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How to Study

WILD FLOWERS

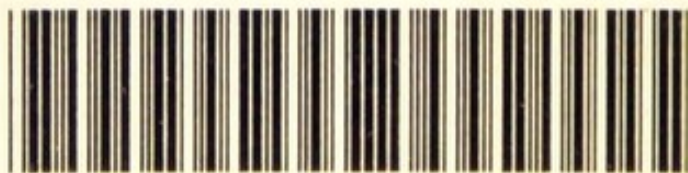
GEORGE HENSLOW

M.A. F.L.S. F.G.S.

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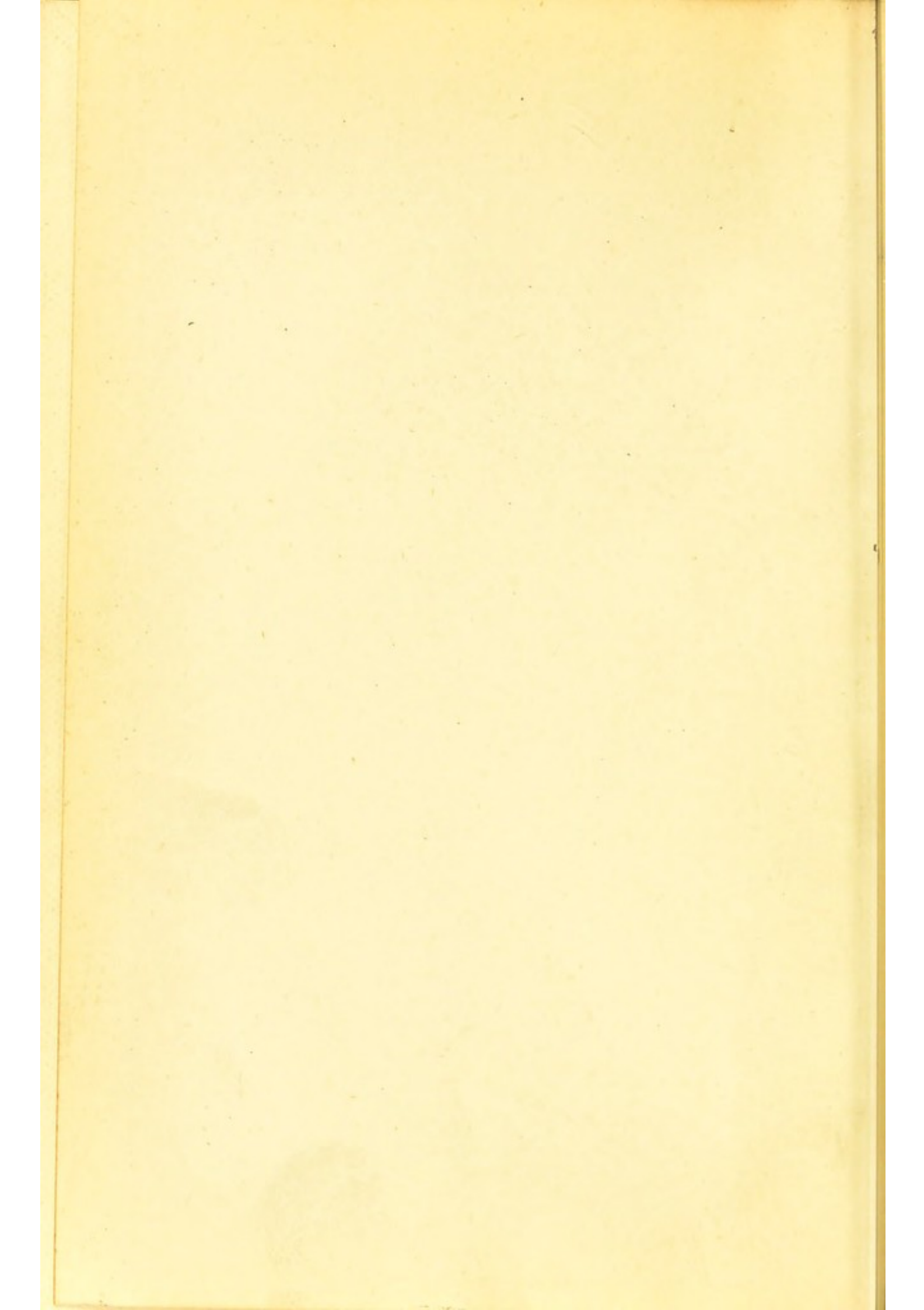


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HOW TO STUDY WILD FLOWERS

BY THE

REV. GEORGE HENSLOW, M.A., F.L.S., F.G.S., ETC.

EXAMINER IN BOTANY FOR THE COLLEGE OF PRECEPTORS

*Author of 'Botany for Beginners,' 'Floral Dissections,' 'The Making
of Flowers,' 'The Origin of Floral Structures,' 'The
Origin of Plant Structures,' &c., &c.*

FOR THE USE OF SCHOOLS AND PRIVATE STUDENTS

(WITH FIFTY-SEVEN ILLUSTRATIONS)

THE RELIGIOUS TRACT SOCIETY

56 PATERNOSTER ROW AND 65 ST. PAUL'S CHURCHYARD

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PREFACE

(*To the Teacher.*)

THE object of this book is to enable students to rapidly acquire an *accurate* knowledge of typical British wild flowers.

The author's experience as an examiner for the last forty years has shown him that some examinees only acquire an inaccurate smattering of botany at school. He hopes that, if teachers would place this book in the hands of their pupils, make them dissect and examine the flowers with its aid, and above all things *insist upon accuracy*, the great use of botany in schools, viz. *the training the young mind in systematic observation and accurate habits*, will be secured. Hitherto, the frequent carelessness in the answers (even in the spelling of the simplest botanical terms, e.g. caylx, cailyx, &c., for *calyx*) shows that the subject must have been very indifferently taught and scarcely with the above object kept steadily in view; for such is, indeed, the sole use of introducing it into schools. Taught *con amore* and properly, botany has a most important educational value; otherwise it may become worse than useless. Still, good teachers are many.

(*To the Student.*)

I am presuming that he wishes to know something about our wild flowers, but does not quite know how to begin to study them. To show how he may be able to do this without other assistance is the aim of the present book. There is, however, no 'Royal Road' to Botany; but the beginner must be prepared

to observe closely, to compare one plant with another, to note their agreements and their differences; and then it is desirable that he should record his observations in a note-book, and make plenty of sketches of the various parts of flowers, &c. He must on no account be contented with merely knowing the names of plants. His aim should always be first to understand thoroughly the entire structure of all flowers he examines, and then to study their interpretation. In other words, he must never rest satisfied until he has learnt the 'Why' and the 'Wherefore' of everything he sees, as far as it is at present possible.

But the mere knowledge of the structure of any number of flowers alone will not be sufficient. The student must understand their relationships. To do this, botanists have classified plants into various groups, called families, genera, species, &c.¹, and have written 'Floras' or descriptions of every plant in technical botanical terms, and arranged them according to the method of classification adopted by botanists of all countries. The object of the present work is to familiarize the beginner with the majority of the commonest of our wild flowers. It is so far an epitomized flora; but for a more thorough comprehension of the structure and differences, especially of *genera* with many *species*, the reader must look forward to the use of Sir J. D. Hooker's book entitled *The Student's Flora of the British Isles*. Hence the plants herein described follow the arrangement adopted by that author.

This book, however, is something more than a flora; for such a work does not profess to give more than the bare details of structure, so that every plant may be known by a collection of characters taken from all parts of the plant. A beginner, however, naturally asks what is the *use* of this or that peculiarity in

¹ To assist beginners in the study of flowers, I would recommend my book of eight lithographed plates called *Floral Dissections*: 'Illustrative of Typical Genera of the British Natural Orders.' It is published by Mr. Stanford, price 3s.

a flower. Consequently, as far as one can, I have endeavoured to supply an answer, or at least give suggestions, so that the student can follow them out himself.

When a student has thoroughly examined some flower of which he does not know the name, he will first require to refer it to the position in classification to which botanists have assigned it. Here comes in the use of its name. To do this, he must carefully follow the plan hereafter more fully given. Thus he first writes down its 'floral formula.' He then refers to the group in the 'key' containing the same number of stamens. He then compares his own floral formula with those of the flowers within that group. If there be more than one like it, he compares the few points of structure given in words. He will soon find the plant without much difficulty, and the index (p. 9) will give him its position at once, if it be one described.

It is hoped that the student, as soon as he has found out the name of any plant, will perceive that the key is not merely an instrument for discovering this, but that the floral formula really indicates the main features of the structure of the flower itself: and this is the most important thing to know.

Lastly, after the description of the plants, attention will be called to the most important features, and opportunities will be taken to illustrate the most interesting points, not only of plant-structure, but of a good deal of physiology or the phenomena of plant-life, such as are shown in the fertilization by insects. Occasional references will also be made to their uses to man, and particularly to such as are poisonous¹.

¹ To examine the more minute structures of flowers, the student must provide himself with a pocket lens and a simple microscope; such, e. g. as is made by Mr. Collins, 157 Great Portland Street, on a suggestion of the present writer; which he has called 'Henslow's dissecting microscope.' The price is 15s., without the rack motion, and 17. 1s. with it. It consists of a cast-iron bronzed stand, affording good rests for the hands. A sharp penknife, as well as a pair of pointed forceps, and a couple of strong needles in pen-holders, will be all the instruments required. To prepare the last-mentioned, let the student get a few coarse needles, 'fours' or 'fives,' and

In preparing this work for the Religious Tract Society, it is hoped that it may lead the young student to study nature, not only as merely supplying interesting facts for his intellect to enjoy, but that he will look somewhat deeper into the mysteries of plant-life; and when trying to trace out the effects of causes, and to discover the origin of things, he will be thereby led to see how—judging by analogy from the capacities of man—there must be a Mind somewhere and somehow directing the many forces of nature. So far from the supposed truth underlying Paley's celebrated argument of the watch being disproved at the present time, scientific knowledge of to-day greatly extends that argument. For if the mechanism of a watch reveals the presence of mind in the maker of it, how much more would the discovery of its having self-repairing powers if it went wrong—such as all animals possess—be proof of a far greater power and skill than man possesses? It is true that man has invented an automatic self-regulating governor to the steam-engine, but a boiler cannot mend a crack, as a finger can a cut.

Further, he sees in plants and animals a marvellous power of self-adaptation to their outward circumstances. Thus, plants frequenting water have acquired structures adapted to live submerged. Similarly, plants growing on high mountains, in deserts, in arctic regions, on rocky ground, &c., &c., have all put on just those structures which best enable them to live in such places, respectively. This power of alteration with adaptation has long proved to be of inestimable value to man. For by the domestication of wild cattle, and by cultivating wild plants, they have responded to the changed conditions with which he has supplied them; and man has thereby discovered how he can almost mould his animals and

thrust the point into the broad end of a wooden pen-holder; then take it out, break the needle in two, and thrust the broken end of the pointed half into the hole. Two of such dissecting needles will be sufficient.

plants to any special forms required! So different have many, if not most of them, become now, that the original wild forms are totally unknown; nothing at all like many of them can now be found wild anywhere.

The student will find it interesting to bear these facts in mind, and apply this principle whenever he can. Thus, in studying wild flowers, he should always note the character of the surroundings in which any particular plant habitually grows. Take e.g. the rest-harrow, the gorse, and the needle-furze; they are all spiny plants, and they all grow in comparatively dry and barren places. They are three British illustrations of a common feature of desert-plants all over the world: such spinescent features being simply a result of an arid climate, as can be, and has been, easily proved by experiment.

Now let us apply this principle to Paley's argument of the watch. We should wonder at the exquisite arrangement of its parts, but we should wonder more if we discovered, as, indeed, Paley observes, that the watch could bear offspring like itself. We should marvel yet more when we discovered that, if the offspring of watches were taken to different places, they gradually assumed the forms of time-pieces, clocks, chronometers, &c., according to the localities in which they found themselves. This may seem fanciful, but it is precisely analogous to what really takes place in nature, and especially under the hands of man in domestication and cultivation.

If, therefore, the argument by analogy be a sound one, our present knowledge of nature both confirms and extends the truth, not only that Job's advice was good: 'Speak to the earth, and it shall teach thee¹,' but that science affords the strongest confirmation of the words, that 'God is not far from each one of us; for in Him we [and all nature] live, and move, and have our being².' To all who will see, 'Earth is *crammed* with heaven.'

¹ Job xii. 8.

² Acts xvii. 27, 28.

May the student realize the truth of the following words of the late Rev. J. S. Henslow, Professor of Botany in the University of Cambridge, on the pursuit of natural science.

‘We hail that joy which is felt in the pursuit of these occupations as a sacred gift, which may be compared to the rain from heaven, sent for the benefit of all . . . for procuring blessings equally to the good and to the evil; but which the former only know how thoroughly to appreciate, and to apply to the highest and best advantages.’

LIST OF THE GENERA OF THE PLANTS DESCRIBED



[Those illustrated are indicated by an asterisk.]

A.

- *Acer, 89.
- Achillea, 140.
- Aconitum, 56.
- *Aethusa, 124.
- Agrimonia, 105.
- Agropyrum, 220.
- Ajuga, 177.
- Alchemilla, 104.
- *Alisma, 210.
- *Allium, 203.
- Alnus, 188.
- Alopecurus, 216.
- Ammophila, 216.
- Anagallis, 153.
- *Anchusa, 158.
- Anemone, 51.
- Anthemis, 139.
- Anthriscus, 124.
- Antirrhinum, 164.
- Apium, 123.
- Arbutus, 147.
- *Artemisia, 140.
- *Arum, 208.
- Asparagus, 203.
- Asperula, 132.
- Atriplex, 179.
- Avena, 216.

B.

- *Ballota, 176.
- Bartsia, 167.
- *Bellis, 138.
- *Berberis, 57.
- Beta, 179.
- Betula, 187.
- Bidens, 139.
- Borago, 157.
- Brassica, 66.
- Briza, 217.
- *Bromus, 218.
- Brunella, 175.
- *Bryonia, 119.
- Buxus, 184.

C.

- Calamintha, 173.
- Calluna, 149.
- Caltha, 55.
- *Campanula, 145.
- *Capsella, 67.
- Carduus, 142.
- *Carex, 213.
- Carpinus, 190.
- Centaurea, 141.
- Cephalanthera, 196.
- Cerastium, 78.

- Cheiranthus, 65.
 Chelidonium, 62.
 *Chenopodium, 178.
 Chlora, 155.
 Chrysanthemum, 140.
 Cichorium, 143.
 Circaea, 117.
 Clematis, 50.
 Cnicus, 142.
 Colchicum, 205.
 Conium, 123.
 Convallaria, 203.
 Convolvulus, 159.
 Cornus, 127.
 *Corylus, 190.
 Cotyledon, 110.
 Crambe, 68.
 Crataegus, 106.
 Crepis, 143.
 Crithmum, 124.
 Crocus, 200.
 Cuscuta, 160.
 Cypripedium, 199.
 *Cytisus, 93.
- D.
- Dactylis, 217.
 *Daphne, 181.
 Daucus, 126.
 Delphinium, 56.
 *Dianthus, 76.
 *Digitalis, 165.
 Dipsacus, 132.
 *Drosera, 111.
- E.
- Echium, 157.
 *Epilobium, 115.
 Epipactis, 196.
 *Erica, 148.
 Eriophorum, 213.
 Eryngium, 123.
 Erythraea, 155.
 *Euphorbia, 183.
 Euphrasia, 168.
- F.
- Fagus, 189.
 Festuca, 217.
 Foeniculum, 124.
 *Fragaria, 102.
 *Fraxinus, 154.
 *Fumaria, 63.
- G.
- Galanthus, 201.
 *Galium, 130.
 Genista, 92.
 *Gentiana, 155.
 *Geranium, 87.
 Geum, 102.
 Githago, 78.
 Glyceria, 217.
 Gnaphalium, 139.
- H.
- Habenaria, 199.
 Heracleum, 126.
 Hieracium, 143.
 Holcus, 216.
 Hordeum, 220.
 Hydrocotyle, 123.
 Hyoseyamus, 161.
 Hypericum, 81.
- I.
- Iris, 200.
- J.
- Jasione, 145.
 Juncus, 205.
 *Juniperus, 192.
- L.
- Lactuca, 144.
 Lamium, 175.
 Lapsana, 143.
 Lathraea, 168.
 Lathyrus, 98.
 Lavatera, 83.
 Lemna, 210.
 Leontodon, 144.

Leucojum, 201.
 *Ligustrum, 153.
 Linaria, 164.
 *Linum, 85.
 Listera, 195.
 Lolium, 219.
 *Lonicera, 128.
 *Luzula, 205.
 Lychnis, 78.
 *Lythrum, 113.

M.

*Malva, 82.
 Matricaria, 140.
 Matthiola, 65.
 *Medicago, 94.
 Melampyrum, 168.
 Mercurialis, 185.
 Mimulus, 165.
 Myosotis, 159.

N.

Narcissus, 201.
 Nardus, 220.
 Neottia, 195.
 Nepeta, 175.
 *Nymphaea, 59.

O.

*Oenothera, 117.
 Ononis, 94.
 Ophrys, 198.
 *Orchis, 196.
 Orobanche, 169.

P.

*Papaver, 61.
 *Parietaria, 186.
 Pedicularis, 168.
 *Petasites, 141.
 Peucedanum, 126.
 Phleum, 216.
 Phragmites, 216.
 Pinguicula, 169.
 *Pinus, 192.

Poa, 217.
 *Polygala, 73.
 *Polygonum, 179.
 Populus, 190.
 Potamogeton, 212.
 Potentilla, 104.
 Poterium, 105.
 *Primula, 150.
 Prunus, 99.
 Pulicaria, 139.
 Pyrus, 106.

Q.

*Quercus, 188.

R.

*Ranunculus, 51.
 Raphanus, 69.
 *Reseda, 69.
 Rhinanthus, 168.
 *Ribes, 108.
 Rosa, 105.
 Rubia, 130.
 Rubus, 101.
 Rumex, 181.
 Ruscus, 202.

S.

Sagittaria, 211.
 Salicornia, 179.
 *Salix, 191.
 Salsola, 179.
 Salvia, 173.
 Sambucus, 128.
 Samolus, 153.
 *Saxifraga, 107.
 *Scabiosa, 132.
 Scandix, 124.
 Scilla, 204.
 Scirpus, 212.
 Scrophularia, 164.
 *Sedum, 110.
 Sempervivum, 112.
 Senecio, 141.

Sherardia, 132.
 Silene, 77.
 *Solanum, 161.
 Sonchus, 144.
 *Sparganium, 207.
 Spiraea, 101.
 Spiranthus, 195.
 *Stellaria, 79.
 Symphytum, 158.

T.

*Tagetes, 136.
 Tamus, 202.
 Tanacetum, 140.
 *Taraxicum, 144.
 *Taxus, 193.
 Teucrium, 177.
 Thymus, 173.
 Tilia, 84.
 Tofieldia, 205.

Tragopogon, 145.
 *Trifolium, 95.
 Triticum, 220.
 Tussilago, 141.
 Typha, 208.

U.

Ulmus, 185.
 Urtica, 186.
 Utricularia, 170.

V.

*Vaccinium, 147.
 Verbascum, 163.
 Veronica, 166.
 *Viburnum, 127.
 Vicia, 97.
 *Viola, 70.
 Viscum, 182.

HOW TO STUDY WILD FLOWERS



INTRODUCTION

THE STRUCTURE OF FLOWERS.—Supposing our beginner to know nothing whatever of flowers, and that he has no one to tell him, the first thing to understand is that all flowers are constructed upon one and the same fundamental plan. Like all of nature's works, there is an infinite amount of variety, but all the innumerable diversities in flowers are referable to very few simple facts. Thus a typical flower has four parts, called the four floral *whorls*. These are named the *calyx*, the *corolla*, the *stamens* (this whorl is occasionally double), and the *pistil*.

The pieces of each of these whorls are known respectively as the *sepals*, the *petals*, the *stamens* (as these have no other collective name to be now mentioned), and the *carpels*.

The whorls are usually fixed closely one above the other in the order named, the rule being that the pieces of each whorl alternate in position with those of the next whorls above or below them. The extremity of the flower-stalk or *pedicel*¹ which carries a flower is generally somewhat enlarged, and is called the floral *receptacle* (e.g. Fig. 1. 3).

The beginner should procure a few flowers and make out the four floral whorls in each case, by dissecting them and placing the parts of the several whorls by themselves.

¹ If there is only a single flower-stalk, as in a tulip, it is called a *peduncle*; but if this bears others, as in a currant, the secondary stalks are *pedicels*.

The sepals and petals usually somewhat resemble miniature leaves, the former being green and the latter white or coloured; such being usually the case in the 'class' called 'Dicotyledons'; though the sepals are occasionally white, as in the wood anemone, or coloured, as in the marsh marigold, larkspur, and aconite, all of which belong to that class.

In the class 'Monocotyledons,' to be hereafter described, the green calyx and coloured corolla are sometimes quite distinct, e.g. frogbit and water plantain (Fig. 55), but it more often happens that these two whorls are both white or coloured, the parts being sometimes all alike, as in a bluebell or onion (Fig. 51); or they may differ in form and colour, as in a snowdrop and *Orchis* (Fig. 50). In either case the two whorls (inner and outer) are collectively regarded as the *perianth*, the parts being called its *leaves*. When they are coherent, as in a lily of the valley, they more readily resemble a single whorl; but it is really always composed of two.

The stamens and pistil are more complicated, and require a few further details. If any flower be taken, say a wallflower or a tulip, it will be observed that each stamen is composed of two parts, the usually slender stalk or *filament*, and the two-celled bag at the summit called the *anther* (Fig. 1. 2). The filament is often continuous between the anther-cells, or may even be extended beyond them (as in the pansy, Fig. 8. 2, 3 *a*); such portions are called the *connective*. The cells contain a powder composed of grains of *pollen* (Fig. 32. 6, 12). A carpel will be best known by the familiar pea-pod in the unripe condition (Fig. 16). It consists of a lower bag-like portion, the *ovary*, which contains two rows of rudimentary peas or seeds called *ovules*. In some carpels they may be reduced to a few or even one (Fig. 1. 5). The ovary contracts above into a prolongation called the *style* (Fig. 1. 4 *b*); very short in the buttercup and wallflower, but very long in a crocus or cowslip (Fig. 35. 3, 5). This terminates with a *stigma*, i.e. a rough and often sticky

surface capable of arresting the pollen grains when they fall upon it: as will be explained hereafter. Any other figures given in this book will illustrate these details.

NUMBER.—If a few flowers be compared, it will be soon seen that the number of parts of the whorls are not always the same. The commonest are threes (Fig. 51) and fives (Fig. 14). Twos are rare (Fig. 36). Multiples of these may occur, so that fours (Figs. 23, 24), sixes (Fig. 22), eights (*Chlora*), tens (*Genista*, stamens), and even twelves (*Sempervivum*) may be found: but beyond twelve the parts need not be counted, but may be represented by the mathematical symbol for an indefinite number, ∞ (Fig. 1, stamens and carpels). Any one, two, or three whorls may be wanting altogether; so that a flower may be reduced to stamens or pistil alone (Figs. 36, 48), and of these there may be two or even one stamen or one carpel only (Fig. 45). On the other hand, the calyx and corolla may exist without stamens or pistil. The flower is then said to be neuter (*Viburnum Opulus*).

If a flower has a pistil but no stamens it is called female. If it have stamens and no pistil, it is said to be male; if both these organs are present, the flower is bisexual: being unisexual in both the preceding conditions. If the sexes are in separate flowers on the same plant, the plant is said to be *monoecious*, i.e. 'one-housed,' as the box. If on separate plants, they are called *dioecious*, as the common stinging-nettle. If a plant possess all three conditions, it is *polygamous*, a word meaning 'many unions,' as the ash-tree (Fig. 36).

If two or more whorls be composed of the same number, or are multiples of the same number of parts, the whorls are said to be symmetrical. If the numbers in any two or more whorls of the same flower are different, then they are unsymmetrical.

ARRANGEMENT.—The parts of a whorl, say the sepals of the calyx, or petals of the corolla, seem to be all on exactly the same level, as is the case when they are united, as in a primrose; or when the sepa-

rate edges meet without overlapping, as do the sepals of *Clematis* and petals of privet (Fig. 36), when they are said to be *valvate*. More usually the parts of a whorl overlap one another, when they are said to be *imbricate*, and they then point to what is really a spiral arrangement. This latter is best seen when the parts of the whorls are numerous, as are the stamens and carpels of a buttercup, both of which are indefinite in number, the individual members being arranged spirally up the elongated receptacle in the centre of the flower, as may be seen by the scars when they are removed. This spiral arrangement explains the origin of the numbers of the parts of the floral whorls; for flowers are in truth metamorphosed leaf-buds, that is to say, every part of a flower is *homologous*, or fundamentally of the same nature with a leaf, but 'differentiated' so as to assume different forms and functions from those of leaves. Sometimes, while retaining more or less the form of the floral organs, it may revert to a leaf or become partially 'foliaceous,' by being green and assuming more or less perfectly the shape of a leaf. Such is the case with the green rose and Alpine strawberries cultivated as curiosities of nature.

Now, leaves are arranged in two ways on stems. They may be either whorled, i.e. when three or more arise out of the same joint in the stem or *node*. If there be only two, they will then be opposite. In all these cases, a whorl or pair alternates in position with the next, above and below it: the same rule holds good, as stated, for the floral whorls.

If there be only one leaf at each node, they are then said to be *alternate*, and are arranged up the stem on a spiral line. If any leaf, on many kinds of shoots—say on a branch of a rose or oak—be called No. 1, it will be found that the sixth leaf will be the first reached which stands vertically over the first. The leaves 1-5 constitute what is called a *cycle*: and a floral whorl, as of the corolla of a buttercup, is simply a cycle of leaves with the *internodes*, or portions of the stem

between the nodes, suppressed. Such is the origin of 5-*merous*¹ floral whorls. When these contain two or four parts, these numbers usually result from the leaves of the plant being in opposite pairs, as occurs in privet, lilac, *Circaea*, &c.

In the class Monocotyledons the flowers have their whorls mostly in threes. This is due to the fact that the leaves of plants in that class are often so arranged that the fourth is over the first, or the leaf selected as No. 1: so that three leaves constitute a cycle².

COHESION.—The pieces of each whorl may be quite separate or free from each other, as are the petals of a rose, or they may be united by cohesion, so as to form a cup or tube-like structure, as the united sepals and united petals of the cowslip (Fig. 35). The number of sepals in this flower may be easily recognized by the five points; similarly the five-rounded (and slightly notched) portions or *lobes* of the corolla indicate its five petals³. The stamens are not so often coherent as the sepals or petals, but they are in the order *Leguminosae* by their filaments (Fig. 16), and in the order *Compositae* by their anthers (Fig. 31. 4, 5). The carpels are seldom free, though this condition characterizes some few orders, as *Ranunculaceae* (Fig. 1. 3, 6), and *Rosaceae* (Fig. 17. 2. 6).

The union may exist from the first emergence of the parts from the axis or receptacle, in which case the parts are sometimes said to be *connate*, i. e. born together or congenitally united. This is the usual origin of coherent sepals, petals, &c.; but in a few cases the cohesion is only by means of a subsequent contact. Thus, while in most of the pea-family, *Leguminosae*,

¹ *Meros*, the Greek for 'parts.'

² Further details and explanations will be found in my work *The Origin of Floral Structures* (K. Paul & Co.).

