; perianth superior, 3-lobed, bell-shaped or trumpet-shaped; stamens 6–12, epigynous; ovary 6-locular; styles 6; ovules many; fruit a capsule or berry.

Order 66. **Thymelæaceæ.**—Shrubs, evergreen, or deciduous; leaves alternate, entire; without stipules; flowers bisexual; perianth inferior, tubular, petaloid, 4–5-fid; stamens 8, in 2 series; anthers 2-celled; ovary 1–2-celled, free; ovules 1–3, pendulous; fruit a drupe or berry.

Order 67. **Elæagnaceæ.** — Shrub, deciduous, spinous; plant dicœcious; leaves alternate; male flowers in axillary clusters; perianth 2-lobed; stamens 4; female flowers solitary, perianth tubular, style short; stigma long; nut 1-seeded, enclosed in calyx-tube.

Order 68. **Loranthaceæ.** — Shrub, evergreen, parasitic; stem jointed; leaves opposite, without stipules; plant dicœcious; flowers small, green; perianth superior, 4-partite; stamens 4, adnate to perianth lobes; anthers sessile; stigma sessile; ovary 1-locular; fruit a berry, 1-seeded.

Order 69. — **Santalaceæ.** — Herbaceous plants, hemiparasitic on roots; leaves alternate; no stipules; flowers bisexual; solitary, or in cymes or racemes; perianth 5-lobed, persistent, with tuft of hairs on face of lobes, adnate to ovary; stamens 5; filaments short; ovary 1-celled; style short; stigmas 1–5; ovules 2–5, placenta central; fruit 1-celled, 1-seeded.

Order 70. **Euphorbiaceæ.**—Herbaceous plants or shrubs, with or without milky latex; leaves alternate; stipules present sometimes; flowers 1–2 sexual; perianth lobed or not; male flowers with 1 or more stamens; anthers 2-celled; female flowers with superior 2–3-lobed, 2–3-celled ovary; stigma simple or compound. Capsule 2–3-celled, opening by elastic mechanism; 1–2 seeds in each cell.

Order 71. **Ulmaceæ.**—Trees, deciduous; leaves alternate; stipules soon falling; flowers 2-sexual, not in catkins; perianth inferior, 4–8 cleft, bell-shaped; stamens 4–8 on perianth and opposite lobes; ovary 1–2-celled; ovules solitary; styles 2; fruit a samara.

Order 72. **Urticaceæ.** (Plants monœcious or dicœcious as a rule.)—Herbaceous plants, some twining; leaves opposite or alternate, often with stinging hairs; stipules present; flowers 1-sexual, male inflorescence in a panicle, female inflorescence in catkins; perianth inferior, 4–5 partite; stamens 4–5; inflexed in bud; on perianth; ovary 1-celled, free; ovules solitary; fruit an achene.

Order 73. **Myricaceæ.** (Plant dicœcious or monœcious.)—Shrub, deciduous, aromatic; leaves alternate; no stipules; flowers in axillary catkins; bracts overlapping; stamens 6–8, ovary 1-celled; styles 2; fruit a drupe, with waxy coat.

Order 74. **Amentaceæ** (*Cupuliferæ*).—Trees or shrubs, deciduous; leaves alternate; with stipules; plants monœcious; bracts forming a 3–5-lobed scale; male flowers in spikes; stamens 2–20; anthers 2-celled; female flowers with calyx adnate to ovary, or absent; ovary inferior, 2–3-locular, ovules 2–6; fruit a nut, winged or not, free or enclosed in cupule.

Order 75. **Salicaceæ.**—Tree or shrubs, deciduous; leaves alternate; with stipules; plants dicœcious or monœcious; flowers in catkins, before leaves; bracts simple; no perianth; stamens 1 or 2 or more; ovary 1-celled, superior; ovules many; placentæ parietal; styles 2; stigmas 2; fruit a capsule, 2-valved; seeds many, with tuft of hairs.

Order 76. **Empetraceæ.** — Shrub, heath-like, leaves alternate; no stipules; flowers regular, bisexual or plant dicœcious; perianth of 6 scales, hypogynous; stamens 3–4; anthers 2-celled; pollen compound; ovary 3–9-celled; 1 ovule in each cell; fruit a drupe.

Order 77. **Ceratophyllaceæ.**—Aquatic plants, submerged; leaves in whorls, multifid; spinose; no stipules; plants monœcious; flowers axillary; perianth or involucre 8–12 partite; stamens 6–12; ovary 1-celled; ovule 1, pendulous.

CLASS II.—MONOCOTYLEDONS

Cotyledon 1 (if more, alternate); leaves parallel veined; usually alternate, sheathing; parts of flower in 3's or 6's or 9's, &c., rarely in fours; wood in scattered bundles, not in rings; no medullary rays.

Sub-class I.—Petaloideæ
Orders 78–84, 88–90.

Flowers usually bisexual, perianth in 2 rows, inner or both petaloid, hypogynous; ovary inferior or superior.

Series MICROSPERMEÆ

Order 78. **Hydrocharidaceæ.**—Aquatic plants, floating or submerged; flowers regular, 1-sexual; perianth 6-partite, in 2 series, inner petaloid; stamens 3 or more, epigynous; ovary inferior; 1- or 3–6-locular; styles free; fruit a berry.

Order 79. **Orchidaceæ.**—Herbaceous plants; roots tuberous; flowers in spikes, 2-sexual, irregular; sepals 3, reversed; petals 3, 2 above, 1 below, spurred as a rule; stamens 1 or 2, adnate to style; ovary 1-locular; ovules many, placentæ 3, parietal; fruit a capsule; seeds numerous, minute.

Series EPIGYNEÆ

Order 80. **Iridaceæ.**—Herbaceous plants; with rhizome or corm; leaves equitant, ensiform, &c.; flowers 2-sexual, regular; perianth tubular, 6-partite, petaloid, in 2 rows as a rule; stamens 3, epigynous; anthers extrorse; ovary 3-locular; ovules numerous; placentæ axile; stigmas 3, sometimes petaloid; fruit a capsule.

Order 81. **Amaryllidaceæ.**—Herbaceous plants, bulbous; leaves narrow; flowers regular, bisexual; perianth superior, 6-partite, petaloid; stamens 6, distinct on base of perianth-tube; with corona sometimes; anthers introrse; ovary globose, 3-celled; ovules many; placentæ axile; fruit a capsule, 3-valved.

Order 82. **Dioscoreaceæ.**—Herbaceous plant, twining; plant diœcious, leaves alternate, net-veined; flowers unisexual, in axillary racemes; perianth petaloid, superior, 6-partite; stamens 6, on perianth-segments; anthers introrse; ovary inferior, 3-celled; styles 3; fruit a berry; seeds few.

Series CORONARIEÆ (and see Order 90)

Perianth in 2 series, petaloid or not; ovary superior, syncarpous; seeds albuminous.

Order 83. **Liliaceæ.**—Herbaceous plants, rarely evergreen undershrubs; flowers bisexual as a rule and regular; perianth petaloid, inferior, 6-partite; stamens 6, hypogynous, or on the perianth; anthers introrse; ovary 3-celled, superior; ovules several in each cell; styles 1 or 3; fruit a capsule or berry.

Order 84. **Juncaceæ.**—Herbaceous plants, with grass habit; leaves narrow, slender, flat or channelled; flowers bisexual; perianth 6-partite, segments membranous, sepaloid, glumaceous; stamens 6, on base of segments; anthers 2-celled; ovary 1–3-locular, ovules 3, or many; placentæ axile, parietal, or basal; fruit a capsule, 3-valved.

SUB-CLASS II.—SPADICIFLORÆ (*Nudifloræ*)

Perianth rudimentary or wanting; ovary superior, syncarpous or 1-carpellary; flowers unisexual, in spadix with or without spathe.

Order 85. **Typhaceæ.**—Plants aquatic or marsh plants, herbaceous; leaves linear, rigid; sheathed below; flowers in spadix without spathe; plants monœcious; perianth of scales or hairs, or absent; stamens 3 or 6; filaments long; anthers wedge-shaped, basifixed; ovary 1–2-celled, superior; style persistent; ovule 1, pendulous; fruit a utricle or drupe.

Order 86. **Araceæ** (*Aroideæ*). — Herbaceous plants; leaves net-veined, broad; flowers in spadix, with spathe; flowers 1–2-sexual; perianth 6-partite, hypogynous, scale-like, or none; stamens 6 or fewer; filaments short, or none; anthers extrorse; ovary superior, 1- or more celled; fruit a berry; seeds few or many.

Order 87. **Lemnaceæ.**—Plants aquatic, floating, leafless, frondose, proliferous, small, cellular; flowers in hollow of frond; plants monœcious; flowers in spathe, 1–3; perianth none; stamens 1–2, distinct; ovary 1-celled; style short; stigma simple; fruit not opening; carpel 1.

SUB-CLASS I.—PETALOIDEÆ (and see Orders 78–84

Series APOCARPEÆ

Order 88. **Alismaceæ.**—Aquatic or marsh plants; leaves mainly radical, net-veined; flowers usually bisexual; perianth 6-partite, wholly or in part petaloid; stamens 6 or more, hypogynous; ovary superior, 3–6 or more, distinct carpels; fruit aggregate of achenes or follicles.

Order 89. **Naiadaceæ.** — Aquatic or marsh plants, herbaceous; leaves floating or submerged, parallel-veined; hermaphrodite, monœcious or diœcious; perianth of 4 scales or none; stamens 1–4, hypogynous; ovary superior; carpels 1–4, apocarpous; ovule 1; fruit 1-celled, 1-seeded.

Series CORONARIEÆ (and see Orders 83 and 84)

Order 90. **Eriocaulonaceæ.**—Herbaceous plants; leaves linear, with grass habit; flowers 1-sexual, small, in head, with involucre; perianth of 2–6 scales, 3 inner, 3 outer; stamens 2–6; anthers 2-celled; ovary 2–3-celled, superior; ovule 1, pendulous; stigmas 2–3; fruit a capsule, 2–3-valved.

SUB-CLASS III.—GLUMACEÆ (*Glumifloræ* in part)

Flowers in spikes, with glumes; perianth of scales or absent; ovary 1-celled; ovule 1; styles 2–3; stigmas 2–3.

Order 91. **Cyperaceæ.**—Plants herbaceous, with grass habit; stem 3-angled, solid; leaves in 3 ranks; sheaths entire; flowers 1–2-sexual, in axils of glumes of spikelets; perianth of hypogynous scales or 3–6 bristles; stamens 1–3; ovary 1-locular; style 1; stigmas 2–3; ovule 1; fruit a nut or achene.

Order 92. **Graminaceæ.** — Plants herbaceous, grass-like; stem hollow between nodes; leaves in 2 rows; sheaths split; flowers 2-sexual as a rule, sessile, in spikelets; enclosed in glumes and paleæ; perianth of scales or none; stamens 3; anthers versatile; ovary 1-locular; stigmas 2, feathery; style none; ovule 1; fruit a caryopsis or false achene.

APPENDIX II

THE GENERA OF BRITISH FLOWERING PLANTS

In the following summary 520 genera are included. A few must be regarded as British, only because the species have become established here in various ways. The European flora includes a far larger number of genera; and of the British genera none can be regarded as peculiar, so intimately allied is the British insular flora to that of the mainland. Had one included all the genera noticed in this country, embracing a large number of species (1000 or more) whose occurrence is more or less accidental, sporadic, or ephemeral, the list would have been considerably extended. (See Druce's *List of British Plants*, Oxford.) But many of the plants that have found a place here are little removed from the garden, their place of origin, or similar habitats, and one cannot include here many species that figure in horticultural lists, since they may persist spontaneously for but a year and then disappear. As, however, such plants come, from time to time, to establish themselves widely and tenaciously in these islands, one can no longer ignore their claim to a place in our flora, cosmopolitan and adventitious as a large part of it must be considered. This is the line adopted here.

Order 1. Ranunculaceæ

1. **Clematis.**—Climbing shrub; leaves opposite; sepals valvate, 4–6; fruit an achene; styles feathery, persistent, many; stamens many.

2. **Thalictrum.**—Herbaceous plants; involucre 0; sepals imbricate, 4–5, petaloid; fruit an achene, without awns; styles and stamens many.

3. **Anemone.**—Involucre of 3 leaves; sepals, 5–20, petaloid; carpels in head, not bursting, tipped with persistent styles; styles and stamens many; fruit an achene.

4. **Adonis.**—Involucre 0; calyx of 5–8 sepals; petaloid; petals 5–16; no honey glands; carpels awnless, not bursting; stamens and styles many.

5. **Myosurus.**—No involucre; sepals 5, spurred; petals 5, with tubular claw; receptacle elongated; stamens 5; carpels imbricate; seed pendulous.

6. **Ranunculus.**—Sepals imbricate, 5, rarely 3; petals 5, rarely more, with honey glands; with or without a scale; carpels not bursting, in head; fruit an achene; seed ascending.

7. **Caltha.**—Sepals imbricate 5, petaloid, deciduous; no petals; follicles 5–10, many-seeded, bursting; stamens numerous.

8. **Trollius.**—Sepals 5, imbricate, deciduous, petaloid; petals 5–15, small, clawed; flowers globular; follicle many-seeded.

9. **Helleborus.**—Sepals 5, green, persistent; petals 8–10, tubular, with long claw, 2-lipped; follicles 3–10, sessile, many-seeded.

10. **Eranthis.**—Sepals 5–8, petaloid, deciduous; petals 5, small, 2-lipped, tubular, claw long, inner lips short; follicles stalked, 3–8, many-seeded.

11. **Aquilegia.**—Sepals 5, petaloid, deciduous; petals 5, funnel-shaped, irregular, with horn-like spur; follicles 5.

12. **Delphinium.**—Flowers irregular; sepals 5, petaloid, deciduous, dorsal (upper) spurred; petals 4, 2 upper enclosed in spurred sepal; follicles 1, 3, or 5, many-seeded.

13. **Aconitum.**—Flowers irregular; sepals 5, petaloid, upper one hooded, helmet-shaped; petals 2–5, 2 upper tubular on long stalks enclosed in spurred sepal; follicles 3–5, many-seeded.

14. **Actæa.**—Flowers more or less regular; sepals 4, petaloid, soon falling; petals 4, small; fruit a berry, many-seeded, not bursting.

15. **Pæonia.**—Flowers regular; sepals 5, persistent; petals 5, or more; follicles 2–5, many-seeded, opening inwards.

Order 2. Berberidaceæ

16. **Berberis.**—Shrub, with spines; flowers yellow, in raceme; sepals, petals, stamens, 6; fruit a berry, 2–3-seeded.

17. **Epimedium.**—Herbaceous, woody plant; sepals 4, deciduous; petals 4; stamens 4; nectaries 4; fruit a capsule, many-seeded.

Order 3. Nymphæaceæ

18. **Nymphæa.**—Flowers regular, yellow; sepals 5–6; petals numerous, on receptacle; stigma sessile, with many rays; fruit a berry, many-seeded.

19. **Castalia.**—Flowers white; sepals 4, green; petals numerous, on disk or base of ovary; fruit a berry, many-seeded.

Order 4. PAPAVERACEÆ

20. **Papaver.** — Petals 4; stamens numerous; stigma a 4–20-rayed, nearly sessile disk; fruit a capsule; opening by pores.

21. **Meconopsis.**—Petals 4; stamens numerous; stigma 5–6-rayed, free; style short, club-shaped; fruit a capsule, oblong, opening by pores.

22. **Glaucium.**—Flowers large; petals 4; stamens numerous; stigmas 2; fruit a capsule, 2-celled; seeds not crested.

23. **Rœmeria.**—Flowers violet; petals 3; stamens numerous; stigmas 2–4, radiant; fruit a capsule, 2–4-valved, 1-celled; seeds not crested.

24. **Chelidonium.**—Flowers yellow, small; petals 4; stigmas 2; fruit a capsule, 2-valved; seeds crested.

Order 5. FUMARIACEÆ

25. **Corydalis** (*Capnoides*).—Flowers irregular; sepals 2, or 0; petals 4, upper spurred below; stamens diadelphous; fruit a pod, 2-valved; many-seeded, opening.

26. **Fumaria.**—Sepals 2; petals 4, upper spurred below; stamens diadelphous; fruit a nut, 1-seeded, not opening.

Order 6. CRUCIFERÆ

27. **Matthiola.**—Flowers purple; stigma 2-lobed, lobes erect, gibbous or horned on back; fruit a pod, round or flattened, linear.

28. **Cheiranthus.**—Flowers yellow; lateral sepals saccate; lobes of stigma spreading; pod compressed or 2-edged, with rib on each valve; seeds in single row in each cell.

29. **Radicula** (*Nasturtium*).—Pods round in section, short, linear; valves turgid, nerveless; seeds in 2 irregular rows, small.

30. **Barbarea.**—Pod round or 4-angled in section, linear; valves convex, with longitudinal rib; seeds in 1 row, oblong.

31. **Arabis.**—Pods flattened, linear; valves not elastic, 1-nerved with prominent rib; seeds in 1 or 2 rows.

32. **Cardamine.**—Pod flattened; valves elastic, nerveless; funicle slender.

33. **Dentaria.**—Like 32, but funicle dilated.

34. **Alyssum.**—Petals entire; filaments simple or toothed, shorter with a gland each side below, pouch compressed, oval; seeds 2–4 in each cell.

35. **Draba.** — Petals entire; filaments simple; pods oblong, flat, seeds in 2 rows, not margined.

36. **Erophila.**—Petals notched; pods oblong, linear, turgid.

37. **Cochlearia.**—Petals entire; filaments simple; pouch round, turgid; valves convex, dorsal vein prominent; seeds many.

38. **Hesperis.**—Stigma 2-lobed, lobes erect, decurrent on style; pod 4-sided or flattened, valves keeled, 3-veined; seeds in single row.

39. **Sisymbrium.** — Stigma blunt; pods round in section or 4-angled; valves convex, 2-nerved; seeds in 1 row, smooth, funicle slender.

40. **Erysimum.**—Stem leaves not heart-shaped; stigma blunt; pod 4-edged; valves with prominent rib, and 1 longitudinal vein; seeds in 1 row, funicle slender.

41. **Conringia.**—Like 39, but stem-leaves heart-shaped, clasping; flowers white.

42. **Camelina.**—Stem-leaves stalkless, auricled; pod sub-oval; valves inflated, with projection adnate to style, 1-nerved; seeds numerous in 2 rows.

43. **Subularia.** — Aquatic, scapigerous; leaves awl-like; pod oval, flattened, valves boat-shaped; cells 4-seeded.

44. **Brassica.** — Flowers yellow; calyx erect; pods round in section or angled, beaked; seeds in 1 row, round.

45. **Diplotaxis.**—Flowers yellow; calyx spreading; pods flattened, seeds in 2 rows, flattened.

46. **Capsella** (*Bursa*). — Flowers white; silicle triangular, inversely heart-shaped; valves flattened, keeled; seeds many.

47. **Coronopus** (*Senebiera*). — Silicle wrinkled, didymous, not opening, kidney-shaped, entire at end, or notched above and below, 2-jointed, 2-seeded.

48. **Lepidium.**—Petals equal; silicle round, oblong, entire or notched, valves flat, keeled; cells 1–2-seeded.

49. **Thlaspi.**—Petals equal; filaments without scales, simple; silicle round, notched, inversely ovate; valves winged; seeds 4–8 in each cell.

50. **Iberis.** — Petals unequal, 2 outer larger; filaments simple; silicle rounded, notched; valves boat-shaped, keeled, winged at back; seeds 1 in each cell.

51. **Teesdalia.**—Petals unequal; filaments with scales at base; silicle round or oblong, notched; valves boat-shaped, keeled below, slightly winged above; seeds 2 in each cell.

52. **Hutchinsia.**—Petals equal; filaments without scales; silicle elliptic, entire, oblong; valves boat-shaped, keeled, not winged at back; seeds 2 in each cell.

53. **Isatis.** — Silicle indehiscent, 1-celled, 1-seeded, flat, oblong; valves keeled, at length separating.

54. **Crambe.** — Silicle, 2-jointed, lower joint slender, seedless, upper round, 1-seeded.

55. **Cakile.**—Silicle angular; joints 2, indehiscent, 1-seeded, upper deciduous, sessile, ensiform with an erect seed; lower persistent, seedless, or with 1 pendent seed, inversely conical, 2-edged.

56. **Raphanus.**—Pod jointed, linear, oblong, tapered above, indehiscent, or moniliform and divided into 1-seeded cells, lower seedless, 2-valved.

Order 7. RESEDACEÆ

57. **Reseda.**—Calyx many-partite, sepals divided; petals unequal; stamens 10–40; styles 3–6; fruit 1-celled.

Order 8. Cistaceæ

58. **Helianthemum.**—Sepals 5, 2 outer smaller; petals regular, 5, deciduous, white or yellow; stamens numerous, free; capsule 3-valved.

Order 9. Violaceæ

59. **Viola.**—Sepals 5, produced at the base; petals 5, unequal, the lower spurred; stamens 5; anthers united, 2 lower spurred.

Order 10. Polygalaceæ

60. **Polygala.**—Sepals 5, persistent, 2 inner winged, petaloid; corolla irregular, petals 3–5, united, lower keeled; capsule flattened; seeds solitary.

Order 11. Frankeniaceæ

61. **Frankenia.**—Style 3-fid, lobes oblong with stigma on inner side; capsule 1-locular, 3–4-valved.

Order 12. Caryophyllaceæ

62. **Dianthus.**—Calyx gamosepalous, with 2 opposite bracts below, 5-toothed; styles 2, free; capsule 4-valved, 1-celled; seeds many, peltate, keeled.

63. **Tunica.**—Like 62; petals narrowed below, wedge-shaped.

64. **Saponaria.**—Calyx without bracts below, round in section, 5-toothed; styles 2; capsule 4-valved above, 1-celled; seeds granulate.

65. **Silene.**—Calyx 5-toothed; styles 3–4; capsule 3- or 6-valved, with 6 apical teeth.

66. **Cucubalus.**—Calyx 5-toothed; styles 3; capsule a berry, 1-seeded, globular.

67. **Lychnis.**—Calyx 5-toothed; petals, with scale below; styles 5; capsule 5-celled, opening above by 5 or 10 teeth.

68. **Holosteum.**—Sepals 5; petals 5, jagged; stamens 3–5; styles 3; capsule 6-valved, cylindrical.

69. **Cerastium.**—Sepals 5; petals 5, 2-fid; stamens 4–10; styles 4–5; capsule tubular, opening above by 10 teeth.

70. **Stellaria.**—Sepals 5; petals 5, 2-fid; stamens 10; styles 3–5; capsule globose, 6–10-valved; seeds many.

71. **Arenaria.**—Sepals 5; petals 5, entire or slightly notched; stamens 8–10; styles 3–5; capsule 3–10-valved.

72. **Sagina.**—Sepals 5 entire; petals 4–5, entire, or 0, shorter than sepals; stamens 4–10; styles 4–5; capsule 4–5-valved; seeds wingless, uniform.

73. **Spergula.**—Stipules membranous; sepals 5; petals 5 entire, as long as calyx; stamens 5–10; styles 5; capsule 5-valved; seeds many.

74. **Spergularia.**—Sepals 5, petals 5, entire; stamens 5–10; styles 3 or 5; fruit a capsule 3-valved.

75. **Polycarpon.**—Sepals keeled on back; petals 5, notched; stamens 3–5; styles 3, united below, short; capsule 1-celled; seeds many.

Order 13. Portulaceæ

76. **Portulaca.**—Calyx 2-fid, falling; petals 4–6, distinct or united below; stamens 8–15 distinct.

77. **Claytonia.**—Sepals 2, persistent; petals 5, free; stamens 5, opposite and adnate to petals; style 3-cleft; capsule 3-valved, globose; seeds 3.

78. **Montia.**—Sepals 2, persistent; petals 5, united below; stamens on throat of tube; style short; stigmas 3; capsule 3-valved.

Order 14. Tamaricaceæ

79. **Tamarix.**—Shrub; sepals 4–5; petals 4–5; styles 3; seeds crowned with tuft of hairs.

Order 15. Elatinaceæ

80. **Elatine.**—Aquatic; sepals, petals, stamens and styles 3–4; capsule 3–4-celled.

Order 16. Hypericaceæ

81. **Hypericum.**—Flowers yellow; sepals 5; petals 5; styles 3 or 5; capsule 3-celled; seeds numerous.

Order 17. Malvaceæ

82. **Althæa.**—Calyx double; inner 5-fid; outer of 6–9 lobes, united below; styles numerous; carpels in a ring, 1-seeded.

83. **Lavatera.**—Calyx double, inner 5-fid, outer 3-lobed, united below; styles many; carpels in a ring, 1-seeded.

84. **Malva.**—Calyx double, inner 5-fid, outer of 3 free segments; carpels in a ring, 1-seeded.

Order 18. Tiliaceæ

85. **Tilia.**—Trees; sepals 5, deciduous; petals 5, with or without a scale below; stamens numerous, free or not; style 1; capsule 1-celled; seeds 1–2.

Order 19. Linaceæ

86. **Radiola.**—Sepals 4, united below, 3-fid; petals 4; stamens 4; styles 4; capsule 8-celled, 8-valved.

87. **Linum.**—Sepals 5, entire; petals, stamens, styles 5; capsule 10-celled, 10-valved.

Order 20. Geraniaceæ

88. **Geranium.**—Sepals 5; petals 5; stamens 10, all functional; carpels rounded above, of cocci, 1-seeded; awns not spirally coiled.

89. **Erodium.**—Sepals and petals 5; stamens 5; staminodes 5; carpels with 2 depressions above; awn spirally coiled.

90. **Oxalis.**—Sepals 5, united below; petals 5, united below; stamens 10; styles 5; capsule 5–10-valved, cells with 2 or more seeds.

91. **Impatiens.**—Sepals 3, petaloid, lower hooded, spurred; petals 3, upper symmetrical, lateral unequally 2-lobed; stamens 5; anthers united; capsule explosive; cells 2 or more seeded.

Order 21. AQUIFOLIACEÆ

92. **Ilex.**—Tree; calyx 4–5-fid; corolla rotate, 4–5-fid; stamens and stigmas 4–5; fruit fleshy, indehiscent.

Order 22. CELASTRACEÆ

93. **Euonymus.**—Shrub; flowers in cyme; calyx 4–5-lobed; petals and stamens 4–5, on margin of disk, perigynous; ovary 3–5-celled; fruit reddish; seeds with orange aril.

Order 23. RHAMNACEÆ

94. **Rhamnus.** — Shrubs; calyx 4–5-cleft, pitcher-shaped; petals 4–5, or 0, perigynous; stamens 4–5; fruit fleshy, a berry, 2–4-celled.

Order 24. ACERACEÆ

95. **Acer.**—Trees; calyx 5-partite; petals 5; stamens 8; fruit a schizocarp of 2 winged samaras.

Order 25. LEGUMINOSÆ

96. **Lupinus.** — Leaves digitate; calyx deeply 2-fid; keel rostrate; style slender, curved; stigma capitate; pod flat.

97. **Genista.** — Leaves simple; calyx shortly 2-lipped, toothed; style awl-like; stigma terminal; corolla longer than calyx.

98. **Ulex.** — Leaves simple; calyx deeply 2-lipped, coloured, with small bracts below, nearly as long as corolla; pod thick, seeds few.

99. **Cytisus.** — Leaves 3-nate; calyx 2-lipped; upper lip 2-fid, lower 3-fid; style long, curved; pod flat.

100. **Ononis.** — Leaves 3-nate; calyx 5-cleft, segments narrow, linear; keel beaked; stigma terminal; pod thick.

101. **Trigonella.**—Flowers in short racemes; calyx teeth 5, sub-equal; petals distinct, falling; filaments not adhering to claws of petals; pods flat, slightly curved, longer than corolla, opening; seeds numerous.

102. **Medicago.**—Flowers in short racemes; calyx teeth 5, sub-equal; keels blunt; filaments slender; pod spiral; seeds numerous.

103. **Melilotus.** — Flowers in long one-sided racemes; keel free; pods nearly straight, short, not opening; seeds 1–4.

104. **Trifolium.**—Flowers in head; calyx teeth 5, unequal; keel adnate; petals persistent; filaments enlarged above, adhering to claws of petals; pod short, nearly straight; seeds 1–4.

105. **Anthyllis.**—Leaves pinnate; calyx tubular, inflated, including pod with 5 unequal teeth; keel not beaked; style slender; stigma capitate.

106. **Lotus.**—Flowers in umbel; calyx teeth 5, sub-equal, not inflated; keel beaked; pod straight, linear, exserted; seeds several.

107. **Astragalus.**—Leaves pinnate, no tendrils; calyx with 5 teeth; keel blunt; pod continuous, imperfectly 2-celled, lower suture inflexed.

108. **Oxytropis.**—Keel beaked, with incurved tip; pod with upper suture inflexed.

109. **Coronilla.**—Flowers in an umbel; claw of petals as long as calyx; pod long, straight, jointed, 4-angled.

110. **Ornithopus.**—Flowers in an umbel; pod flat, many-jointed, of 1-seeded joints.

111. **Hippocrepis.**—Flowers in an umbel, yellow; pod flat, of many curved, 1-seeded joints.

112. **Onobrychis.**—Flowers in racemes, pink or red; keel blunt; pod flat, 1-celled, 1-seeded, 1-jointed, hard.

113. **Vicia.** — Leaves pinnate, with tendrils; calyx 5-fid; style slender, hairy all over above, or bearded below.

114. **Lathyrus.** — Leaves pinnate or simple, with tendrils; calyx 5-fid; style flattened upwards, hairy below stigma on upper face.

Order 26. ROSACEÆ

115. **Prunus.** — Tree; calyx 5-cleft, falling; petals 5; styles 1–5, united; drupe fleshy, not bursting; stone smooth or furrowed.

116. **Spiræa.**—Leaves compound; calyx 5-cleft; petals 5; stamens numerous, on disk adhering to calyx; fruit of 3–12 follicles, inserted on calyx-tube.

117. **Rubus.** — Shrubs; calyx 5-partite, persistent; petals 5; styles numerous; carpels free; fruit an aggegate of numerous succulent drupels, on spongy, conical receptacle.

118. **Dryas.**—Leaves simple; scape 1-flowered; calyx 8–10-cleft, in 1 row; petals 8; stamens numerous; styles persistent, hairy, not jointed, tipping the fruit; fruit of many awned achenes enclosed in top-shaped receptacles.

119. **Geum.**—Leaves pinnate; calyx 10-cleft in 2 rows (i.e. with epicalyx); stamens numerous; styles jointed, hooked, elongating after flowering; fruit on long fleshy receptacle.

120. **Fragaria.**—Leaves 3-foliolate; petals 5; stamens numerous; receptacle large, succulent, pulpy, deciduous; fruit of small 1-seeded nutlets sunk in receptacle.

121. **Potentilla.** — Leaves 3- many foliolate; calyx 8–10-partite, with smaller epicalyx; petals 4–5; stamens numerous; style not elongating after flowering, lateral or sub-terminal; fruit on short, dry receptacle.

122. **Alchemilla.** — Calyx 4–5-lobed, with 4–5 bracts; apetalous; stamens 1–4 in ring on throat of calyx, opposite epicalyx lobes; nuts 1–5.

123. **Agrimonia.**—Calyx 5-lobed, without scales; tube turbinate, armed with hooked bristles above; petals 5; stamens 12–20; achenes 2.

124. **Poterium.** — Calyx of 4 lobes, petaloid, with 3 scales below; petals none; stamens 4–30; nuts 2–3.

125. **Rosa.**—Shrubs; calyx 5-fid, urn-shaped, fleshy at length; petals 4–5; stamens numerous; fruit of several achenes enclosed in receptacle.

126. **Pyrus.**—Trees or shrubs; calyx 5-toothed; petals 5; styles 2–5, united; fruit fleshy (a pome), cells cartilaginous, 2–5, distinct, 2-seeded.

127. **Mespilus.**—Tree; sepals 5, large, leafy; petals 5; styles 2–5; fruit turbinate, endocarp bony, exposed above.

128. **Cratægus.** — Calyx-segments 5, acute; petals 5; styles 1–5; fruit a drupe, oval, with 1–5 long stones, 1–2-seeded.

129. **Cotoneaster.** — Calyx-segments 5; petals 5; styles 2–5; fruit a drupe, turbinate, with 3–5 half-exserted stones, not cohering at centre.

Order 27. Saxifragaceæ

130. **Saxifraga.** — Herbaceous plants; calyx 5-fid; petals 5; stamens 10; styles 2; ovary 2-celled; fruit a capsule.

131. **Chrysosplenium.** — Herbaceous plants; calyx 4-fid; petals 0; stamens 8–10; styles 2; capsule 1-celled, 2-beaked.

132. **Parnassia.** — Herbaceous plants; calyx inferior, 5-cleft; petals 5; stamens 5, perigynous, with 5 scales; stigmas 3–4; capsule 1-celled.

133. **Ribes.**—Shrubs; calyx 5-cleft, superior; petals 4–5; stamens 4–5; ovary 1-celled; fruit a berry, many-seeded, crowned with persistent calyx.

Order 28. Crassulaceæ

134. **Tillæa.**—Leaves opposite; sepals, petals, and stamens 3–4; no scales; carpels 3–4, 2-seeded.

135. **Cotyledon.**—Leaves alternate; sepals 5; petals 5, united below; stamens 10, inserted on corolla; scales 5.

136. **Sedum.**—Leaves alternate; sepals and petals 5; stamens 10–12; scales entire; carpels 5–6; seeds numerous.

137. **Sempervivum.**—Succulent; leaves alternate; sepals 6–10; petals 6–20; stamens 12–40; scales laciniate.

Order 29. Droseraceæ

138. **Drosera.**—Leaves glandular; sepals, petals, and stamens 4–8; styles 3–5, 2-fid; capsule 1-celled, 3–5; seeds numerous.

Order 30. Haloragaceæ

139. **Hippuris.** — Aquatic; leaves in whorls, entire; calyx 2-lobed, minute; petals 0; stamen 1; fruit a nut, 1-celled.

140. **Myriophyllum.** — Aquatic, submerged; calyx 4-fid; petals 2–4; stamens 8; styles 4; fruit of 4 hard nuts.

141. **Callitriche.** — Aquatic mainly, floating; leaves opposite, entire; perianth 0; stamen 1; fruit of 4 lobes, not opening.

Order 31. Lythraceæ

142. **Peplis.**—Calyx bell-shaped, with 12 teeth; petals 6 or 0; stamens 6 or 12; style short; capsule 2-celled.

143. **Lythrum.** — Calyx tubular, cylindrical, teeth 8–12; petals 4–6, exceeding calyx-teeth; style slender.

Order 32. Epilobiaceæ (Onagraceæ)

144. **Epilobium.**—Flowers pink or red; calyx 4-cleft; petals 4; stamens 8; capsule 4-celled, 4-valved.

145. **Ludwigia.**—Plant floating; flowers small; calyx 4-cleft; petals short, 4 or 0; stamens 4; stigma capitate; capsule obovate, 4-celled.

146. **Œnothera.**—Flowers yellow; calyx united below; petals 4; stamens 8; seeds not bearded.

147. **Circæa.** — Flowers small, white; calyx 2-fid; petals 2; stamens 2; capsule 1–2-celled, with hooked bristles.

Order 33. Cucurbitaceæ

148. **Bryonia.**—Plant dicœcious; tendril climber; calyx and corolla 5-toothed; stamens 5, in 3 bundles; style 3-fid; fruit a berry; seeds oval; few.

Order 34. Umbelliferæ

149. **Hydrocotyle.** — Stem creeping; leaves peltate, simple; calyx small; petals entire; fruit of 2 flat carpels with 5 ridges; vittæ 0.

150. **Eryngium.** — Leaves palmate, spinose; flowers in dense capitate umbels; calyx of 5 leaf-like teeth; petals erect; fruit covered with chaffy scales.

151. **Astrantia.** — Leaves palmate; calyx of 5 teeth, leafy; bracts very large; coloured; petals erect; fruit with 5 plaited, dentate ridges.

152. **Sanicula.**—Leaves palmate; calyx 5-fid; petals with long inflexed point; fruit with hooked spines.

153. **Danaa** (*Physospermum*). — Calyx with 5 teeth; petals obcordate; fruit bladdery; carpels round, with 5 sharp ridges, 2 lateral within margin; vittæ solitary, in furrows.

154. **Conium.**—Calyx small; petals obcordate, point inflexed; carpels with 5 thick, wavy, scalloped ridges; vittæ none or several.

155. **Smyrnium.**—Calyx none or small; petals entire, elliptic; fruit black, flat; mericarps kidney-shaped, with 3 prominent sharp ridges; vittæ many.

156. **Bupleurum.**—Leaves simple, entire; flowers yellow; calyx small; petals round, entire; carpels with winged ridge.

157. **Trinia** (*Apinella*).—Leaves compound; leaflets linear; plant dicœcious; petals entire, white; involucre of few bracts or none.