³ The Greek word 'poly' is used as a prefix to designate freedom, while 'gamo' stands for cohesion. Thus the three words *polysepalous*, *polypetalous*, and *polyphyllous* mean that the calyx, the corolla, and the perianth, have their sepals, petals, and leaves perfectly free respectively. On the other hand, if they be united, the terms *gamosepalous*, *gamopetalous*, and *gamophyllous* are used.

the two lower petals, or the 'keel,' are quite united, in the furze they only cling together by means of a fringe of hairs on each margin. A similar false cohesion causes the anthers of violets and pansies to cling together round the ovary (Fig. 8. 1). In the *Compositae*, the so-called *syngenesious* condition of the anthers is due to a gummy exudation; therefore this term, meaning 'begotten together,' is not strictly accurate (Fig. 31. 5). In the *Leguminosae*, mentioned above, the filaments are congenitally coherent (Fig. 16); sometimes into one complete tube: the stamens are then said to be *monadelphous*, making, as it were, 'one brotherhood.' In the majority of the members of that order nine are united and one is free. This is for the purpose of giving facility to insects to extract the honey which is secreted by a receptacular *disk* within the tube. If filaments are thus united into two groups they are *diadelphous*. In *Hypericum*, the St. John's worts, they are grouped into clusters or phalanges of three or five. These are therefore *triadelphous* and *pentadelphous*. Botanists thus use the Greek numerals in conjunction with the termination derived from *adelphos*, a brother, since the stamens represent males. The union of carpels is effected by two different methods. Suppose one to take three pea-pods. Arrange them with their edges (those to which the peas are attached) meeting, not side by side, but in the *position* of the lines of a Y. Now imagine them to be compressed until the two sides of each pod bulge out and meet those of the next pods. If now these sides in contact, of every two adjacent pods, were coherent, we should have a structure which as seen in a cross-section might be represented by drawing a circle and putting a Y within it, the three ends being on the circle (Fig. 51. 6). This is the usual way in which carpels cohere. It will be, however, now perceived that each branch of the Y must be regarded as composed of a double line, as it represents two coherent sides.

If an apple, however, be cut across, the five carpels

or 'core' will be seen to be arranged in the midst of the fruit, just as first described, before coherence; but if the pistil of a tulip or bluebell be cut across, the three carpels will be seen to be quite coherent, there being three cells or chambers, corresponding to the three carpels, the ovules being in two rows in each inner angle at the centre.

A second, but much less common method of coherence is effected as follows. Suppose we split open the pea-pods down that edge where the peas are fixed: half the peas will be now found to belong to one edge and half to the other. Take, say three, as before. Arrange them in a circle and unite them, edge to edge. We now get a single chamber with *two* rows of ovules down each of the *three* pairs of united margins of the carpels. The ovary of a pansy (Fig. 8. 6) or mignonette (Fig. 7. 7), if cut across, will thus show three double rows of ovules, as they are composed of three carpels.

The coherence may be confined to the ovaries, the styles and stigmas remaining free, as in pinks (Fig. 10. 3); or the styles may cohere as well, the stigmas being separate, as in mallow (Fig. 12. 2); or the ovaries, styles and stigmas may be so perfectly coherent that it may be difficult to say how many carpels there are, as in the cowslip (Fig. 35. 5).

The margins which carry the ovules are mostly enlarged. They are then called the *placentas*. When the carpels meet in the middle, the *placentation* is said to be *axile* (Fig. 39. 2); when they unite on the circumference, it is *parietal* (Figs. 6, 7, 8); and when there is a free central column which carries the ovules, it is said to be *free central*, as will be explained under the families or orders *Caryophylleae* (Figs. 10, 11) and *Primulaceae* (Fig. 35. 7, b).

ADHESION.—Botanists distinguish yet another kind of union by the word 'adhesion.' This refers to a union between two whorls of different kinds. Thus, when the petals are *coherent* (as of a foxglove or primrose), it is almost an invariable rule to find the

stamens *adherent* to the inner surface of the tube of the corolla (Fig. 35. 2).

Another curious condition arises from an alteration of the receptacle. As the flower develops it may sometimes be found that the calyx, corolla and stamens stand round the rim of a little disk or circular groove (as in the raspberry); this is lined with a honey-secreting surface; or it may be cup-shaped (as in the cherry); the rim of the cup now carries the sepals, petals, and stamens. This cup was formerly regarded as being composed of the lower coherent portions of the sepals, so that it received the name of 'calyx-tube,' and the term *episepalous*, 'upon the sepals,' was applied to the petals and stamens. It is now regarded as a *receptacular tube*; and as it carries the petals and stamens at some little distance from a position immediately below the pistil, the term *perigynous*, or 'around the ovary,' is used (Fig. 17. 2). When there is no such expansion of the receptacle, the petals and stamens arise from the stalk just 'below the pistil.' To indicate this position or 'insertion,' the term *hypogynous* is used (Fig. 1. 3).

In the centre of the receptacular tube is the pistil. It may consist of one or more carpels, free or coherent. They are sometimes borne on a terminal prolongation in the centre of the cup or dish called the gynophore or 'ovary-bearer'; such is the edible part of the strawberry (Fig. 17. 2, 6). More usually the pistil is situated at the bottom of the cup, as in the cherry, which has only one carpel; or the cup may be filled with carpels, as may be seen by cutting the hip of a rose across; for this is really the receptacular tube, from which the little seed-like fruits or *achenes* can be picked out separately. Minute receptacular tubes (T, in floral formulae) occur in *Rosaceae*, Tribe *Poterieae*.

A further condition of adhesion is arrived at when the cup, on growing, actually adheres to the outer surface of the ovaries, so that they seem to form part of it. Apple, pear, hawthorn, and medlar illustrate

this condition, in which fruits the cohesion between the carpels themselves is very imperfect; but in the snowdrop, daffodil, iris or Canterbury-bell (Fig. 33. 3) the union between the carpels is complete, as already described above¹.

Certain botanical terms are requisite to describe these results: for as the tube now completely coalesces with the ovary of the pistil, the calyx, corolla and stamens appear to arise from the top of it, the ovary being now below them, so that this is said to be *inferior*, the calyx (or perianth) being *superior*. For the corolla and stamens a different word is used, to run parallel with hypogynous (Fig. 1. 3) and perigynous (Fig. 17. 2), namely *epigynous*, or 'upon the ovary' (Figs. 27, 29, and 32. 1).

FORM.—There remains a fifth kind of difference between flowers. If the pieces of any whorl be all alike in size, shape, colour, &c., the whorl is said to be *regular*, as are the petals of a buttercup, rose and primrose; but if one or more pieces be in any way different from the rest, the whorl is *irregular*, as are the corollas of the pansy (Fig. 8), pea, snapdragon, and *Ballota* (Fig. 41). The form, especially of the corolla, but of other parts as well, is a very important feature, as the 'genera' are largely based upon it, as will be shown hereafter. The different shapes in the above examples, and of the corollas of others, are described by botanists in technical terms, which will be given and explained as occasions arise.

Hence all flowers, though formed on one plan, can thus be explained, however different they may be in appearance, by the use of these five terms, NUMBER, ARRANGEMENT, COHESION, ADHESION, and FORM. It is simply by means of their various combinations and changes that flowers are constructed and classified according to the amount of agreements or differences

¹ The fusion between the tube and the ovary is caused by the *inner skin* or *epidermis* of the tube, as well as the *outer skin* of the ovary not being formed; so that the soft interior tissue of the receptacular tube becomes continuous with the middle layer of the ovary wall.

from one another. The student should familiarize himself as soon as possible with the method of making *Diagrams* of all the flowers he examines. Curved lines or crescents represent transverse sections of sepals and petals; an ∞ may stand for a stamen, a ring (○) for the section of an ovary, with or without radii, to indicate ovary cells.

To make a floral diagram a cross-section of a flower just expanding should be made, or it may be examined by looking down into it. It will then be seen how the sepals and the petals may overlap one another, and the curved lines or crescents should be drawn in exactly the same position. If they be coherent, the tips of the crescents must be united by short straight lines, curves or angles, the 'caret' (∧) of printers, the petals being similarly represented in their exactly relative positions; so also the stamens and ovary cells. If any two whorls are adherent, short radial lines connecting them may indicate this; { } on either side of the diagram signifies an inferior ovary and superior calyx or perianth. In my *Floral Dissections*, diagrams of typical flowers are given, illustrating the method. A few are also given in this book, viz. in Figs. 5, 15, 27, 34.

USES OF THE FLORAL ORGANS; *Pollination* and *Fertilization*.—We must now consider very briefly the uses to the plant of these four floral whorls. The calyx is generally green, and protects the undeveloped whorls within the bud. Sometimes it subsequently becomes coloured, whether there be any corolla or not, as in clematis, anemone, and marsh marigold, in all of which the latter is absent; or it may be coloured as well as the corolla, as in larkspur, aconite, barberry and ling, all of which have a corolla as well as the coloured calyx. The calyx thus assists as an attractive organ to invite insects to come for honey or pollen, and thereby to pollinate other flowers; for the important use of the stamens and pistil is to set seed, and this can only be done by the pollen being applied to the stigmas. This is called pollination,

and it may be effected in four different ways; first, by the pollen of the stamens being applied to the stigmas of the same flower by the anthers being situated in close contact with them, as in the so-called cleistogamous flower-buds which never open, or just above them (Fig. 18. 3); secondly, the pollen may be carried off by bees and other insects, by their getting dusted with it when visiting a flower for honey or pollen for food, and then the stigmas of other flowers subsequently visited will strike their bodies just where the pollen had been previously deposited (Fig. 40). This sort of pollination is called the crossing or intro-crossing of flowers. A third method is effected by the wind (Fig. 46). Lastly, in some few aquatic plants the pollen may be conveyed by the water (*Callitriche*).

Unless pollination take place, the ovules will not become seeds capable of germinating and reproducing the plant. To secure this end, a further process called *fertilization* must follow pollination. This is effected by the grains of pollen when placed on the stigmas growing as it were by a sort of germination; for they send down long root-like tubes, the *pollen-tubes*, containing fertilizing matter, which ultimately finds its way into the ovules by a little orifice, the *micropyle* ('little gate'). A microscopic body called the *germ-cell* is situated within a large cell called the *embryo sac*, and is capable of being fertilized. The result is the formation of a young plant or *embryo* within the embryo sac of the ovule; which last now grows into a *seed*. As a secondary consequence of fertilization of the ovule, the ovary now grows and enlarges simultaneously with its ovules, and becomes the *fruit* or *pericarp* in botanical language.

Besides the ovary and ovules thus becoming changed into fruit and seed, the receptacle itself may be affected and grow simultaneously, and enter into the composition of what is popularly called the fruit. Such is the case with apples and pears; the fleshy edible part being, as already explained, really the now greatly enlarged receptacular tube. The 'core' with the pips

are the carpels. Again, the part eaten in a strawberry is the receptacle, and it may be often observed that the 'seeds,' really true fruits or achenes, are aborted and clustered together at a certain spot which remains green and shrunken. The fact is that the scarlet receptacle has not grown there, because the ovules of these individual carpels happen not to have been fertilized at that spot. Again, in a mulberry fruit the edible part is composed of the four sepals of each of the many flowers of the 'head,' being fleshy and purple. In all these, and many other cases, we see the subsidiary or secondary results accruing to other parts than the embryo itself, which when fertilized was the primary cause of all the other changes.

The seed itself calls for a further remark. As the embryo on germination has to grow before it can develop a root and leaves, it is often supplied with a quantity of nutriment in which it lies buried. This is called *albumen* or *endosperm*. It constitutes the flour of wheat. In many cases the embryo absorbs all this nourishment while growing to maturity within the seed itself. Such embryos as beans, peas and mustard are comparatively large and can, so to say, 'live upon themselves' when germinating. The first are called *albuminous*, the second *exalbuminous* seeds.

To return for a moment to the phenomenon of pollination. The student might ask whether there is any special advantage in the pollination by one method over that of another. The answer to this lies in the further question, What do we mean by advantage? Now, as the process has only one 'end,' that of producing seed, it is obvious that the method which produces the most and best seed is the most advantageous. Looking at wild flowers from their own point of view, therefore, it will be soon evident that self-fertilization is by far the best method. First, because the plant runs no risk of not being pollinated at all, as it does when it has to depend upon the chance visits of insects or the fickleness of the wind; and secondly, self-fertilizing plants always set an

extraordinary abundance of good seed. This is seen in the great rapidity with which they multiply and smother plants often much larger than themselves individually. The reader may think of such weeds as chickweed, shepherd's purse, and groundsel in a kitchen garden, and daisies on a lawn. These and many others soon monopolize the soil in the struggle for life. Again, if we trace the distribution of plants over the world, the self-fertilizers will be found to be more widely dispersed than any others; though wind-fertilized herbs often are as widely distributed. Thus many of our small weeds, as chickweed, are found in out-of-the-way islands of the southern hemisphere. The above-mentioned examples have very inconspicuous flowers, and such is the rule as compared with those which are habitually visited by bees and other insects: not that these may not be also able to fertilize themselves as well as be crossed by insects¹.

If we ask how it is that insect-visited flowers are generally more conspicuous and less fertile in nature than the insignificant self-fertilizers, the answer resides in the fact that intercrossing is a temporary stimulating process, and tends to make the plants raised from their seed 'finer' plants, in the popular sense of the term. For florists find that when they cross their flowers, those on the seedlings raised from them are often larger and more variously coloured, and the foliage may be also 'improved'; while even a large number of seeds may at first be produced: but all this tends to detract from the 'reproductive energy,' and soon reduces the degree of fertility; so that florists find that, after having crossed and recrossed a plant with the view of 'improving' it more and more, i.e. in a floricultural sense, they soon get to the end of their tether, the 'best' flowers at last fail

¹ Much information upon the adaptations of flowers to insects and for self-fertilization will be found in H. Müller's large work on *The Fertilization of Plants*, from which the present writer will frequently quote.

to produce much or even any good seed, and they have to start afresh on some new line.

These experiences of horticulturists explain how it is that the finer flowers in nature which depend more or less completely on the visits of insects are not the most abundant. Thus in the family of orchids, the flowers of which are so constructed that the majority of them cannot set seed at all unless they are visited, it has been observed that, e.g. a *Dendrobium speciosum* which bore 40,000 blossoms growing in the open in its native country, produced only one pod!

On the other hand, florists are perfectly well aware that the poorest flowers, or the most 'weedy'-looking plants, are always the most prolific. Indeed, a certain florist always kept a stock of 'worthless' cyclamens, solely for the sake of procuring an abundance of seed; which he then raised and cultivated till they reached the required standard of excellence, the 'best' cyclamens being very barren.

It is worth while mentioning that it was formerly thought, that as regularly self-fertilized plants are often small weeds and annuals, and bore insignificant flowers when compared with insect-pollinated plants, that there must be something injurious in self-fertilization. This was a great error, due to its being what is called an '*a priori* assumption' of what was thought to be best for the plant; instead of studying the plants themselves to see what really happened in nature.

HONEY-SECRETING ORGANS.—Bees and other insects visit flowers for the sake of the honey or pollen, or both, for food. The honey is secreted in various ways. Thus it may be by means of a *disk* or fleshy ring on the floral receptacle at the base of the flower within the calyx, or by one or more separate *glands*. It has been thought that these latter, when they occur on the receptacle, may be derived from rudimentary organs, representing suppressed stamens or carpels. They may occasionally occupy the site of such, as in the male flower of *Lychnis dioica*, where it stands

in the place where the pistil is wanting; but as a rule they are only superficial and purely 'cellular,' that is, without any 'vascular' structures at all, are developed on the surface, and can appear anywhere. They always, however, occur precisely where the proboscis of an insect can best reach them, which is specially adapted to do so. Thus in regular flowers, which can be approached from all points of the compass, the rule is that the honey is secreted all round the base of the flower, or by every petal, &c., as the case may be; but in irregular flowers, which are almost invariably situated close to the stem, so that they can be visited on one side only, the usually single gland is just where the proboscis can best reach it, and nowhere else.

The glands may be situated or developed by any member of the flower, as well as on the receptacle. Thus in the lime the five sepals are like little boats, the honey-gland being found in the middle of each sepal.

The buttercup family is characterized by several of the members carrying honey-glands or *nectaries* on the petals, as the buttercup (Fig. 1. 1); in others, as the winter-aconite and hellebore, the outer row of stamens is completely altered in form, so that they have become little honey-pots¹. Sometimes the stamens secrete it, as do those of our purple anemone, or pasque flower, while violets and the pansy have two of their five stamens possessing honey-secreting tails or appendages (Fig. 8. 2, 3). In many flowers with a tubular gamopetalous corolla, honey is secreted by the base of the ovary; but if the corolla be on the top of it, or epigynous, as in the whortleberry (Fig. 33. 7), or in every member of the *Umbelliferae* (Fig. 26), then it is the top of the ovary which is converted into a honey disk. Other localities occur which will be alluded to in their proper places.

¹ If the nectaries of the winter-aconite be compared with the petals of a buttercup, it will be seen how the latter are 'exaggerations' of the former. A transition can thus be noticed from a true anther through the nectary to the petal. See also what is said under water-lilies (p. 59).

THE FUNCTIONS OF PLANTS.—Regarding plants from their own point of view, they may be called upon to fulfil three things, for which they have been endowed with the necessary qualifications. First, they are expected to grow up from the seedling stage and develop all their various parts or *organs*, such as leaves, flowers, &c., to perfection, and to live as healthy a life as circumstances will permit till they die. Secondly, they must propagate their kind, either by means of the *reproductive system*, i.e. the flowers and fruits, or by means of bulbs, tubers, suckers, runners, &c.; a process called *vegetative multiplication*, because it is by means of the *vegetative system*, as it is called. Thirdly, if the seeds be transferred to another and different kind of soil, climate, &c., they must grow up in harmony with these new things, or, if they cannot, they must die. Plants, however, can generally adapt themselves, provided the change be not too extreme, as from the tropics to a very cold, temperate, or arctic climate, or from being submerged to a life in air; though many can readily succeed even in this latter case. The new adaptations are effected by their altering the minute anatomical or microscopic structure of their tissues, and thence also their outward appearance.

Thanks to this wonderful power of *self-adaptation*, with which plants have been endowed, we are enabled to produce our innumerable and valuable kitchen vegetables and garden flowers; for, as already observed, the majority of them do not exist, nor ever have existed in the wild state at all; such as the many 'races' of the radish, cabbage, carrot, &c., or the many colours of the flowers of the wallflower, hyacinth, dahlias, nasturtiums, &c.

Again, it has often been noticed how plants of many different kinds growing in some very particular conditions, say the hot, sandy, nearly waterless deserts of Africa, &c., are nearly all alike in certain respects, e.g. in being clothed with a dense hairiness and in having spines, &c. Just as all the native animals, of

whatever class they may be, whether quadrupeds, snakes, or spiders, have the same tawny colour as the sand of the desert. Similarly most aquatic plants have the same or very similar anatomical structures and often leaves of the same form; e.g. when submerged they become finely dissected, like fennel (water crowfoot), or else elongated and ribbon-like (burweed), though, as botanists say, they may have no 'affinity' whatever. All such resemblances, whether internal or external, arise from the fact that all plants have this same power of self-adaptation, in varying degrees; so that they put on very similar kinds of adaptive structures to enable them to live under the same conditions.

When any particular individuals of one kind or *species* of plant exhibit only some slight differences from the common type, on some difference or change of locality, botanists call it a *variety* of the species. If the points of difference are more numerous, say about four to six in point of number, it is called a *sub-species*, or else a *species*. Thus, for example, since the structure of the white flower of the water crowfoot (*Ranunculus heterophyllus*) is the same as that of the yellow-flowered buttercups, it is called by the same 'generic' name, *Ranunculus*, but is recognized as a distinct 'species'; but of the water 'kinds' there are many sorts, which some botanists would regard as species, others as varieties, because there is no hard and decided line between these two expressions. Thus certain 'forms' frequent still water, others, running streams; and it is thought that they have been formed under these correspondingly different conditions. For the finely divided *segments* of the submerged leaves always spread out circularly in the still water, but run out parallel to one another in the direction of the flowing water. As another case, many plants growing by the seaside have a great degree of fleshiness or succulency. This is due to the presence of salt; for experiments show that if plants, say garden cress, be watered with salt and water,

they tend to become similarly fleshy. Again, maritime plants may lose this fleshiness when grown inland: so many plants have a 'maritime variety' or 'species' according to the predilection of the botanist who may describe them¹.

HYBRIDIZATION.—There is yet another source or cause of variety both in nature and especially among our garden plants; and this is obtained by intercrossing different species of the same genus. Thus e.g. when the originals of our garden calceolarias were first brought from South America, they consisted of two or three distinct wild species with very small red and yellow flowers; but by pollinating a red one with the pollen of a yellow flower, or vice versa, hybrid seedlings were produced which bore variously spotted, streaked or blotched flowers; and by cultivating them in a rich soil, the flowers gradually became larger and larger, till now a flower of a prize calceolaria is about twelve times the size of that of the original *C. arachnoides*, which was introduced about 1825. Many of our garden plants contain two, three, or more species in combination, for florists have again and again crossed their hybrids with other species, for they find that by so doing they can greatly increase the number of varieties, and improve their size and beauty.

We thus find that there are two methods at our disposal for improving our cultivated plants: that if plants be grown in a variety of soils, they may produce variations in colour, &c., without any crossing at all, but that by hybridizing and again crossing the offspring, a similar if not a still greater variety may be obtained, as may be seen in begonias, roses, rhododendrons, fuchsias, &c., the majority of which may be called compound hybrids.

Now, in pursuing these two methods, the florist has

¹ Should the reader desire further information on the subject of self-adaptation in plants, he is referred to the author's two works, *The Origin of Floral Structures*, vol. 64, and *The Origin of Plant Structures*, vol. 77, in the INTERNATIONAL SCIENTIFIC SERIES.

only imitated nature, though more systematically; for while on the one hand the same genus or species may be often found in widely different and far distant localities, they are very generally represented by different species or different varieties respectively. On the other hand, botanists have detected many natural hybrids; for instance, they are particularly abundant among willows, docks, and mulleins¹.

CLASSIFICATION.—We will now consider how plants are classified. Suppose we gather a bunch of flowers in spring or early summer containing, let us say, a buttercup, a wallflower, a violet or pansy, a pea, an apple blossom, a cowslip, a deadnettle, a tulip, a lily of the valley, a snowdrop, and an orchis. The first and simplest thing to do is to dissect the flowers, removing all the several parts carefully, and to write down the number of pieces in each floral whorl, and so commence what is called their *Floral formulae*. Thus²—

	<i>Sepals.</i>	<i>Petals.</i>	<i>Stamens.</i>	<i>Carpels.</i>
1. Buttercup (Fig. 1)	5	5	∞^3	∞
2. Wallflower (cf. Fig. 6)	4	4	2 Gls.; 2 + 4 ⁴	(2)
3. Violet (cf. Fig. 8)	5	5	5	(3)
4. Pea (cf. Fig. 16)	[(5)	3 ⁵ , (2)	(5 + 4), 1]	D ⁶ ; 1
5. Apple	½[(5)	5	∞]	5 ⁷
6. Cowslip (Fig. 35)	(5)	[(5)	o ⁷ + 5]	(5)
7. Deadnettle (cf. Fig. 41)	(5)	[(5)	4, o]	(2)

¹ It would be out of place to discuss all the functions of the vegetative organs, viz. the roots, stems, and leaves; these may be learnt from any textbook of botany. Allusion is made here to the functions of the reproductive organs, because it is they which supply the characters upon which flowering plants are mainly classified.

² The numbers as here given may not be always easily detected by the beginner; but they will be fully explained hereafter, as well as the meaning of the brackets.

³ ∞ signifies an indefinite number, i. e. more than twelve.

⁴ Gl. signifies the presence of honey-glands, and + means that there are *two* whorls of stamens.

⁵ The , signifies that 3 and 2 constitute *one* whorl of five parts; but that two of the petals only are coherent () and three are free.

⁶ D stands for honey-disk round the base of the ovary.

⁷ The o implies that one of the two whorls of stamens is suppressed altogether.

	<i>Sepals.</i>	<i>Petals.</i>	<i>Stamens.</i>	<i>Carpels.</i>
8. Tulip (cf. Fig. 51)	3	3	3 + 3	(3)
9. Lily of the Valley	[(3	3)	3 + 3]	(3)
10. Snowdrop	{3	3	3 + 3	(3)
11. Orchis (Fig. 50)	{3	3	1, 1 ⁰ + 0	(3)}

Looking at these numbers only, the reader would be inclined to group Nos. 1, 3, 4, 5, 6, and 7 together, as having two or more fives; while No. 2 seems to stand alone, being characterized by twos or fours, or a multiple of twos. Lastly, Nos. 8, 9, 10, and 11 closely agree in the prevailing number 3.

If we took a much greater quantity of flowers and wrote down their numbers of parts, with rare exceptions we should only increase the fives on the one hand and the threes on the other. Botanists have, therefore, divided all flowering plants into two groups or *Classes*, one being characterized by having the whorls of the flowers in threes, the other in fives, or rarely other numbers in comparison with these. Several other features accompany these numbers, respectively, in each class; so that, in fact, they are usually distinguished by other and quite as important characters, from which they take their names, viz. *Monocotyledons* or *Endogens*, and *Dicotyledons* or *Exogens*. These names refer to the structure of the embryos in the seed and to the methods of growth in the stems, respectively; as will be more fully explained directly.

The next point to be considered is the subdivisions of these two Classes. Briefly stated Classes are made up of Families or natural *Orders*. These are composed of *Genera*, and the latter of *Species*, *Sub-species* with or without *Varieties*.

It has been already briefly indicated how a plant can give rise to a variety in nature, and, if the latter be sufficiently distinct, it may be called a species. Now, the species of a genus as they occur in nature are distinguished from each other by several features

¹ In the orchis one stamen out of three only is present in the outer whorl; the inner whorl is entirely suppressed.

taken collectively, though it often happens that one or two stand out more conspicuously than the others. These features may be peculiar to the roots, stem, or leaves, with some slight differences in the size and colour of the floral whorls; but their floral formulae, as well as the *form*, will be almost invariably the same for every species of a genus. Let us take, for example, buttercups, i. e. certain species of the genus *Ranunculus*. If a handful be gathered, it is easy to separate them into two, three, or more kinds or species. Thus the 'creeping' buttercup has long runners like those of a strawberry. It has a leaf divided into three main divisions, or is *3-foliolate*, as it is called. Its flower stalk, or *peduncle*, is furrowed. The sepals spread out under the petals, &c. The 'bulbous' buttercup has a solid globular underground stem or *corm*. It also has 3-foliolate leaves, and its peduncles are furrowed, but its sepals are reflexed, &c. Again the 'field' buttercup has a thick underground stem or *rootstock*, the leaves are deeply divided or *5-partite*, with very pointed *segments* or divisions. The peduncles are not furrowed, but the sepals are spreading, &c. Each of these three kinds of buttercup are thus known by several, say some half-dozen, constant characters taken collectively. Hence every plant has two names, the 'generic' and the 'specific,' and Linnaeus gave the names *Ranunculus repens* to the creeping, *R. bulbosus* to the bulbous one, and *R. acris* to the last, on account of its poisonous acidity.

Next, what is a genus? A genus includes one or more species. All the species of a genus not only have, as a rule, the same floral formula, but they agree especially in the forms of the parts of their floral whorls as well; so that *form* (assisted by any other peculiar and constant characters) mainly underlies the idea of a genus. Thus the reader will probably be able to recall the appearance of the corolla of a fox-glove, a snapdragon, a toad-flax (*Linaria*), a mimulus or musk, or that of a garden calceolaria, and the little blue speedwell. Now each of these genera has several

species; but no one would hesitate for a moment in recognizing respectively and calling them by the above generic names at least, because *the form of the corolla* is the same, and supplies the conspicuous character of each genus.