158. **Apium.** — Leaves compound; flowers bisexual, white; calyx 0; petals entire; fruit ovoid; carpels with 5 filiform ridges; vittæ solitary.

159. **Cicuta.**—Calyx with 5 teeth, leafy; petals obcordate; fruit didymous, with obscure ridges; vittæ solitary.

160. **Carum.** — Calyx small; petals notched; base of style depressed; carpophore 2-partite; ridges slender.

161. **Sison.**—Upper leaves pinnatifid; fruit flat, with blunt ridges; vittæ club-shaped, solitary.

162. **Falcaria.**—Petals notched; calyx margin with 5 teeth; vittæ solitary.

163. **Sium.**—Leaves all pinnate; calyx with 5 small teeth; petals obcordate; general and partial involucral bracts numerous; carpels with 5 blunt ridges; disk depressed or conical; vittæ long, several.

164. **Ægopodium.**—Calyx o or small, teeth obsolete; petals obovate; fruit oblong, rounded, with slender ridges; vittæ o.

165. **Pimpinella.**—Calyx-teeth obsolete; petals obcordate; involucre o; fruit flat, with blunt ridges; vittæ 3 or more.

166. **Conopodium.**—Petals notched; base of style conical; vittæ many in each furrow, often faint.

167. **Myrrhis.**—Leaves compound; calyx small; petals obcordate; fruit not beaked; carpels acutely ribbed, of double membrane; vittæ o.

168. **Chærophyllum.**—Leaves compound; calyx small; petals obcordate; fruit hardly beaked; carpels with 5 equal blunt ridges; vittæ 1 or o.

169. **Scandix.**—Calyx small; petals obovate; fruit with long beak, 5 blunt ridges; vittæ o.

170. **Anthriscus.**—Calyx of 5 teeth; petals obcordate; fruit flattened; beak slender, shorter than fruit; ridges none or obscure.

171. **Seseli.**—Calyx with acute teeth; petals white, notched, obcordate; fruit ovoid, flattened dorsally, hairy, ribs thick; style long, reflexed.

172. **Fœniculum.**—Calyx-teeth obsolete; petals yellow, entire, rounded; fruit oblong, ribs prominent, blunt; style short.

173. **Crithmum.**—Leaflets fleshy; petals elliptic, entire, involute; fruit with triangular sharp ridges; vittæ 2 or more.

174. **Œnanthe.**—Calyx-teeth lanceolate; petals obcordate; bracteoles whorled; fruit ovoid, corky ridges blunt; style long, erect.

175. **Æthusa.**—Calyx small; petals obcordate; bracteoles on one side; fruit globose, ribs acute; style short, reflexed.

176. **Silaus.**—Leaflets lance-shaped; calyx small; petals yellow, nearly entire, with appendage below; fruit elliptic, ridges winged.

177. **Meum.**—Leaflets capillary; calyx small; petals elliptic, acute each end, entire, inflexed at point; seed concave ventrally; vittæ several.

178. **Ligusticum.**—Leaflets ovate; petals white, obcordate; fruit elliptic, ridges sharp, winged; vittæ many or obscure.

179. **Selinum.**—Calyx inconspicuous; petals oblong, notched; fruit ovoid or oblong; seed biconvex, adhering to carpel; vittæ solitary.

180. **Angelica.**—Leaflets ternately 2-pinnate; calyx small; petals lanceolate, entire, incurved; fruit dorsally flattened; ridges slender; vittæ solitary.

181. **Archangelica.**—Calyx with 5 small teeth; petals elliptic, entire; ridges thick, 3 dorsal, 2 lateral; vittæ o.

182. **Peucedanum.**—Calyx of 5 teeth; petals entire, obovate or obcordate; fruit with thin flat margin dorsally flattened, 2 lateral ridges close to base of dilated margin.

183. **Heracleum.**—Calyx with 5 teeth; petals obcordate; flowers white; fruit dorsally flattened, wings even; vittæ short, club-shaped.

184. **Tordylium.**—Calyx-teeth 5, awl-like; petals obcordate; fruit with thickened wrinkled wings, the 2 lateral distant.

185. **Coriandrum.**—Calyx-teeth 5; petals obcordate; fruit globose, ridges small, 4 secondary keeled, larger; carpels hardly separating.

186. **Daucus.**—Bracts pinnatifid; calyx-teeth 5; petals obcordate; fruit prickly, dorsally flattened, ridges prominent; seed flat in front.

187. **Caucalis.**—Bracts entire, or o; calyx-teeth 5; petals obcordate; fruit prickly, laterally flattened, primary and secondary ridges with 1–2 rows of bristles.

Order 35.—Araliaceæ (*Hederaceæ*)

188. **Hedera.**—Shrub, climbing by roots; stem woody; calyx superior, limb 5-fid; petals, stamens, and styles 5–10; fruit a berry, 5-celled, 5-seeded.

Order 36.—Cornaceæ

189. **Cornus.**—Shrub or herbaceous plant; calyx-limb superior, 4-fid; petals 4; stamens 4; style 1; fruit a drupe; stone 2-celled.

Order 37.—Caprifoliaceæ

190. **Adoxa.**—Herbaceous plant; leaves 3-nately compound; calyx 2–3-cleft; corolla rotate, 4–5-lobed; stamens 8–10, in pairs; styles 5–10; fruit 4–5-celled.

191. **Sambucus.**—Shrub or large herb; leaves pinnate; calyx 5-cleft; corolla rotate, 5-lobed; stamens 5; stigmas 3, sessile; fruit 3–4-seeded.

192. **Viburnum.**—Shrubs, deciduous; leaves simple; calyx 5-cleft; corolla bell-shaped or funnel-shaped; stamens 5; stigmas 3, sessile; fruit 1-seeded.

193. **Linnæa.**—Evergreen creeping shrub; calyx-segments awl-like; corolla bell-shaped; stamens 4, unequal.

194. **Lonicera.**—Shrubs, deciduous, climbing; calyx 5-cleft; corolla tubular or funnel-shaped, 5-fid or irregular; stamens 5; style slender; ovary 2–3-celled; ovules many in each cell.

Order 38. Rubiaceæ

195. **Rubia.**—Calyx none; corolla rotate, 5-cleft; fruit succulent.

196. **Galium.**—Calyx none; corolla rotate, 4-fid; fruit dry.

197. **Asperula.**—Calyx-limb reduced; corolla funnel-shaped; fruit dry.

198. **Sherardia.**—Flowers in an umbel with involucre; calyx-teeth 4–6; corolla funnel-shaped; fruit dry, crowned with calyx.

Order 39. Valerianaceæ

199. **Valeriana.**—Calyx pappose; corolla 5-lobed, without spur, gibbous; stamens 3; fruit crowned with feathery pappus, 1-celled.

200. **Kentranthus** (*Centranthus*).—Calyx pappose; corolla 5-lobed, spurred; stamen 1; fruit crowned with feathery pappus, 1-celled.

201. **Valerianella.**—Calyx toothed or lobed; corolla obconical, not spurred, 5-lobed; stamens 3; fruit crowned with unequal teeth of calyx-limb.

Order 40. DIPSACEÆ

202. **Dipsacus.**—Calyx-limb cup-shaped, entire; floral bracts spinose, exserted, covering the head; corolla 4–5-fid; stamens 4; fruit crowned with pappose calyx.

203. **Scabiosa** (including *Knautia*). — Floral bracts concealed, scale-like or 0; calyx-limb 4–15 bristles.

Order 41. COMPOSITÆ (*Asteraceæ*)

204. **Eupatorium.**—Flowerheads reddish-purple; florets few, all tubular, funnel-shaped, bisexual; phyllaries overlapping, oblong; anthers included; style arms exserted; receptacle naked.

205. **Solidago.**—Flowerheads with ray; florets all yellow; involucral bracts overlapping; anthers simple; pappus in 1 row, rigid; fruit round in section.

206. **Bellis.**—Receptacle conical, naked; scape 1-flowered; involucral bracts in 2 rows, equal, blunt; achene flattened; pappus 0.

207. **Aster.**—Ray florets in 1 row, female, ligulate; disk florets tubular, perfect; receptacle naked, pitted; phyllaries overlapping; pappus rigid, in many rows.

208. **Erigeron.** — Like 207, but ray florets in several rows.

209. **Filago.** — Receptacle conical; marginal scales few; flowerheads bisexual; outer florets female, in several rows, outermost with a few inner phyllaries; disk florets tubular, few.

210. **Antennaria.** — Plant dicœcious as a rule; receptacle flat, naked; male florets tubular; pappus club-shaped; female florets slender; phyllaries with coloured tip.

211. **Gnaphalium.**—Flowerheads bisexual, tubular; receptacle, flat, naked; involucre hemispherical, with overlapping phyllaries.

212. **Inula.**—Ray florets female, ligulate; disk florets tubular, bisexual; receptacle naked; involucral bracts overlapping; anthers bristly below; pappus simple, hair-like, rough.

213. **Pulicaria.**—Phyllaries in few rows, loosely overlapping; anthers bristly below; pappus in 2 rows, with another row of short scales, rough.

214. **Xanthium.**—Plant monœcious; male florets: with involucre of 1 row of free phyllaries; receptacle scaly; corolla funnel-shaped; anthers free; female florets: 2, in beaked involucre, with hooked spines; corolla and stamens 0; fruit flattened.

215. **Bidens.** — Leaves opposite; flowerheads sometimes rayed; disk florets bisexual, tubular; receptacle flat; phyllaries in 2 rows; pappus of 2–5 barbed bristles.

216. **Galinsoga.**—Receptacle conical, scaly; ray florets in 1 row, female, ligulate; disk florets tubular, perfect; phyllaries 4–5, ciliate, in 1 row; pappus of broad ciliate scales.

217. **Achillea.**—Receptacle conical, scaly; ray florets female, ligulate, short; ligule broad, short; disk florets tubular, perfect; phyllaries overlapping; fruit flattened, winged; pappus 0.

218. **Diotis.** — Receptacle scaly; flowerheads discoidal, all tubular, perfect; tube auricled below; compressed; fruit crowned with auricled tube; pappus 0.

219. **Anthemis.**—Receptacle conical, scaly; ray florets female or neuter, ligulate, in 1 row; disk florets tubular, perfect; ligule oblong; fruit round in section; pappus 0.

220. **Chrysanthemum.**—Receptacle flat or convex, naked; phyllaries with membranous margins; fruit of disk florets not winged, of ray florets slightly winged; pappus 0.

221. **Matricaria.** — Receptacle convex or at length conical, lengthening, naked; phyllaries without membranous margins; fruit angular; pappus 0.

222. **Cotula.**—Plant succulent; leaves clasping; flowerheads solitary, discoidal, yellow.

223. **Tanacētum.**—Receptacle broad, not scaly; phyllaries overlapping, numerous, in many series; involucre hemispherical; fruit angular.

224. **Artemisia.**—Receptacle narrow, not scaly; phyllaries in few rows; fruit obovate, with epigynous disk; involucre roundish.

225. **Tussilago.** — Flowerheads solitary on scapes, with many florets; ray-florets ligulate, female, in many rows; disk florets tubular, male; phyllaries in 1 row, with membranous margins.

226. **Petasites.** — Plant sub-dicœcious; flowerheads in raceme, numerous, pink; outer florets tubular; female florets slender, blunt, or shortly ligulate, in many rows (in male flowerheads in 1 row); male florets tubular, few and central in female flowerheads, forming entire disk in male flowerheads.

227. **Doronicum.**—Phyllaries in 2 or 3 rows, equal; involucre hemispherical; ray florets in 1 row, ligulate, female; disk florets tubular, perfect; no pappus in ray florets; pappus rigid.

228. **Senecio.**—Ray florets in 1 row, ligulate, female, or 0; disk florets tubular, perfect; phyllaries in 1 row, equal, with membranous edges; style arms of disk florets free; pappus silky.

229. **Carlina.**—Outer phyllaries spinose, inner coloured, spreading; florets all perfect; receptacle scaly; pappus in 1 row, feathery.

230. **Arctium.**—Phyllaries with hooked points; involucre globose; receptacle flat, scaly; anther cells tailed; pappus short, hair-like.

231. **Carduus.**—Phyllaries all spinous; receptacle scaly; filaments free; fruit not angled; pappus united below in a ring, deciduous, rough, simple.

232. **Cirsium** (*Cnicus*).—Phyllaries all spinous; filaments free; fruit flat, not angled; pappus feathery.

233. **Onopordon.**—Phyllaries all spinous; receptacle honeycombed; filaments free; fruit 4-angled or ribbed, wrinkled; pappus rough.

234. **Silybum** (*Mariana*).—Phyllaries leafy below, with spinous points; filaments united below; fruit round in section, wrinkled; pappus hair-like or scaly.

235. **Saussurea.**—Flowers all bisexual; phyllaries not spinose; anthers bristly below; pappus longer than fruit.

236. **Serratula.** — Phyllaries unarmed, sharp;

receptacle with bristly scales; anthers simple below; fruit flattened; pappus longer than fruit.

237. **Centaurea.** — Receptacle chaffy; anthers with papillose filaments; pappus shorter than fruit hair-like or none.

238. **Cichorium.** — Flowerheads blue, axillary ligulate, many; phyllaries in 2 rows, outer short, loose, inner at length turned back; pappus in 2 rows, chaffy.

239. **Arnoseris.**—Flowerheads yellow, terminal, many; phyllaries in 1 row, at length converging; fruit inversely pyramidal crowned with a ring.

240. **Lapsana.**—Flowerheads 8–12; phyllaries in 1 row, with 4–5 bracts below; fruit striate, blunt; pappus none.

241. **Picris.**—Phyllaries in 1 row, with unequal linear spreading ones below; fruit transversely striate, beaked, narrowed each end; pappus hairs feathery.

242. **Crepis.** — Flowerheads many; involucre double, inner in 1 row; fruit narrowed above or beaked; pappus simple, soft.

243. **Hieracium.**—Flowerheads many, yellow; phyllaries overlapping, oblong; fruit blunt; pappus hairs rough, brown, brittle, rigid.

244. **Hypochæris.** — Receptacle naked, paleaceous; phyllaries oblong; fruit muricate, beaked; pappus in 2 rows, feathery.

245. **Leontodon.**—Receptacle naked; involucre more or less overlapping; outer phyllaries in 3 rows; fruit beaked; pappus in 2 rows, feathery, inner longer.

246. **Taraxacum.**—Receptacle naked; involucre double; inner phyllaries erect; outer few, loose; fruit muricate, narrowed below; pappus hairs simple.

247. **Lactuca.** — Flowerheads few; phyllaries with membranous edge; stem leafy; in 2–4 rows; fruit flattened, beaked, ribs smooth.

248. **Sonchus.**—Flowerheads many; phyllaries overlapping, in 2–3 rows, unequal; fruit flattened, not beaked, ribs rough or smooth.

249. **Tragopogon.** — Involucral bracts united below, 8–10, equal; fruit striate, beaked; pappus in many rows, feathery, interwoven in ring.

Order 42. Campanulaceæ

250. **Lobelia.**—Calyx 5-fid; corolla irregular, limb 2-lipped; anthers uniting in tube, 5; stigma blunt; capsule 2–3-celled opening by 2–3 valves.

251. **Jasione.**—Flowers capitate; calyx 5-fid; corolla regular, rotate, 5-fid; segments linear; anthers connate, tips free; capsule 2-celled.

252. **Wahlenbergia** (*Cervicina*).—Corolla regular, bell-shaped, 5-lobed, lobes broad, capsule 3-celled, opening by 3–5 valves above calyx segments.

253. **Phyteuma.** — Flowers capitate; calyx 5-partite; corolla 2-lipped, regular, 5-fid, segments linear; anthers free; capsule opening at the sides below the calyx-lobes.

254. **Campanula.**—Calyx 5-partite; corolla bell-shaped, segments 5, broad; anthers free; filaments swollen below; stigmas 3–5-fid; ovary short, broad; capsule opening at sides.

255. **Legousia** (*Specularia*).—Corolla regular, rotate or bell-shaped; capsule linear, narrow, oblong opening by lateral pores between calyx-lobes.

Order 43. Vacciniaceæ

256. **Vaccinium.**—Undershrub; calyx entire or 5-toothed; corolla bell- or pitcher-shaped; stamens 8–10; berry globose; seeds many.

257. **Oxycoccus.**—As 256, but corolla rotate.

Order 44. Ericaceæ

258. **Arbutus.**—Tree; calyx 5-partite; corolla ovoid, 5-cleft; stamens 10; anthers with pores and appendages; fruit tubercled, rough, globose; cells many-seeded.

259. **Arctostaphylos.** — Undershrub, prostrate, small; fruit smooth, cells 1-seeded.

260. **Andromeda.**—Undershrub; leaves broad; buds clothed with scales; corolla ovate, deciduous; stamens 10; capsule 5-celled, 5-valved.

261. **Calluna.**—Undershrub; calyx 4-partite, longer than corolla, with 4 green bracts; corolla bell-shaped, 4-cleft, persistent; capsules opening in loculi; seeds numerous in each cell.

262. **Erica.** — Undershrub; calyx 4-partite; corolla 4-fid, persistent; stamens 8; capsule septicidal; seeds few in each cell.

263. **Loiseleuria** (*Azalea*).—Undershrub; calyx 5-partite; corolla bell-shaped, 5-cleft, deciduous; anthers 5, opening by slits; capsule 2–3-celled.

264. **Bryanthus** (*Menziesia*) (*Phyllodoce*). — Calyx 5-partite; corolla ovoid, pitcher-shaped, ventricose, deciduous; stamens 10; anthers opening by pores; capsules 5-celled.

265. **Dabœcia** (*Boretta*).—Calyx 4-cleft; corolla pitcher-shaped, 4-toothed; stamens 8; anthers opening by pores; capsule 4-celled.

266. **Ledum.**—Corolla 5-partite; anthers opening by pores.

267. **Pyrola.** — Undershrub; flowers in raceme; calyx green, 5-partite; corolla of 5 free concave petals; stamens 10; style 5-lobed; capsule 5-valved, loculicidal.

268. **Moneses.**—Flowers solitary; calyx 5-partite; petals spreading, slightly adhering below; stamens 10; stigma rayed; capsule 2-celled.

Order 45. Monotropaceæ

269. **Hypopitys** (*Monotropa*). — Fleshy saprophyte; calyx 4–5-partite, coloured; corolla of 4–5 petals; stamens 8–10; anthers 2-valved; stigma peltate; capsule 5-valved; seeds numerous.

Order 46. Plumbaginaceæ

270. **Limonium.**—Flowers in one-sided panicled cymes; calyx membranous-edged; corolla 5-partite; styles smooth.

271. **Statice** (*Armeria*).—Flowers in head, with bracts; inverted cylindrical sheath; styles hairy below.

Order 47. PRIMULACEÆ

272. **Hottonia.** — Aquatic; leaves pectinate; calyx 5-partite, hardly united below; corolla salver-shaped; stamens epipetalous; capsule valvular.

273. **Primula.**—Leaves radical; calyx tubular, 5-fid; corolla salver-shaped, tube cylindrical; lobes spreading; stamens and styles dimorphic; capsule 5-valved; seeds numerous.

274. **Cyclamen.** — Leaves radical; calyx bell-shaped, 5-cleft; corolla bell-shaped; limb 5-partite, reflexed; stamens 5; capsule many-seeded.

275. **Lysimachia.**—Leaves cauline; calyx 5-partite; corolla rotate, limb 5-partite; stamens 5; capsule 5-valved.

276. **Trientalis.**—Leaves cauline; flowers white; calyx 7-partite; corolla rotate; stamens 7; capsule many-seeded.

277. **Glaux.**—Leaves cauline; calyx bell-shaped, coloured, 5-partite; corolla none; stamens 5; capsule with few seeds.

278. **Anagallis.**—Calyx 5-partite; corolla rotate or funnel-shaped; no tube; stamens 5; filaments hairy; capsule opening transversely.

279. **Centunculus.** — Calyx 4-partite; corolla tube inflated subglobose; filaments smooth; stamens 4–5; capsules with many seeds.

280. **Samolus.**—Leaves mainly radical; flowers white; calyx 5-partite; corolla salver-shaped; limb 5-partite; stamens 5; capsule half-inferior, many-seeded.

Order 48. OLEACEÆ

281. **Fraxinus.**—Tree, deciduous; calyx 0 or 4-cleft; corolla 0, or of 4 petals; wanting in this country; plant polygamous; fruit winged (samara), dry.

282. **Ligustrum.**—Shrub, deciduous; calyx with 4 teeth; corolla funnel-shaped, limb 4-cleft; stamens 2; fruit a fleshy berry, 2-seeded.

Order 49. APOCYNACEÆ

283. **Vinca.**—Creeping shrub; calyx 4-partite; corolla salver-shaped; tube 5-angled, long; fruit of 2 follicles.

Order 50. GENTIANACEÆ

284. **Microcala.** — Leaves opposite; corolla funnel-shaped, yellow; stamens 4; stigma 1, entire, peltate.

285. **Blackstonia** (*Chlora*).—Leaves perfoliate; calyx 8-partite; corolla yellow, rotate, 8-partite; stamens 6–8; capsule 1-celled.

286. **Centaurium** (*Erythræa*). — Calyx 4–5-fid; corolla funnel-shaped; limb 4–5-fid; stamens 4–5; anthers twisted; stigmas 2; capsule 2-celled.

287. **Cicendia** (*Exacum*). — Calyx 4-partite; corolla salver-shaped, limb 4-fid; stamens 4; anthers erect; stigmas 2; capsule 1–2-celled.

288. **Gentiana.**—Calyx 4–5-cleft; corolla funnel- or salver-shaped; limb 4–5-cleft; stamens 4–5; anthers erect; stigmas 2; capsule 1-celled.

289. **Menyanthes.**—Leaves trifoliate; flowers whitish-pink; calyx 5-partite; corolla funnel-shaped, fleshy; stamens 5; stigma notched; capsule 2-valved.

290. **Limnanthemum.**—Leaves rounded; plant aquatic, floating; flowers yellow; calyx 5-partite; corolla rotate, limb 5-partite; stamens 5; stigma 2-lobed; capsule 1-celled.

Order 51. POLEMONIACEÆ

291. **Polemonium.**—Calyx 5-fid; corolla rotate, tube short; stamens 5; stigmas 3-fid; capsule 3-celled.

Order 52. BORAGINACEÆ

292. **Omphalodes.** — Radical leaves cordate; flowers in raceme, blue.

293. **Cynoglossum.** — Calyx 5-cleft; corolla funnel-shaped; filaments very short; nutlets ovate, with hooked bristles.

294. **Lappula** (*Echinospermum*).—Corolla with tube, lobes rounded; style very short; fruit a nutlet, with hooked bristles.

295. **Symphytum.**—Calyx 5-cleft; corolla tubular, bell-shaped, 5-toothed, tube short, straight; anthers included; nutlets ovate.

296. **Borago.** — Calyx 5-fid; corolla rotate; anthers exserted, forming a cone; filaments 2-fid; nutlets 4.

297. **Anchusa.** — Calyx 5-fid; corolla funnel-shaped, tube straight; stamens included; nutlets depressed.

298. **Lycopsis.**—Calyx 5-fid; corolla funnel-shaped, tube curved; limb oblique.

299. **Pulmonaria.**—Calyx tubular, 5-fid, tube long; corolla regular, funnel-shaped, throat naked; stamens included; styles simple; nutlets attached by base.

300. **Asperugo.**—Calyx 5-cleft, with smaller teeth between, lobes leafy; corolla funnel-shaped, scales in throat; filaments short; nutlets flattened, granulate.

301. **Mertensia** (*Pneumaria*).—Calyx 5-fid, tube short; corolla bell-shaped, tube with protuberances; stamens exserted; nutlets fleshy, inflated.

302. **Myosotis.**—Calyx 5-partite, tube long; corolla salver-shaped, twisted in bud; limb 5-fid; stamens included; nutlets smooth.

303. **Lithospermum.**—Calyx 5-fid, short; corolla regular, funnel-shaped; stamens included; nutlets stony.

304. **Echium.**—Calyx 5-fid; corolla irregular, bell-shaped, throat naked, swollen; stamens exserted; filaments unequal; style 2-fid; nutlets wrinkled.

Order 53. CONVOLVULACEÆ

305. **Calystegia** (*Volvulus*). — Plant leafy; bracts 2, large, enclosing the calyx; stigma broad.

306. **Convolvulus.**—Bracts small, distant from flower; corolla bell-shaped, plaited in bud; style simple; stigmas 2; capsule 2–4-celled.

307. **Cuscuta.** — Parasite, leafless; twining; calyx 4–5-cleft; corolla bell-shaped, imbricate in bud; stamens 4–5; styles 1–2; capsule opening transversely.

Order 54. SOLANACEÆ

308. **Solanum.**—Corolla rotate, limb 5-cleft, reflexed; anthers erect, opening by terminal pores; berry round, 2- or more-celled.

309. **Lycium.**—Shrub; calyx pitcher-shaped; corolla funnel-shaped; tube short, lobes spreading; stamens exserted; fruit a berry, 2-celled.

310. **Atropa.**—Calyx 5-partite; corolla bell-shaped; anthers not opening by pores but by slits; stamens included; fruit a berry, globose, 2-celled.

311. **Datura.**—Calyx falling; corolla funnel-shaped, angular; stigma 2-lobed; capsule 4-valved, spiny.

312. **Hyoscyamus.** — Corolla funnel-shaped, tube short, lobes 5, unequal; capsule 2-celled, opening transversely.

Order 55. SCROPHULARIACEÆ

313. **Verbascum.**—Leaves alternate; calyx of 5 sepals; corolla rotate, lobes spreading, unequal; stamens 2 or more, unequal, hairy below.

314. **Linaria.**—Calyx 5-partite, tubular; corolla personate, spurred below; palate closing mouth; capsule opening by pores.

315. **Antirrhinum.** — Calyx 5-partite; corolla personate, saccate below, with palate in mouth; capsule opening by pores.

316. **Scrophularia.** — Calyx 5-lobed; corolla globose, with scale, or staminode; stamens 4; capsule 2-valved.

317. **Mimulus.**—Calyx prismatical, 5-toothed; corolla ringent, upper lip reflexed at side; capsule 2-valved; seeds numerous.

318. **Limosella.** — Aquatic; leaves narrow; calyx 5-cleft; corolla bell-shaped, 5-fid; capsule globose, 2-valved; anthers 1-celled.

319. **Sibthorpia.** — Leaves alternate, rounded; calyx 5-fid; corolla rotate, 5-cleft; anthers 2-celled, sagittate.

320. **Digitalis.** — Calyx 5-fid; corolla tubular or bell-shaped; stamens 2 or 4; capsule septicidal.

321. **Erinus.** — Calyx 5-fid; corolla salver-shaped, tube short, lobes unequal; capsule 2-celled.

322. **Veronica.**—Leaves opposite, calyx 4–5-partite; corolla rotate, irregularly 2-lobed; capsule flattened, 2-celled.

323. **Euphrasia.**—Calyx tubular, bell-shaped, 4-fid; corolla tubular, 2-lipped, upper lip 2-fid, not flattened; capsule blunt or notched; seeds angular, not winged.

324. **Bartsia** (including *Eufragia*). — Leaves opposite; calyx bell-shaped or tubular, 4-cleft; corolla tubular, upper lip entire, not flattened; capsule pointed; seeds not winged.

325. **Pedicularis.** — Leaves alternate; calyx inflated, 5-toothed; corolla ringent, upper flattened; capsule acute; seeds many, angular.

326. **Rhinanthus.**—Leaves opposite; calyx inflated, 4-toothed; corolla ringent, upper lip flattened; capsule blunt; seeds winged.

327. **Melampyrum.**—Leaves opposite; calyx tubular, 4-toothed; corolla ringent, upper lip flattened at sides, lower furrowed; capsule oblong, flattened; seeds smooth, not winged.

Order 56. OROBANCHACEÆ

328. **Orobanche.** — Parasite, leafless; calyx 4-cleft, or 2-fid; corolla ringent, 4–5-cleft, deciduous; bracts 1–3.

329. **Lathræa.** — Parasite, leafless; rootstock fleshy, with thick scales; corolla 2-lipped, upper lip concave, entire; calyx bell-shaped, 4-cleft.

Order 57. LENTIBULARIACEÆ

330. **Utricularia.** — Aquatic; leaves multifid, bearing bladders; flowers yellow; calyx 2-leaved; corolla personate, spurred; stamens at base of corolla lip.

331. **Pinguicula.**—Bog plants; leaves entire; glandular, radical; flowers blue or pink; calyx 2-lipped, lower lip 2-fid; corolla gaping, spurred; stamens at base of corolla.

Order 58. VERBENACEÆ

331 bis*. **Verbena.**—Leaves pinnatifid or 3-partite; flowers in terminal spikes; calyx tubular, unequally 5-toothed; corolla-limb oblique, 2-lipped, 5-fid; capsule splitting into 4 granulate nutlets.

Order 59. LABIATÆ (LAMIACEÆ)

332. **Mentha.** — Calyx regular, 4-toothed; corolla 4-fid, tube short; perfect stamens 4; anther-cells parallel.

333. **Lycopus.**—Calyx regular, 5-cleft; corolla 4-cleft; stamens 2, 2 upper imperfect; anther-cells at length spreading.

334. **Origanum.**—Leaves broad; spike 4-sided; calyx-teeth 5, equal, veins 10–13, throat hairy; corolla 2-lipped; stamens 4, distant.

335. **Thymus.**—Procumbent; flowers in whorl, axillary, or in spikes; calyx 2-lipped; corolla 2-lipped; stamens 4, tips spreading.

336. **Satureia** (*Calamintha*, *Clinopodium*). — Flowers in many whorls, flowers loose; bracts small; upper lip of corolla flat; tube straight.

337. **Melissa.** — Calyx 2-lipped; upper lip of corolla hollow, tube curved, ascending; tips of stamens meeting together under upper lip of corolla; anther-cells diverging.

338. **Salvia.**—Calyx 2-lipped, tubular; corolla 2-lipped, gaping; filaments with 2 spreading branches.

339. **Nepeta.**—Calyx 5-toothed; corolla gaping; upper lip flat, straight, 2-fid, notched; anther cells spreading.

340. **Scutellaria.**—Calyx ovate, hairy in British plant, closed in fruit, 2-lipped; corolla 2-lipped, upper lip hollow; filaments simple, 2 lower anthers 1-celled.

341. **Prunella.**—Calyx closed at length, ovate; upper lip flat, 3-toothed, lower 2-fid; filaments 2-fid; anthers all 2-celled.

342. **Melittis.**—Calyx inflated or 2-lipped, membranous, bell-shaped; upper lip of corolla flat; anthers forming a cross.

343. **Marrubium.**—Calyx tubular, teeth subequal; upper lip of corolla straight, erect, flat, lower 3-lobed; 2 lower stamens longest; anther-cells spreading; nutlets flatly truncate.

344. **Stachys.** — Calyx tubular, bell-shaped, teeth 10, equal; upper lip of corolla hollow; lower lip with lateral lobes reflexed; anthers smooth; nutlets smooth.

345. **Galeopsis.**—Calyx-teeth 5, spinous; calyx tubular, bell-shaped; upper lip of corolla arched, lower 3-lobed, with 2 teeth on upper side; anthers ciliate; nuts flattened.

346. **Leonurus.**—Calyx-teeth 5, spinous; calyx tubular, spinous; upper lip of corolla nearly flat, lower 3-lobed; lobes blunt; anthers smooth; nutlets 3-sided, truncate.

347. **Lamium** (and *Galeobdolon*).—Calyx bell-shaped, 10-ribbed; upper lip of corolla arched; lower lip entire, with 1–2 teeth each side; anthers hairy; nutlets 3-sided.

348. **Ballota.**—Calyx funnel-shaped, 10-ribbed; upper lip of corolla hollow, erect; lower lip 3-fid, middle lobe largest; anthers smooth; nutlets blunt.

349. **Teucrium.** — Calyx tubular, 5-toothed; upper lip of corolla 2-partite; nutlets united.

350. **Ajuga.**—Calyx ovate, bell-shaped, 5-cleft; corolla with short upper lip, entire or notched.

Order 60. PLANTAGINACEÆ

351. **Plantago.**—Plant terrestrial; flowers bisexual; calyx 4-cleft; corolla-tube ovoid, 4-partite; stamens epipetalous; capsule opening transversely.

352. **Littorella.** — Plant aquatic; monœcious; male flowers stalked; sepals 4; corolla-tube cylindrical; limb 4-partite; stamens hypogynous; female flowers sessile; sepals 3; style long; capsule 1-seeded.

Order 61. ILLECEBRACEÆ

353. **Illecebrum.** — Leaves opposite; sepals white, concave, long-pointed; no petals or small scales.

354. **Herniaria.**—Leaves opposite, not united below; sepals green, blunt; petals slender; stigmas 2; no style.

355. **Corrigiola.**—Leaves alternate; petals 5, as long as sepals, oblong; stigmas 3.

356. **Scleranthus.**—Leaves opposite, filiform, united below; sepals and petals 5; stamens 10; stigmas 2.

Order 62. AMARANTHACEÆ

357. **Amaranthus.**—Plant monœcious; perianth 3–5-partite; stamens 3–5; stigmas 3; capsule 1-celled, 1-seeded.

Order 63. CHENOPODIACEÆ

358. **Chenopodium.**—Flowers bisexual; no bracts; perianth 3–5-partite; stamens 5; stigmas 2–3; utricle membranous; pericarp free; testa crustaceous.

359. **Beta.** — Perianth 5-partite; stamens 5; styles 2–3; utricle striate, hard above; pericarp adhering to perianth; testa thin.

360. **Atriplex** (and *Obione*).—Plant monœcious; stem leafy; male flowers 3–5 sepals; stamens 5; style 0; female 2 sepals; perianth flattened; stamens 0; stigmas 2; pericarp membranous; testa crustaceous.

361. **Salicornia.**—Flowers bisexual; stem leafless, jointed; perianth fleshy; stamens 1–2; style short; stigma 2-fid; pericarp membranous.

362. **Suæda** (*Dondia*) (*Lerchia*).—Stem leafy; leaves not spinous, ½-cylindrical; perianth 5-partite; not appendaged; stamens 5; stigmas 2–3; pericarp membranous; testa crustaceous.

363. **Salsola.** — Stem leafy; leaves spinous; perianth 5-partite, segments appendaged, transversely winged in fruit; stamens 5; styles 2; pericarp membranous.

Order 64. POLYGONACEÆ

364. **Polygonum.**—Flowers in raceme; perianth 5-partite, segments sub-equal; stamens 5–8; styles 2–3; fruit compressed, 3-angled, wingless.

365. **Fagopyrum.**—Flowers cymose; perianth 5-partite; stamens 8; styles 3; nut 3-angled; cotyledons large, leafy, twisted plicate.

366. **Rumex.**—Perianth 6-partite, 3 inner segments longer; stamens 6, in pairs; styles 3; fruit 3-angled.

367. **Oxyria.**—Perianth 4-partite, 2 inner segments large; stamens 6; stigmas 2, multifid; nut flattened, winged.

Order 65. ARISTOLOCHIACEÆ

368. **Asarum.** — Herbaceous; perianth bell-shaped, 3-cleft; stamens 12; stigma 6-lobed; capsule 6-celled.

369. **Aristolochia.**—Stem erect; perianth tubular, swollen below, mouth oblique; stamens 6; style columnar; stigma 6-lobed; capsule 6-celled.

Order 66. THYMELÆACEÆ

370. **Daphne.**—Shrub, perianth 4-partite, deciduous; stamens 8, in 2 rows; fruit a berry, fleshy, 1-seeded.

Order 67. ELÆAGNACEÆ

371. **Hippophae.**—Shrub, spinose; plant dioecious; male flowers in catkin, scales ovate, perianth of 2 leaves; stamens 4; female flowers solitary; perianth tubular; style short; nut 1-seeded.

Order 68. LORANTHACEÆ

372. **Viscum.**—Hemi-parasite, on trees, yellowish-green; plant dioecious; perianth fleshy, 4-partite; anthers opening by pores; stigma sessile; berry 1-seeded, white.

Order 69. SANTALACEÆ

373. **Thesium.**—Hemi-parasite on roots, green; plant prostrate; leaves linear; perianth 4–5-cleft funnel-shaped; stamens 5; style 1; nut drupe-like.

Order 70. EUPHORBIACEÆ

374. **Euphorbia.**—Plant monœcious; stem with milky juice; involucre calyciform, several male flowers (monandrous) surrounding 1 female.

375. **Buxus.**—Shrub, evergreen, glossy; plant monœcious; male perianth 3-partite, inner segments 2; stamens 4; female perianth 4-partite, inner segments 3; capsule 3-celled.

376. **Mercurialis.** — Plant monœcious or diœcious; perianth 3-partite; 9–16 stamens in male, 2 barren filaments in female flowers; style forked; capsule 2-celled.