Further, although so different in the forms of the corollas, botanists group all the above-named genera in one and the same order or family, because their floral formulae are very nearly or else precisely the same¹, since 'form' does not enter the formula; so that the floral formulae are often to a considerable extent 'ordinal.'

The floral formulae therefore, if not characteristic of an entire order, are very often so of groups of genera within one and the same order. Thus with rare exception, the same formula, viz. {5 or 0. 5. 5. (D; 2)} will answer for all the thirty-five genera of the umbelliferous family. Again, the same formula, viz. {Pap., &c. [(5). (5 a).] (2).}, represents all the perfect flowers of the forty-two British genera of composites; and we might include the thousands of foreign members of this order. Hence when the student has thoroughly mastered the details of some one or more types, he often has the clue to very many more members of the same family. The word sub-species has been introduced, and sometimes sub-genus, by botanists to indicate intermediate groupings; when in the estimation of the systematic botanist a plant seems to rank between the well-marked characters of some species and those of a variety. These terms are more or less arbitrary, for Nature is not so exact in constructing plants as to enable us always to separate them by any hard and fast lines. Indeed, in the great family *Compositae*, Mr. Bentham, who studied them, tells us that nearly one hundred of the genera even shade into one another without any absolute breaks. Much the same may be said of our British species of

¹ (5). [(5). 4, 0.] (2) represents the first four genera, and (4). [(4). 2.] (2) the last two; one part of two outer whorls and three stamens having been suppressed.

Hieracium. The discrimination of the different 'forms' can only be effected after prolonged study, and one might almost say by a 'specific' expert. In this book, therefore, only one or two or few of the commoner forms or species of such large genera are referred to as types.

The student should always aim at becoming familiar with the chief characters of every family or order. This might possibly be done by learning them by heart from some flora; but that would give him no true insight into the structure of flowers. They must be acquired solely by studying some one or more types of each order, when he will soon see what features are common to the several genera comprised in the order. Thus, e. g., let us take the order *Labiatae* (Fig. 41). Whatever member he may examine, with rare exception, he will find that they are all herbs with a square stem, with opposite and exstipulate leaves; the inflorescences are axillary clusters or glomerules. The fl. f. is (5). [(5). 4.] (2). The corolla is irregular and lipped; the stamens being four, of which two are longer than the others; the ovary is deeply four-lobed, the style rising from the base with a forked stigma; and the fruit consists of four nutlets.

The student should thus draw up his own 'ordinal diagnoses,' such as the above, for every family of which he can examine one or more typical plants.

My object being to enable the student first to recognize our principal wild flowers, and *then to study them thoroughly*, I will explain how he is to compose a floral formula, which represents the main points of structure of a flower. He must proceed as follows: Take four spaces separated by dots, to represent the sepals, petals, stamens, and carpels. Then dissect the flower carefully, and write down the *number* of pieces in each whorl.

The next step is to represent *Cohesion* (if it occur at all) between the pieces of any whorl. This is done by semicircular brackets (). Thus, if the flower be a cowslip, (5) represents five coherent sepals, five

coherent petals and five coherent carpels. It will be observed in the formula of the cowslip given above that the number of stamens is represented as $0 + 5$. The 0 means that one of the two whorls (the one *opposite* to or *in front* of the sepals) is wanting; but it is represented by short filaments without anthers or *staminodes* in some other members of the primrose family¹.

Next, to indicate *Adhesion*, as between the stamens and the corolla of the cowslip, square brackets [] are to be used; or when the petals and stamens are 'inserted' on the rim of a receptacular tube, as in the pea and apple.

One more kind of bracket is required. If the receptacular tube be adherent to the ovary, as described above in the case of the apple or snowdrop, the calyx or perianth, as the case may be, appears to grow from the summit of the ovary, and is 'superior,' while the ovary is 'inferior.' It must be remembered that these two expressions *only* apply to the ovary on the one hand, and the calyx or perianth on the other. Superior and inferior can never be said of the corolla and stamens, which may be variously situated irrespective of this adhesion.

All this may seem to be very puzzling to a beginner, especially if he attempt to understand it without the flowers before him; but as soon as flowers are examined—and *this book is only intended as a help to the study of living plants themselves*—it will be soon seen how simple their structures really are, when once the meaning of the above differences are understood.

I propose selecting about seventy of the principal families or natural orders of British flowering plants, describing in sufficient length for recognition the most prominent features of one or more species of the commoner genera. Some genera, as rose, hawkweed, willow, &c., have a large number of species. A beginner

¹ It will be seen that the stamens are represented as adherent to the tube of the corolla on a line running down the *middle* of each petal, not alternating in position with them (Fig. 35. 2).

is not expected to attempt to study them. He should aim at acquiring a sound knowledge of types of every important order, first; then, when he has become tolerably familiar with their structural peculiarities, he may, if he feel so disposed, study more minutely the species and sub-species which he has omitted. This he can do with the aid of Hooker's *Student's Flora of the British Isles*, mentioned above.

Commencing with the class DICOTYLEDONS, the student will recognize any plant belonging to it by the following features. THE FLORAL WHORLS.—These are very rarely in twos (*Circaea*), and only occasionally in fours (privet, Fig. 36, and willow herb, Fig. 23), but are most generally in fives (cowslip, Fig. 35). THE LEAVES.—These have a reticulated or netted skeleton composed of the miscalled *ribs* and *veins*, the central one, if present, being the mid-rib, as in an oak leaf; all being connected by irregularly arranged branchlets. THE WOOD.—This consists of numerous cords or fibres arranged in a single circle, and isolated from each other in a herb; but they are compacted and form concentric circles, as seen in a cross section, in the stems of all our British shrubs and trees (one alone, *Ruscus aculeatus*, the butcher's broom, being excepted), and as one circle, i.e. really a cylinder of wood, is formed each year *outside* the last year's *growth*; this class is also called *Exogens*, a word indicating that peculiarity. THE EMBRYO.—This has two *cotyledons* or seed-leaves, as seen in mustard and cress when germinating, or in peas and almonds, which 'split' asunder; i.e. the two cotyledons, which are united at one spot like a hinge, separate and break asunder, when the seed-skin or *testa* has been removed. Hence the term di-cotyledons, *di* being the Greek for *two*, and *cotyledon* that for a *cup*; but it is not clear what suggested this term. The embryo has a *radicle*, from which the primary axial or tap-root is developed; the opposite end constitutes the *plumule* or bud, which grows upwards and develops into the aërial stem. When the embryo germinates, a tap-root is produced from the end of the

radicle, though it is sometimes arrested in aquatic exogens.

Three British plants, the Scotch fir, the common juniper, and the yew—all trees or shrubs—have no carpels, though they bear ovules and stamens. The former are *naked* on the branches (in the yew), or on the surface of scales (fir), or at the base of scales (juniper).

This is so remarkable a condition that botanists separate them under a sub-class called *Gymno-sperms*, i.e. 'naked-seeded.' All other flowering plants have their ovules enclosed in carpels, so that the first sub-class is called *Angio-sperms*, i.e. 'vessel-seeded.'

In the second class, or MONOCOTYLEDONS (*mono* being the Greek for *one*), the parts of some or all of the FLORAL WHORLS are almost always in threes. The LEAVES are sometimes narrow, and straight or parallel-veined, as in grasses (easily seen if held up to the light), tulips, hyacinths, &c., or the blades may be oval (pondweed, water plantain) (Fig. 55), or round (frog-bit, *Hydrocharis*), fan-leaved palms; or arrow-shaped (*Arum*) (Fig. 54, *b*), and the trumpet-lily of florists. The long strap-shaped leaves and the arrow-form common in monocotyledons resemble the first-formed leaves of seedling water-lilies, while the round leaf of the frog-bit is like the floating leaves of water-lilies. Lastly, some monocotyledons have the stalk entering the middle of the blade, which is then called *peltate*, or shield-like, as in the foreign *Caladium*. Peltate leaves are also seen in the money-wort (*Hydrocotyle*), the garden nasturtium (*Tropaeolum*), as also in the Indian lotus (*Nelumbium*), which belongs to the water-lily family. All these last named are dicotyledons.

A cross section of the STEM shows many dots, these being the cut ends of cords of wood, running down the stem anywhere, and not grouped into concentric circles or cylinders, as in Exogens. An asparagus shoot cut across and also vertically will reveal this structure just as well as the more solid stem of the butcher's broom (*Ruscus aculeatus*), the solitary instance of a truly

woody stem among Endogens in this country. Palms are the principal trees of this class. As Dicotyledons have been also called Exogens, so Monocotyledons are called, as it were in contradistinction, *Endogens*, or 'inside-growers'; but this term does not express the actual order of formation of wood-fibres, as does the name Exogen. A certain number of the isolated cords in the stem form a group which pass off upwards towards the circumference, and enter into a leaf-stalk, their lower ends distributing themselves below, also outwards, but terminating at various points in a sort of inner network at a certain depth below the surface. There is no 'inward-growth,' as is apparently implied by the term Endogens, at all.

It is worth while observing that there is really no fundamental difference between an exogenous and an endogenous stem: for in the former the cords, usually one, three, or five, which enter a leaf-stalk are all derived from the cylinder of wood, which consists therefore of leaf-cords arranged in a circular manner. Each cord continues down the stem for a greater or less length till it tapers off to nothing. If now we can imagine these cords to be *pushed inwards* at about their middle point, so that the cylinder of cords would be irregularly dislocated, we should have the appearance of an endogenous stem. But, while in exogens there is an active layer called the *cambium*, continuous with the outer surface of the wood, to which it contributes a new layer annually, this cambium is arrested, and therefore wanting in endogens. On the other hand, another layer, called the *pericycle*, is more active in endogens in increasing the diameter of the stem when required. Whereas this layer is mostly only required for making strengthening fibres, &c., in exogenous stems, as the fibre of the lime-bark, of flax and hemp; but it is otherwise almost in abeyance in many stems of exogenous trees. The EMBRYO has only one cotyledon, as may be seen in germinating onions, which send up at first a single narrow green leaf in the form of a loop. This is caused by the tip of the cotyledon remaining

behind within the seed, in order to convey the nourishing matters of the endosperm stored up within the seed-skin into the growing plantlet. On germinating there is rarely formed any primary or tap-root in monocotyledons. It occurs in Indian corn, the date tree, and other palms, but is then very transitory. As a rule, the secondary roots only appear in ascending order from the base of the stem of the embryo or the radicle. The stem ultimately assumes the form of an inverted cone. Such roots are called *adventitious*. This order of development is precisely the same as that of aquatic exogens, as of the water-lily. The arrest of the axial root is probably due to a similar imperfection in the primary leaves under water, so that the nourishment of the root is stopped.

A concluding remark of some importance must now be made with regard to classification, and that is, that no group can be so rigidly defined as not to include exceptions. A group always represents the great majority, but the absence of one or more characteristic features is not sufficient to exclude a member. The reader may be referred to what is said about the ash tree (*Fraxinus excelsior*).

The following is a concise table of all the principal groups of flowering plants :—

CLASSIFICATION.

SUB-KINGDOM I. Phaenogamous or Flowering Plants.

CLASS I. Dicotyledons or Exogens.

SUB-CLASS I. Angiospermous Dicotyledons.

DIVISION I. Polypetalae¹.

SUB-DIVISION I. Thalamiflorae².

„ II. Calyciflorae³.

¹ Petals free.

² Petals hypogynous ; no receptacular tube (e. g. Fig. 1).

³ Petals perigynous on a free receptacular tube (Fig. 17) ; or, if it be adherent, on a continuation of the tube *beyond* the inferior ovary (Figs. 19, 24) ; or, epigynous on an adherent receptacular tube, *not* prolonged above the ovary (Figs. 18, 26).

DIVISION II. Gamopetalae¹.

„ III. Incompletae².

SUB-CLASS II. Gymnospermous Dicotyledons³.

CLASS II. Monocotyledons or Endogens.

DIVISION I. Petaloideae⁴.

SUB-DIVISION I. Epigynae⁵.

„ II. Hypogynae⁶.

DIVISION II. Glumaceae⁷.

¹ Petals coherent, hypogynous (Fig. 35) or epigynous (Fig. 28).

² Petals wanting. ³ *Coniferae* only (Fig. 49).

⁴ Having a perianth. ⁵ Perianth superior (Fig. 50).

⁶ Perianth inferior (Figs. 51, 55).

⁷ No true perianth, but alternate glumes, *Cyperaceae* (Fig. 56), and *Gramineae* (Fig. 57).

ARTIFICIAL KEY TO THE ORDERS AND GENERA.

STAMENS O OR I.

BISexual.

[T ¹ ; 4 Br.; (4).] o. 1-4 ² . 1. Very small herb; fls. green, clustered between toothed stipules	Alchemilla arvensis.
{ o. o. 1. 1. } Aq. herb; l. linear, whorled	Hippuris.
{ Pl. pap. [(5). 1.] (3). } Glabrous herb; cor. red, spurred	Centranthus.
(3-4). o. 1-2. (2-3). Leafless, fleshy, saline herb	Salicornia.
{ 3. 3. 1 + o ³ . (3). } ⁴ Perianth irregular (Fig. 50)	Orchidaceae.
Glumes, &c. 1-3. (2). A meadow grass	Festuca.

MONOECIOUS.

m. ⁵ , 2 Br.; o. o. 1. o.; f. ⁶ , o. o. (2). Aq. herb; floating l. in rosettes	Callitriche.
m., o. o. 2. o.; f., o. o. o. (2). Tree; l. opposite (Fig. 36)	Fraxinus.
m., (5). o. 5. o.; f., 2 Br.; o. o. o. (2). Herbs; fls. small, green	Atriplex.
m., o. o. 1. o.; f., o. o. o. (3). Herbs; juice milky; ∞ m. fls. with 1 f. fl. within an involucre cup (Fig. 45)	Euphorbia.
m., 3 hairs. o. (2-6 f.). ⁷ o.; f. ∞ hairs. o. o. 1. Aq. pl.; infl. long dense spikes; f. below, m. above	Typha.
m., 3. o. 3 + 3. o.; f., 3. o. o. (2). Aq. herb; infl. globular (Fig. 53)	Sparganium.
m., o. o. 1. o.; f., o. o. o. 1. Infl. on a clavate spadix, within a large leafy spathe (Fig. 54)	Arum.
m., o. o. 1. o.; f., o. o. o. 1. Minute floating pl.; 2 m. fls. of 1 st. with 1 f. fl. within a spathe	Lemna.
m., o. o. 1. o.; f., o. o. o. 4-6. Aq. pl.; l. 1-2 ins.	Zannichellia.
m., o. o. 1. o.; f., o. o. o. 1. Marine pl., l. 1 ft. or more	Zostera.

¹ T stands for 'Receptacular Tube' when *free* from the ovary; Br. i. e. bracteoles, united to the outside of it. The Rec. Tube carries the sepals, petals, and stamens, when present.

² 1-4, i. e. varying from 1 to 4.

³ + o signifies that there ought to be two whorls.

⁴ The fl. f. of an order represents that of the majority of genera: any exceptions find their places elsewhere.

⁵ m. stands for male.

⁶ f. stands for female.

⁷ (6 f.) signifies cohesion by filaments only; (a) would mean cohesion by anthers only, i. e. syngenesious, e.g. *Compositae*.

STAMENS 2.

{ (2). 2. 2. (2). }	Herb, with creeping stem ; l. opp.	...	...	Circaea.
(4). [(4). 2.] (2).	Tree or shrub ; l. opp. ; cor. white (Fig. 36)	...	...	Ligustrum.
(4). [(4). 2.] (2).	Herb ; cor. irreg., blue ...	...	...	Veronica.
(5). [(5). 2.] (2).	Cor. purple or yellow, spurred : frt. capsule	...	...	Lentibularineae.
(5). [(5). 2.] (2).	Cor. not spurred ; frt. 4 nutlets ...	...	...	Lycopus, Salvia.
m., 1 Br. ; o. o. 2. o ; f., 1 Br. ; o. o. (2).	Tree, bark white ; monoec.	...	...	Betula.
m., Br. ; o. o. 2 Gl. ¹ ; 2. o. ; f., Br. ; o. o. Gl. ; (2).	Tree, dioec.	...	...	Salix diandra.
(3-4). o. 1-2. (2-3).	Leafless, fleshy, saline herb ...	...	...	Salicornia.
{ (2), 1. 3. 1 std ² + 2. (3). }	Herb ; fl. large, yellow, lipped ...	...	...	Cypripedium.
m., o. o. 2. o ; f., o. o. 4.	Saline herb ; stem filiform ...	...	...	Ruppia.
Glumes 2. (2-3).	Sedges ; no bristles ...	...	...	Cladium.
	" with bristles ...	...	...	Rhynchospora.
Glumes, &c. 2. (2).	Grasses ; short-awned ...	...	...	Anthoxanthum.
	" long-awned ...	...	...	Bromus Madritensis.

STAMENS 3.

5. 5. 3-10. (3).	Herb ; l. opp. ; fls. small ; caps. 5-toothed ...	...	...	Stellaria media.
5. 5. 3. (3).	Herb ; l. whorled ; fls. minute ; caps. 3-toothed...	...	...	Polycarpon.
m., 3. 3. 3. o. ; f., 3. 3. o (6-9).	Heath-like shrub ; Polygam. ; frt. berry	...	...	Empetrum.
{ Pl. pap. [(5). 3.] (3). }	Herb ; cor. pouched below ...	...	...	Valeriana.
{ o. [(5). 3.] (3). }	Herb ; cor. not pouched ...	...	...	Valerianella.
m., o. o. Gl. ; 3. o. ; f., o. o. Gl. ; (2).	Tree ; dioec. ; scales very shaggy	...	...	Salix undulata.
	scales nearly glabrous	...	...	S. triandra.
{ [(3+3). 3.] (3). }	...	...	...	Iridaceae.
m., 3. 3. (3 f.). o. ; f., 3. 3. (3 std).	(3). Subdioec. shrub with cladodes ...	...	...	Ruscus.
m., 3 hairs. o. (2-6 f.). o. ; f., ∞ hairs. o. o. 1. Aq. pl. ; infl. long dense spikes ; m. above, f. below		...	...	Typha.
3. 3. 3. (3).	Tall herb ; infl. globular tufts	...	...	Juncus effusus.
3. 3. 3-6. (3).	Small herb ; infl. lax panicle	...	...	J. bufonius.
Glumes. Bristles, or none. 3. (3). (Fig. 56)		...	...	Cyperaceae.
Glumes, &c. 3. (2). (Fig. 57)		...	...	Gramineae.

¹ Gl. stands for gland.² Std. stands for staminode, a rudimentary or imperfect stamen.

STAMENS 4.

4. o. 4. (4).	Small tufted herb; l. short, pointed	...	...	Sagina apetala.
(4). 4. 4. (4).	Minute herb; branches filiform, forked	...	...	Radiola.
(4). [4 or (4). 4.] (4).	Tree or shrub; l. alt., coriaceous, spiny	...	...	Ilex.
[(4). 4. D; 4.] (4).	Tree or shrub; l. opp. ...	...	...	Euonymus.
m., [T; (4). D; 4. 4.] o.; f., { [T; 4. 4.] o. (4). }	Tree or shrub; l. alt.	...	...	Rhamnus catharticus.
[T; 4 Br.; (4). o. 4.] i.	Herb; l. simple; fls. small, green	...	...	Alchemilla.
[T; (4). o. 4.] i.	Herb; l. compound; fls. purplish	...	...	Poterium officinale.
m., (4). 4. 4. o.; f., { (4). 4. o. (4). }	Aq. herb; l. pectinate	...	...	Myriophyllum.
{ 4. 4. 4. (2). }	Tree or shrub; l. opp.	...	...	Cornus.
{ o. [(4). 4.] (2). }	L. stellately whorled (Fig. 29)	...	...	Rubiaceae.
{ (4-5). [(4-5). 4.] 1-2. }	Fls. in heads (Fig. 30)	...	...	Dipsacaceae.
4. [(4). 4.] (2).	Herbs; infl. dense spikes; fls. minute	...	...	Plantagineae.
4. [(4). 4.] (2).	Herbs; infl. cymes; fls. not minute	...	...	Gentiana campestris.
(5). [(5). 4.] (2).	Herbs; capsules co-seeded (Fig. 40)	...	...	Scrophularineae.
" "	Herbs; leafless parasites	...	...	Orobanchaceae.
" "	Herbs; style terminal; frt. 4 nutlets	...	...	Verbena.
" "	Herbs; style basal; frt. 4 nutlets	...	...	Labiatae.
m., 4. o. 4. o.; f., 4. o. o. (4).	monoec., evergreen tree or shrub	...	...	Buxus.
m., (4). o. 4. o.; f., (4). o. o. i.	Herb; l. opp., stinging	...	...	Urtica.
" "	l. alt., not stinging (Fig. 46)	...	...	Parietaria.
m., Br.; o. o. 4. o.; f., Brs., 2. o. o. (2).	Small shrub, monoec.; infl. in small catkins	...	...	Myrica.
m., (4). o. 4. o.; f., Brs., o. o. o. (2).	Tree; frt. persistent, woody, cone-like	...	...	Alnus.
(4). o. 4. 4.	Aq. herb; infl. spike	...	...	Potamogeton.

STAMENS, 5.

5. 5. about 5. ∞.	Small cornfield herb; pistil recept. elongated	...	...	Myosurus.
5. 5. about 5. ∞.	Aq. herb; fls. small white	...	...	{ Ranunculus hetero- phyllus, vars.
5. 5. 5. (3).	Herb; one petal spurred (Fig. 8)	...	...	Viola.
5. 5. (5f). (5).	Herb (Fig. 13)	...	...	Linum.
5. 5. (5f + 5 stdes). (5).	Herb; l. pinnately divided	...	...	Erodium.
3. 1 + (2) + (2). (5 a). (5).	Herb; capsule bursting elastically	...	...	Impatiens.

(5). [5 or (5). 5.] (4).	Tree or shrub; l. alt. coriaceous, spiny	...	Ilex.
[(5). D; 5. 5.] (4-5).	Tree or shrub; l. opp.	...	Eunymus.
{[T; (5). D; 5. 5.] (4).}	Tree or shrub; l. alt. herbaceous ...	...	Rhamnus Frangula.
5. 5. 5. (3-5).	Herb; l. glandular, insectivorous (Fig. 20)	...	Drosera.
{[(5). 5. 5.] (2).}	Shrub; frt. berry (Fig. 19)	...	Ribes.
m., (5). [(5). 1 + (2f) + (2f)]. o.; f., {(5). (5). o. (3).}	Herb; climbing by tendrils (Fig. 25)	...	Bryonia.
{5 or o. 5. 5. D; (2).}	Herbs; infl. mostly compound umbells (Fig. 26)	...	Umbelliferae.
{5. 5. 5. (2-3).}	Shrub; climbing by roots	...	Hedera.
{5. [(5). 5.] (3).}	4 opp. (Figs. 27, 28)	...	Caprifoliaceae.
{o. [(5). 5.] (2).}	Herbs; l. whorled	...	Rubia.
{Papp. or o. [(5). (5a.)] (2).}	Fls. in heads (Figs. 31, 32)	...	Compositae.
{5. [(5). (5a.)] (2).}	Fls. not in heads	...	Lobelia.
{(5). (5). 5. (2-5).}	(Fig. 33)	...	Campanulaceae.
(5). [(5). 5.] (5).	St. opp. petals; Styles 5	...	Plumbaginaceae.
"	St. opp. petals; Styles 1 (Fig. 35)	...	Primulaceae.
(5). [(5). 5.] (2).	L. opp.; st. alt. with oblique pets.; frt., carpels free	...	Vinca.
"	" " straight pets.; frt., capsule (Fig. 37)	...	Gentianaceae.
"	L. alt.; frt. 4 nutlets (Fig. 38)	...	Boraginaceae.
"	L. alt., or o; climbing herbs	...	Convolvulaceae.
"	" stamens, regular (Fig. 39)	...	Solanaceae.
"	" irregular	...	Verbasum.
[[(5). o. 5.] 1.	Herb; fls. small, green; ovary free (Fig. 42)	...	Chenopodium.
{(5). D; o. 5. 1.}	Herbs; fls. small, green; ovary sunk within the disk	...	Beta.
(5). o. 5. (2).	Prickly herb; calyx winged in frt.	...	Salsola.
m., (5). o. 5. o.; f., 2 Br.; o. o. o. (2).	Herbs; with minute green fls.	...	Atriplex.
5. o. 5-8. (2-3).	Herbs; stipules, ochreate (Fig. 43)	...	Polygonum.
m., 5. o. 5. o; f., Br.; o. o. o. (2).	Climbing herb	...	Humulus.

STAMENS, 6.

3 Br.; 3 + 3. 3 + 3. 3 + 3. 1.	Shrub; spines foliaceous (Fig. 2)	...	Berberis.
2. 2 + (2). (3f) + (3f). 1.	Herb; l. compound (Fig. 5)	...	Fumariaceae.

STAMENS, 6.

3 Br.; 3 + 3. 3 + 3. 3.	Shrub; spines foliaceous (Fig. 2)	...	...	Berberis.
2. 2 + (2). (3 <i>f</i>) + (3 <i>f</i>). 1.	Herb; l. compound (Fig. 5)	...	...	Fumariaceae.

4. 4. 2 + 4. (2).	Herbs (Fig. 6)	...	...	...	...	Cruciferae.
[(6). 6 or 0. 6.] (2).	Aq. herb; 1. opp.	...	...	...	...	Peplis.
3. 3. 3 + 3. (3).	Herbs; stipules, ochreate	...	...	...	...	Rumex.
2. 2. 3 + 3. (2).	" "	...	...	...	...	Oxyria.
{[(3. 3.) 3 + 3.] (3).}	Fls., with corona	...	...	...	...	Narcissus.
{3. 3. 3 + 3. (3).}	Fls., without corona; pet. cuneate	...	...	...	...	Galanthus.
" "	" "	...	...	...	...	Leucoium.
m., [(3. 3.) 3 + 3.] o.; f., {(3. 3.) o. (3).}	" " " " " " Climbing herb; 1. cordate	...	...	...	...	Tamus.
3. 3. 3 + 3. (3).	Perianth petaloid (Fig. 51)	...	...	...	...	Tulipa, &c.
[3. 3. 3 + 3.] (3).	" "	...	...	...	...	Scilla, &c.
[(3. 3.) 3 + 3.] (3).	" "	...	...	...	...	Convallaria, &c.
3. 3. 3. 3 + 3. (3).	" "	...	...	...	...	Juncea.
[3. 3. 3 + 3.] (3).	Aq. plt.; fls. on spadix	...	...	...	...	Acorus.
3. 3. 3 + 3. 6 or ∞.	Aq. plt. (Fig. 55)	...	...	...	...	Alismaceae.
3. 3. 3 + 3. (6) (3 aborted + 3.)	Fruiting spikes elongated	...	...	...	...	Triglochin.
m., 3. o. 3 + 3. o.; f., 3. o. o. (2).	Aq. herb; infl. globular (Fig. 53)	...	...	...	...	Sparganium.

5. [5. (4. f + 4. f).] (2).	Herbs; 2 sepals petaloid (Fig. 9)	...	...	...	...	Polygala.
(5-9). 5-9. D; 8. (2).	Tree; 1. opp.; frt. samara (Fig. 15)	...	...	...	...	Acer.
(4-5). (4-5). 8-10. Gls.; (4-5).	Herbs; 1. fleshy (Fig. 21)	...	...	...	...	Sedum.
{(4). 4. 4 + 4. (4).}	Herbs; fls. red or yellow (Figs. 23, 24)	...	...	...	...	Onagraceae.
{4-5. o. 4-5 + 4-5. (2).}	Herbs; fls. small greenish yel.	...	...	...	...	Chrysosplenium.
{4-5. [(4-5). 4-5 + 4-5.] (3-5).}	Herb; infl. in heads green	...	...	...	...	Adoxa.
{(4). (4). 4 + 4. (4).}	L. coriaceous; frt. berry (Fig. 34)	...	...	...	...	Vaccinium.
4. (4). 4 + 4. (4).	Cal. green; frt. loculicidal (Fig. 34)	...	...	...	...	Erica.
4 Br.; 4. (4). 4 + 4. (4).	Cal. coloured; frt. septicidal	...	...	...	...	Calluna.
4-5. (4-5). 4-5 + 4-5. (4-5).	Yellow parasite	...	...	...	...	Hypopithys.
8. [8. 8.] (2).	Herb; 1. connate, fls. yel.	...	...	...	...	Chlora.
[4. o. 4 + 4.] 1.	Small shrub (Fig. 44)	...	...	...	...	Daphne.
[5. o. 5 + 3.] (2-3).	Herb; stipules ochreate (Fig. 43)	...	...	...	...	Polygonum.

STAMENS, 8.

m., Br., 2 bractioles, o. o. 8. o.; *f.*, involucre { (5?). o. o. (2). } Tree or shrub; infl. catkins; frt. nut (Fig. 47. 5-8)
 4. 4. 4 + 4. (4). Herb; l. whorled

Corylus.
Paris.

STAMENS, 9.

m., 3. o. 9-12. o.; *f.*, 3. o. 2 std. (2). Herbs; l. opp.
m., Br.; o. o. abt. 9. oo; *f.*, Br.; brle. { (5?). o. o. (2). } Tree; infl. catkins, with sub-foliceous bracts; frt. a minute nut within a 3-lobed bract
 3. 3. 6 + 3. (6). Aq. herb; infl. umbel, fls. red

Mercurialis.

Carpinus.
Butomus.

STAMENS, 10.

(5). internode; 5. 5 + 5. (2-5). Herbs; l. opp.; nodes swollen (Fig. 10)
 4-5. 4-5 or o. 3-10. (3-5). " " (Fig. 11)
 5. 5. 5 + 5. (5). Herbs; fls. red or purple (Fig. 14)
 5. 5. (5*f* + 5*f*). (5). Herbs; fls. white or yellow
 [(5). 3. (2). 10*f* or (9*f*) + 1. 1. Herbs; fls. papilionaceous (Fig. 16)
 5. 5. 5 + 5. (2). Herbs;
 { (5). 5. 5 + 5. (2). } Herb; (Fig. 18)
 " " half inf. Herb
 { (4-5). o. 4-5 + 4-5. (2). } Herb; fls. yellow-green
 (5). [(5). 5 + 5.] Scales; (5). Herb; l. peltate, fleshy
 (4-5). (4-5). 4-5 + 4-5. Scales; (4-5). Herbs; l. fleshy (Fig. 21)
 { 4-5. [(4-5). 4-5 + 4-5.] (3-5). } Herb; infl., head, green
 5. (5). 5 + 5. (5-10). Tree; frt. berry, granulated
 " " Woody trailing plt.; frt. berry, smooth
 5. 5. 5 + 5. (5). Herb; l. radical
m., (4-7). o. 10. o.; *f.*, cupule; { (5). o. o. (3). } Tree; m. catkins slender; frt. acorn in cup (Fig. 47)
m., (4-7). o. 8-∞. o.; *f.*, cupule; { (4-5). o. o. (3). } Tree; m., catkins globular; frt. 3-angled mast in a 4-partite cup

{ *Caryophylleae*, tr.
Sileneae.

" tr. *Alsineae*.

Geranium.

Oxalis.

Leguminosae.

Saxifraga, sp.

Sax. tridactylites.

Sax. granulata.

Chrysosplenium.

Cotyledon.

Sedum.

Adoxa.

Arbutus.

Arctostaphylos.

Pyrola.

Quercus.

Fagus.

STAMENS, 12.

12. 12. 12 std. + 12. 12.	Herb; 1. fleshy	...	...	...	...	Sempervivum.
[(5-7). (5-7). 6+6.] (2).	Herbs; 1. opp.; fls. dimorphic, purple (Fig. 22)	...	...	...	...	Lythrum Salicaria.
m., 3. 3. 3-6 stdes; 6-9. o.; f., {3. 3. 6 stds. (6).}	Aq. floating herb	...	...	...	...	Hydrocharis.

STAMENS, ∞.

4-5. o or 5. ∞. 1, 3, 5, or ∞. (Fig. 1)	...	...	...	...	...	Ranunculaceae.
4-5. ∞. [∞. D; (∞).]	Aq. plants (Fig. 3)	...	...	...	...	Nymphaeaceae.
2. 4. ∞. (2), (4) or (10).	Herbs; milky juice (Fig. 4)	...	...	...	...	Papaveraceae.
5-6. 5. D; ∞. (3).	Herb; petals minute, yellowish-white fringed (Fig. 7)	...	...	...	...	Reseda.
5. 5. ∞. (3).	Herb; petals yellow	...	...	...	...	Helianthemum.
5. 5. D; ∞. (5).	Tree; peduncle on bract	...	...	...	...	Tilia.
5. 5. (∞) + (∞) + (∞). (3).	Herb; 1. opp.; petals oblique	...	...	...	...	Hypericum, sp.
5. 5. five phalanges. (3).	Herb	...	...	...	...	{ Hypericum calycinum.
(5). [5. (∞f).] (+ 10).	Herb or tree (Fig. 12)	...	...	...	...	Malvaceae.
[T; (5). 5. ∞.] 1-5 or ∞.	...	...	...	...	...	Rosaceae.
[T; 5. 5. ∞.] ∞.	...	...	...	...	...	Rosa.
m., (4-7). o. 8-∞. o.; f., {(4-5). o. o. (3)}.	Tree; frt. mast in cupule	...	...	...	...	Fagus.
m., (5?). o. ∞. o.; f., (5?). o. o. (2).	Tree; 1. rhomboidal; frt. capsule	...	...	...	...	Populus.
m., o. o. ∞. o.; f., o. o. o. 1.	Aq. Herb; L. whorled, subbipinnate	...	...	...	...	Ceratophyllum.
m., 3. 3. ∞. o.; f., 3. 3. o. ∞.	Aq. Herb; L. sagittate	...	...	...	...	Sagittaria.
m., catkins oblong, $\frac{1}{4}$ in.; f., a cone.	Tree, 1. acicular (Fig. 49)	...	...	...	...	Pinus.
m., catkins green, anth. 2-6 celled; frt. baccate.	Bush (Fig. 49)	...	...	...	...	Juniperus.
m., catkins peltate; f. erect ovule in cupule.	Tree or bush; 1. acicular (Fig. 49)	...	...	...	...	Taxus.

CLASS I. DICOTYLEDONS.

SUB-CLASS I. ANGIOSPERMS.

DIVISION I. POLYPETALAE.

SUB-DIVISION I. THALAMIFLORAE.

ORDER I. RANUNCULACEAE.

Excepting *Clematis*, which has a woody stem and opposite leaves, all others are herbs with alternate leaves. These are usually simple with more or less divided blades, or are compound with several distinct leaflets, as *Clematis* and columbine. The petioles generally have broad bases more or less sheathing the stem. The flowers have all their parts free. The calyx is sometimes white or coloured, and the corolla is wanting in a few genera. Both whorls are imbricated, i.e. the parts overlap one another, except in *Clematis*, in which the sepals are valvate, or meet without overlapping. The honey is generally secreted by the petals, which may be quite transformed into *nectaries*. The many stamens and many achenes, or else few follicles, are characteristic. In one, *Actaea*, the baneberry, the follicle is fleshy. The seeds are always albuminous. The order is marked by a poisonous, acrid, and narcotic juice. The most virulent plants are *Clematis*, *Ranunculus flammula*, *R. sceleratus*, hellebore, and especially aconite. The order contains from 30 to 40 genera, with some 500 to 600 species; abounding in cool climates, only occurring in hot countries on the mountains.

The order is subdivided into tribes as follows:—

TRIBE I ¹ . Clemati'deae. A woody climber; l.					
opp.,	comp.;	sep. petaloid,	valvate;	frt.,	
achenes;	seed, 1,	pendulous	...	...	...
					<i>Clematis</i> , l.

¹ In these and other 'keys' to the genera, &c., more are mentioned than space allows for with full descriptions in the text. The numbers correspond with those in *Hooker's Student's Flora*.

- TRIBE II. *Anemo'neae*. Herbs; l. alt.; sep. petaloid, imbricated; frt. as in I.
1. comp.; sep. yellow; fl. f., 4. o. ∞ . ∞ *Thalictrum*, 2.
1. nearly comp., involucre, leafy; sep. petaloid; fl. f., 6. o. ∞ . ∞ *Anemone*, 3.
1. simp., dissected; sep. and pet. crimson. ... *Adonis*, 3*.
1. simp., linear; sep. shortly spurred; pet. tubular, fl. f., 5. 5. few. ∞ *Myosurus*, 4.
- TRIBE III. *Ranuncu'leae*. Frt., achenes; seed erect i.
- Sep. green; fl. f., 3 or 5. 5 or more. few or ∞ . ∞ *Ranunculus*, 5.
- TRIBE IV. *Hellebo'reae*. Frt. dry, ∞ -seeded folicles.
- Sep. yellow; fl. f., 5. o. ∞ . ∞ *Caltha*, 6.
- Sep. yellow; fl. f., \pm 7. ∞ . ∞ . ∞ *Trollius*, 7.
- Sep. green; fl. f., 5. ∞ . ∞ . ∞ *Helleborus*, 8.
- Sep. red; pet. all spurred; fl. f., 5. 5. ∞ . 5. ... *Aquilegia*, 9.
- Sep. blue, post. spurred; pets. spurred; fl. f., 5. 2. ∞ . 1-3. ... *Delphinium*, 9*.
- Sep. blue, post. hooded: pets. crozier-like; fl. f., 5. 2. ∞ . 3. ... *Aconitum*, 10.
- Sep. yellow; pet. yellow minute; frt. ∞ -seeded, succulent; fl. f., 4. 4. ∞ . 1. ... *Actaea*, 11.

1. *Cle'matis vital'ba*, *Traveller's Joy*, or *Old Man's Beard*. A shrubby climber, scrambling over hedges; each leaf has five distinct leaflets, and is therefore compound; for a simple leaf has only one blade, however much it may be dissected, as of the buttercup, provided the divisions or segments are not completely separated. The little stalks of the leaflets of the clematis are highly sensitive to touch; so that when they press against a twig, in a few hours they will be found curled round it. They then begin to thicken by increasing the woody tissues. Thus they strengthen the grasp, and never again lose hold of the support; but if a leaf has not caught anything, when it dies in the autumn it falls off. Like all members of this order, the juice is very poisonous¹.

The flowers have four greenish-white downy and valvate sepals, but no petals. The stamens are numerous, nearly concealing the many carpels. When

¹ Tramps have been known to rub the juice of this plant or of species of buttercup into scratches, to raise ulcerations to excite sympathy.

the former have fallen off, the styles of the separate carpels elongate into little feathery or silky 'tails,' the one-ovuled ovaries becoming seed-like, dry indehiscent fruits, called achenes. There is no honey. The matting together of the many-tailed achenes has suggested the second name to the plant.

3. *Anemo'ne nemoro'sa*, *Wood Anemone*. This has a subterranean creeping stem, from which the flowering-stem or scape arises, bearing a few 3-foliolate compound leaves—the so-called involucre. The sepals are mostly six. The flower is sometimes found double, i.e. the numerous stamens and carpels are replaced by petals, and then they may be much increased in number. The carpels turn into achenes, and as the styles do not grow, as in the clematis, they are said to be tailless. In our only other species, *A. Pulsatilla*, the purple pasque flower, with silky foliage, found on chalk and limestone regions, the achenes are tailed. The wood anemone secretes no honey, but the outer stamens of the pasque flower are converted into nectaries. Like other members of the family, the juice of anemones is very acrid, though *pulsatilla* is a favourite homœopathic medicine.

5. *Ranun'culus a'cris*, *Buttercup*. Selecting this species as a type of the genus, the main details will be learnt from Fig. 1. It is a tall plant, flowering a little later than *R. bulbosus*, which will be readily recognized by its globular solid base to the stem, called a corm, its furrowed flowering-stem, and by the sepals being reflexed. *R. acris* has a thick stem, called a root-stock, pentangular leaves with pointed segments, a furrowed flowering stem, and sepals spreading below the petals (Fig. 1, *b*); *a* represents bracts. These are rudimentary leaves reduced to one or a few linear segments only. The petal (1) shows the little notched flap in front of the honey-secreting spot. (2*) is a front, and (2) is a back view of a stamen showing how the connective is the continuation of the filament between the anther-cells, which burst laterally. (3) is a vertical section of the flower; the inferior

sepals, hypogynous petals, and most of the stamens being removed. The pistil is formed of many separate carpels. (4) is a carpel, showing *a*, the ovary; *b*, the style; and *c*, the stigma. (5) is a vertical section of a carpel, showing the very young ovule at the base of the ovary. (6) is a ripened fruit, an etaerio or cluster of achenes. (7) is a single achene; and (8) one cut vertically, shows the seed now completely filling the ovary, and invested by the pericarp. The white substance is albumen or endosperm, the minute embryo

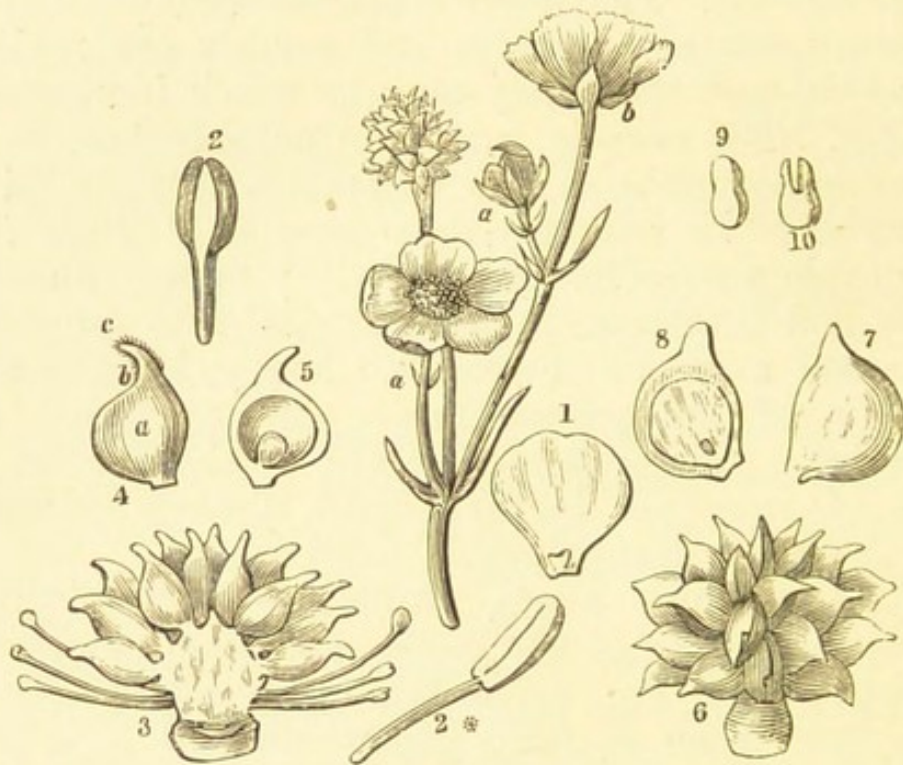


FIG. 1. *Ranunculus acris*.

lying embedded in it at the base. (9) is the embryo detached; (10) is a side view of it, showing the two cotyledons, the rounded end being the radicle.

There are about twenty native species of ranunculus, twelve of which grow in water or on marshy ground¹.

R. Ficaria, the Lesser Celandine, is the earliest species to flower (March and April). It has smooth or glabrous, cordate or heart-shaped leaves, with a sheathing base to the petiole. It bears thick, club-

¹ Hence the name from *rana*, a 'frog.'

shaped fleshy root-tubers. Its fl. f. is $3. \pm 8. \infty. \infty.$ All the water-crowfoots have white flowers. There are numerous forms regarded as species or varieties, according to the views of different botanists. They may be all grouped under three types, viz. *R. heterophyllus*, which has submerged finely dissected leaves, and floating completely formed leaves. This frequents still water. *R. fluitans*, with long submerged dissected leaves, and no floating ones. This grows in running streams. *R. hederaceus*, or 'ivy-leaved' species, grows in very shallow water, or more usually on mud, and has no dissected leaves.

R. heterophyllus illustrates the power of self-adaptation very well; for if a pond be dried up, or if the seeds be sown in a garden, the seedlings will first produce a quantity of dissected leaves, much like those under water, but their microscopic structure is quite different, being now adapted to live in air. Neither kind of dissected leaf can live in the wrong medium; for if a growing plant be transferred from air to water, or *vice versa*, all its leaves soon perish. The plant, however, puts out fresh ones suitable to the new surroundings. When growing on land, the 'floating' form of leaf may, or may not, be subsequently produced. It sometimes happens that when it is growing very thickly in a pond, a shoot will rise up into the air out of the water; when this happens, precisely the same changes take place; so that while one-half of the shoot is submerged and bears leaves adapted to water, the upper half lives in the air with its foliage all suitable to it. The flowers are always in the air, though the flower-buds are developed below the surface.

The facility with which plants can adapt themselves, leads one to suspect that the three typical forms are simply adaptations to the different conditions: for the first may assume the form of the third, if it grow on mud; and conversely Sir J. D. Hooker remarks that a 'mud' form, *R. tripartitus*, is with difficulty distinguished from forms of *R. heterophyllus*.

There are several anatomical features which are found in all aquatic plants; and when these occur in terrestrial plants it affords a presumption that they have descended from such. This applies to *R. Ficaria*, the Lesser Celandine. Thus one of their most obvious peculiarities is the lacunae or air-canals penetrating the stems and leaves. When leaves float, the breathing-pores or stomata are confined to their upper surface, while in ordinary leaves they are mainly on the lower side. Thus in the floating leaves of *R. heterophyllus* they are all on the upper surface, and in *R. Ficaria*, now a land plant, they are still more numerous above than below. This species is remarkable for producing little solid balls or axillary corms (i. e., in the axils or angles between the leaf-stalk and stem) when it grows in shady places. It may then produce no flowers at all. The corms fall to the ground, and these give rise to new plants. It is, however, more usually propagated by root-tubers; that is to say, a bud arises from the bottom of the short stem, and carries a club-shaped root with and below it. This can be detached, and can then grow up into a new plant; a similar procedure occurs in *Orchis*. This species, therefore, propagates itself by its vegetative system; and in fact it does not readily or often ripen its seed here. It is remarkable for the embryo having only one cotyledon. There are three other species of ranunculus commonly growing in wet places or in water; two have long narrow and pointed leaves, *R. flammula*, the Lesser Spearwort, with small yellow flowers ($\frac{3}{4}$ inch diameter), and *R. lingua*, with similar but larger pointed leaves. It has flowers about 2 inches in diameter. The third, *R. sceleratus*, celery-leaved r., is an annual, with smooth 3-lobed leaves, and numerous small flowers ($\frac{1}{4}$ inch diameter) with globular heads of achenes. The first and *R. sceleratus* are especially poisonous species. The half-ripe fruits are very dangerous. The corm of the bulbous buttercup has been found beneficial, if a slice be laid against an aching tooth. Vegetable poisons are readily destroyed

by heat, so that even *R. sceleratus* is eaten cooked in Wallachia. The water-crowfoots are exceptions, and are collected from some rivers, as the Avon, for feeding cattle.

6. *Cal'tha palus'tris*, *Marsh Marigold*. This common herb, frequenting marshy meadows or growing in water, is conspicuous for its rounded leaves and golden calyx. This, with the following genera, differs from all the preceding in that the carpels are larger, many-ovuled, and ripen into little pods called follicles, which ultimately burst or dehisce down and between the two margins which bear the seeds. This is called the ventral suture. If pods, as those of the pea, burst down the opposite side, such is called the dorsal suture.

The leaf of *Caltha* resembles that of the Lesser Celandine, but is larger, and like that plant abounds in air-canals, being a sub-aquatic¹ plant. It will be seen that the leaf-stalk or petiole widens at the base, and partly sheaths the stem. This is a common feature with the *Ranunculaceae*, and is also more or less characteristic of water-plants as well as of the class *Endogens*. If a portion of the sheath forms a part more or less distinct from the rest, it is called a stipule².

As it has no petals, the honey, when secreted, is produced by two glands, one on either side of each carpel; but they cannot always be seen in this country. A double form is sometimes cultivated as a garden plant.

The juice of *Caltha* boiled with alum furnishes a yellow dye; it is more or less poisonous, though

¹ The prefix sub- is often used by botanists in the sense of 'somewhat.'

² Many plants carry appendages at the base of their petioles. These may be of various kinds, and often included under the general term 'stipule.' A true stipule should have a median vascular cord, which itself arises from one of the lateral cords which enter the petiole. This can only be detected by making microscopical sections through the stem below the insertion of the leaf.

the young buds are pickled and sold as capers in Germany.

9*. *DELPHINIUM AJACIS*, *Larkspur*. This plant is naturalized in cornfields in Cambridgeshire, and occasionally found elsewhere. This and the aconite are the only two genera with irregular flowers in this order. The posterior sepal is spurred, while the two petals are also prolonged backwards into the spur, but secrete honey, which is stored up therein. Five petals would be the complete number, and one or more of the usually deficient ones may sometimes be present, as often occurs in some foreign cultivated species. The stamens at first have their filaments curved downwards, but when the anthers dehisce they are erect, thus placing the anther so as to hit a bee's head on searching for honey. After shedding the pollen, the filaments bend downwards again. After the last stamen has retired, the carpels now become ready for pollination, the stigmas standing just where the anthers had previously been. Hence self-fertilization cannot take place in the absence of insects. This feature of the carpels maturing their stigmas after the anthers have shed their pollen is common with conspicuous flowers much visited by insects. It is called protandry, and the flower is said to be protandrous, words meaning, 'stamens first.' Sometimes it is reversed, especially in inconspicuous flowers, and the 'stigmas' mature 'first.' This is called protogyny, and the flower is said to be protogynous.

10. *Aconitum Napel'us*, *Monkshood*. Like the larkspur, this has a coloured calyx; but the posterior petal takes the form of a hood; within it are concealed the two honey-bearing crozier-like petals. The method of pollination and the movements of the stamens, &c., are the same as described in the larkspur. It is found in some counties in the West of England, but has been so long cultivated that it may often be an escape. It is the most deadly poisonous of all the members of the *Ranunculaceae*. It has been long

a favourite in cottage gardens, and has unfortunately poisoned many persons who have eaten the root for horse-radish. It can, however, be easily distinguished from the latter, in that the root is rather short, conical, and tapering in the aconite, with a dark brown skin; while horse-radish is long, cylindrical, and pale-coloured.

ORDER II. BERBERIDEAE.

This order contains but one native plant, the common barberry.

Berberis vulgaris, *Barberry*. Fl. f., 3 + 3 + 3. 3 + 3. 3 + 3. 1. A shrub with spinous-toothed leaves (Fig. 2. 1, *b*) and racemes¹ of yellow flowers, the sepals and petals being all coloured alike. The fruit consists of a small scarlet, oblong berry (Fig. 2. 6).

The leaves on the woody shoots are *fascicled* or clustered, on account of the arrest of the branch which should bear them (1, *b*). They spring from the axil of a leaf reduced to 3-7 forked spines (1, *a*). This structure is the result of growth in dry air; for when the barberry is made to grow in a very moist air, it produces no spines at all, but full-sized leaves in their stead. The leaves are often subject to the attack of a fungus, which produces bright red spots on them, called the barberry blight. When the spores or reproductive cells are thrown off and can fall on the leaves of wheat, they attack it, producing the disease known as wheat-rust, from the red-brown colour of the new spores produced. At a later period in the autumn this form of the fungus bears black spores, and is called the wheat-mildew. These, again, give rise to a third kind of spore of an orange colour, which now returns to the barberry, and so reproduces the blight, to run through the series in another year.

The flowers are peculiar in having their parts in 'threes,' a rare occurrence in dicotyledons; it occurs also in docks; but this symmetry is characteristic of

¹ A raceme has a main peduncle with pedicels to the flowers. If these are wanting, the inflorescence is called a spike.

monocotyledons. The petals have two honey-glands at the base (2, *b*), between which lies the filament. When the flower is expanded, as represented in (2), if the filament be lightly touched at the base, the stamen flies forward and the anther strikes the pistil, as shown in (3). Of course if a bee has done this, then she gets dusted with the pollen, and can transfer it to another flower. This power of movement is due to the so-called sensitiveness or irritability of the protoplasm. The anthers, instead of dehiscing by

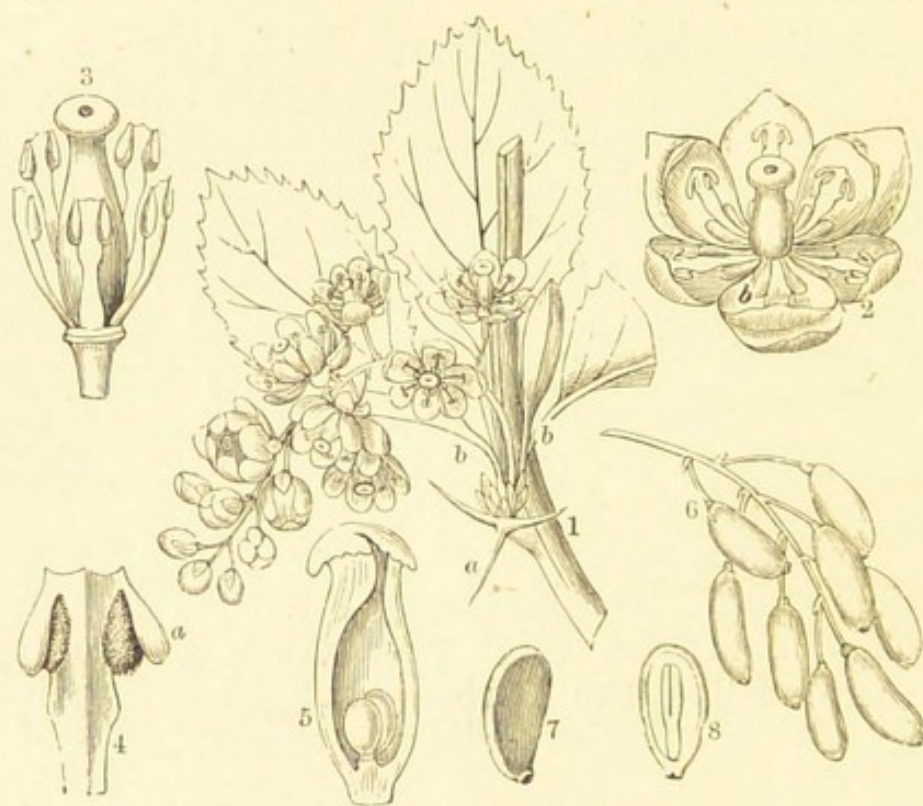


FIG. 2. *Berberis vulgaris*.

slits, as in buttercups, &c., have little flaps which lift upwards (4, *a*). This is the only British plant having this peculiarity; but it occurs in the garden bay-laurel, introduced from the South of Europe. The pistil consists of a single carpel, a vertical section of which (5) reveals the presence of two ovules at the base. The scarlet fruit is sub-acid, and is often used for a conserve with a pleasant acid flavour. (7) represents a ripe seed, and (8) a vertical section of one, showing the straight embryo lying embedded in endosperm. A variety has been cultivated, of

which the fruit has no seeds, like sultana raisins. This is due to the fact that the ovary may swell after pollination, although the ovules may not have been fertilized at the same time.