Order 71. Ulmaceæ

377. **Ulmus.**—Tree, deciduous; perianth 4–5-partite; stamens 5; styles 2; capsule winged.

Order 72. Urticaceæ (and Cannabinaceæ)

378. **Humulus.**—Twining plant; plant diœcious; female flowers in catkins, paired; perianth of male 5-partite, of female scale-like; ovary 1-celled.

379. **Cannabis.** — Plant herbaceous, diœcious; flowers in racemes; stamens 5; perianth 5-partite; female perigonium 1-leaved.

380. **Urtica.**—Leaves opposite, with stinging hairs; plant herbaceous, monœcious or diœcious; male perianth 4-partite; stamens 4; female perianth 2-partite; flowers in racemes.

381. **Parietaria.** — Leaves alternate, hairs simple; flowers polygamous, in axillary clusters; perianth bell-shaped, 4-partite; stamens 4; style slender.

Order 73. Myricaceæ

382. **Myrica.**—Shrub, aromatic; perianth 0; plant monœcious or diœcious; flowers in catkins with concave scales; fruit drupe-like, 1-celled; stamens 4–8.

Order 74. Amentaceæ

383. **Betula.**—Tree, deciduous; plant monœcious; flowers in catkins; scales of female catkins thin, deciduous, 3-fid; stamens 2; perianth 0; fruit with membranous margin.

384. **Alnus.** — Tree, deciduous; stamens 4; female catkin small, ovoid; scales persistent, woody; fruit not winged.

385. **Carpinus.** —Involucre leafy, 3-lobed; female spike large, with many leafy scales; stigmas 2; scales of male catkin 3-cleft.

386. **Corylus.**—Tree or shrub; scale of male catkins round; involucre leafy; anthers 1-celled; stigmas 2, red.

387. **Quercus.**—Tree, deciduous; male catkins slender; stigmas 3; involucre a cupule, entire; not spiny or leafy; nut (acorn) 1-seeded.

388. **Castanea.**—Stamens 8–20; involucre muricate, 4-lobed; stigmas 5–8; nut 1–3-seeded.

389. **Fagus.**—Male flowers in globose catkin; stigmas 3; involucre prickly, entirely enclosing 3-angled nut (mast).

Order 75. Salicaceæ

390. **Salix.**—Tree, deciduous; plant diœcious; leaves usually narrow; catkins generally erect with overlapping entire scales; perianth 0; stamens 1–5; fruit a 1-celled nut.

391. **Populus.** — Tree, deciduous; plant diœcious, leaves broad; catkins drooping with slashed scales; perianth cup-shaped; stamens 4–30; fruit nearly 2-celled.

Order 76. Empetraceæ

392. **Empetrum.**—Heath-like low shrub; calyx 3-partite; petals 3-partite; stamens 3; drupe black.

Order 77. Ceratophyllaceæ

393. **Ceratophyllum.** — Aquatic; plant monœcious; leaves forked, whorled, linear, spinose; anthers 12–20, sessile; perianth 0; ovary 1-celled; stigma unilateral.

MONOCOTYLEDONS

Order 78. Hydrocharidaceæ

394. **Elodea** (*Anacharis*).—Aquatic, submerged; plant diœcious; leaves linear, opposite or in whorls; flowers small, male rare, female long-stalked; calyx 3-partite; spathe 2-fid.

395. **Hydrocharis.**—Aquatic plant, diœcious; leaves reniform, floating; flowers large; calyx 3-partite; petals 3; males with stamens, 9–12 in 3 rows, and 3 functionless styles; female with 3 functionless filaments, 3 scales, and 6 styles; capsule 6-celled.

396. **Stratiotes.**—Plant submerged and floating alternatively, diœcious; leaves ensiform, serrate; flowers white, large; perianth 6-partite, in 2 rows; male with 12 stamens, female with 6 2-fid styles; berry 6-celled.

Order 79. Orchidaceæ

397. **Malaxis.** — Herbaceous, leafy; perianth spreading; lip superior; spur 0; rostellum short; pollen-masses connected above; column short.

398. **Liparis.** — Herbaceous, leafy; perianth spreading; lip inferior; column slender; rostellum 0.

399. **Corallorrhiza.**—Saprophyte, leafless; perianth meeting together; lip inferior, white with purplish markings; spur 0; column long; rostellum 0.

400. **Neottia.** — Saprophyte; brown scales in place of leaves; perianth hooded; pollen powdery; spur 0; lip turned down, yellowish brown, 2-lobed, enlarged below; rostellum flat.

401. **Listera.**—Leaves in pairs, sub-opposite; perianth spreading; lip turned down, linear, free; pollen powdery; rostellum leaf-like, arching over stigma.

402. **Spiranthes.**—Leaves several; flowers spiral on stalk; perianth gaping; lip inferior with fleshy projections below, clawed; lateral sepals coloured; rostellum straight; 2-fid at length.

403. **Goodyera.** — Leaves several; perianth gaping; lip swollen below, entire, free; rostellum 2-partite; pollen-grains cohering.

404. **Epipogium.**—Saprophyte, brown, leafless; perianth spreading, lip superior; ovary not twisted; pollen granular.

405. **Cephalanthera.**—Stem leafy; flowers erect, in a spike; perianth meeting; column long; ovary twisted; beak of style short.

406. **Helleborine** (*Epipactis*). — Stem leafy; flowers in raceme, drooping; perianth spreading; lip interrupted; rostellum short; column short; ovary straight, stalk twisted.

407. **Orchis.** — Perianth hooded; lip 3-lobed, spurred; spur long; pollen glands in one pouch.

408. **Aceras.**—Perianth hooded; lip pendant, 3-lobed; spur 0; pollen glands in 1 pouch.

409. **Ophrys.**—Perianth spreading; lip lobed; spur 0; pollen glands in 2 pouches.

410. **Herminium.** — Perianth spreading, bell-shaped; lip petaloid; spur 0; lip 3-lobed; pollen glands naked, exserted.

411. **Habenaria.** — Perianth gaping, hooded; lip spurred; spur long or short; lip 3-lobed or entire; pollen glands naked.

412. **Cypripedium.** — Perianth spreading; lip large, saccate; anthers 2 (1 in rest of Orchids); column 3-fid above.

Order 80. Iridaceæ

413. **Iris.**—Perianth regular, 6-cleft, segments unequal, alternate ones reflexed; stigmas 3, petaloid; ovary 3-celled.

414. **Hermodactylus.**—As 413, rootstock digitate; ovary 1-locular.

415. **Crocus.**—Perianth regular, funnel-shaped; tube long, segments equal; stigma 3-fid or 3-partite.

416. **Romulea.**—Perianth regular, 6-cleft, segments equal; tube short; styles 3, 2-fid; lobes slender.

417. **Sisyrinchium.**—Perianth 6-cleft, segments subequal; tube short; styles 3, short, entire, slender; filaments united below.

Order 81. Amaryllidaceæ

418. **Narcissus.**—Perianth-mouth with circular corona (crown); limb 6-partite, segments equal; stamens included, unequal.

419. **Galanthus.** — Perianth without corona, 6-partite, segments unequal. in 2 series, outer larger; stamens equal.

420. **Leucojum.**—Perianth bell-shaped, without corona; segments equal with thickened tips; stamens equal.

Order 82. Dioscoreaceæ

421. **Tamus.**—Twining plant, diœcious, stem twining to left; perianth bell-shaped, small, limb 6-partite; 6 stamens; in female, perianth adnate to ovary; fruit a berry.

Order 83. Liliaceæ (and Asparagaceæ and Melanthaceæ)

422. **Ruscus.** — Shrub; cladodes in axils of minute scales; plant diœcious; stamens 3; filaments united below; berry 1-celled, 2-seeded.

423. **Asparagus.**—Herbaceous; stem branched; flowers axillary; perianth 6-partite, tubular below; stamens 6; filaments free; stigmas 3, reflexed.

424. **Polygonatum.** — Stem simple; leaves many; flowers axillary; perianth tubular, 6-cleft, deciduous at length; berry with 1–2-seeded cells.

425. **Maianthemum** (*Unifolium*).—Stem simple; leaves 2; flowers in terminal racemes; perianth 4-partite; stamens 4; berry 2-celled.

426. **Convallaria.**—Stem simple; leaves radical; flowers in raceme; perianth globular, 6-partite; berry with 1-seeded cells.

427. **Simethis.** — Rootstock bulbous; flowers jointed on pedicels, purple outside, white within; perianth-segments 6, spreading; filaments bearded; anthers attached by back.

428. **Allium.**—Flowers in umbel; spathe of 1 or 2 leaves; perianth-segments 6, spreading; anthers attached by backs.

429. **Muscari.**—Leaves radical; perianth-segments coherent below; perianth globose, mouth narrowed; 6-cleft.

430. **Scilla** (*Endymion*).—Flowers blue or pink, in racemes; perianth-segments 6, spreading; anthers attached by backs.

431. **Ornithogalum.**—Flowers white or greenish; perianth segments 6; persistent; stamens on receptacle; anthers attached by backs.

432. **Lilium.**—Flowers on leafy scape, few, nodding, panicled; nectaries 0; perianth spreading or turned back; anthers attached above the base; seeds flat.

433. **Fritillaria.** — Flowers nodding, large, solitary, red or white, chequered; nectary oblong; perianth deciduous; anthers attached above their base.

434. **Tulipa.**—Flowers large, erect, solitary, yellow; nectaries 0; perianth deciduous; anthers erect.

435. **Gagea.**—Flowers in umbel, yellow, small; nectaries 0; leaves 1–2, linear; anthers erect; perianth-segments 6, spreading; persistent.

436. **Lloydia.**—Flowers white, small, erect; nectary transverse; anthers erect; perianth spreading, persistent; stigma 3-angled; seeds angular above.

437. **Colchicum.** — Style 4; ovary 4–5-lobed; rootstock a corm; flowers like *Crocus*, autumnal, funnel-shaped; tube long; leaves several, radical; ovaries buried.

438. **Narthecium.**—Rhizome slender, creeping; flowers yellow; scape leafy; perianth 6-partite; capsule 3-celled; seeds appendaged.

439. **Tofieldia.** — Flowers greenish-white; perianth 6-partite; styles 3; stigmas 3; capsule septicidal.

440. **Paris.**—Leaves net-veined; rhizome stout; leaves in whorl, 4–5; flowers terminal; perianth 4-partite, in 2 whorls; styles 4; ovary 4–5-lobed.

Order 84. Juncaceæ

441. **Juncus.** — Leaves round; plant smooth; perianth 6-fid, glumaceous; style simple; stigmas 3; capsule 3-celled; seeds many.

442. **Luzula.**—Plant tufted, hairy; leaves flat, grass-like; capsule 1-celled, 3-valved; seeds 3 at base.

Order 85. TYPHACEÆ

443. **Typha.**—Plant monœcious; flowers in long cylindrical spikes; upper male, stamens united, surrounded by hairs; lower female.

444. **Sparganium.**—Plant monœcious; flowers in round heads; perianth-segments 3–4; stamens free; fruit dry.

Order 86. ARACEÆ (AROIDEÆ)

445. **Arum.**—Plant monœcious; leaves hastate; flowers in spadix, enclosed in spathe; perianth o; male flowers of 1 sessile 2-celled anther; spadix naked above.

446. **Acorus.** — Flowers bisexual on lateral spadix; perianth-segments 6; stamens 6.

Order 87. LEMNACEÆ

447. **Lemna.** — Aquatic, floating; stem and leaves none, frond with 1 or more roots; flowers unisexual, in spathe, from lateral slit in frond; stamens 1–2; anthers 2-celled.

448. **Wolffia.**—Plant rootless, aquatic, floating; no spathe; stamen 1; flowers from surface; anther 1-celled.

Order 88. ALISMACEÆ

449. **Alisma.**—Leaves flat; flowers bisexual, in whorls; stamens 6; carpels numerous, free, in a ring; ovules solitary.

450. **Echinodorus.**—Flowers bisexual, in umbel or whorl; stamens 6; carpels numerous, free.

451. **Elisma.**—Leaves floating; flowers bisexual, sub-solitary; carpels numerous, free; stamens 6.

452. **Sagittaria.** — Plant monœcious; leaves erect, sagittate; flowers whorled; stamens many; carpels free.

453. **Damasonium.**—Leaves erect, 2; flowers bisexual, in whorls; stamens 6; carpels united below, star-like, spreading.

454. **Butomus.** — Leaves 3-angled; perianth-segments 6, rose-coloured; stamens 9; carpels 6, united below.

Order 89. NAIADACEÆ (including POTAMOGETONACEÆ)

455. **Triglochin.**—Marsh plants; flowers without bracts; perianth-segments erect; stamens 6; anthers short; carpels free, 1–2-seeded; stigma downy.

456. **Scheuchzeria.** — Flowers with bracts; perianth-segments 6, deciduous, spreading; stamens 6; filaments and anthers long; stigmas feathery.

457. **Potamogeton.** — Flowers bisexual, in spikes; perianth-segments 4; anthers 4, sessile; styles o; drupes 4, sessile.

458. **Ruppia.**—Flowers bisexual, 2 together; perianth o; stamens 4; styles o; achenes 4, stalked.

459. **Zannichellia.**—Plant monœcious; flowers solitary, axillary; male flower: perianth o; 1 stamen; female flower: perianth bell-shaped; stigma peltate; nuts 2–5.

460. **Zostera.**—Marine plant; plant monœcious; stamens and pistils in slit of leaf; perianth o; stigmas 2; style 1; anther 1.

461. **Naias.**—Plant monœcious; flowers solitary, axillary, sheathed; perianth tubular; 1 stamen; stigmas 2–4.

Order 90. ERIOCAULONACEÆ

462. **Eriocaulon.** — Plant monœcious; leaves radical; flowers in scaly head; perianth 4–6-fid; stamens 4–6; stigmas 2–; capsule 2–3-celled.

Order 91. CYPERACEÆ

463. **Cyperus.** — Flowers bisexual; spikelets many-flowered, flattened; glumes in 2 rows, deciduous, all flowering, keeled, many; fruit chestnut brown.

464. **Eleocharis** (*Heleocharis*). — Spikelet solitary, terminal, round in section; 1 of lowest glumes empty; bristles 3–6, included; nut compressed, crowned by style base.

465. **Scirpus.**—Spikelets in clusters, lateral; glumes overlapping, sub-equal; bristles o or 3–8, included; nut 3-angled.

466. **Eriophorum.**—Spikelets solitary or clustered, terminal; glumes sub-equal; bristles longer than glumes, silky; nut 3-angled.

467. **Rhynchospora.**—Spikelets round in section, in an ovoid head, few-flowered; glumes 6 or 7; bristles 6, slender; nut convex, beaked.

468. **Schœnus.**—Spikelets flattened, in 2 rows, 2–4-flowered; glumes 6–9, lower barren; bristles few or none; nut black, not beaked.

469. **Cladium.**—Spikelets round in section, few-flowered, in several crowded, compound cymes; glumes 5 or 6, lobed, lower empty; bristles o; nut blunt, with fleshy coat.

470. **Kobresia.** — Plant monœcious; spikelets 1–2-flowered; spikes close; upper flowers male, perianth o; lower flowers female, with perianth of 1 scale; fruit not enclosed in perigynium.

471. **Carex.**—Plant monœcious; male flowers above, female below, as a rule; spikelets many-flowered, in overlapping spikes, with glumes; female flowers enclosed in a bottle-shaped persistent perigynium; style 1; stigmas 2–3; male flowers of 3 stamens; perianth o; nut enclosed in perigynium.

Order 92. GRAMINACEÆ

472. **Panicum.**—Spike compound, spreading; spikelets flattened dorsally; glumes 4, unequal; pedicels of spikelets smooth or hairy.

473. **Setaria.** — Spike cylindrical, compound, interrupted below; spikelets with an involucre of bristles, in dense spike; glumes 4.

474. **Spartina.**—Spikes erect; spikelets laterally compressed, awnless; style long; glumes 3, unequal.

475. **Leersia.**—Spikelets laterally compressed, in loose panicle; glumes o; paleæ 2, awnless, lower broader.

476. **Phalaris.**—Spike ovate; spikelets laterally

compressed; glumes equal, boat-shaped, keeled, 6, third and fourth imperfect, not awned; stamens 3.

477. **Anthoxanthum.** — Spikelets in spike-like panicle, interrupted; glumes unequal, awned, 6, third and fourth empty; stamens 2; paleæ leathery, unequal.

478. **Hierochloe.**—Spikelets in an open panicle; upper floret perfect; 2 lower male, 3-androus, awnless; ovary smooth.

479. **Alopecurus.**—Spikelets in dense, cylindrical spike, jointed on pedicel; glumes 6, awnless; paleæ awned, 1-nerved.

480. **Milium.** — Panicle spreading; spikelets stalked; rachilla not produced beyond flowering glume; glumes equal; paleæ awnless; flowering glume hardening round fruit.

481. **Phleum.** — Spikelets in dense, cylindrical spike, or panicle; flowering glume enclosing the fruit; paleæ awned, 2-nerved, glumes 3.

482. **Mibora** (*Knappia*).—Spike simple; spikelets dorsally compressed, solitary, one-sided, 1-flowered; glumes blunt; palea membranous, shaggy, truncate, awnless.

483. **Agrostis.** — Spikelets in loose panicle; flowering glume small, hyaline; glumes unequal, upper smaller; outer paleæ awnless.

484. **Polypogon.**—Spikelets in close contracted spike-like panicle; glumes with long bristles, membranous, lower palea awned from just below tip.

485. **Calamagrostis.**—Panicle spreading; rachilla with long silky hairs; glumes subequal; lower palea awned.

486. **Deyeuxia.** — Panicle close, spike-like; glumes equal; rachis ciliate, longer than flowering glume; empty glumes large; flowering glumes awned.

487. **Gastridium.** — Panicle close, spike-like; rachilla produced beyond flowering glume; glumes acute, awnless; empty glumes large, boat-shaped; flowering glume small, 4-toothed.

488. **Apera.**—Panicle loose; glumes acute, awnless, unequal, lower smaller; outer paleæ awned; flowering glume 2-fid, awned; empty glumes large.

489. **Ammophila.** — Spike cylindrical, large; spikelets large; glumes subequal, lower shorter; paleæ hairy below; rachilla long, silky.

490. **Lagurus.**—Spike ovate; glumes with long bristles; empty glume plumose; flowering glume 3-awned; lower palea with 2 bristles and twisted awn.

491. **Aira.**—Spikelets in loose panicle; rachilla not produced beyond uppermost flowering glume; awn dorsal, twisted, lower paleæ 2-fid; glumes equalling lower floret.