It is said that the inner bark of the stem infused in beer has the reputation of curing the jaundice; but the idea was probably based on the supposition that as both are yellow, so 'like cures like'! With alum a beautiful yellow dye can be obtained for linen and wool. The bark is very astringent, so that it has been used for tanning leather in Poland, and in lieu of quinine for fevers.

ORDER III. NYMPHAEACEAE.

Of this order we have two genera, *Nymphaea*, the White, and *Nuphar*, the Yellow Water-lily. Other species are found all over the northern hemisphere. The largest is known as *Victoria regia*, first discovered in Bolivia about 1800. It first flowered in England at Chatsworth in 1849. It is an annual.

Nymphaea alba, *White Water-lily*. Fl. f., 4. [∞ . ∞ . D; (∞)]. The flowers of water-lilies reveal the origin of petals from stamens; a perfect transition from one to the other will be readily seen on dissecting the flower (Fig. 3. 1, 2, 3 and 4). The petals arise by a broadening of the filament, accompanied by a gradual reduction of the anther-cells till they disappear altogether. Another feature is the upward expansion of the receptacle till it surrounds and adheres to the ovary, called a disk (2); (D, in fl. f.). The petals and stamens adhere to the surface in ascending series (2), so that if they be carefully removed the scars will be seen arranged spirally at different heights upon the disk, which completely invests the ovary. (5) is a transverse section of the ovary, showing the numerous cells and many ovules. If a seed be cut open vertically, the embryo will be found lying in the permanent embryo-sac, sometimes called the amniotic sac, and surrounded by perisperm.

The circular or orbicular leaf, characteristic of

water-lilies, is seen in other aquatic plants not belonging to this order¹; and, according to the researches of an eminent mathematician, it appears that this form is precisely the one best able to resist any strain produced by running water, which might otherwise lacerate it. If the petiole of a leaf or flower-stalk be cut across and wetted with Indian ink, &c., good impressions can be made showing the air-chambers, characteristic of aquatic plants.

An interesting feature about this order is that all

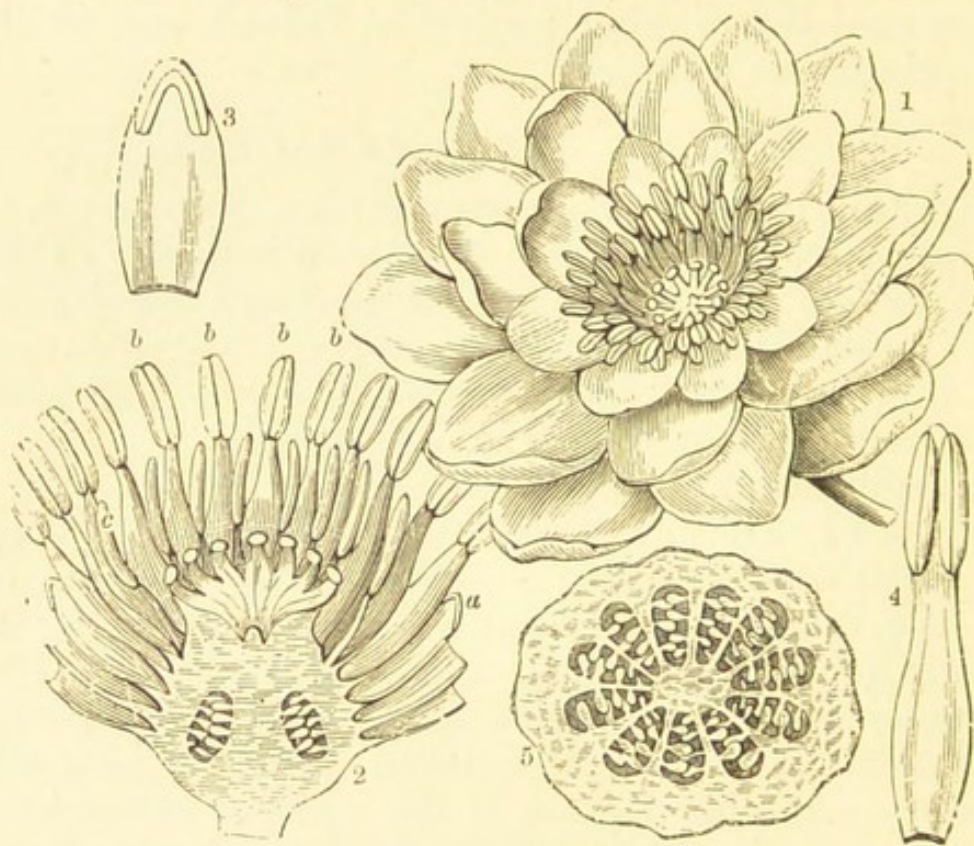


FIG. 3. *Nymphaea alba*.

the plants included in it so much resemble endogens in certain features, that about half a century ago a controversy arose as to which class it belonged. The dicotyledonous embryo decided the point, but the structure of the stem is much the same as that of an endogen. Besides that, there is a like arrest of the primary root; the forms of the first-formed leaves being narrow strap-like or linear without a blade, then the blades are spear or arrow-shaped, then round,

¹ *Limnanthemum* (Gentianeae), *Hydrocharis* (Hydrocharideae).

and finally peltate, are paralleled in the *Aroideae* of endogens (Fig. 54). The fact is, that instead of these features being proofs of *affinity*, they are simply *adaptations* to a watery existence. They point to the fact that the entire class of endogens has arisen from aquatic exogens; though many are now terrestrial (the majority of the families of that class, however, being still aquatic) they have retained features characteristic of water-plants, just as the form of submerged leaves of *Ranunculus heterophyllus* is retained when this plant grows on dry ground.

ORDER IV. PAPAVERACEAE.

The members of this order are characterized by a milky or yellow poisonous juice; that of the poppy, when hardened, forms the crude opium of commerce, which yields morphia, &c.

Papa'ver, Poppy. Fl. f., 2. 4. ∞ . (abt. 8). Of this genus we have four species with scarlet flowers, readily distinguished by their ovaries. Thus *P. Rhæas*, the common field poppy, has a globular and smooth 'head'; *P. hybridum* has a globular and bristly one (Fig. 4); in *P. dubium* it is club-shaped and smooth, while *P. Argemone* has a club-shaped and bristly ovary. *P. somniferum*, the garden or opium poppy, has glaucous foliage and large white or purple flowers, and is established in Kent. It is not known truly wild, but is probably derived from *P. setigerum* of the Mediterranean regions.

All the poppies have two sepals (1), which fall off as the bud expands. The petals are crumpled in the bud. The pistil consists of about eight carpels, coherent by their edges. Hence the placentas are parietal, but plates bearing many ovules radiate from them inwards, but do not meet in the middle (3, 6). There is no style, but the stigmas (each corresponding to the edges of *two* adjacent carpels) lie over the plates or septa (2, 3), so that the pollen-tubes can grow downwards, within the loose tissue of which the septa are composed, and then emerge to enter the

ovules on their surfaces. The tissues, especially adapted for conveying the pollen-tubes in flowers, are called conducting tissues. The fruit is a dry capsule, which opens by holes or pores below the roof-like summit (5, *a*). The seeds (7, 8) are albuminous (8 *a*) and oily, but do not partake of the poisonous principle of the milky juice. They contain a minute embryo (8 *b*) at one end.

Our field poppies have no honey, and are only visited by insects for pollen. They are readily self-

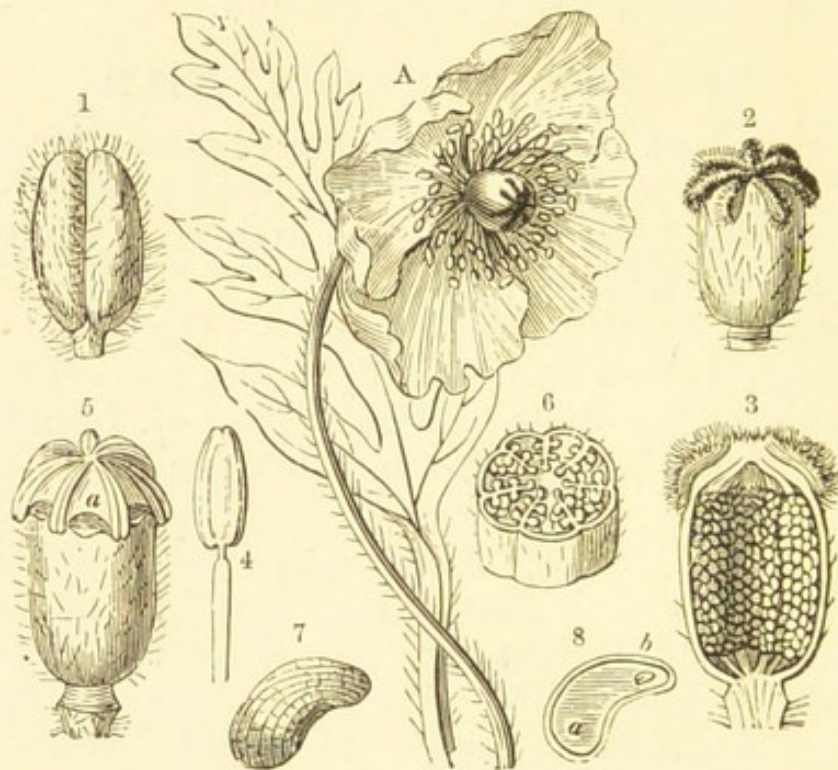


FIG. 4. *Papaver hybridum*.

fertilized, with the exception of *P. dubium*; for in this species the stigmas are elevated somewhat above the anthers, which in other species stand at about the same height as the stigmas.

The 'gall' of Scripture was most probably the opium poppy¹.

Chelido'nium ma'jus, *Celandine*. Fl. f., 2. 4. ∞. (2). This has a very poisonous and acrid yellow juice, capable of blistering the skin, though a popular remedy for corns and warts. It has rather small,

¹ *Plants of the Bible* (Pres. Day Primers), p. 39.

4-petalled yellow flowers, and long pods. It is often found in hedgerows near villages, &c. The flower and fruit resemble that of the wallflower, but although the two valves separate from the placentas in a similar manner, there is no 'false dissepiment'¹. Moreover, the stamens are many instead of six, while the seed is albuminous, which is not the case in the *Cruciferae*.

Glau'cium lu'teum, *Horned Poppy*. Fl. f., 2. 4. ∞.
(2). This is a large plant with rough but glaucous²

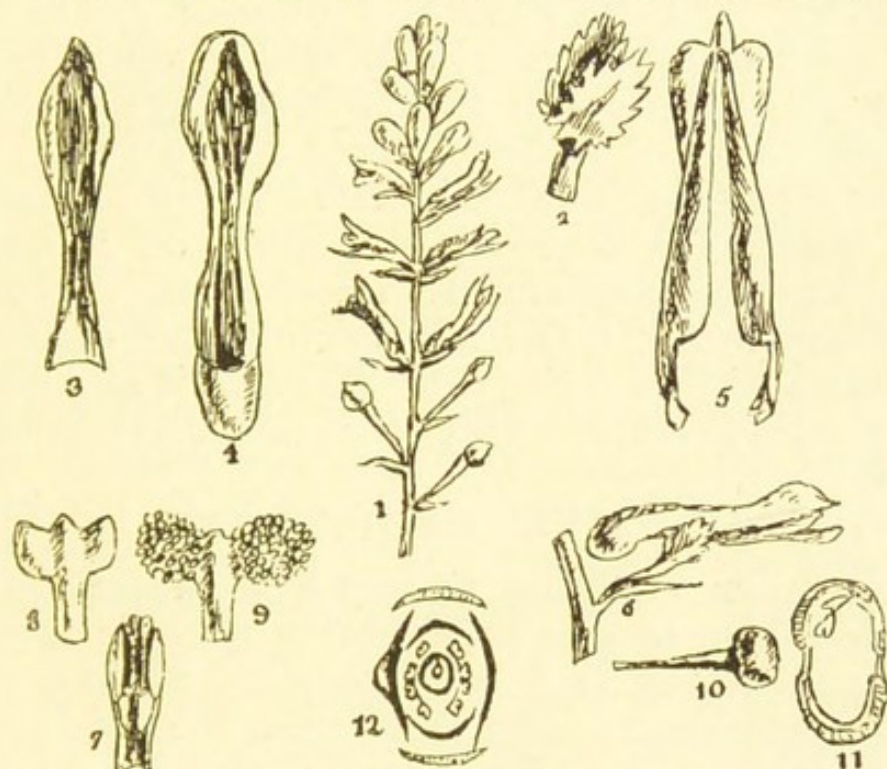


FIG. 5. *Fumaria officinalis*.

leaves, growing by the sea on sand-dunes. It has large yellow flowers, and pods sometimes a foot long.

ORDER V. FUMARIACEAE.

This order contains two genera, consisting of slender herbs with smooth divided leaves and small irregular flowers.

Fuma'ria officina'lis, *Fumitory*. Fl. f., 2. 2 + (2). (3 f.), (3 f.). (2). This genus has four species and several varieties. The two sepals, which have jagged

¹ Explained under the wallflower.

² The glaucous or blue-green colour is due to the secretion of wax, as may be noticed in the cabbage, when water runs off a leaf without wetting it. The bloom on a plum or grape is of the same nature.

edges, are very minute and pink, like the corolla (Fig. 5. 2, 6). Of the four petals (3, 4, 5) the posterior¹ one is slightly gibbous or bulging at the base (6), while the anterior¹ petal has no pouch. The two inner petals are narrow and coherent by their tips only (5). The stamens are six in number, and united by their filaments in two groups of three each (12). The anthers of the middle ones of each group are two-celled, but those of the outer ones are one-celled. The three anthers of each group form three sides of a square (7) and enclose the horn-like stigma (8). The flower is self-fertilizing; (9) shows the two horns or stigmas completely covered with adhering pollen-grains. If visited by an insect, the inner petals are depressed, swinging on a sort of hinge, and the anthers are thereby easily exposed. The ovary is one-celled and one-ovuled; it forms a globular seed-like fruit (10). The seed is albuminous with a minute embryo (11). (12) is a diagram of the flower.

ORDER VI. CRUCIFERAE.

This order contains twenty-five genera in the British Isles; so great uniformity prevails that the fl. f., 4. 4. 2 + 4. (2)², will represent all but one³. A few have conspicuous flowers, as the stock, wallflower, cabbage, &c., but the majority have minute ones, as shepherd's purse and watercress. They are all herbs, and no poisonous plant exists in the order, several being the source of kitchen vegetables. They often contain a pungent juice. The following are edible species — turnips, radish, kohl-rabi, horse-radish, mustard, cress, cabbage, watercress, sea-kale, cauliflower, broccoli, navew. Woad, a blue dye obtained from *Isatis tinctoria*, wild on the cliffs by the Severn, Tewkesbury, was used by the ancient Britons for staining their bodies.

¹ These are really lateral petals; but the flower becomes twisted a quarter of a circle in position: see diagram (12).

² The structure of the flower is explained under the wallflower.

³ *Senebiera didyma* has only two stamens.

1. *Matthi'ola*, *Stock*, has two species, *M. incana*, the origin of the Brompton stocks, and *M. sinuata*; both grow by the sea-side, having very hairy¹ or woolly leaves, and purple flowers.

CHEIRAN'THUS CHEI'RI, *Wallflower*. This, as a wild plant, has rather small yellow flowers. It occurs on old ruins, &c., having been cultivated from the Middle Ages, and originally introduced from S. Europe. As this plant is everywhere cultivated and easily procured, the peculiarities of the flowers of the *Cruciferae* will be here introduced.

The flowers and buds constitute a flat-topped inflorescence, which is called a corymb; but as the buds open the stem elongates, forming a raceme, so that fruits below, flowers above, and buds at the top, may be seen altogether. Such is called an indefinite inflorescence, because the main stalk or peduncle continues to grow and is never terminated by a flower.

Each flower has its own little pedicel, but, contrary to what is usual, there are no bracts—i. e. rudimentary leaves, often coloured, from the axils of which flowers proceed—hence the inflorescence of the *Cruciferae* is said to be ebracteate.

The sepals are slightly unequal in size, the two lateral ones (i. e. while the flower is on the stem) will be seen to be gibbous or slightly pouched at the base. On removing them, the four petals together form a cross, which suggested the name *Cruciferae*, or 'cross-bearers.' They have broad limbs, but slender stalks called claws, the petals being said to be 'clawed.' Two shorter stamens will be seen at a lower level than the four taller ones, hence the stamens form two whorls, 2 + 4, a condition of things not known outside this order. The shorter pair arise from squarish, green, fleshy honey-glands, the pouches of the sepals being just below them, to catch any honey. The pistil consists of two carpels, as indicated by the two stigmas. They are coherent, accord-

¹ Under the microscope the hairs will be seen to be stellate or branching.

ing to the second method described above, so that there *ought* to be only one chamber. The four lines of ovules exist on the circumference in two opposite pairs; but two extra outgrowths proceed from them, and by meeting in the middle, and being, so to say, welded together, constitute a sort of wall across the ovary, separating off two rows of ovules on each side of it. This is called the false dissepiment; for when two carpels unite according to the first method, the placentas, or ovule-bearing coherent margins, will be in the middle of the ovary, the division across being formed by the sides of the two carpels themselves. When the pistil ripens, two *valves* split off from below upwards, leaving a frame, formed of the opposite placentas together with the false dissepiment between them. This kind of long pod is called a *siliqua*.

The wallflower and other conspicuously flowering kinds are adapted for insect pollination. Thus, if a blossom be looked at from above, it will be seen that there are two small spaces leading down to the two glands; and that if a bee alight on the top and pass its proboscis down the hole, it cannot fail to be dusted with pollen. The two stigmas branch off so that the pollen gets lodged in the fork over which the proboscis glides.

9. **Bras'sica**, *Cabbage*, *Turnip*, &c. Of this genus there are seven species, as well as several varieties. *B. oleracea*, the wild cabbage, occurs on sea-cliffs. It is the origin of all the cabbage tribe, the different kinds of which may be grouped under three types; (1) 'Greens,' or the globular-headed cabbages and Brussel sprouts, as well as the open-leaved and taller savoys and kales; (2) the flowering tops, i. e. cauliflower and broccoli; and (3) the turnip-stemmed kohl-rabi.

This species illustrates the great variability some plants possess, especially in the artificial soil of cultivation; for it is found that the greater the variety there may be in the nature of the soil, the more will a plant be likely to vary; and conversely, when

a new variety has appeared, the cultivator should grow it as much as possible in the same kind of soil. This tends to 'fix' the variety, so that it may 'come true' by seed, as all the usually cultivated forms now do. *B. campestris* is a most variable species, and has given rise to the turnip, swede and navew, as well as the rape and colza. These last are cultivated for the oil in the seed, and the root does not swell; but if the object be the 'turnip' then the oil is more or less deficient, by what is called the law of compensation. *B. Sinapis*, the Charlock, is only too common in arable land, where its yellow flowers are very conspicuous. *B. nigra*, Black Mustard, is truly wild round our coasts. It has erect, four-angled siliques adpressed to the stem. The seeds have dark brown skins¹. *B. alba*, the White Mustard, occurs in cultivated fields, and has spreading siliques, terminated by a broad flat *beak*, usually without a seed. The seeds have yellow skins. This is the one usually cultivated with cress and eaten when the two cotyledons have turned green.

15. *Capsel'la* *Bur'sa-Pasto'ris*, *Shepherd's Purse*. This is one of the commonest weeds, easily recognized by its little triangular pods (Fig. 6. 6). They are flattened, with the very narrow dissepiment running across the *silicula*. About eight insect visitors have been observed, but it is a regularly self-fertilizing plant.

The figure shows the usual ebracteate or bractless inflorescence characteristic of the Crucifer family; namely, a corymb, or a more or less flat-topped cluster of flowers and buds, which passes into a raceme when in fruit. The basal or radical leaves of the shepherd's purse are usually lobed, but those on the stem or cauline, as in the figure, are without stalks or sessile, and spear-shaped or hastate. (1) is a complete flower. In (2) the calyx and corolla are removed. The stigma (1, 2, 5) is rough and globular; such is usually the

¹ This is the same plant as the mustard of the parable. It has been seen to grow higher than a man on horseback in Palestine, according to Dr. Thomson (*The Land and the Book*, p. 414).

case with regularly self-fertilizing flowers of this family. (3) is a transverse section of the ovary showing the narrow dissepiment. Hence the silicula (6) is said to be laterally compressed. (4) is an ovule. (6) A ripe silicula (or little siliqua), (*a, a*) being the valves, (*b*, the remains of the style) which separate from the frame-like placentas (7, 8). (7) shows the seeds attached to them in four rows; two rows being on each side. (8) is the same with the seeds removed. (9) is a ripe seed. (10) is a vertical

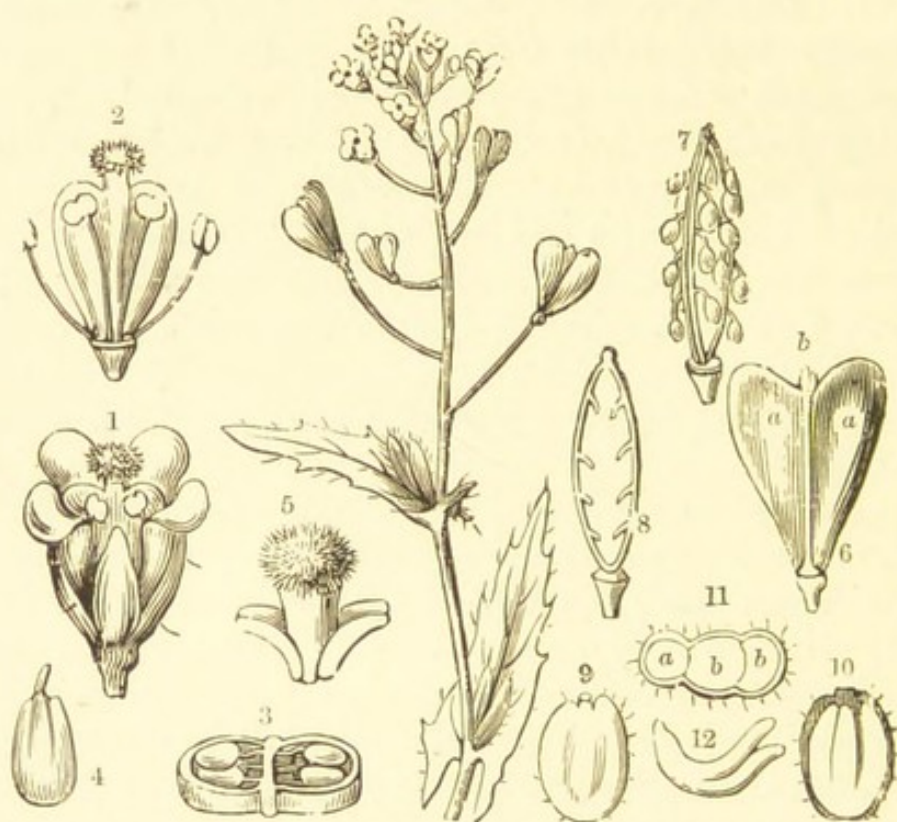


FIG. 6. *Capsella Bursa-Pastoris*.

section, showing the exalbuminous embryo with the radicle, on the right, folded back upon the two cotyledons. (11) is a seed cut transversely, (*a*) being the radicle, (*b, b*) the cotyledons. (12) is an embryo laid open.

23. *Cram'be marit'ima*, *Sea-kale*. A large herb with broad, waved, toothed, glaucous leaves, occurring on sandy sea-coasts. It has much branched corymbs of white flowers, producing a one-seeded indehiscent fruit. It can best be studied in the garden, for it was

formerly eaten wild, but has been cultivated for 200 years in England, whence it was introduced to the Continent.

25. *Raph'anus*, *Radish*. Of this genus we have two species, *R. raphanistrum* and *R. maritimum*. The flowers are in long racemes, the petals being white or straw-coloured with purple veins. The former is undoubtedly, and perhaps also the latter, the origin of the garden radish. M. Carrière raised several garden forms of various colours from the seed of the first named wild species, and found that they produced the long form in a light soil, and the turnip-rooted form in a stiff soil. Pliny, writing in the first century, records how the Greeks long ago obtained the latter kind from the former by growing it in a stiff soil. A similar result has occurred with carrots. By selecting seed from plants having the best formed roots, these have become fixed and hereditary.

ORDER VII. RESEDACEAE.

This order is represented by two native species of Mignonette.

Rese'da Lu'teola, *Dyer's Weed*, *Weld*. Fl. f., 4. 3-5. D; ∞ . (3). This species has long, narrow, and undivided leaves. The petals in both species are very small, yellowish white, unequal in size and fringed. A large one-sided honey-disk, D, is inserted between the petals and stamens. The pistil is peculiar in opening at the top before the seeds are ripe. The leaves of this plant were formerly used for yielding a yellow dye. *R. lutea* has divided leaves; its fl. f. being 6, 6. D; ∞ . (3). The disk is fringed.

As the garden mignonette is more easily procurable, a figure and description of the flower is here given instead of that of the wild species. Its origin is probably *R. Phyteuma* of S. Europe. It was introduced in the middle of last century. (Fig. 7. 1) shows a flowering spray; (2) a flower with about six narrow sepals (*a*); (2, *b*, 3) is a petal with a broad claw which clasps the edge of the disk (4, *b*). (4) is a flower with

the sepals and petals removed, showing the little internode or gynophore (*a*); the stamens (5) with their brownish-red anthers are inserted above the disk. (6) is a half-ripe fruit with the persistent calyx and disk (*a*) remaining. (7) is a transverse section of the one-celled ovary with its three parietal placentas (*a*) and rows of ovules. (8) is a ripened capsule open at the summit (*b*). (9) is a seed, and (10) the same cut open to show the exalbuminous embryo; (*a*), point of attachment.

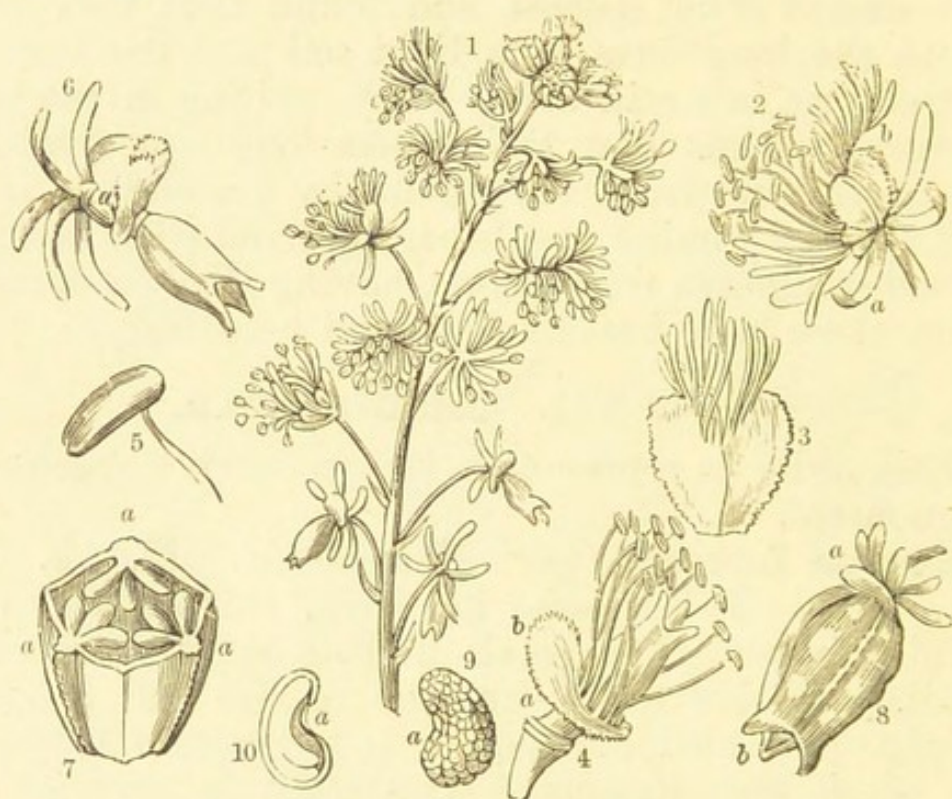


FIG. 7. *Reseda odorata*.

ORDER IX. VIOLACEAE.

This order contains seven species of the genus *Viola*, one being the pansy. In all of them the flower is upside down, in consequence of a twist in the peduncle. The fl. f. is 5. 5. 5. (3). There are many varieties or sub-species, according to the nature of their localities.

Viola odorata, *Violet*. This is the only scented species. The sepals are attached to a point above the base, which hangs down like a little green flap, an unusual condition. One petal is spurred, hence the flower is irregular. Of the five stamens, two in front

have honey-secreting appendages springing out just below the anthers. These pass down into the spur. The other three are without these tails; all of them have a triangular orange-coloured flap at the top, which close up round the ovary, so that when the pollen escapes it accumulates inside the little cone-like structure formed by the five anthers. The pistil has a one-celled ovary; the style is slightly bent at the base, forming a spring, while it terminates with a bent beak-like process having a hole at the extremity; within this is the stigma. If an insect should alight upon the lower petal, and pass its proboscis down the spur, it must pass between two of the anthers, and so get dusted with pollen. Carrying it away, the orifice of the stigma of the next flower visited secures it from the bee's proboscis.

As a matter of fact, however, the sweet-scented flowers of the violet do not set seed in this country. If the leaves be lifted up at a later period numerous minute buds will be found. These never open, but contain rudimentary petals or none and stamens which have their anthers laid on the top of the ovary concealing a short flat stigma; the 'beak' being entirely wanting, the pollen is thus applied directly to the stigma. Such flowers are cleistogamous. They set an abundance of seed as the bursting capsules will readily be found. There are three valves, each carrying several seeds down the middle. Now, as these middle lines are the placentas, it shows that each valve must be composed of the halves of two carpels.

There are five species having the shape of the violet, such as *V. canina*, the Dog-Violet, and *V. sylvatica*, the Wood-Violet. *V. tricolor*, the Heartsease or Pansy, has a much broader flower and differs in having a globular head to the style, and never has cleistogamous buds. It is a very variable plant, and was the origin of numerous garden forms cultivated in 1720; but a new series was raised in 1810. They have been subsequently crossed with *V. grandiflora* and *V. lutea*, &c.; so that existing forms are often

hybrids. Fig. 8 illustrates the various organs as follows: *A* is a flowering stem which bears leaves (*a*) and their stipules (*b*). Each flower-stalk has two little bracts (seen on the flower to the right). These are rudimentary leaves¹. The sepals have basal appendages, shown in the bud (*A*). (1) is a flower from which the sepals and petals have been removed.

Two of the stamens (1, 2 and 3) carry honey-secreting appendages, which lie within the spur which one of the petals possesses; the other three stamens

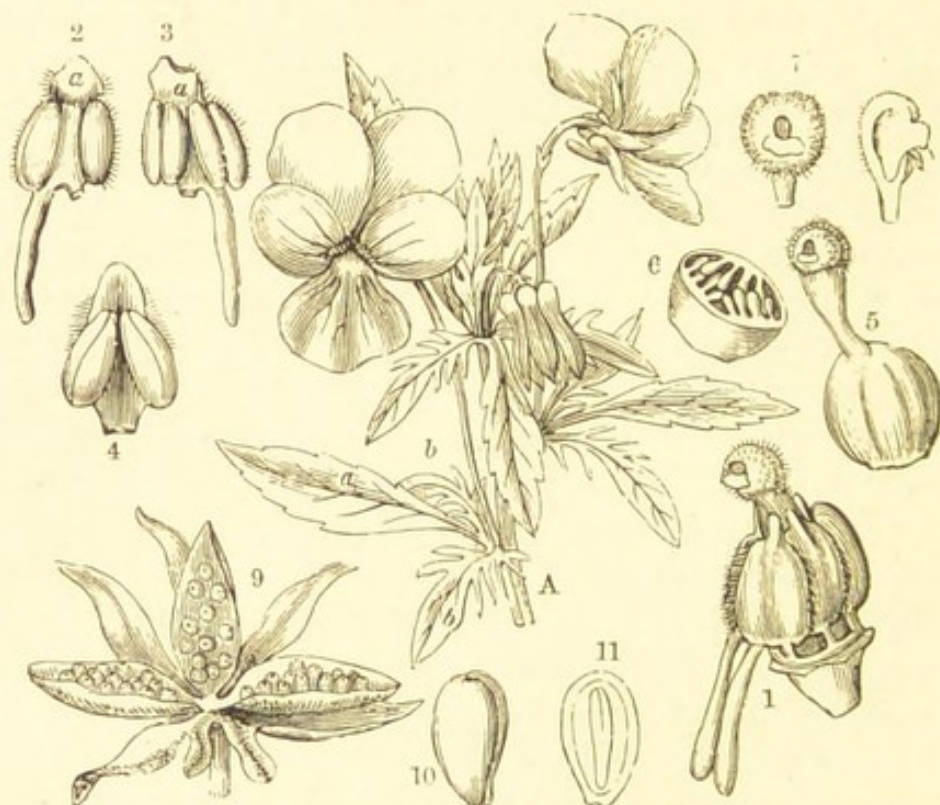


FIG. 8. *Viola tricolor*.

have no such tails (4). (2 and 3, *a*) are the orange-coloured prolongations of the connective, which meet and form a cone-shaped structure round the ovary (1). (1, 5, 7 and 8) show the pistil, with the globular head and the orifice leading to the stigma within, and a tongue-like flap in front which catches the pollen. (6) is a transverse section of an ovary showing three parietal placentas with their groups of seeds, each

¹ They are usually regarded as two stipules; but their central cords rise out of the cylinder of cords in the stem exactly as do those of true leaves.

arising from the union of two carpellary margins. (8) is a vertical section of the stigmatic and hollow head. (9) a ripe capsule dehiscing by three valves. Each valve carries a group of seeds down the middle. This shows that each valve is really composed of half one carpel and half another. The dehiscence is called *loculicidal*. (10) a seed, and (11) a vertical section of a seed, showing a straight embryo embedded in endosperm.

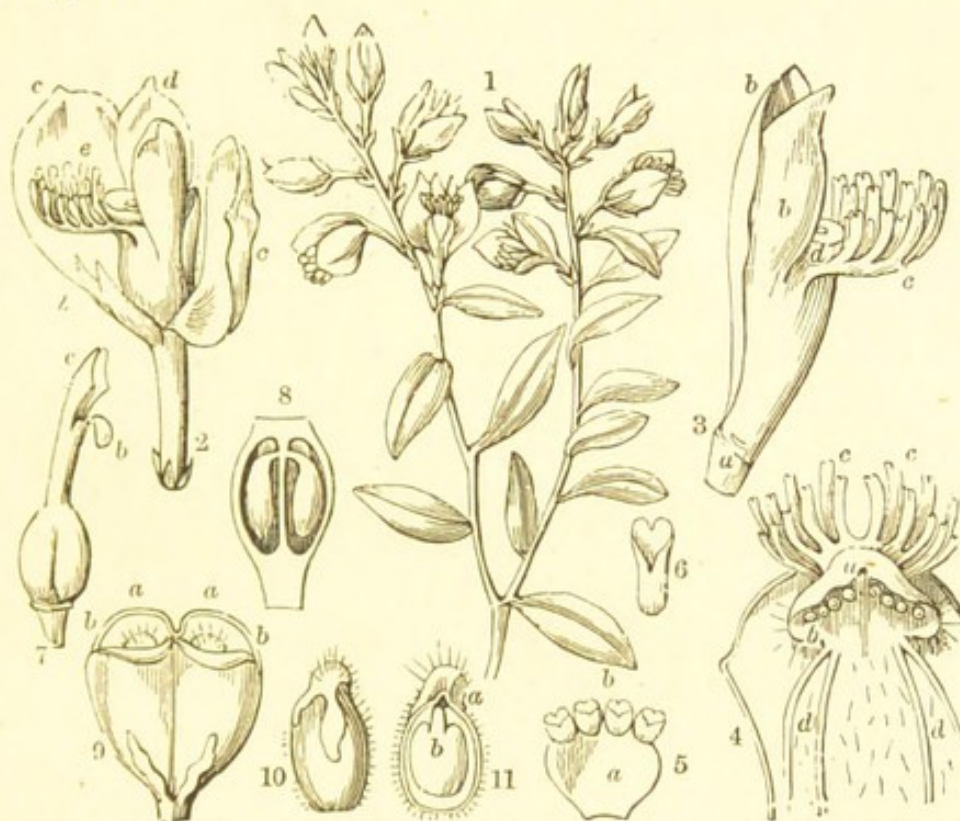


FIG. 9. *Polygala vulgaris*.

ORDER X. POLYGALEAE.

One genus represents this order.

Polyg'ala vulga'ris, *Milkwort*. Fl. f., 5. [(5). (4, 4)].
(2). There are three species, all being small herbs with blue or white flowers. The structure is very peculiar. There are five sepals, the two inner are blue and much larger than the other three (Fig. 9. 2, b, c), which are green. They, however, turn green afterwards in the fruiting stage. The five petals are all united together (2, d, e; 3, b, c) by being adherent to the 'split-tube' (3, 4, d; 5, a) of the coherent filaments

of the stamens. The largest petal has a fringe or crest at the summit (3, *c* ; 4, *c*). There are eight anthers, four on each side of a spoon-shaped extremity of the style (4, *b* ; 7, *c*). The stigma is a knob (7, *b*) at the base of the spoon. The two anther-cells of each of the eight stamens become confluent, so that they resemble four short fingers of a glove with the tips cut off (4, *a* ; 5, *b*). Each of these two groups of anther-tips grip one of the edges of the spoon, into which they pour their pollen. The ovary is supported by a little stalk or gynophore and is two-celled (8). Each cell contains a pendulous ovule (8). An insect on inserting its proboscis to the base of the flower glides it over the sticky knob-like stigma, and on withdrawing it carries away some pollen out of the spoon. Then it transfers it to the next flower visited. Notwithstanding this elaborate contrivance the flower is often self-fertile, in consequence of the pollen being deposited at the lower end of the spoon, which comes in direct contact with the stigma. After fertilization, the two large blue sepals turn green and enclose the pistil. The capsule dehisces at the top (9 *a*, *b*). The seeds have an excrescence or caruncle (10, *a*). (11) is a vertical section of a seed, showing the embryo, with large cotyledons (*b*), lying in endosperm.

ORDER XII. CARYOPHYLLEAE.

This order consists entirely of herbs. They all have opposite, entire, i. e. smooth-edged leaves arising from swollen nodes. The inflorescence is definite and cymose (cf. p. 158). The pistil has a single ovarian chamber with a central column, called the free central placenta, which bears many ovules. It arises by the rupture of the septa ; for at first the walls of the carpels meet in the middle, giving rise to an axile placentation, but on the growth and expansion of the ovary, the septa break away. Except in *Polycarpon*, the styles are always entirely free, and usually rather long. The fruit is a capsule dehiscing by teeth at the summit.

The seeds are albuminous, and in the majority the embryo is coiled round a central perisperm¹.

The order is divided into three tribes: the first contains the genus *Dianthus*, which is the source of all our garden pinks, carnations, and piccotees. *Lychnis* and *Silene* supply a few garden plants as well. The second tribe furnishes a few for cultivation, such as *Cerastium tomentosum*, but is characterized by including many so-called insignificant weeds, as chickweed, pearlworts, sandworts, &c. The third tribe contains only one plant, *Polycarpon*.

Artificial Key to the Genera.

TRIBE I. *Sileneae*. Fl. f., (5). 5. 5 + 5. (2), (3) or (5). Cal. and Cor. separated by an internode or gynophore. Pet. clawed.

L. linear, styles 2	...	...	...	...	<i>Dianthus</i> , 1.
L. broad, styles 2	...	...	...	...	<i>Saponaria</i> , 1*.
styles 3	...	...	...	...	<i>Silene</i> , 2.
Pet. with scales, styles 5	...	...	...	...	<i>Lychnis</i> , 3.
Pet. without scales, styles 5	...	...	...	...	<i>Githago</i> , 4.

TRIBE II. *Alsineae*. Fl. f. 4-5. 4-5. 4-10. (3), (4) or (5). No gynophore. Pet. not clawed.—*Stipules*, 0.

Pet. notched, styles 3	...	...	...	...	<i>Cerastium</i> , 6.
Pet. cleft, styles 5	...	...	...	...	<i>Stellaria</i> , 7.
Pet. entire, styles 3	...	...	...	...	<i>Arenaria</i> , 8.
Pet. entire or 0, styles 4-5	...	...	...	...	<i>Sagina</i> , 9.

Stipules, membranous, white.

styles 5	...	...	...	...	<i>Spergula</i> , 10.
styles 3	...	...	...	...	<i>Spergularia</i> , 11.

TRIBE III. *Polycarpeae*.

L. 4-whorled. Fl. f. 5. 5. 3. (3), styles 3, coherent *Polycarpon*, 12.

I. *Sileneae*. This tribe is at once recognized by the tubular calyx, within which are petals with long claws, and sometimes having a little fringe or scales at the top of the claw (*Lychnis*). Between the insertion of the calyx and corolla is an internode or gynophore. The honey-disk is between the stamens and the pistil.

1. *Dianthus*, *Pink* and *Carnation*. Fl. f., (5). 5.

¹ Botanists distinguish between *endosperm*, formed within the embryo-sac and embedding the embryo, and *perisperm*, which consists of nutritive matter laid up in the tissues of the nucleus which sometimes remains after maturity.

5 + 5, (2). This genus contains four British species, and two others long cultivated and now naturalized on old walls, &c. These are *D. Caryophyllus*, the clove pink, the origin of carnations; and *D. plumarius*, the origin of the garden pinks.

The species which are genuinely native are *D. caesius*, the Cheddar pink, which grows on the limestone rocks of Cheddar; *D. Armeria*, Deptford pink, a very small

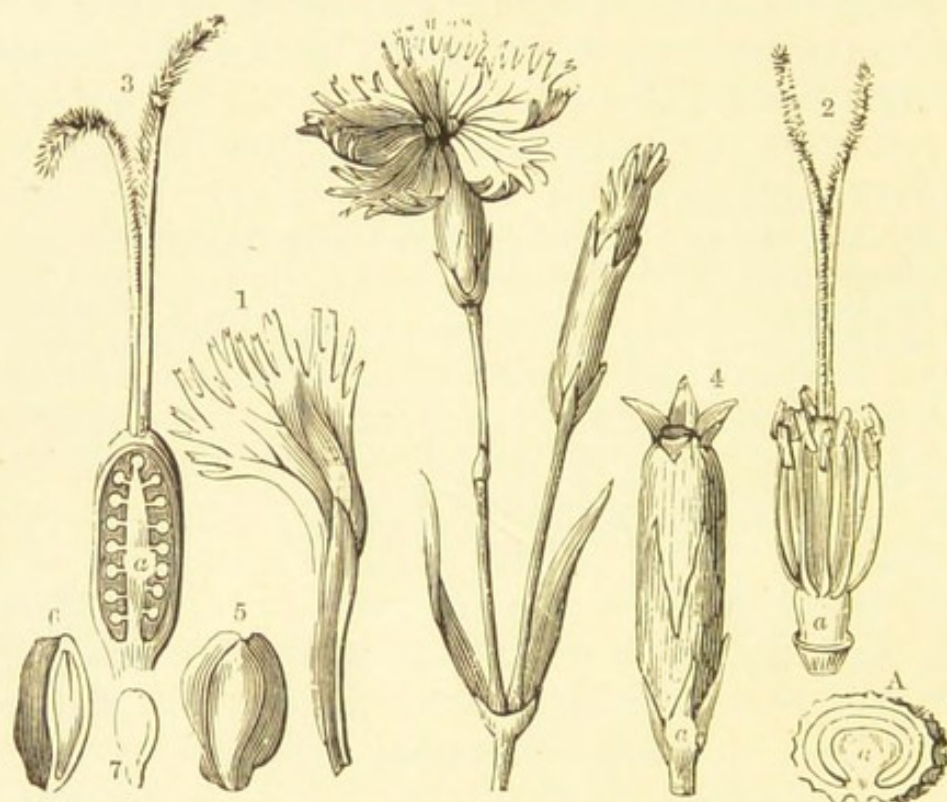


FIG. 10. *Dianthus deltoides*.

flowering species; *D. deltoides*, maiden pink, found on dry places. These are rare plants.

The illustration (Fig. 10) is that of *D. deltoides*, var. *glaucus*, characterized by being very glaucous, and not downy. Its bracts are four in number (4, *a*), and the petals are white. It is found near Edinburgh and Croydon. (1) is one of the fringed petals; (2) a flower from which the calyx has been removed from the circular rim seen below; as well as the petals which were inserted with the stamens on the top of the short internode or gynophore (*a*). The stamens are represented in the immature state of the flower, and would

be quite concealed within the calyx; the stigmas are immature at this stage also. (3) represents the advanced stage of the pistil, with the spreading stigmas, showing a vertical section of the ovary with the free central placenta (*a*). (4) is a ripe capsule, dehiscing above by four teeth. (5) is a ripe seed. (6) is a vertical section of a seed showing the straight embryo, (7). This is exceptional in the order. The embryo is usually coiled round the perisperm (*a*), as shown in *A*. This represents a seed of chickweed.

The fertilization in *D. deltoides*, which is probably much the same in other species, is as follows. The honey-disk, which surrounds the stalk of the ovary, is only readily accessible to Lepidoptera. The petals first of all spread outwards; then the five outer anthers which dehisce first protrude one after another, the five inner still remaining within the calyx. After a period these inner protrude, the styles all the while being quite immature within the tube of the calyx. After all the stamens have withered, then at last the two styles emerge and elongate; they become spirally twisted, an advantage, in that some point must thereby be touched by the insect. Thus the flower is strongly protandrous, and self-fertilization precluded.

2. *Sile'ne Cucu'balus*, *Bladder Campion*. Fl. f., (5). 5. 5 + 5. (3). The genus *Silene* is also known as 'catchfly,' and contains eight species; the present one is easily recognized by its inflated calyx, suggesting the name. The whole plant is glabrous and even glaucous. The five stamens standing before the petals are sometimes adherent to them. An allied species, or rather variety, *S. maritima*, is common by the sea; the flowers vary in being sometimes only staminate; others only pistillate. The bladder catchfly or campion is sometimes eaten as asparagus or instead of green peas, the young shoots having the flavour of both.

S. acau'lis, *Moss Campion*, is a densely tufted species, with pink flowers, found as high as 4,300 feet on alpine rocks, from Forfar southwards. It is one of our truly arctic plants.

3. *Lych'nis Flos-cucu'li*, *Ragged Robin*. This genus only differs from *Silene* in having five styles instead of three. This species is known by its laciniated or jagged petals, and is common in meadows. It has about sixteen insect visitors. *L. diurna*, Red Campion, and *L. vespertina*, White Campion, are much alike, except in the colour; they are both dioecious; the female flowers being at once recognizable by the calyx investing the globular ovary. They are tall branching herbs with softly hairy, broad leaves. *L. alpina* is a tufted plant, four to eight inches in height, growing on alpine moors and ravines to 3,200 feet; the flowers are rather large for the size of the plant, being half-an-inch in diameter, with rosy-coloured petals. It occurs on the Alps, Pyrenees, and in the arctic regions. It is a member of our true alpine or arctic flora, and as it does not occur on low-lands between these mountains and the arctic regions, it is thought that it spread from the north when the climate was generally 'arctic,' as far south as Spain. When the temperature rose till it became temperate, these arctic plants then survived only on those heights where the climate was favourable to them.

4. *Githa'go se'getum*, *Corn-cockle*. Fl. f., (5). 5. 5 + 5. (5). This is a very common tall annual herb frequenting cornfields. The flower is of the same structure as that of *Lych'nis*, but the sepals are prolonged into subleafy tips, and the petals have no appendages. The flowers are solitary, nearly two inches in diameter, and pale purple.

TRIBE II. *Alsineae*. This contains seven genera, most of them being very small herbs, and nearly all with small white flowers. The commonest are the following.

5. *Ceras'tium*, *Mouse-ear Chickweed*. Fl. f., 5. 5. 5 + 5. (3). There are eight species, one of the commonest being *C. glomeratum*, which assumes various varietal forms and grows in fields and dry places. The flowers are usually densely compacted together, and

when ripe the rather long capsule is curved. The petals are only slightly notched in this genus, not deeply cleft, as in the next, *Stellaria*. Moreover, *Cerastium* is generally more hairy than *Stellaria*. The buds very often do not expand, so that they remain cleistogamous.

6. *Stella'ria*, *Stitchwort*. This chiefly differs from *Cerastium* in having five styles instead of three, and in being more decidedly glabrous. The three commonest species are *S. Holo'stea* (Fig. 11), the Great

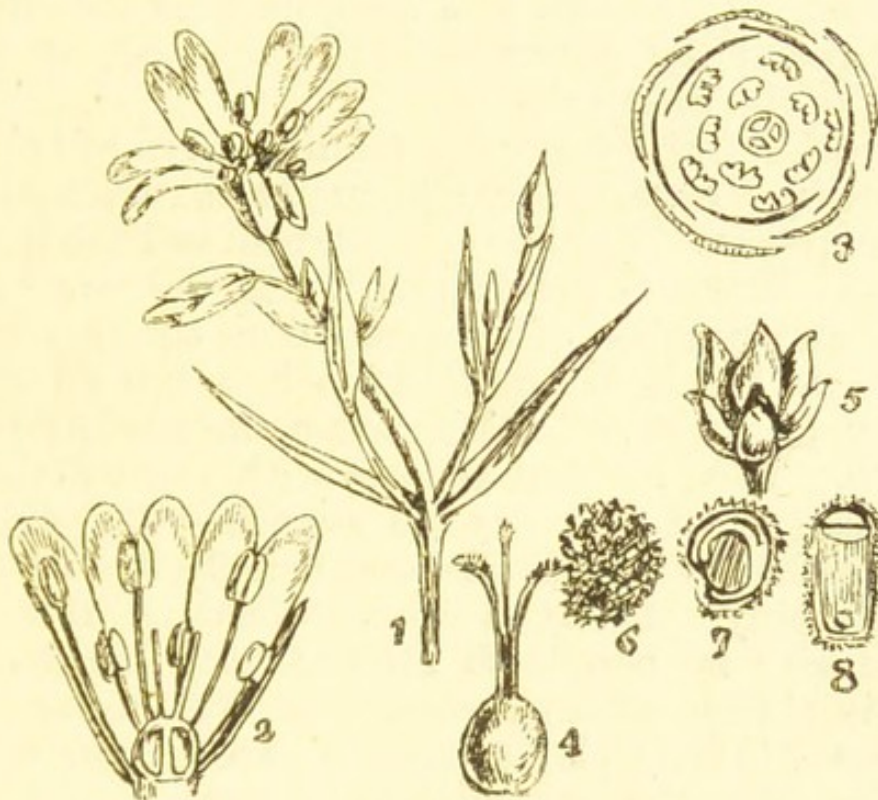


FIG. 11. *Stellaria Holostea*.

Stitchwort, *S. media*, Chickweed, and *S. graminea*. The first has long narrow or grass-like and acuminate leaves (1), and large white flowers, *apparently* with ten petals, but each petal is really cleft almost to the base (2)¹. It is excessively common in hedges, and blossoms in early summer.

The flower contains five honey-glands, one at the base of each of the outer stamens. These latter mature

¹ This has so often deceived beginners, that it is worth while reminding them that it is never enough to merely *look* at a flower without dissecting it.

their anthers first, then those of the inner dehiscence, and finally the stigmas mature. Though strongly protandrous, the stigmas can reach the anthers, and often get pollinated by self-fertilization.

(2) Represents a vertical section of flower in the protandrous stage, the styles being still short and immature. (3) is a diagram showing the imbricated sepals and petals, and the originally three-celled ovary before the solution of the septa. (4) is the pistil matured. (5) is a capsule bursting by six valves; (6) a seed; (7) section of a seed, showing the embryo coiled round the perisperm; (8) a seed cut at right angles to the position in (7).

S. media, Chickweed, is a familiar weed of cultivation, easily recognized by a line of hairs running down the internodes. The leaves are broad, and the flowers minute. There is great variation in the size of the petals and number of stamens; thus, the petals may exceed the sepals in length, when it is known as the variety *grandiflora*. This occurs in Mediterranean regions. This, as well as one with the corolla not exceeding the calyx, has ten stamens. Our English varieties have small petals, and usually five or three stamens only. Lastly, a common form in Malta, &c., is one with no corolla at all, and only two stamens. This is always cleistogamous. In cold weather, in summer, in shady places, and all through the winter, our English forms remain cleistogamous.

S. graminea looks like a slender form of *S. Holostea*, having much finer leaves and smaller flowers. It is common in grassy places, and blossoms in June; the three-nerved sepals are sub-coherent, and the petals about equal them in length. Two other species, *S. palustris* and *S. uliginosa*, occur in marshy places, and agree with *S. graminea* in having coherent sepals.

ORDER XV. HYPERICINEAE.

One genus containing eleven species represents the order. They are all herbs, with opposite entire leaves and yellow flowers.

Hypericum perforatum, *St. John's Wort*. Fl. f., (5). 5. (∞), (∞), (∞). (3). This common species has oil glands in the leaf, which, if held to the light, appear as translucent dots, hence the name. The sepals are slightly coherent at the base, with black glandular dots on the margin. The petals in all the species are very oblique: i.e. a line down the middle does not divide the petal into two equal halves. These and the anthers have also black dots. The stamens are very numerous, but a careful dissection will show that they are united at the base into three bundles or *phalanges*, as represented by the floral formula. The stamens mature their anthers from within outwards, so if the flower has not been crossed, the long projecting styles will have their stigmas dusted by the outermost anthers. There is no honey, but bees visit it for the pollen; about thirty visitors have been observed.

The *St. John's worts* have a yellow resinous juice; they are in fact somewhat allied to the gamboge tree. They were for ages regarded as valuable drug plants, but are no longer held in esteem. The dried plant boiled in alum dyes wool yellow. It is regarded as a charm against storms on the Continent and in Wales; and is hung in windows on *St. John's Day* for that purpose. *H. calycinum* is a common trailing shrub of our gardens, having very large terminal yellow flowers, sometimes known as *Aaron's beard*, from its numerous stamens.

ORDER XVI. MALVACEAE.

This order contains three genera; all are stipulate herbs, excepting the 'Tree Mallow,' which is a shrub or small tree, six or more feet in height. There is often a downy pubescence consisting of stellate or branching hairs on the surface. The numerous anthers on the united column of filaments is the great characteristic feature of this order. They arise, as e.g. in *Malva sylvestris*, from ten tubercles, which develop into the coherent tube of filaments (Fig. 12).

These latter keep subdividing until there are three anthers to each, or thirty in all. Each anther being originally two-celled, becomes unilocular by the obliteration of the partition (1). No member of this order is poisonous, but as they possess much mucilage, they have been used in medicine and (the marsh mallow) in preparations for coughs. Of important foreign plants, mention must be made of cotton, this being the hair on the seeds of the species of *Gossypium*.