492. **Corynephorus** (*Weingærtneria*). — Florets 2, awned; awn straight, jointed, upper part club-shaped, tuft of hairs at junction.

493. **Deschampsia.**—Florets 2; awn straight, rachilla longer than upper flowering glume; lower palea jagged.

494. **Holcus.**—Florets 2; lower perfect, awnless; upper male, with dorsal awn; paleæ hardening on fruit.

495. **Trisetum.**—Florets 2–6 in spikelet, crowded; flowering glume 2-fid, awned; awn twisted; ovary smooth; fruit not crested.

496. **Avena.** — Florets 2–6; glumes equalling lower floret; awn dorsal, keeled, twisted; ovary hairy above; fruit crested and furrowed.

497. **Arrhenatherum.**—Florets 2; upper perfect, lower staminate only; rachilla produced beyond flowering glumes; lower with awn long, twisted from below middle; upper with short straight awn near tip.

498. **Cynodon.** — Spikelets fingered in compound, spreading spike; in 1–2 series; rachis flat, laterally compressed; glumes equal, spreading, awnless.

499. **Sieglingia** (*Triodia*).—Spikelets 2-(or more) flowered; rachilla not bearded; glumes unequal, acute, as long as outer palea; flowering glume deeply concave, notched, with teeth; fruit free.

500. **Phragmites** (*Arundo*). — Spikelets with 2 or more perfect flowers; rachilla bearded, with long silky hairs; fruit not attached to palea.

501. **Sesleria.**—Florets without awn; spikelets in panicled spike, with ciliate bract below, overlapping; lower palea keeled, membranous; with 3–5 points.

502. **Cynosurus.**—Spikelets in spike or head; bract below pectinate; glumes subequal, keeled; lower palea with bristle; fruit enclosed in palea.

503. **Kœleria.**—Spikelets in sub-cylindrical interrupted spike, 2- (or more) flowered, flattened; flowering glume membranous; fruit not enclosed in palea.

504. **Molinia.** — Panicle contracted, conical, round in section, glumes shorter than florets, without lateral ribs; florets 1–2; palea hardening in fruit.

505. **Catabrosa.** — Panicle spreading, loose, branches whorled; glumes unequal, 1-veined; florets 2, distant.

506. **Melica.**—Florets 1–2 perfect, rounded on back, and 1 or more imperfect; glumes equal, veined, nearly as long as spikelet; palea hardening in fruit.

507. **Dactylis.** — Panicle secund; spikelets crowded, few; glumes unequal; lower keeled; lower palea flattened; fruit free.

508. **Desmazeria.**—Spikelets 2-rowed, in spike, rigid; glumes 8–12; blunt, blunt-pointed, with faint nerves.

509. **Briza.** — Spikelets in panicle, drooping; glumes broad, blunt, membranous, boat-shaped, saccate; fruit attached to palea.

510. **Poa.**—Spikelets in panicle; glumes acute, unequal; flowering glumes flat, keeled, awnless, tips nerved.

511. **Glyceria.**—Spikelets with many flowers; glumes unequal, membranous; flowering glumes convex, tip blunt, nerveless; lower palea with 7–10 ribs.

512. **Festuca.** — Panicle one-sided; flowering glumes convex, tip nerved, acute, or awned; ovary smooth; lower palea rounded or with excurrent vein.

513. **Bromus.** — Spikelets in panicle; florets

many; lower glumes 1-veined, upper 3–5-veined; glume shorter than lower floret; awn straight.

514. **Brachypodium.** Spikelets solitary, nearly sessile; glumes unequal, opposite; edges to rachis; upper palea coarsely fringed on ribs; ovary-tip villous.

515. **Lolium.**—Spikelets solitary; florets many; sides to rachis; glume 1, or inner smaller.

516. **Agropyrum** (*Triticum*).—Spikelets solitary, edge to rachis; glumes equal, opposite; lower palea ciliate on ribs.

517. **Lepturus.** — Spikelets solitary, alternate on rachis; glumes 1–2; both on same side of rachis, cartilaginous; empty glumes 1–3.

518. **Nardus.**—Spikelets solitary; spike 2-rowed, one-sided; style long; glumes 0.

519. **Hordeum.** — Spikelets 1-flowered, in 3's; paleæ with long awns; glumes 2, with long bristles.

520. **Elymus.** — Spikelets 2–3, florets 2–7; glumes 2, on same side of spikelet; no awns or bristles.

APPENDIX III

BIBLIOGRAPHY

This list of works is not intended to be exhaustive, and only a selection can be given. Fuller lists will in many cases be found in the works cited.

Access to most of these can usually be had at any free library or lending library. Those who subscribe to Mudie's, Lewis's, the London Library, Smith's, or Times Book Club should have no difficulty also in obtaining them. Scientific papers, journals, monographs are less easy to consult, save in a museum, university, or scientific society's library. Those resident in London, Oxford, Cambridge, Dublin, Edinburgh, Aberystwith should, however, be able to consult any desired work at the National Library, where copies of all books published are required to be sent.

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HORWOOD, A. R.: The Past History of Monocotyledons.

LEWIS, F. J.: The Plant Remains in the Scottish Peat Mosses.

OLIVER, F. W.: Pteridosperms and Angiosperms.

REID, CLEMENT: The Origin of the British Flora.

REID, CLEMENT: Submerged Forests.

REID, CLEMENT: The Cromer Forest Bed.

REID, CLEMENT: Norfolk Amber.

REID, CLEMENT: The Lignite of Bovey Tracey.

REID, CLEMENT, and REID, ELEONORA: On the Preglacial Flora of Britain.

SAPORTA, G. DE: Plantes jurassiques.

SAPORTA, G. DE: Types Proangiospermes.

SAPORTA, G. DE: L'Evolution du Règne Végétal.

SARGANT, E.: A Theory of the Origin of Monocotyledons, &c.

SARGANT, E.: The Evolution of Monocotyledons.

SARGANT, E.: The Early History of Angiosperms.

SCHARFF, R.: On an Early Tertiary Land-connection between North and South America.

SCHARFF, R.: On the Resemblance of the Fauna and Flora of Ireland to that of the Spanish Peninsula.

SCHARFF, R.: On the Evidences of a Former Land-bridge between Northern Europe and North America.

SCOTT, D. H.: The Evolution of Plants.

SCOTT, D. H.: Studies in Fossil Botany.

SEWARD, A. C.: Fossil Botany.

SEWARD, A. C.: Links with the Past in the Plant World.

SEWARD, A. C.: The Geological History of Monocotyledons.

STOPES, M. C.: Ancient Plants.

WIELAND, G. R.: American Fossil Cycads.

II. BRITISH DISTRIBUTION (Type, Altitude, Status, &c.)

BENNETT, A.: Supplement to Topographical Botany.

DRUCE, G. C.: Comital Census Numbers.

HOOKER, Sir W. J.: Flora Scotica.

LINDLEY, J.: Synopsis of the British Flora.

MARSHALL, E. S.: The Status of some Britannic Plants.

MARSHALL, E. S.: On the Probable Status of some Irish Plants.

MARSHALL, E. S.: Remarks on Cybele Hibernica, 2nd Ed.

MARSHALL, E. S.: Irish Topographical Botany.

MORE, A. G.: Cybele Hibernica, 2nd Ed.

PRAEGER, R. LL.: Irish Topographical Botany.

PRAEGER, R. LL.: Geographical Distribution of Plant Groups in Ireland.

PURTON, T.: Midland Flora.

ROGERS, W. M.: On the Distribution of Rubi in Great Britain.

TURNER, D., and DILLWYN, L. W.: Botanist's Guide.
WATSON, H. C.: Cybele Britannica.
WATSON, H. C.: New Botanist's Guide.
WATSON, H. C.: Geographical Distribution of British Plants.
WATSON, H. C.: Topographical Botany.
WILLIAMS, F. N.: The High Alpine Flora of Britain.

III. HABITAT (ECOLOGY)

ADAMSON, R. S.: The Ecology of a Cambridgeshire Wood.
BAKER, J. G.: Elementary Lessons in Plant Geography.
BOULGER, G. S.: Plant Geography.
CANDOLLE, A. DE: Géographie Botanique Raisonnée.
CLEMENTS, F. E.: The Development and Structure of Vegetation.
CLEMENTS, F. E.: Research Methods in Ecology.
CLEMENTS, F. E.: Plant Physiology and Ecology.
DARWIN, C.: The Origin of Species.
DRUDE, O.: Manuel de Géographie Botanique.
DRUDE, O.: Atlas der Pflanzenverbreitung.
ELGER, F.: The Moorlands of East Yorkshire.
ENGLER, A.: Versuch einer Entwickelungsgeschichte der Pflanzenwelt.
ENGLER, A., and DRUDE, O.: Vegetation der Erde.
FLAHAULT, CH., and SCHRÖTER, C.: Phytogeographical Nomenclature.
FORBES, A. C.: The Development of British Forestry.
GADOW, H.: Geographical Distribution of Animals.
GRAEBNER, P.: Pflanzengeographie.
GRAEBNER, P.: Lehrbuch der Pflanzengeographie.
GRISEBACH, H. R. A.: Die Vegetation der Erde.
GRISEBACH, H. R. A.: Über den Einfluss des Klimas auf die Begrenzung der natürlichen Floren.
HEMSLEY, W. B.: Report on Insular Floras.
HENSLOW, G.: Introduction to Plant Ecology.
HERBERTSON, A. J.: Outlines of Physiography.
HOOKER, Sir J. D.: Lecture on Insular Floras.
HORWOOD, A. R.: Practical Field Botany.
KINAHAN, G. H.: A Handy Book on the Reclamation of Waste Lands.
LEWIS, F. J.: Geographical Distribution of Vegetation of the Basins of the Rivers Eden, Tees, Wear, and Tyne.
MARCEL, H.: Esquisse de la Géographie et de la Végétation des Highlands d'Ecosse.
MERRILL, J. F.: Rocks, Rock-weathering, and Soils.
MEYEN, F. J. F.: Botanical Geography.
MOSS, C. E.: The Fundamental Limits of Vegetation.
MOSS, C. E.: Peat Moors of the Pennines, &c.
MOSS, C. E.: Geographical Distribution of Vegetation in Somerset, &c.
MOSS, C. E.: Vegetation of the Peak District.
MOSS, C. E., RANKIN, W. M., and TANSLEY, A. G.: The Woodlands of England.
NISBET, J.: British Forest Trees.
OLIVER, F. W.: Blakeney Point.
PEACOCK, E. A. W.: The Rock-soil Analysis of Plants.
PETHYBRIDGE, G. H., and PRAEGER, R. LL.: The Vegetation of the District lying South of Dublin.
PRAEGER, R. LL.: A Tourist's Flora of the West of Ireland.
PRAEGER, R. LL.: Open-air Studies in Botany.
SCHIMPER, A. F. W.: Plant Geography on a Physiological Basis.
SCIENCE IN MODERN LIFE.
SMITH, R.: Botanical Survey of Scotland, Edinburgh District.
SMITH, R.: Botanical Survey of Scotland, Part II, North Perthshire.
SMITH, W. G.: Botanical Survey of Scotland, Forfar and Fife.
SMITH, W. G., and MOSS, C. E.: Geographical Distribution of Vegetation in Yorkshire, Leeds and Halifax District.
SMITH, W. G., and RANKIN, W. M.: Geographical Distribution of Vegetation in Harrogate and Skipton District.
STEELE, A.: History of Peat Moss.
SUESS, F.: The Face of the Earth.
TANSLEY, A. G.: Types of British Vegetation.
TREUB, M.: Flora of Krakatau.
WALLACE, Sir A. R.: Geographical Distribution.
WALLACE, Sir A. R.: Island Life.
WARD, R. DE C.: Handbook of Climatology.
WARMING, E.: Œcological Botany (with good Bibliography).
WOODHEAD, T. W.: Ecology of Woodland Plants, &c.
WOODWARD, H. B.: The Geology of Soils and Substrata.
WOODWARD, H. B.: The Geology of Water Supply.
WOODWARD, H. B.: The Geology of England and Wales.
YAPP, R. H.: Wicken Fen.

IV. HABIT

ARESCHOUG, F.: Beiträge zur Biologie der Holzgewächse.
ARESCHOUG, F.: Geophile Pflanzen.
BOULGER, G. S.: Aquatic Plants.
DARWIN, C.: Climbing Plants.
DARWIN, C.: Insectivorous Plants.
FREIDENFELDT: Wurzeln Krautiger Pflanzen.
GOEBEL, F.: Organography of Plants.
GOEBEL, F.: Pflanzenbiologische Schilderungen.
GROOM, P.: On Bud Protection.
KEEBLE, F. W.: On Hanging Foliage.
POTTER, M. C.: On Bud Protection.
SARGANT, E.: On Geophytes.
SCHENK, H.: Biologie u. Anatomie d. Lianen.
SCHIMPER, A. F. W.: Die Epiphytische Vegetation Amerikas.

SCHIMPER, A. F. W.: Die Indomalayische Strandflora.
STAHL, E.: Pflanzen und Schnecken.
STAHL, E.: Regenfall u. Blattgestalt.
VÖCHTING, H.: Knollengewächse.
WARMING, E.: Halofytstudier.

V. CHARACTERS, HEIGHT, FLOWERING PERIOD, DURATION

DRUCE, G. C.: Hayward's Botanist's Pocket-book.
FOX, H.: How to find and name Wild Flowers.
HOOKER, Sir W. J.: British Flora.
HOOKER, Sir W. J., and ARNOTT, G. A.: British Flora.
KNAPP, F. H.: The Botanical Chart.
LINDLEY, J.: Synopsis of the British Flora.
SMITH, Sir J. E.: English Botany.
SMITH, Sir J. E.: The English Flora.
SMITH, Sir J. E.: Compendium of the English Flora.
STEELE, W. E.: A Handbook of Field Botany.
WATTS, W. M.: A School Flora.
WITHERING: Arrangement of British Plants.
(See also under Floras, XIII.)

VI. POLLINATION; FRUIT AND SEED DISPERSAL

ALLEN, GRANT: The Colour of Flowers.
AVEBURY, LORD: Flowers, Fruits, and Leaves.
BEALE, W. J.: Birds.
BEHRENS, W. J.: Blumen u. Insekten.
DARWIN, C.: Cross- and Self-pollination.
DARWIN, C.: Fertilization of Orchids.
DARWIN, C.: Forms of Flowers.
GUPPY, H. B.: Studies on Fruits and Seeds.
HENSLOW, G.: The Making of Flowers.
HILDEBRAND, F.: Die Farben der Blüten.
KERNER VON MARILAUN, A., and OLIVER, F. W.: The Natural History of Plants.
KERNER VON MARILAUN, A.: Flowers and their Unbidden Guests.
KNUTH, P.: Flower Pollination.
MÜLLER, H.: Fertilization of Flowers (full Bibliography).
RILEY, C. V.: Monograph on Yucca Pollination.
SPRENGEL, C. K.: Entdecktes Geheimnis der Natur.
TRELEASE, W.: Fertilization of Flowers by Humming Birds.
WALLACE, Sir A. R.: Darwinism.

VII. SOIL

AIKMAN, C. M.: The Food of Crops.
BAYLISS, W. M.: The Nature of Enzyme Action.
BRENCHLEY, W.: Plant Poisons.
FREAM, W.: Soils and their Properties.
FREAM, W.: Elements of Agriculture.
HALL, A. D.: The Soil.
HILGARD, E. W.: Soils.

JOHNSTON, J. F. W.: Lectures on Agricultural Chemistry and Geology.
KING, F. H.: The Soil.
LYON, T. L., and FIPPEN, G. O.: Soils.
MARR, J. E.: Agricultural Geology.
MERRILL, G. F.: Rocks, Rock-weathering, and Soils.
MORTON, J.: On the Nature and Properties of Soils.
RUSSELL, E. J.: Soil Conditions and Plant Growth.
RUSSELL, E. J.: The Fertility of the Soil.
RUSSELL, E. J.: Lessons on Soil.
SCOFFEN, J.: The Chemistry of Soils.
SCOTT, J., and MORTON, J. C.: The Soil of the Farm.
SOMERVILLE, W. J.: Agriculture.
SNYDER, H.: Soils and Fertilizers.
SNYDER, H.: The Chemistry of Plant and Animal Life.
WRIGHTSON, J.: Agricultural Textbook.

VIII. FUNGAL AND OTHER PLANT PESTS

BERKELEY, M. J.: Outlines of British Fungology.
BOARD OF AGRICULTURE and FISHERIES: Leaflets.
CONNOLD, E.: British Vegetable Galls.
COOKE, M. C.: Handbook of British Fungi.
COOKE, M. C.: Fungi, their Nature, Influences, &c.
GROVE, W. B.: The British Rust Fungi.
MASSEE, G.: A Textbook of Plant Diseases.
MASSEE, G.: Diseases of Cultivated Plants and Trees.
PLOWRIGHT, C. B.: British Uredineæ and Ustilagineæ.
SWANTON, E. B.: British Galls.
TUBEUF, K. VON: Diseases of Plants.
WARD, H. M.: Diseases of Plants.
WARD, H. M.: Disease in Plants.
WARD, H. M.: Timber and some of its Diseases.

IX. INSECT AND OTHER ANIMAL PESTS

BOARD OF AGRICULTURE and FISHERIES: Leaflets.
BOS, J. R.: Agricultural Zoology.
BUCKTON, G. B.: Monograph of British Aphides.
CAMERON, P.: British Phytophagous Hymenoptera.
COLLINGE, W. G.: Reports on the Injurious Insects and other Animals observed in the Midland Counties.
COLLINGE, W. T.: A Manual of Injurious Insects.
CURTIS, J.: Farm Insects.
FOWLER, W. W.: Coleoptera.
GILLANDERS, A. T.: Forest Entomology.
KIRBY, W. F.: British Butterflies and Moths.
KIRBY, W. F., and SPENCE, W.: An Introduction to Entomology.
KOLLAR, V.: Insects Injurious to Gardeners and Farmers, &c.
MARTIN-DUNCAN, J.: Insect Pests of the Farm and Garden.

MURRAY, A.: Economic Entomology, Aptera, &c.
NEWMAN, E.: British Moths.
NEWMAN, E.: British Butterflies.
ORMEROD, E. O.: Manual of Injurious Insects.
ORMEROD, E. O.; A Handbook of Injurious Insects.
ORMEROD, E. O.: Notes for Observations of Injurious Insects, &c.
ORMEROD, E. O.: Handbook of Orchard and Fruit Pests.
OSBORN, H.: Insects affecting Domestic Animals.
SANDERS, T. W.: Garden Foes.
SAUNDERS, E.: Hymenoptera Aculeata.
SAUNDERS, E.: Hemiptera Homoptera.
SAUNDERS, E.: Hemiptera Heteroptera.
SOUTH, R.: British Butterflies.
SOUTH, R.: British Moths.
THEOBALD, F. V.: Reports on Economic Zoology (British Museum).
TUTT, J. W.: British Moths.
VERRALL, J. H.: Diptera.
WOOD, T.: The Farmer's Friends and Foes.
WOOD, T.: Our Insect Enemies.
WOOD, T.: Our Bird Allies.
WOOD, T.: Nature and her Servants.