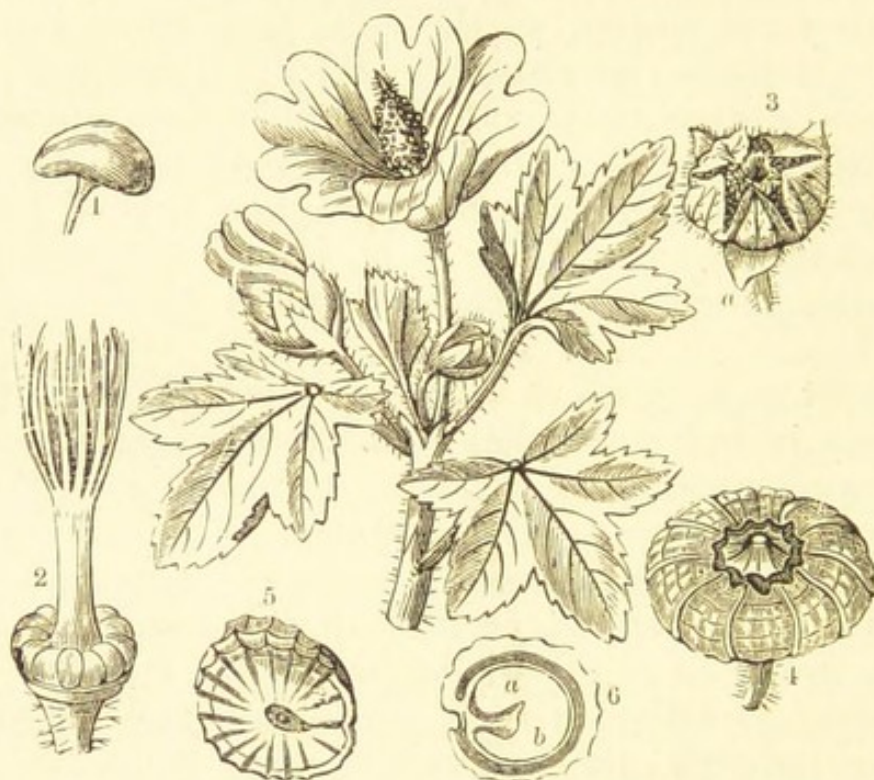


FIG. 12. *Malva sylvestris*.

It is a native of Peru and of India. Cotton is only once mentioned in the Bible (Esther i. 6¹), in which it is said that the curtains of the palace at Shushan, in Persia, were made of cotton, blue and white. Many large-flowered species of *Hibiscus* and the hollyhock are cultivated for their beauty.

Mal'va sylves'tris, *Common Mallow*. Fl. f., [3 Br. ; (5)]. [5. (∞f)]. (∞). This is a common herb with large mauve-coloured flowers (Fig. 12). There are three small bracts or bracteoles adherent to the

¹ *Plants of the Bible* (Pres. Day Primers), p. 25.

calyx (3, *a*). The sepals are valvate, the edges being turned outwards. The petals are twisted up spirally or contorted in the bud. The stamens are numerous, coherent by their filaments into a hollow tube. The five free petals are adherent to the base of it¹. To find the pistil the tube must be split open, when it will be seen quite free within it (2). The one-celled anthers (1) mature and shed their pollen before the stigmas are mature or appear above them (2), and it is not until they have shrivelled that the numerous purple stigmas grow up and out of the middle of the tube. The flower is thus strongly protandrous. The honey is secreted in five little pits protected by hairs between the bases of the petals. Thirty-one visitors have been seen to come to it. The fruit consists of a flattish cheese-shaped ring of carpels (3, 4), enclosed by the persistent calyx. The carpels break asunder, but each remains investing a seed (5, 6). The seed is exalbuminous (6). The embryo has rather large and folded cotyledons (6, *a*). These convolutions are well seen if an entire fruit be cut transversely. (6, *b*) is the radicle.

Mal'va moscha'ta, *Musk Mallow*. This has large pink flowers and divided leaves. A white variety is in cultivation. The structure of the flower is the same as in the flowers of the common mallow. It is also strongly protandrous.

Mal'va rotundifo'lia. This is a much smaller plant than the other two species, lying prostrate in waste places, and has small pink flowers. In these the stigmas protrude nearly simultaneously with the anthers, among which they intertwine, so that it is a self-fertilizing species. Only three insects have been seen to visit it.

Lavate'ra arbo'rea, *Tree Mallow*. Fl. f., (3 Br.); (5). [5. (∞f)]. (∞). This only occurs on maritime rocks,

¹ As epipetalous describes the condition of stamens when adherent to a gamopetalous corolla; so some botanists regard the petals of mallow as epistaminate, because they are free while the stamens are coherent to which they adhere.

and is sometimes grown in gardens by the sea. It grows from three to six feet in height, has broad leaves, and purple flowers. The *epicalyx* (Br.) has three very large ovate, i. e. egg-shaped, lobes.

ORDER XVII. TILIACEAE.

This order is represented by two species of lime, considered as natives, as well as the one commonly planted, introduced from Europe, viz.—

TIL'IA VULGA'RIS, *Common Lime* or *Linden*. Fl. f., 5. 5. ∞ . (5). The English species are *T. parvifolia* and *T. platyphyllos*, the *Large-leaved Lime*. These two are found in woods, but the first named is more readily met with. The leaves are oblique, one half being smaller than the other at the base. The expanding buds in early summer well illustrate how plants are enabled to avoid the evil effects of a chill. As the bud expands its brown stipular bud-scales are thrown off. The leaves are now seen to be *conduplicate*, i. e. the two halves are folded together, and they bend downwards, while the inner stipules grow more or less covering the edges of the leaves. As the first leaves enlarge they rise up again, and gradually assuming a horizontal position, protect in turn the more delicate and undeveloped leaves below them. The object is to place the surface of the leaves, as long as they are immature, in a vertical position, as the radiation of heat is much less liable to injure them then, than if they were horizontal. The buds should be examined in different stages. A very similar curvature of the growing bud will be seen in the elm and hazel, and in the leaves of the walnut, in which each pair of leaflets are folded, while the leaf-stalk is at first strongly curved downwards.

The flower-stalk is attached to a long bract for about half its length.

With regard to the flowers, the unusual occurrence of the sepals secreting honey is here met with; each sepal forms a little bowl which contains it. The numerous stamens are mostly free, occasionally a

slight coherence between some of them may be seen. It rarely ripens its seed in this country, though abundantly visited by bees. Fourteen visitors have been noticed in Germany. The inner bark of the lime can be stripped off in ribbons. It is this which supplies the material of garden matting or bast mats, principally imported from Russia. Another genus, *Corchorus*, supplies the fibre known as Indian jute. It is from this that the 'gunny' bags are made in which rice is imported.

ORDER XVIII. LINEAE.

This order contains two genera, and takes its name from *Linum*, the Flax, from which word is derived linen and linseed (Fig. 13. 7).

Li'num cathar'ticum, *Purging Flax*. Fl. f., 5. 5. (5 + 5 std. *f*). (5). This is a small annual, two to ten inches, with opposite very small elliptical sessile leaves, and small white flowers on forked spreading pedicels. It is common among grass in heaths and pastures. The stamens are coherent by the bases of the filaments; five, really the inner whorl, have no anthers, and are therefore called staminodes (std. 3, *a*). The fruit is a globular capsule. It is mostly self fertilizing, as it is rarely visited by insects.

L. peren'ne (Fig. 13). This is a somewhat rare species, but grows on the chalk hills near Cambridge and elsewhere on the east side of England. It is from one to two feet high, wiry-stemmed, with narrow linear leaves, and bright blue flowers. They are remarkable for being *dimorphic*; in that, while all the flowers on one plant may have the five stamens shorter than the five styles, in all on another, it will be the reverse (Fig. 13. 2, 3); but if the two kinds of flowers be compared the short styles will be found of the same length as the short stamens, and similarly with the long ones. This necessitates intercrossing; and Darwin found that the pollen took no effect when applied in the wrong way, so that it could not be self-fertilized in his experiments. This is not always

the case with such dimorphism; for primroses, which are similarly dimorphic, can be fertilized any way, but with different degrees of fertility. Nor must these conditions be regarded as absolute or unchangeable. Indeed, a plant of this kind of flax, raised from English seed in America, which for fourteen years had never fruited, only one form being there, suddenly bore a number of capsules, because every flower had become *homomorphic* and self-fertilizing, i.e. the stamens and styles were of the same length, just as in *L. cathar-*

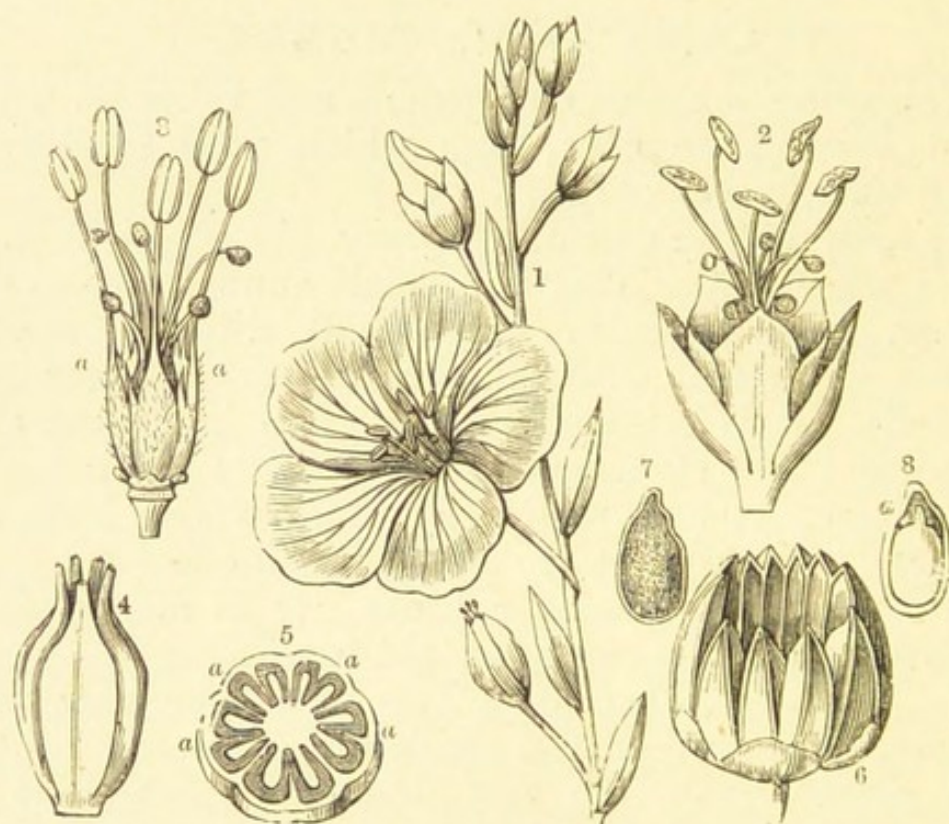


FIG. 13. *Linum perenne*.

ticum. The following are further details of the floral structure. (Fig. 13. 4) is the ovary of the pistil, the styles having been cut away. (5) is a transverse section of the ovary showing the axile placentae with five slender septa, two ovules being in each chamber (*a*), but partially separated by a dorsal plate extending from the mid-rib inwards. (6) is a capsule, the 'boll' of flax growers, bursting and showing the ten divisions. (8) is a vertical section of a seed with the large embryo; (*a*) is the radicle. This is very oily

and supplies the linseed oil from the flax plant. It rapidly oxidizes, and is thus a drying oil, used in painting. The testa or seed-skin swells into mucilage with water (just as cress and plantain seed do); hence the value of linseed for poultices.

L. angustifolium is occasionally met with, and has pale lilac-blue flowers.

L. USITATISSIMUM, *Common Flax*. This is not indigenous, but occasionally found wherever it is cultivated for the fibre or oil from the seed. The fibre is obtained from the inner bark, as in the lime tree, called the pericycle, and consists of long cylindrical tubes pointed at each end, with a very thick flexible wall. It thus gives flexibility and elasticity to the stem of the plant, as well as to cordage made of it.

Flax is the earliest known material used in textile fabrics, the mummy cloth of the ancient Egyptians being entirely made of it. It is frequently mentioned in Scripture¹. The expression 'the smoking flax' refers to the use of the 'tow' for the wick of oil lamps.

ORDER XIX. GERANIACEAE.

All the members of this order are herbs, and comprised in three tribes, viz. I. *Geranieae*, containing two genera, *Geranium* and *Erodium*; II. *Oxalideae*, with the genus *Oxalis*, Wood-sorrel; and III. *Balsamineae*, also with one genus, *Impatiens*, Balsam.

Gera'nium, *Geranium*. Fl. f., 5. 5. 5 + 5. (5). There are eleven species of geranium. Four of these are perennials, the rest annuals. *G. pratense* (Fig. 14). This is not uncommon in moist meadows in some counties (e.g. Derbyshire, near Bakewell), but none of these four are as abundant as the annual species. This one has large blue-purple flowers, and has long been cultivated, so it may be met with for examination. The pistil is the most characteristic feature of the flower; for it consists of five carpels (3, 4, 5, 6),

¹ *Plants of the Bible* (Pres. Day Primers), p. 18.

united by their margins only (5, *b*); the ovaries are one-ovuled (5, *a*); the united styles (2, 4) form a prolonged 'beak;' when ripe (6) each carpel separates from below upwards, bursts and discharges its seed (7). It is this long beak which suggested the name crane's-bill; and to the next genus, stork's-bill. Other details, given in the figure, are (2) the ten stamens in two lengths dehiscing around the immature adpressed stigmas. (4) The stigmas spreading after the anthers have shed their pollen; (8) and (9) are vertical and

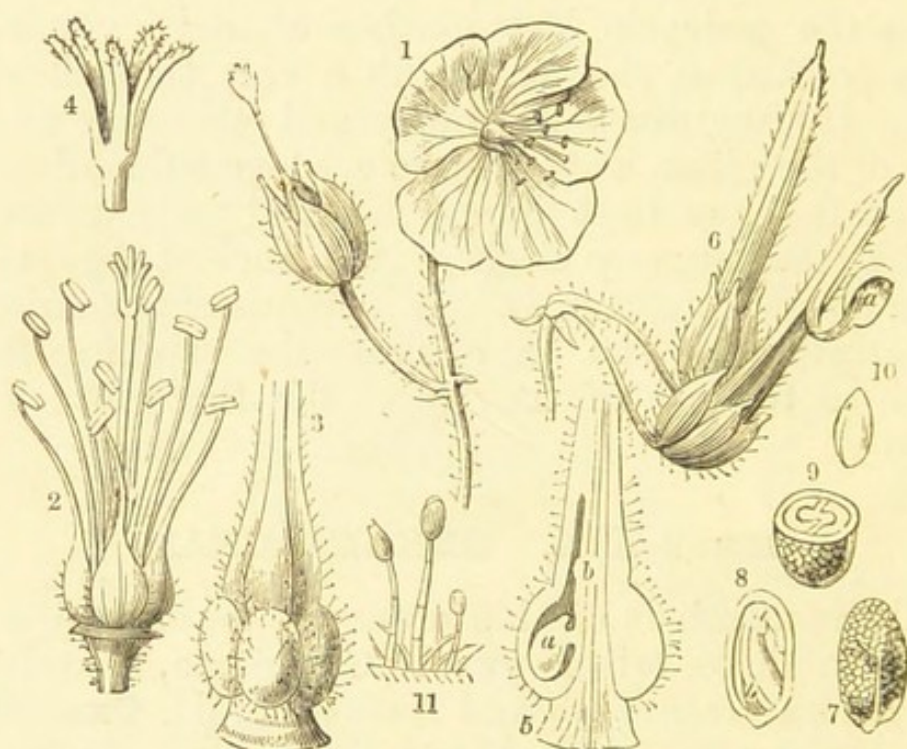


FIG. 14. *Geranium pratense*.

transverse sections of seeds showing the curved embryo (10), without any albumen. (11) are glandular hairs seen on the surface of the plant in (1) and (6).

Of the annual species, *G. molle*, with softly hairy round but indented leaves, *G. columbinum* and *G. dissectum*, with much divided leaves, are not uncommon in waste places, having small mauve-coloured flowers; but *G. Robertianum*, Herb-Robert, is perhaps the commonest. It has three-partite leaves, and dissected lobes, arising from swollen nodes. The sepals are long-awned, and covered with long spread-

ing hairs. The whole plant is of a reddish colour and strong-smelling. The flowers are red.

ORDER XXIV. SAPINDACEAE.

Tribe ACERINEAE.

This order is represented by two trees, the maple and the sycamore, both belonging to the same genus *Acer*.

A'cer campes'tre, *Common Maple*. Fl. f., (5-9). 5-9. D; 8. (2). This is a small tree common in

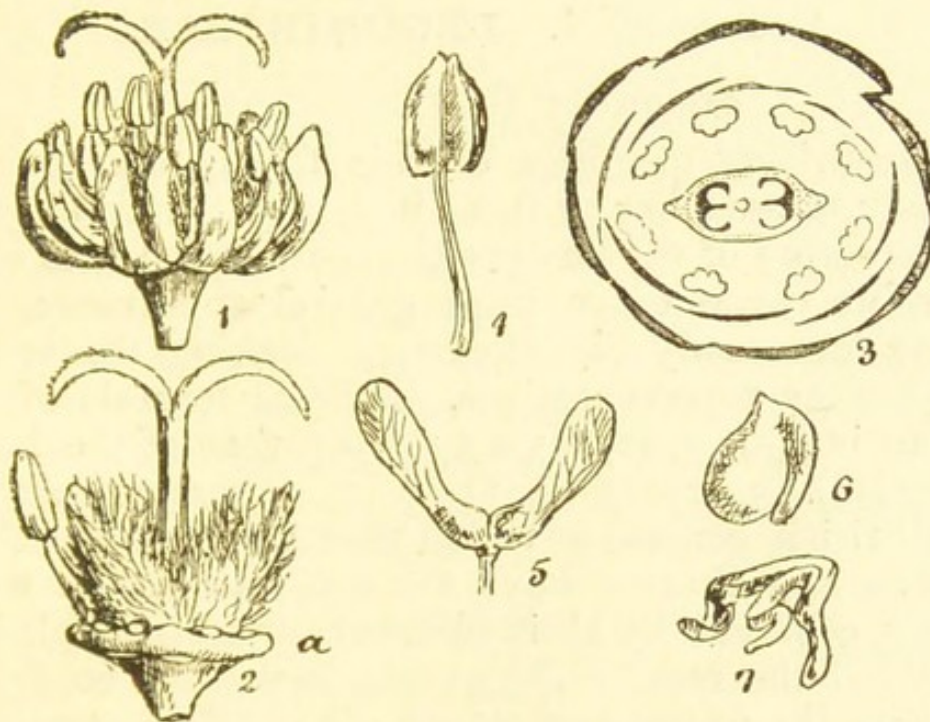


FIG. 15. *Acer campestre*.

hedgerows, having roundish lobed leaves and corymbs of green flowers (Fig. 15. 1-4). There is a thick honey-disk between the petals and stamens (2, a), which are inserted upon it. The ovaries (2) develop long horizontal wings as the fruit ripens. Each contains a single exalbuminous seed (6), with folded cotyledons (7). A winged fruit is called a samara. It occurs also in the ash (Fig. 36. 10) and the birch. The wood is beautifully marked and useful for turnery work.

A. PSEUDOPLAT'ANUS, *Great Maple* or *Sycamore*. This is a much planted tree introduced from Middle

Europe. The five-angled leaves resemble those of the plane, also introduced; hence it is sometimes called the 'plane of Scotland.' The sap, like that of the N. American sugar-maple, contains sugar, and the wood is also used for turnery. It is very subject to a parasitic fungus, which makes black blotches on the leaves. Even the leaves of extinct species found in a fossil state are sometimes similarly marked. The fruit develops its two winged samara at an angle (5), instead of being horizontal.

ORDER XXV. LEGUMINOSAE.

Sub-order PAPILIONACEAE.

The British members of this family are divided into six tribes; but as there is a great uniformity in the structure of the flowers, though coupled with considerable diversity in their general appearance, the genera are easily distinguished. Taking the broom and pea as representatives, the floral formula of the former is [(5). 3, (2). (5 + 5 *f*)]. 1; that of the latter being [(5). 3, (2). (5 + 4, *f*), 1]. 1. There are seventeen British genera, of which four, viz. *Genista*, *Ulex*, *Cytisus*, and *Ononis*, have the ten stamens all more or less coherent by their filaments or monadelphous; while all the rest of the genera have nine coherent, and one, the uppermost stamen, free. This condition is called diadelphous. The pistil in all consists of a single carpel, the fruit being a legume, the typical form being that of a pea dehiscing by both dorsal and ventral sutures. In some cases it bears but one or two seeds, and is indehiscent, as in *Onobrychis sativa*, sainfoin (Fig. 16. 8). This order is characterized by having some very poisonous members, as the garden *Laburnum*, allied to our broom, while two British species of *Lathyrus*, *L. Aphaca* and *L. hirsuta*, are said to be so. On the other hand, it contains the most valuable of all vegetable foods, as peas, beans, and lentils. They contain more of the essential element of food, nitrogen, than any other plants. It appears

that the 'nodules' found on the roots of leguminous plants contain bacterioid fungi, which by some unknown method can 'fix' the nitrogen of the air; this by their mysterious aid is then secured by the plant. This union for mutual benefit between the fungus and its host is called symbiosis (Fig. 16. 7).

This order supplies a greater diversity and number of plants useful to man than any other. It contains gigantic timber trees as well as small herbs, cultivated for their flowers. Numerous edible fruits and seeds, besides beans, peas, and haricots, are eaten in other countries; many, as clovers, sainfoin, and lucerne, are fodder crops. Medicines, as senna (*Cassia*) and broom, &c., gums, arabic and tragacanth; fancy woods, as rosewood, laburnum, &c. Many plants are poisonous, as laburnum, and even the roots of the scarlet-runner are narcotic; and *Physostigma*, the very poisonous bean of Calabar, was used as an ordeal by the natives. There are several dyes, as indigo (a violent poison), peach-wood, genista, &c. Other plants would be too numerous to mention.

Artificial Key to the principal Genera.

MONADELPHOUS. Corolla yellow.

Calyx shortly two-lipped, lips deeply toothed, green	Genista, 1.
Calyx shortly two-lipped, lips obscurely toothed, green	Cytisus, 3.
Calyx deeply two-lipped, lips obscurely toothed, yellow	Ulex, 2.
Calyx deeply five-toothed, corolla red	Ononis, 4.
DIADELPHOUS. Leaves trifoliolate.	
Fls. sub-capitate, explosive; legume spirally coiled	Medicago, 6.
Fls. in long racemes, non-explosive; legume straight	Melilotus, 7.
Fls. in heads; st. epipetalous	Trifolium, 8.
Fls. sub-umbellate, with a trifoliolate bract	Lotus, 10.
Leaves pinnate.	
Fls. yellow or reddish, calyx inflated	Anthyllis, 9.
Fls. white; legume cylind., many-jointed	Ornithopus, 13.
Fls. yellow; legume flat, curved, notched	Hippocrepis, 14.
Fls. pink; legume, one-seeded	Onobrychis, 15.
Fls. cream or blue-purple; one-seeded, with lower edge infolded	Astragalus, 11.

Fls. yellow ; with upper edge infolded	...	Oxytropis, 12.
L. with tendrils ; standard narrow ; style, hairy all round below the stigma, or mostly on the under side	... ..	Vicia, 16.
L. with tendrils ; standard broad ; style, dilated upwards, hairy only on the upper (posterior) side	... ..	Lathyrus, 17.

1. *Genis'ta tincto'ria*, *Dyer's Greenweed*. There are three species of this genus ; the present one was formerly used for a yellow dye, hence its name. *G. anglica*, Needle Furze, so called because of its very prickly nature, is found on dry heaths and moors, while a third species, *G. pilosa*, is rare. They are small and woody-stemmed plants with yellow flowers. The flowers are irregular, and as the forms of the petals are characteristic of all the members of the family, the following description will apply to the whole. The largest uppermost and posterior petal is called the standard, or *vexillum* ; the two lateral petals are called the wings, or *alae* ; the two in front, which are slightly coherent along their lower edges, form the keel, or *carina*. The wings and the keel are often 'locked' together by protuberances on the latter which fit into depressions on the former ; in some genera this actually results in a coherence. The petals have long claws, by which they are inserted upon the disk by the edge of the sepals. If, e.g. the bottom of the calyx of a pea be examined, it will be seen to have flattened out, as it were. This really means that the extremity of the flower-stalk or receptacle has extended so as to develop a honey-secreting surface between the stamens and pistil. In the pea and all others with an upper free stamen, the honey is *within* the staminal tube, and one stamen is free, so that insects can obtain it. In the four genera named above, in which the ten stamens are all joined, there is no honey, but bees, &c., come for pollen ; and in the *Genista* there is a peculiar irritability in the petals and style. If a flower be observed when first fully grown, the wings and keel project horizontally, or nearly at right angles to the

standard; now, if the observer thrust a pointed pencil down to the base of the standard, the flower explodes, the wings and keel drop down vertically by the contraction of their claws, the stamens with the included pistil rising up vertically; and if a bee be supposed to have performed this operation, it will get a cloud of pollen thrown over it. This peculiarity is characteristic of other species of *Genista* as well as the present, in which it may be readily observed.

3. *Cytisus scoparius*, *Broom* (Fig. 16). This shrub usually has no leaves, but when present they

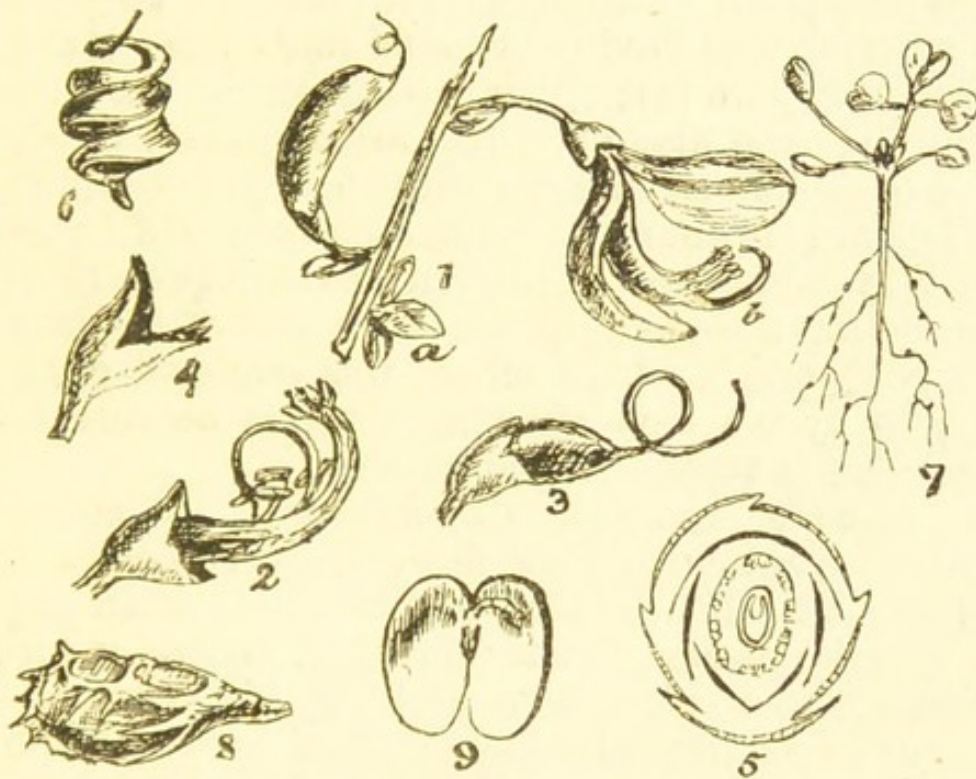


FIG. 16. *Cytisus scoparius* (1-5); &c.

are trifoliate (1, *a*). The style is remarkable for its great length. When the flower is first open, it is about the same length as the anthers of the five longer stamens (1, *b*); but afterwards it grows spirally, so as to come down and to place the stigma among those of the five shorter stamens (2).