X. NAMES OF PLANTS, NOMENCLATURE, ETC.

ALCOCK, R. H.: Botanical Names for English Readers.
ANON.: International Rules for Botanical Nomenclature (Vienna).
BRITTEN, J., and HOLLAND R.: A Dictionary of English Plant-names.
BROCKETT, J. T.: A Glossary of North Country Words.
CLARKE, W. A.: First Records of British Flowering Plants.
COLES, W.: The Art of Simpling.
DIEZ, F.: Dictionary of Romance Language.
DRUCE, G. C.: List of British Plants.
DRUCE, G. C.: Notes on the New Edition of Babington's "Manual of British Botany".
DRUCE, G. C.: The Nomenclature of Plants.
DRUCE, G. C.: Notes on English Botany Supplement.
DRUCE, G. C.: On the British Plant Lists and their Discrepancies.
DRUCE, G. C.: The Oxford Plant List.
DRUCE, G. C.: Linnæus's "Flora Anglica".
EARLE, J.: English Plant Names.
EGERTON-WARBURTON, G.: Names and Synonyms of British Plants.
GARRY, F. N. A.: Notes on the Drawings for "Sowerby's English Botany".
GERARDE, J.: The Herball.
GRASSMAN: Deutsche Pflanzennamen.
HALLIWELL-PHILIPPS, J. O.: Dictionary of Archaic Words.
HANBURY, F. J.: London Catalogue of British Plants.
HIERN, W. P.: Index Abcedarius.
HOLLOWAY, W.: A General Dictionary of Provincialisms.
JACKSON, B. D.: Index Kewensis (and Durand's Supplement).
JACKSON, B. D.: Guide to the Literature of Botany.
JAMIESON, J.: A Dictionary of the Scottish Language.
LINDLEY, J.: Introduction to Botany.
LINNÆUS, C. VON: Species Plantarum.
LINNÆUS, C. VON: Genera Plantarum.
LYTE, A.: A Niewe Herball.
MARSHALL, E. S.: Notes on the "London Catalogue, 10th Ed.".
MENTZELIUS, C.: Index nominum plantarum universalis.
MORITZI, M.: Dictionnaire des Noms vulgaires des Plantes.
PARKINSON, J.: Theatrum Botanicum.
PRIOR, R. C. A.: Popular Names of British Plants.
PRITZEL, G. A.: Icones Plantarum.
RENDLE, A. B., and BRITTEN, J.: British Seed Plants.
RENDLE, A. B., and BRITTEN, J.: Notes on the List of British Seed Plants.
ROGERS, W. M.: On the Rubi List in "London Catalogue, 9th Ed.".
RUSHBY, H. H., and BRITTON, N. L.: Druce's List of British Plants.
SKEAT, W.: Etymological Dictionary.
TAYLOR, J.: Names and Places.
THEIS, M.: Glossaire de Botanique ou Dictionnaire Etymologique.
TRENCH, R. C.: The Study of Words.
TRENCH, R. C.: Glossary.
TREVERS, P.: The Grete Herball.
TURNER, W.: The Names of Herbes.
WRIGHT, T.: Dictionary of Obsolete and Provincial English.

XI. FOLK-LORE

ADAMS, H. G.: Moral, Language, and Poetry of Flowers.
ADAMS, H. G.: Language of Flowers.
ALLEN, G.: The Colour Sense.
ALLEN, G.: Le véritable Language des Fleurs.
BARING-GOULD, S.: Curious Myths.
BARRETT, W. A.: Flowers and Festivals.
BAUHIN, C.: De plantis a divis sanctisve nomen habentibus.
BLACK: Folk-Medicine.
BOHN, H. G.: Polyglot of Foreign Proverbs.
BOHN, H. G.: English Proverbs.
BRAND, W.: Popular Antiquities.
BREWER, J.: Dictionary of Phrase and Fable.
BUNSEN: God in History.
COCKAYNE, O.: Saxon Leechdoms.
CONWAY, M. D.: Demonology and Devil-lore.
COOKE, M. C.: Freaks and Marvels of Plant Life.
DAVIES, J. A.: On the Evil Eye.
DYER: English Folk-lore.
EARLE, J.: Philology of the English Tongue.
ELLACOMBE, H. N.: Plant-lore of Shakespeare.
FARRER: Primitive Manners and Customs.

FORSTER, T.: The Perennial Calendar.
FRIEND, H.: Flowers and Flower-lore.
GERARDE, J.: The Herball.
GRIMM: Fairy Tales.
GRIMM: Teutonic Mythology.
GRINDON, L.: Nature and Phenomena of Life.
GUBERNATIS, DE: Mythologie des Plantes.
HALLIWELL-PHILIPPS, J. O.: Illustrations of Fairy Mythology.
HENDERSON, W.: Folk-lore of Northern Counties.
HIBBERD, SHIRLEY: Field Flowers.
HIBBERD, SHIRLEY: Flowers and their Teachings.
HIBBERD, SHIRLEY: Flora Domestica.
HIBBERD, SHIRLEY: Language and Sentiment of Flowers.
HIBBERD, SHIRLEY: Clavis Calendularia.
HIBBERD, SHIRLEY: Flower-lore.
HILL, J.: Herbal.
INGRAM, J. H.: Flora Symbolica.
INWARDS, R.: Weather-lore.
JONES, W.: Credulities, Past and Present.
JONES: Crowns and Coronations.
KEIGHTLEY, T.: Fairy Mythology.
KING: Sketches and Studies.
LAMBERT, Miss: The Ceremonial Use of Flowers.
LANKESTER, Mrs.: Wild Flowers.
LINCOLN, Mrs.: Botany (American).
MALLET; Northern Antiquities.
MANDEVILLE, Sir T.: Travels.
MANT, P.: The British Months.
MÜLLER, M.: Chips from a German Workshop.
PHILLIPS, H.: Flora historica.
SCHWARTZ: Der Ursprung der Mythologie.
SKEAT, W.: Dictionary of Philology.
SKEAT, W.: Etymological Dictionary.
SPALDING, T. A.: Elizabethan Demonology.
SWAINSON, C.: Weather Proverbs.
SYKES WIRT: British Goblins, &c.
SYLVESTER, J.: Christmas Carols and Ballads.
TAYLOR, J.: The Complete Weather Guide.
TYLOR, E. B.: Primitive Culture.
WADDY: A Year with the Wild Flowers.

XII. USES

AIKMAN, C. M.: The Food of Crops.
ARCHER, T. C.: Popular Economic Botany.
BAILEY, L. H.: Cyclopedia of Horticulture.
BAILEY, L. H.: Plant Breeding.
BARDSWELL, F.: The Herb Book.
CANDOLLE, A DE: Origin of Cultivated Plants.
FLÜCKIGER, F. A., and HANBURY, D.: Pharmacographia.
GAMBLE, J. S.: A Manual of Indian Timbers.
HANNAN, W. I.: Textile Fibres of Commerce.
HENSLOW, G.: The Uses of British Plants.
HENSLOW, G.: Poisonous Plants.
HENSLOW, G.: British Pharmacopeia.
HITCHCOCK, A. S.: A Textbook of Grasses.
JACKSON, B. D., and SYMONS, G. F.: Vegetable Technology.
LINDLEY, J.: Flora Medica.
LINDLEY, J.: The Vegetable Kingdom.
LINDLEY, J.: Medical and Economical Botany.
MORRIS: Plants Yielding India-rubber.
NICHOLLS: Tropical Agriculture.
NICHOLSON, G.: Dictionary of Gardening.
PIPER, C. V.: Forage Plants.
POTTER, M. C.: Agricultural Botany.
SMITH, J.: Domestic Botany.
SMITH, J.: A Dictionary of Economic Plants.
SORAUER: Physiology of Plants for Gardeners.
STONE, J. H.: The Timbers of Commerce.
TYNAN and MAITLAND: The Book of Flowers.
U.S. DEPARTMENT OF AGRICULTURE: A Descriptive Catalogue of Useful Fibre Plants of the World.
WATT, G.: Dictionary of the Economic Products of India.
WIESNER, J.: Die Rohstoffe des Pflanzenreichs.
WILLIS, G. S. V.: A Manual of Vegetable Materia Medica.
WILLIS, J. C., and WRIGHT: Handbook of Economic Products of India.

XIII. GENERAL BRITISH FLORAS (A Selection)

BABINGTON, G. C.: Manual of British Botany.
BENTHAM, G.: Handbook of the British Flora.
BENTHAM, G., and HOOKER, Sir J. D.: British Flora.
CARTER, H. G.: The Genera of British Plants.
DIXON, H. N., and JAMESON, H. G.: Student's Handbook of Mosses.
DRUCE, G. C.: Hayward's Botanist's Pocket Book.
HOOKER, Sir J. D.: The Student's Flora.
MOSS, C. E.: Cambridge Flora.
PEARSON, W. H.: The Hepaticæ of the British Isles.
SYME, E.: English Botany.
WEST, G. S.: Algæ.
WILLIAMS, F. N.: Prodromus Floræ Britannicæ.

XIV. FOREIGN FLORAS (A Selection)

ANDERSSON, N. J.: Plantæ Scandinaviæ.
ASCHERSON, P., and GRAEBNER, P.: Synopsis der Mitteleuropäischen Flora.
BENTHAM, G., and HOOKER, Sir J. D.: Genera Plantarum.
BOREAU, A.: Flore de la centre de la France.
BRÉBISSON, L. A. DE: Flore de la Normandie.
COSSON, E., and GERMAIN, E.: Flore des environs de Paris.
ENGLER, A.: Das Pflanzenreich.
ENGLER, A., and PRANTL: Die natürlichen Pflanzenfamilien.
FRIES, E. M.: Summa Vegetabilium Scandinaviæ.
GRENIER, C., and GODRON, D. A.: Flore de France.
HOOKER, Sir J. D.: Flora Indica.
KOCH, W. D. J.: Synopsis Floræ Germanicæ et Helvetiæ.
LEVY, O. J.: Flore de l'Ouest de la France.

NYMAN, C. F.: Conspectus Floræ Europæ.
PRITZEL, G. A.: Thesaurus.
PRITZEL, G. A.: Icones Plantarum.
REICHENBACH, H. G.: Icones Floræ Germanicæ.
ROUY, G.: Flore de France.
ROUY, G., and FOUCAUD: Flore de France.
SCHINZ and KELLER: Flora der Schweiz.
SCHKUHR, C.: Riedgräser.
WILLKOMM, M., and LANGE, J.: Prodromus Floræ Hispanicæ.

XV. GENERAL WORKS (A Selection)

ARTHUR J. C., and MACDOUGAL, D. T.: Living Plants.
AVEBURY, LORD: On Seedlings.
AVEBURY, LORD: On Buds and Stipules.
BAILLON, M. H.: Natural History of Plants.
BARY, A. DE: Comparative Anatomy of the Phanerogams and Ferns.
BATESON, W.: Materials for the Study of Variation.
BATESON, W.: Mendels Principles of Heredity.
BATESON, W.: Method and Scope of Genetics.
BERGEN, J. Y., and CALDWELL, O.W.: Introduction to Botany.
BOSE, J. G.: Plant Response.
BOWER, F. O.: Origin of a Land Flora.
BOWER, F. O.: Botany of the Living Plant.
CAMPBELL, D. H.: Plant Life and Evolution.
CHURCH, A. H.: Types of Floral Mechanism.
COULTER, J. M.: Plant Relations.
DARWIN, C.: Climbing Plants.
DARWIN, C.: Movements of Plants.
DARWIN, C.: Variation of Animals and Plants.
DARWIN, Sir F.: The Physiology of Plants.
DARWIN, Sir F.: Elements of Botany.
DAVIES, J. A.: The Flowering Plant.
DETMER, W.: Keimungsphysiologie.
DONCASTER, L.: Heredity.
DUGGAR, B. M.: Plant Physiology.
EICHLER, A. W.: Blüthendiagramme.
FARMER, J. B.: Plant Life.
FRITSCH, F. E., and SALISBURY, E. J.: An Introduction to the Study of Plants.
GANONG, L.: The Living Plant.
GEDDES, P.: Evolution of Sex.
GOEBEL, K.: Organography of Plants.
GREEN J. R.: History of Botany.
HABERLANDT, G.: Physiological Plant Anatomy.
HENSLOW, G.: Floral Structure.
JACKSON, B. D.: Dictionary of Botanical Terms.
JOST, L.: Physiology of Plants.
KERNER VON MARILAUN, A., and OLIVER, F. W.: The Natural History of Plants.
LE MAOUT, E., and DECAISNE, J.: System of Botany.
LOTSY, J. P.: Vorlesungen über Botanische Stammesgeschichte.
MACDOUGAL, D. T.: Textbook of Plant Physiology.
OLIVER, D.: Illustrations of the Natural Orders, &c.
OLIVER, J. W.; Systematic Botany.
PAYER, J. B.: Organogenie de la Fleur.
PAX, F.: Morphologie der Pflanzen.
PUNNETT, R. C.: Mendelism.
RENDLE, A. B.: Classification of Flowering Plants.
SACHS, J. VON: Lectures on the Physiology of Plants.
SACHS, J. VON: History of Botany.
SCHUMANN, K.: Morphologische Studien.
SCOTT, D. H.: Structural Botany.
STEP, E., and KNIGHT, B. E.: The Living Plant.
STEVENS, E.: Plant Anatomy.
STOPES, M. C.: The Study of Plant Life.
STRASBURGER, C.: Textbook of Botany.
TIMIRIAZEFF, C. A.: The Life of the Plant.
VERNON, H. M.: Variation.
VINES, S.: Textbook of Physiology.
VRIES, H. DE: Plant Breeding.
VRIES, H. DE: Species and Varieties.
WARMING, E.: Handbook of Systematic Botany.
WERNHAM, H. F.: Floral Evolution.
WILLIS, J. C.: Flowering Plants and Ferns.

APPENDIX IV

GLOSSARY

Achene, a hard, dry, indehiscent, one-celled, one-seeded fruit; e.g. Buttercup.
Acicular, needle-shaped, tapered.
Acuminate, coming to a point, which is elongate, with concave sides.
Acute, coming to a sharp point, not prolonged.
Adnate, attached by the whole base or side.
Adpressed, closely touching.
Æstivation, the manner of arrangement or folding of parts in the bud of a flower.
Aggregate, of fruits, closely arranged or contiguous carpels.
Alæ, wings of the corolla in Leguminosæ (posterior lateral petals).
Alternate, not opposite, as in leaves, &c.
Amphibious, addicted to land or water conditions.
Amplexicaul, half-clasping the stem, as the bases of leaves.
Anemochorous, dispersed by wind.
Anemophilous, pollinated by the wind.
Annual, of one year's duration.
Anterior, situated in the forepart.
Anther, the distal part of the stamen which contains the pollen.
Anthocyanin, purple colouring-matter in cells.
Apex, the part most removed from the base or attachment.
Apiculate, with a small apical point, as the tip of the midrib in some cases.
Apocarpous, when the carpels are not united.
Aquatic, growing in water, submerged or with leaves floating.
Arcuate, forming an arch or bow.
Arenophilous, growing on sand.
Ascending, growing upwards, and approaching a vertical position.
Asperous, with a rough surface.
Association, a community of definite composition, associated with a definite type of habitat, and recognized by the predominance of one or more floristic types, such as a damp oakwood.
Attenuate, tapering gradually to a slender point.
Auricled, of the leaves, with ear-like lobes at the base.
Autochorous, dispersed by the plant itself—of the seed.
Autonomous movement, spontaneous, not induced by external stimulus.
Awn, a bristle-like appendage, as in Grasses.
Axil, the angle of the stem and leaf.
Axis, the central stem or root.

Barbs, the recurved processes on bristles and teeth on the leaf-margin.
Bark, the external layer of the stem in woody plants where a corky layer is formed.
Bast, the inner layer of the bark, which is soft phloem, or hard bast fibres.
Beak, a prolonged point.
Bearded, furnished with long hair, like a beard.
Berry, a succulent fruit, with several seeds, soft pericarp.
Biennial, of two years' duration, flowering and producing seed the second year.
Bifid, divided into two parts half-way.
Bilabiate, with two lips.
Bipartite, divided into two parts nearly entirely.
Bipinnate, tri-, quadri-, &c., 2, 3, or 4 times divided again in the case of a pinnate leaf.
Bipinnatifid, once again pinnatifid.
Biternate, a ternate leaf divided ternately again.
Bract, a leaf differing from the stem leaves situated in the floral region.
Bracteoles, small bracts on the peduncle.
Bud, an unexpanded shoot, whether on the axis or leaves.
Bulb, an underground bud with fleshy scale-leaves, stored with reserve material.

Cæspitose, tufted, of roots, stems, or leaves.
Calciphilous, addicted to a lime soil.
Calyx, the outermost protective whorl of the perianth, usually green, made up of sepals.
Cambium, the layer between wood and bast, forming new (secondary) wood and bast.
Capillary, thread-like, slender.
Capitate, clustered in heads with a knob like the head of a pin.
Capitulum, a head of sessile flowers, as in Compositæ.
Capsule, a dry many-seeded dehiscent fruit.
Carpel, the modified leaf which forms a single-celled ovary, or a single cell of an ovary.
Caryopsis, a one-seeded fruit in which the seed-coat and pericarp are adherent, indehiscent, as in Grasses.
Catapult fruit, a fruit in which the seed is expelled by an elastic movement of the plant itself.

Catkin, a spike of flowers of one sex only, with bracts in place of perianths.
Caulescent, with an erect stem.
Cauline, arising from the stem.
Centrifugal, growing outwards from the middle.
Centripetal, growing inwards towards the centre.
Channelled, hollowed out in the centre or middle line.
Chasmochomophyte, **Chasmophyte**, plants that grow in crevices on bare rock, with a little detritus only.
Chersophytes, plant formations on waste land.
Chlorophyll, the green colouring-matter in plants which enables them to assimilate carbon by aid of the sun.
Chomophytes, plants growing on rock on which detrital matter is present as a subsoil, on the surface or in crevices.
Ciliate, with a fringe of hairs.
Clavate, club-shaped.
Claw, the attenuate base or stalk of a petal.
Cleft, divided, but not so far as the midrib.
Cleistogamic, flowers that do not open and are self-pollinated.
Coherent, united together.
Column, when the stamens and style fuse to form one structure, as in Orchids.
Commensal, when a species shares, with another, food material, e.g. parasites, saprophytes.
Communities, the different members which together make up a coherent whole, possessing at the same time a general unity of character, as Heath-plants.
Compound, made up of a number of parts which are similar, as opposed to simple.
Compressed, flattened laterally.
Connate, united around the stem.
Connective, a process connecting the cells of the anthers with the filament.
Connivent, uniting together.
Cordate, heart-shaped.
Coriaceous, leathery in texture.
Corm, a fleshy, solid, bulb-like base of a stem.
Corolla, a whorl within the calyx, enclosing the stamens and stigma, made up of petals.
Cortex, the ground tissue enclosing the vascular tissue in a stem.
Corymb, a raceme in which the upper peduncles are shortened to form a flat-topped inflorescence.
Cosmopolitan, plants having a universal distribution.
Cotyledon, the seed-leaves, single in monocotyledons, double or paired in dicotyledons.
Crateriform, cup-shaped.
Crenate, with rounded teeth, scalloped.
Crenulate, with small rounded teeth.
Cross-fertilization, when pollen from the anthers of one flower is carried to the stigma of another, fertilization following.
Cross-pollination, the transfer of pollen from one flower to another.
Cruciform, arranged like a cross in opposite pairs.
Culm, the jointed hollow stems of Grasses, &c.
Cuneate, wedge-shaped.
Cupule, the bract-like cup enclosing a nut, e.g. an acorn.
Cyme, a centrifugal inflorescence; the terminal flower is overtopped by lateral branches.

Deciduous, of leaves, falling off, not evergreen, or of flowers when petals drop.
Decumbent, prostrate, but ascending at the extremity.
Decurrent, when the blade of a leaf runs down the stem below the point of attachment.
Decussate, when opposite pairs of leaves are alternately at right angles.
Deflexed, turned down or backwards.
Dehiscence, the manner in which a fruit splits up or opens.
Denizen, apparently native, but likely to have been introduced by human agency.
Dentate, toothed, the teeth short, triangular.
Denticulate, finely toothed.
Depressed, flattened above.
Dichogamy, when anthers and stigma mature at different times.
Diffuse, widely branching.
Digitate, finger-like.
Dicœcious, unisexual, the sexes on different plants, as in Willows.
Disk, (1) the central part of a capitulum; (2) the flattened part of the receptacle, bearing corolla, stamens, and carpels, e.g. in Acer.
Dissepiment, septum in an ovary.
Distichous, in two opposite rows.
Divaricate, spreading at an obtuse angle.
Divergence, the angle between the insertion of successive leaves on the stem.
Divided, deeply cut.
Dominant, a species forming the strongest feature in a botanical association.
Drupe, 1-celled succulent fruit with a hard stone which encloses a seed or kernel.
Duct, a tube formed by fusion or division of cells, a canal made of cells without division.

Ecology, the study of plants in their natural habitats, their association, and relation to the environment.
Emarginate, with a notch at the extremity.
Embryo, the young plant enclosed in the seed.
Embryo-sac, the large cell containing the ovum, and the embryo in the ovule.
Endemic, confined to a certain district or station.
Endophytic, living within the tissue of another plant.
Entire, untoothed.
Entomophilous, pollinated by insect agency.
Ephemeral, flowers that open for a few hours, or plants that produce several generations in one season.
Epigeal, growing above ground.
Epigynous, seated on the ovary.
Epiphytes, plants that grow on others but do not draw nourishment from them; i.e. not as parasites.
Equitant, folded around.
Ericetal, growing on heaths.
Exserted, projecting beyond a corolla.

Extrorse, when anthers open outwards, away from the centre.

Falcate, sickle-shaped.
Fasciation, when several stems are abnormally fused together.
Fasciculate, clustered in bundles.
Fastigiate, with parallel ascending branches.
Felted, covered with a soft felt.
Fertilization, fusion of the male gamete with the egg-cell; in Angiosperms follows on pollination, and is carried out by the agency of the pollen-tube.
Filament, the stalk of an anther.
Filiform, thread-like.
Fimbriate, with a fringe of fine teeth.
Fistular, hollow.
Flaccid, weak, limp.
Flexuose, wavy.
Flora, the aggregate constituent plants of a particular region.
Floret, a small flower borne in clusters or singly.
Flower, all the modified leaf-like processes which together combine to cause the reproduction of the plant, by the production of seeds from spores (or pollen-grains and embryo-sacs).
Flowering glume, the outer scale of a flower in Grasses, usually bearing an awn.
Follicle, a one-celled carpel, opening only down the ventral suture, and containing numerous small seeds.
Fruit, the seed-vessel, with seeds, and protective envelopes.
Fruticose, shrubby.
Fusiform, spindle-shaped.

Galeate, helmet-shaped.
Gall, an excrescence caused on stems and leaves, &c., by the laying of an insect's egg within the tissue, causing irritation, and producing in each species a characteristic growth, rendering it possible to indicate the gall insect from the gall formed.
Geotropism, a growth-curvature induced by gravity.
Germination, the growth of an embryo into a seedling.
Gibbous, swollen at one part or another.
Glabrous, smooth.
Glandular, bearing glands or slender wart-like outgrowths from the surface.
Glaucous, bluish green.
Glumes, bracts or scales enclosing the spikelets in Grasses.
Growth-form, the result of the adaptation of plants to their external conditions which produces a certain habit.

Habit, the general external form of a plant in outline.
Habitat, the natural haunt of each plant.
Halophilous, addicted to a saline soil.
Halophytes, plants that are confined, more or less, to maritime conditions, and are used to saline soil.
Hastate, spear-shaped below.
Haulm, the stem in Grasses.
Helophilous, addicted to a marshy habitat.
Herbaceous, green, succulent, without wood.
Herbal, the old descriptive Botany, usually restricted to curious medicinal remedies.
Herbarium, a collection of dried plants, or the place in which they are kept, or an illustrated herbal. Formerly called *hortus siccus*.
Hermaphrodite, when both stamens and carpels are present on the same plant.
Heterogamous, bearing two different kinds of flowers of different sexes.
Heterophyllous, bearing different types of leaves.
Heterostyled, with styles of different length in different flowers.
Heterotrophic plants, saprophytes and parasites.
High-moor, opposed to low-moor, a sphagnum-moor.
Hirsute, with stiffish hairs.
Hispid, another term for hirsute.
Humus, vegetable mould, made up of decaying animal and vegetable matter.
Hybrid, the result of crossing two different species, usually allied.
Hydrochorous, dispersed by water—of the seed.
Hydrophytes, another term for aquatic plants.
Hygrophilous, loving moisture, but not necessarily truly aquatic.
Hypogeal, underground.
Hypogynous, not adherent to the calyx, growing from below the base of the ovary.

Imbricate, overlapping like the tiles of a roof (*imbrex*, Latin, roof-tile).
Incised, deeply cut, with irregular sharp teeth.
Incurved, curved inwards.
Indehiscent, of fruits not opening.
Inferior, when the ovary adheres to the calyx, as in epigynous flowers.
Inflexed, bent inwards.
Infundibuliform, funnel-shaped.
Insectivorous plants, those which attract, trap, and digest insects.
Internode, the interval between the nodes.
Introrse, when the anther dehisces towards the centre.
Involucel, the involucre of a secondary umbel.
Involucre, the whorl of bracts at the base of an umbel or head.
Involute, rolled from the back inwards.

Keel, the two lower petals in a Leguminous flower.
Knot, the node of a Grass stem.

Labellum, the lip or terminal segment in Orchids.
Laciniate, fringed with narrow segments.
Lacustral, addicted to a lake situation.
Lanceolate, lance-shaped, tapering towards the point.
Lax, loose.
Leaf-axil, angle between leaf and stem.
Lenticular, lens-shaped.
Legume, a pod, one-celled, two-valved, seeds ar-

ranged along the inner angle, dehiscing by both sutures.

Ligule, in Grasses a membrane at the base of the limb of the leaf; in Composites applied to the ray floret corollas.

Limb, the flat, enlarged part of a leaf or petal.

Linear, much narrower than long, with parallel borders.

Linear-lanceolate, between linear and lanceolate.

Lipped, having two lips in corolla or calyx.

Lithophytes, plants growing on rocks and stones.

Littoral, growing on the coast, maritime.

Loculicidal, opening down the back, or midrib.

Lomentum, a legume with one-seeded joints.

Lyrate, pinnatifid, the lobes enlarged upwards, with one very large terminal one.

Melliferous, honey-bearing.

Mesophytes, plants found on well-watered and ventilated soil rich in nutriment.

Midrib, the central vein in a leaf.

Monadelphous, when the stamens are united by the filaments into a column.

Moniliform, cylindrical, constricted at several points.

Monocarpic, producing seed once only.

Monœcious, with male and female flowers on the same plant, in separate flowers.

Monopetalous, when the petals are joined by their margins to form a tube.

Morphology, that part of botany which deals with the form, structure, and development of plants.

Mucronate, with a short blunt point.

Muricate, covered with spines.

Mycorhiza, when roots are clothed with the mycelium of a fungus.

Myrmecochorous, dispersed by aid of ants.

Myrmecophilous, plants which protect ants, which in turn ward off enemies.

Naturalized, introduced, but establishing itself by seed.

Nectary, a gland which secretes honey.

Neuter flowers, devoid of stamens or carpels of use to the plant.

Node, point where a leaf or branch is attached to the stem.

Nut, a hard indehiscent one-seeded fruit.

Nutation, a spontaneous movement in plants.

Obovate, ovate, but obtuse apically.

Ocrea, a membranous stipule around the stem, as in Polygonaceæ.

Ovary, the organ in which the ovules and seeds are formed.

Ovate, egg-shaped, flat.

Ovoid, egg-shaped, not flat, but cylindrical.

Ovule, the young seed, the macro-sporangium enclosing the embryo-sac.

Oxylophytes, bog-plants, growing on sour, acid soil.

Palate, the projecting part of the throat of a gaping corolla, or base of the lower lip.

Palea, the inner glume, enclosing the flower in a Grass.

Palmate, with lobes radiating from a centre like fingers of a hand.

Paludal, addicted to a marshy habitat.

Panicle, a raceme with clusters of branched flowers.

Papilionaceous, butterfly-like, as the flowers of a Pea, Vetch, &c.

Papilla, a small wart-like protuberance.

Pappus, the hairy outgrowth of the fruit in Compositæ.

Parasite, a plant which lives on a living plant and draws nutriment from it.

Partite, divided not quite to the base.

Patelliform, disc-like.

Patent, spreading nearly at right angles.

Pedicel, a branch from a peduncle which bears a flower.

Peduncle, flower-stalk.

Peltate, shield-shaped, with the stalk attached below or above the surface, not to the margin.

Perennial, plants that live for several years, seeding several times.

Perfoliate, when the stem is encircled by a leaf, almost or entirely.

Perianth, the outer whorls of a flower, or the calyx and corolla.

Pericarp, the seed vessel or wall of an ovary which forms a fruit.

Perigynous, when the corolla and stamens are borne on the calyx, but are not attached to the ovary.

Persistent, not falling.

Petal, the division of a corolla.

Petiole, the leaf-stalk.

Phænogamous, furnished with stamens and pistil.

Phænology, the recording of the time of flowering, budding of leaves, &c.

Phyllaries, the bracts of the involucre in a Compositæ.

Physiognomy, the general structure or characters of a floral tract.

Pilose, with stiff scattered hair.

Pinnate, with the leaflets arranged on either side of a common stalk.

Pinnatifid, when the leaf is deeply divided pinnately almost to the midrib into narrow segments.

Pinnule, the segment of a bipinnate leaf.

Pistil, the female part of a flower, including ovary, style, and stigma.

Pistillate, flowers with pistils and without stamens.

Pitted, with depressions on the surface.

Plaited, plicate or folded.

Plant association, in a botanical formation there are groups of different species such as woodland, grassland, heath, &c. Each group is an association.

Plant community (see Community).

Plant-formation, a community of species, such as that of clays and loams, associated together by definite external characters of the habitat; an expression of certain defined conditions of life (not affected by floristic differences).

Pollarding, the removal of the crown of a tree causing branches to sprout out.
Pollen, the cells (microspores) contained in the anther.
Pollen-grain, a grain of pollen or microspore.
Pollen-sac, the sporangium containing the microspores.
Pollen-tube, the outgrowth of the pollen-grain which helps to fertilize the plant.
Pollinium, a mass of pollen-grains adhering together.
Polycarpic, seeding more than once.
Polypetalous, with separate petals.
Polysepalous, with several sepals not coherent.
Pome, a fleshy false fruit with many seeds.
Porous, when the anthers dehisce by holes.
Prickle, a hard, sharp epidermal process not woody.
Procumbent, prostrate, lying on the ground.
Prostrate, flat on the ground.
Proterandrous (Protandrous), when the anthers ripen and dehisce before the stigma.
Proterogynous (Protogynous), when the stigma is ripe before the anthers dehisce.
Psammophilous, addicted to a sand-soil.
Pubescent, with down closely pressed to the surface.
Pulverulent, powdery.
Pyriform, pear-shaped.

Raceme, a simple centripetal inflorescence with stalked flowers.
Rachis, the axis of a compound leaf or the central stem of several spikelets in a Grass.
Radical, springing from the crown of the root as leaves.
Ray, the outer circle of florets in a composite.
Receptacle, (1) the terminal part of the floral axis; (2) the flat, short axis of a flowerhead in Composites.
Recurved, bent back.
Reflexed, bent back (markedly so).
Reniform, kidney-shaped.
Revolute, rolled back.
Rhizome, an underground stem, with roots and leafy shoots.
Ringent, gaping, of a corolla.
Rock formations, different geological formations.
Rock-soil formations, which contribute to characterize the different rock-soils that make up a subsoil.
Rootstock, a thick, short root like a rhizome.
Rosette plants, plants that have short internodes and close-set leaves, as the Daisy.
Rostellum, the top of the pistil, in Orchids forming a beak or division between stamen and stigma.
Rotate, wheel-shaped, with short tube.
Rubble plants, developing on soil derived by the disintegration of rock by atmospheric agency, e.g. the chalk.
Runcinate, with the leaf segments turned back.
Runner, a prostrate stem rooting at intervals or at the end.
Rupestral, growing on rocks.

Sagittate, with segments like the barb of an arrow.
Samara, an indehiscent winged fruit; as the key of an Ash.
Saprophyte, growing on dead or decaying animal or vegetable matter.
Saxicolous, growing on stones, walls, &c.
Scabrous, rough.
Scape, a peduncle which is without leaves and radical.
Scarious, thin, dry, semi-transparent, or not green.
Schizocarp, a fruit splitting up into several one-seeded divisions.
Sclerophyllous, term applied to xerophytic bush-land.
Scorpioid, when a cyme is curved like a crozier.
Scrub, a formation of stunted growth.
Secund, turned to one side.
Seed, the fertilized and ripened ovule.
Seedling, the embryo after germination.
Sepal, a division of the calyx.
Serrate, with segments like the teeth of a saw.
Sessile, without stalk or pedicel.
Setaceous, bristle-like.
Shade-plants, plants that dislike too much light.
Shoot, the portions of a plant differentiated into stem and leaves, &c.
Silicule, a short pod in Cruciferæ.
Siliqua, a long pod in Cruciferæ.
Sinuose, undulating.
Sling-fruit, one which, owing to the contraction of certain tissues, hurls the seeds when mature from the fruit.
Sobole, a thin underground creeping stem with roots and buds at intervals.
Spadix, a succulent fleshy spike with close sessile flowers.
Spathe, a large bract enclosing a spadix.
Spathulate, spoon-shaped.
Species, individuals possessing in common several characters suggesting a derivation from a common ancestor.
Spike, a simple elongate axis bearing sessile flowers.
Spikelet, the few flowers enclosed by glumes in Grasses.
Spine, a sharp woody process or thorn.
Spur, a hollow expansion of the basal part of a sepal or petal, connected with the nectary.
Stamen, the male part of the flower, consisting of filament and anther.
Staminode, a sterile stamen.
Standard, the upper (posterior) petal in Leguminosæ.
Stigma, the pollen-receiving part of the pistil.
Stipule, leaf-like appendages at the base of the petioles, usually paired.
Stole, a loose procumbent stem, with buds that root at intervals.
Stoma, a ventilating pore in the epidermis, with surrounding guard-cells.
Style, the prolonged end of the ovary, bearing the stigma.
Sub-dominant, forming a less-marked feature of a botanical association or formation.

Subsoil, the layer below the humus and soil which is derived from the underlying rock formations.
Subulate, awl-shaped, tapered to a fine point.
Sucker, an underground shoot producing a stem at the end.
Sun plants, plants that seek the light.
Switch plants, with reduced leaves, with green shoots serving as leaves.
Symbiosis, when two plants are intimately associated for mutual benefit.
Syncarpous, an ovary or fruit with the carpels joined.

Tendril, a thread-like organ used for climbing.
Tentacle, a sensitive hair, as in *Drosera*.
Terete, round, in transverse section.
Ternate, in threes, as of leaflets.
Thalamus, the receptacle of a flower.
Tomentose, with densely-matted woolly hair.
Torulose, knotted.
Torus, the receptacle.
Transpiration, the giving off of aqueous vapour from leaves, &c.
Trifid, divided into three parts nearly half-way.
Trigonous, with three angles and three convex faces.
Truncate, blunted.
Trunk, main stem.
Tuber, a subterranean fleshy shoot.
Tubercle, a small wart-like excrescence.
Tumid, swollen.
Turfophilous, growing on humus or peat.
Turgidity, a state of tension in a cell due to osmotic pressure of the cell-sap and elastic tension of the cell-wall.
Tussock formations, badly drained pastures, made up of tussocks which exclude other plants.

Umbel, when clusters of stalked flowers radiate from a centre.
Umbilicate, peltate, hollow from the stalk upward.
Undershrubs, the lesser shrubs that lurk under scrub, &c.
Unilateral, turned on one side.

Valvate, opening by means of valves, of capsules.
Venation, the arrangement of the veins.
Ventricose, swollen below.
Vernation, the arrangement of the leaves in a bud.
Verticillate, in whorls.
Villose, with long soft hair.
Viscous, sticky.

Whorl, with parts arranged in a circle.
Wood, the xylem or hard lignified part of a stem.

Xerophilous, fond of dry conditions.
Xerophytes, plants used to dry conditions.

Zoochorous, dispersed by animals.