The following is the method of fertilization by bees, as observed by Prof. Hermann Müller. 'The hive-bee on alighting grasps the alae with its mid and hind-legs, thrusting its head and fore-legs below the

vexillum. The alae and carina are thus pressed down, the carina opens and the five shorter stamens spring out, forcing the pollen upon the underside of the bee. A second explosion follows when the style escapes; freed from restraint, it curls inwards, forming more than a complete spiral. It now strikes the bee's back and sheds a quantity of pollen there. This is, of course, caught up by the stigma of another flower when visited. Moreover the long style can also bring the stigma more or less in contact with the underside of the bee where pollen had been first deposited.' (3) is the pistil and calyx; the latter is two-lobed, the anterior lobe having three minute teeth; the posterior, only two (4); (5) is a diagram of the flower. N.B. in (1) the alae or wings are removed, to show the monadelphous stamens with the style emerging.

The garden laburnum is another species of *Cytisus*, and very poisonous. Children have frequently died from eating the young green seeds out of the immature pod; and a whole school was rendered dangerously ill by the boys chewing the root because they found that it tasted like liquorice.

4. *Ononis spinosa*, *Rest-harrow*. A common shrubby plant with pink flowers, by roadsides, dry pastures, &c. It has spinescent branches when growing in arid places; but a 'form,' *O. repens*, is rarely spinous, with larger flowers and very viscid leaves, on account of its glandular hairs. This, as well as furze and *Genista anglica*, needle-furze, illustrate the fact that drought is a cause of spinescence; hence this feature is of common occurrence in desert countries in all parts of the world. An experiment will show that the rest-harrow will at once cease to form spines if it be grown in wet soil and a damp atmosphere; as e.g. may be done in a garden by putting a hand-light over a plant raised from seed or a cutting, with a bowl of water by its side. *O. spinosa*, in two years under these conditions, assumed all the features of *O. repens*.

6. *MEDICA'GO SATI'VA*, *Purple Medick* or *Lucerne*. This is a cultivated plant, especially on chalky soils,

but is often found naturalized. We have five native species, all being small herbs. The flowers explode on being touched, but unlike the process as described under *Genista*, the irritability resides in the staminal tube, which, from being at first horizontal, curls upwards vertically. *M. falcata* has sickle-shaped pods, and is found only in the East counties. A hybrid between this species and lucerne is cultivated on the Continent. It is remarkable for its great fertility. Its fertility is indeed lessened if it be pollinated by either of its parents. Another common species is *M. lupulina*. It has minute yellow flowers, and forms little heads of black reticulated pods. A peculiarity resides in the pods of nearly all the species of medick in that they curl up into a close spiral (Fig. 16. 6). This is, perhaps, a consequence of the pistil, which is included within the staminal tube, being made to curve when the latter curls upwards and backwards on being touched.

8. *Trifolium pratense*, *Trefoil* or *Red Clover*. Fl. f., [(5). (5). (5 + 4 f), 1]. 1. Of this genus we have seventeen species. They are all herbs, the three-foliolate leaves giving the first name. The present is one of the species, and the commonest cultivated for fodder. The flowers form dense heads, and the corolla differs from the usual type in being gamopetalous, forming a slender tube which is adapted to the proboscis of humble-bees. Moreover, the ten stamens are adherent to the tube; so an additional symbol to represent this is the horizontal line over the second and third numbers; the [] being still required to indicate the fact that both petals and stamens, as in *all* leguminous plants, are perigynous around the edge of the disk. (Fig. 16. 7) illustrates a seedling plant of clover, the first leaves of which have only a single blade. The roots are represented as bearing the nodules common to all leguminous plants, as described above.

The red clover is visited by those species of humble-bee which have a proboscis sufficiently long to penetrate the tube. Some others bite a hole in it, and so

rifle the flower of its honey, without pollinating it. The honey-bee can only obtain the honey by following such another and extracting it illegitimately. When the red clover was first introduced into the southern colonies but little seed was obtained, so the humble-bees were subsequently introduced as well, when plenty of seed followed as the result. It has been reported, however, that in some districts it seeded without the bee. If so, it probably acquired the power of self-fertilization; though it proved to be quite self-sterile with Darwin, for when protected from insects it set no seed; on the other hand, 100 heads produced 2,700 seeds when exposed. As humble-bees are the necessary visitors, Darwin observes that 'we may infer as highly probable, if the whole genus of humble-bees became extinct or very rare in England, the red clover would become very rare or wholly disappear.' The number of humble-bees in any district depends in a great measure on the number of field-mice, which destroy their combs and nests; and Col. Newman, who has long attended to the habits of humble-bees, believes that 'more than two-thirds of them are thus destroyed all over England. Near villages and small towns I have found the nests of humble-bees more numerous than elsewhere, which I attribute to the number of cats that destroy the mice.' Hence, writes Darwin, 'it is quite credible that the presence of a feline animal in large numbers in a district might determine, through the intervention first of mice, and then of bees, the frequency of certain flowers in that district¹!'

T. pratense furnishes a good illustration of the sleep of plants. During the day, the three leaflets are horizontal, but at sundown the two lateral twist and approach each other until the upper surfaces are in contact, both now being situated vertically. The third or terminal leaflet rises up and finally comes down like a roof over the uppermost edges of the other leaflets. The object of this is to prevent a chill

¹ *Origin of Species*, p. 57

by radiation from the uppermost, and apparently the more sensitive sides. Darwin exposed to a clear sky by night several leaflets of *T. pratense* pinned down. The difference in the amount of dew on the pinned-open leaflets and on those which had gone to sleep was generally conspicuous, the latter being sometimes absolutely dry. 'This shows,' he observes, 'how much cooler the leaflets exposed to the zenith must have become, than those which stood almost vertically. There can be no doubt that the position of the leaves at night affects their temperature through radiation to such a degree, that, when exposed to a clear sky during a frost, it is a question of life and death¹.'

T. re'pens, *White or Dutch Clover*. This is common in meadows and roadsides, &c., being much cultivated. The flower being smaller than that of the red clover, is visited by hive-bees, and these readily effect cross-fertilization. There is an oval orifice at the base of the staminal tube through which the bee can insert its proboscis. Mr. Darwin found that when this species was protected from insects it set no seed: whereas twenty heads left exposed yielded 2,290 seeds.

Such cases as these show the great value of the power of self-fertilization, as remarked above. Fortunately, flowers which are generally crossed can readily, and often do slightly, alter their structure, and so reacquire the power which they seem to have lost through the habitual visits of insects to which they have responded, and so become more adapted to their visitors than to set seed on their own account.

16. **Vic'ia Crac'ca**, *Vetch*. This genus consists of climbing herbs with pinnate leaves, the midrib usually ending in a tendril. The leaflets are mostly in many pairs. This species is common in hedges, with long racemes of bright blue flowers, ten to thirty in number. *V. sylvatica*, the wood vetch, is a local plant, with racemes of many white flowers, streaked with blue veins. *V. Or'obus*, bitter vetch, differs from other

¹ *The Movements of Plants*, p. 294.

species in having only a rudiment of a tendril. The flowers are white tinged with purple.

V. SATIVA, *Tares*¹, is cultivated, and when wild is doubtless an escape. The pale purple flowers occur singly or in pairs, and are nearly sessile in the axils of the pinnate leaves.

V. sepium, common in hedges, &c., has dull purple flowers, which are not so numerous as in the three preceding species.

17. *Lathyrus pratensis*, *Meadow Pea*. This genus resembles vetches, but has fewer leaflets; the petals, especially the standard, are broader, while the style is flattened and longitudinally bearded on its inner, i. e. upper surface. There are nine British species. This species is very common. The stipules are very large and arrow-shaped or sagittate. The peduncles carry three to twelve yellow flowers. It occurs in hedges, meadow sides, climbing by means of its tendrils over bushes, &c. The leaflets vary much in breadth.

ORDER XXVI. ROSACEAE.

This order contains herbs, shrubs, and trees. As a rule the leaves are stipulate. The flowers always have a disk or a receptacular tube of various forms, free or adherent to the carpels (Pomeae). The petals and stamens spring from the border of the disk, cup, or tube, and are therefore perigynous. The flowers are always regular, the petals being often rounded and concave, as in the may; while with few exceptions the stamens and carpels are numerous, the latter being free or apocarpous; and only falsely syncarpous in the Pomeae. The fl. f. for the majority of the genera will be [T.; (5). 5. ∞.] ∞.

This order contains seven tribes in Great Britain; and as they are readily distinguished by their fruits, it will be as well to enumerate them here.

¹ The 'tares' of the parable is not this or any other species of *Vicia*, but a grass, *Lolium temulentum* (Darnel), which will be described under *Gramineae*.

TRIBE I.	Pru'neae.	Fruit a drupe	Prunus.
TRIBE II.	Spirae'ae.	Fruit follicles	Spiraea.
TRIBE III.	Ru'beae.	Fruit drupels	Rubus.
TRIBE IV.	Potentil'leae.	Fruit free, exposed achenes Dryas, Geum, Fragaria, and Potentilla.	
TRIBE V.	Poterie'ae.	Fruit free, achenes enclosed in a dry receptacular tube	Alchemilla, Agrimonia, and Poterium.
TRIBE VI.	Ro'seae.	Fruit free, achenes enclosed in a fleshy receptacular tube	Rosa.
TRIBE VII.	Po'meae.	Fruit pome	Pyrus and Crataegus.

Artificial Key to the Genera

(in addition to the fruits mentioned under the Tribes).

Tree or shrub ; l. simple ; t. cup-shaped ; car- pel 1	Prunus, 1.
Herb ; l. interruptedly pinnate ; infl. paniced ; carpels ∞	Spiraea, 2.
Shrub ; l. comp. 1-5 foliate ; infl. corymbose ...	Rubus, 3.
Herb, low ; petals, white, 8	Dryas, 4.
Herb, tall ; styles bent ; achenes hooked ...	Geum, 5.
Herb, low ; receptacle large, fleshy	Fragaria, 6.
Herb, low ; receptacle small, not fleshy	Potentilla, 7.
T closely investing 1-3 achenes ; fls., paniced, cor. o	Alchemilla, 8.
closely investing 1-3 achenes ; fls. spiked, cor. yellow	Agrimonia, 9.
T closely investing 1-3 achenes ; fls. capitate, cor. o	Poterium, 10.
T large and fleshy, containing ∞ free achenes ...	Rosa, 11.
T adherent to cartilaginous carpels	Pyrus, 12.
T adherent to included stony carpels	Crataegus, 13.
T adherent to partly exerted stony carpels ...	Cotoneaster, 14.

1. Pru'nus commu'nis, *Sloe* or *Blackthorn*. Fl. f., [T. ; (5). 5. ∞ .] 1. This spiny shrub bears its white flowers singly or in pairs in March, before the leaves appear. The spines are arrested branches. It bears a glaucous drupe, the flesh of which adheres to the stone. It is very astringent to the taste. The variety *insititia* has globose black or yellow fruit, and is known in cultivation as the bullace. The flower is protogynous, probably in consequence of the early period at which it flowers. The usual protandrous condition of flowers visited by insects is mostly correlated with a later and warmer period of flowering. Temperature, as well as local nourishment, has great effect upon the relative rates of the degrees of development of the different floral whorls. The sloe,

like most protogynous flowers, is self-fertile; for the stigmas remain receptive until some at least of the stamens have matured their anthers. Müller observed twenty-eight visitors; this probably exceeds the number in England, for he also found that the early marsh marigold had many visitors; whereas in England very few insects are about when it is in flower. The fruit is a drupe, the origin of which is as follows. The carpel, on becoming the fruit, differentiates into three layers: the skin called the epicarp; the flesh or mesocarp; and the inner lining, which becomes stony, the endocarp. All three together form the pericarp, the kernels being of course the seeds. There are two ovules, but as a rule in cultivated members of the genus *Prunus*, one only generally matures.

P. Cer'asus, *Wild Cherry*, *Dwarf Cherry*. This occurs either truly wild, or as an escape from cultivation. The drupe is globular. It is said to be the origin of the Morello, Duke, and Kentish cherries. It has nearly erect umbels of flowers, i.e. having the pedicels radiating from one point.

P. A'vium, *Geau*. Its flowers are in drooping umbels. It is the origin of the geans, hearts, and bigaroon cherries. It is regarded by some botanists as a variety of the preceding species.

P. Pa'dus, *Bird Cherry*. The flowers are in racemes; the petals are erose, or irregularly notched. The drupe is small and ovoid.

The species *P. domestica* supplies us with all the many cultivated races of plums. *P. Armeniaca* is the apricot, and *P. amygdalus* the almond, nectarine, and peach; for although these three have very different fruits, they can all be reproduced from the seeds of any one. Moreover, not only do peaches and nectarines sometimes appear on the same branch, but a single fruit is occasionally half peach and half nectarine.

It should be remembered that the kernels or seeds of all the stone fruits of the genus *Prunus* are poisonous when eaten in quantity; for they develop

prussic acid, which is particularly strong in bitter almonds, which should always be used sparingly, even for flavouring. A girl five years old was poisoned to death by eating a quantity of the kernels of cherry-stones. 'The only immediate remedy for poisoning by prussic acid is pouring a stream of cold water from some height upon the head and spine. The effect of this poison is narcotic, and, owing to its rapid action on the nervous system, a convulsive contraction of the muscles of the jaw generally prevents the use of emetics'.¹

2. *Spirae'a Ulma'ria*, *Meadow-sweet*, *Queen of Meadows*. Fl. f., [T.; (5). 5. ∞ .] 5-9. A tall herb frequenting moist meadows and ditches, having long interruptedly pinnate leaves; i.e. a main midrib with leaflets of different sizes, the terminal leaflet being large and lobed. The leaves are white and downy below. The small cream-coloured flowers are very numerous, in branching feathery clusters, and very sweet-scented. The little follicles become twisted together in a curious manner when ripe. The following is a quaint description from Gerarde's *Herball*, 1597: 'The leues and flowers far excell all other strowing herbs, for to decke vp houses, to strowe in chambers, hals, and banketting houses in sommer time; for the smell thereof maketh the hart merrie and delighteth the senses.'

3. *Ru'bus frutico'sus*, *Blackberry*, *Bramble*. Fl. f., [T.; (5). 5. ∞ .] ∞ . This species is remarkable for its immense number of varieties, which botanists have grouped under sub-species. The leaves illustrate the process of obtaining compound leaves from simple ones. Thus, the leaf close to the inflorescence is usually a single simple blade, but lower down it is composed of three leaflets; but a form of simple leaf may often be found with two lobes at the base, showing how the pair of leaflets are, so to say, derived from the terminal one. Similarly, each leaflet of the pair may be often found lobed, and then, lastly,

¹ Johnstone's *British Poisonous Plants*, p. 53.

a leaf with five leaflets may follow. The flower has a gutter-like receptacular tube running round the base of the pistil, which consists of many free carpels on a conical receptacle. When ripe, each carpel forms a miniature stone-fruit or drupel. The cluster of drupels is called an etaerio, from a Greek word *hetairios*, signifying 'companionship.' One variety, or sub-species, *R. caesius*, the dewberry, is common, having usually a prostrate stem. The drupels are very few in number, rather large and glaucous.

R. Idaeus, *Raspberry*. This is common in hedges in the north, as in Perth, &c. The formation of the compound leaf with five leaflets differs from that of the blackberry, in that *both* pairs of leaflets are 'derived' from the terminal; for in a ternate leaf the terminal first parts with a pair (the lowermost of the five), then parts with the second pair (the uppermost ones).

5. **Geum urba-num**, *Avens*. This is a tall herb with pinnate leaves, the terminal leaflet being very large. It is common in hedges, &c., and has small yellow flowers. The calyx has five bracteoles, sometimes called the epicalyx, adherent to it; the sepals being valvate. The styles are bent, and when ripe the achenes carry a long hooked tail, due to the style having broken off at the bend; the lower part forms a hook, by means of which the achenes are dispersed.

6. **Fragaria ves-ca**, *Wild Strawberry*. Fl. f., [T.; 5 Br.; (5). 5. ∞ .] ∞ . This plant frequents woods and shady places. It has trifoliate leaves, and succulent scarlet or white fruits (Fig. 17. 1, 6). As the eatable part is really the swollen end of the receptacle, which is covered with achenes, the true fruit, some have suggested the term *pseudocarp*, or false fruit. *F. elatior*, the hautbois, has no achenes on the base of the receptacle, and is much larger than the wild strawberry. It is a garden escape when occurring wild, and is probably a variety of *F. vesca*.

Other details illustrated in the figure are as follows. The leaf has two adnate stipules (1, *a*). (2) represents

a vertical section of the flower, the corolla being removed. (*a, a*) are the adherent bracteoles constituting the so-called epicalyx. The pedicel (*c*) will be seen to expand a little below its globular continuation. This is covered by the honey-secreting disk, and carries the petals and stamens on its outer rim. This makes them perigynous. The numerous carpels are quite free over the surface. (3) and (4) are front and back view of a stamen. (5) is a carpel showing the peculiar way in which the style (*b*) arises from the

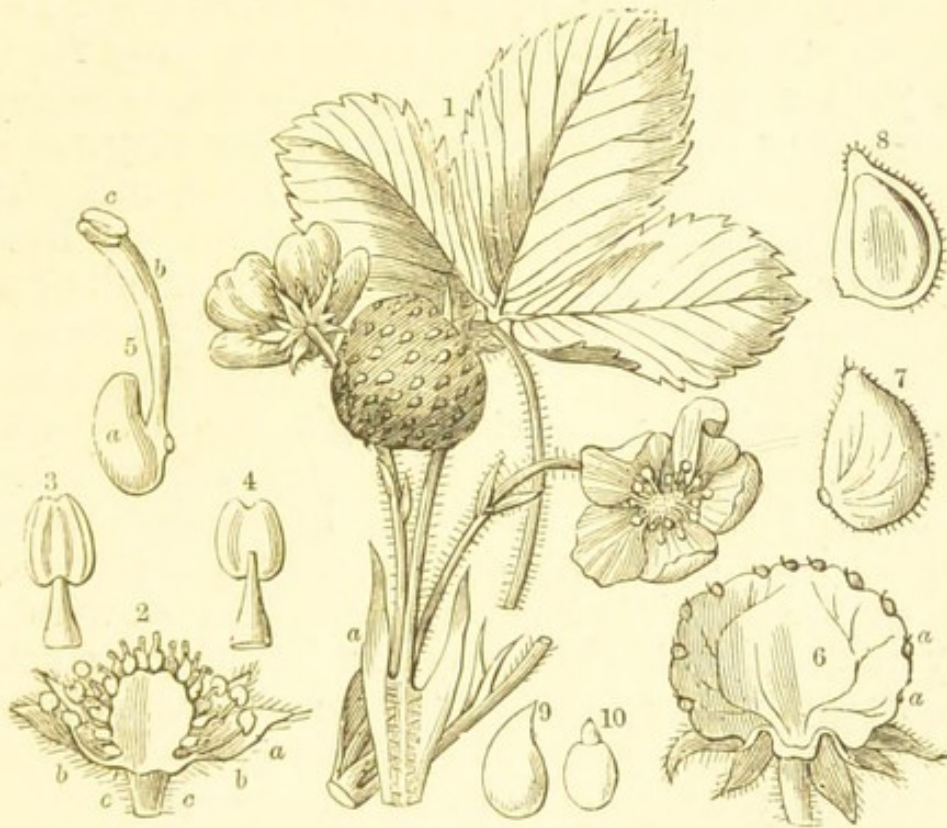


FIG. 17. *Fragaria vesca*.

base of the ovary (*a*), terminating with the twin stigmatic edges (*c*). (6) represents a vertical section of a pseudocarp with achenes on the surface lying in little depressions (*a*). (7) is a ripe achene without the style. (8) is a vertical section of the same showing the seed closely invested by the pericarp. (9) is a seed which is exalbuminous, and (10) the embryo, like a miniature almond. The wild strawberry is slightly protogynous, and visited, according to Müller, by twenty-five insects, though it is self-fertilizing as well.

7. *Potentilla rep'tans*, *Cinquefoil*. This is so called from the usually five digitate leaflets, i.e. radiating from one point like fingers: but if search be made, there may be found leaves with one, three, five, and even seven leaflets; illustrating, as described in the blackberry, how a compound leaf is derived from a simple one. The flowers are yellow. We have ten other species. One of the commonest is *P. anserina*, the silver weed, with interruptedly pinnate and serrated leaves, often very silvery from their silky hairs, especially below, the upper side being often green. It is common by roadsides, producing long runners and yellow flowers, $\frac{3}{4}$ in. diam. It has three-lobed bracteoles or epicalyx. A third species, very common in sandy heaths, is *P. Tormentilla*, *Tormentil*. It is readily known by its small yellow flowers having only four petals, and its leaves being trifoliate. It has a stout rootstock, which is strongly astringent, and has therefore been used for tanning purposes.

8. *Alchemilla vulga'ris*, *Lady's Mantle*. Fl. f., [T.; 4 Br.; (4). o. 4.] 1-3. A herb growing in moist pastures, &c., with *reniform*, i.e. kidney-shaped, plaited leaves, seven lobed, the rounded lobes having finely-pointed serratures. The flowers are very minute, yellowish green, in branching clusters. The flower is a 'degraded' form of the rosaceous type; the calyx being usually 4-merous, with four bracteoles; the corolla is wanting, and instead of the ∞ stamens characteristic of the Rose family, there are only four, and sometimes less or none. The flowers tend to be unisexual, for male flowers occur with rudimentary pistils, and females with short staminodes. There is a honey-ring round the orifice to the receptacular tube. The flower is visited by very few insects. One or two achenes within a tightly fitting, but not adherent receptacular tube constitutes the fruit. There is a dwarf mountain form known as *A. montana*, with very pubescent or silky hairs, a feature not uncommon in mountain plants. The species *A. alpina*, found by mountain streams from

York to Shetland, has very silky five-seven-foliate leaves. *A. arvensis*, *Aphanes*, the only other British species, is a very small plant, often not more than 1 to 2 inches high. It occurs in fields and waste places in dry soil. The clusters of green minute flowers are half-hidden between the deeply-toothed stipules.

9. *Agrimonia Eupatoria*, *Agrimony*. Fl. f., [T.; (5). 5. 5-10.] 2. This is a common herb with very hairy interruptedly pinnate leaves and tall erect flowering stems, with yellow, strongly scented flowers. The receptacular tube closely invests, but is not adherent to the achenes; and is covered with minute spiny hooked processes. The sepals close up over the orifice to the tube; the hooks occurring just below the calyx-limb. There are two sub-connate bracteoles below the tube. Müller observed eleven visitors.

10. *Poterium Sanguisorba*, *Salad Burnet*. Fl. f., [T.; 4. 0. ∞ .] 1-3. A herb with pinnate leaves of about seven or eight pairs of leaflets. The flowers are small, in dense long-peduncled purple heads; the upper flowers are female, lower male, or bisexual. The twenty to thirty stamens hang down out of the lower flowers; the pink stigmas are tufted, the one to three achenes invested by, but not adherent to the minute receptacular tube. The feathery stigmas are very characteristic of wind-fertilized or *anemophilous* flowers.

P. officinale, *Great Burnet*. Very similar to the preceding, but with about four pairs of leaflets, and flowers bisexual; the stamens being reduced to four only. The fleshy ring secretes honey, and as the flowers are purple, though with the usual tufted stigma characteristic of anemophily, it appears that this species has reacquired entomophily.

11. *Rosa canina*, *Dog Rose*. Fl. f., [T.; 5. 5. ∞ .] ∞ . Sir J. D. Hooker recognizes six British species of rose: excepting *R. spinosissima*, Scotch or Burnet rose, each has numerous varieties. The five free sepals are situated on the rim of an ovoid receptacular tube, which ultimately turning scarlet, as in the dog-

rose, forms the 'hip,' including numerous free achenes. Of the species, the Burnet forms small bushes with crowded prickles. *R. villosa* is a large bush, with very hairy leaflets. *R. rubiginosa*, the sweet-brier, has a copious glandular pubescence, rendering the foliage very scented. *R. arvensis*, the field rose, has generally quite white petals, and has its styles exerted from the summit of the tube; whereas the dog-rose shows only the stigmas. Roses have no honey: are probably all self-fertile, though easily crossed by the numerous visitors which come for pollen.

12. *Py'rus commu'nis*, *Wild Pear*. Fl. f., {[(5). 5. ∞ .] (5) }. It is doubtful whether the pear is truly wild or a relict of gardens. The flower has the five carpels slightly coherent by their edges, but with distinct styles. The ovaries are ultimately sunk and adherent with the tube: hence the use of the brackets { }. The calyx spreads out on the top of the tube carrying the petals and stamens away from the middle, which are thus *perigynous*. The general pyriform shape of the pear differs from that of the apple, but is not an absolute distinction, as the bergamot is round, but the stony particles found in pears appears to be never present in apples.

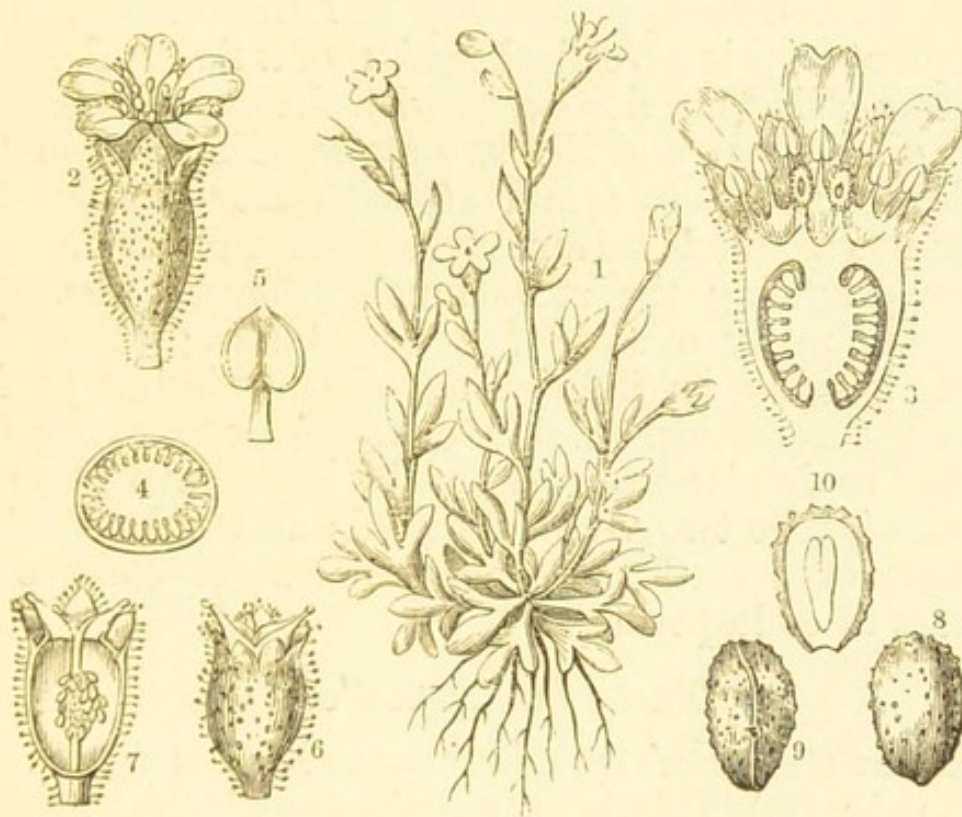
13. *Cratae'gus Oxyacan'tha*, *Hawthorn*, *May* or *Whitethorn*. A common spiny tree with simple lobed leaves and falcate or sickle-shaped stipules. The inflorescence is corymbose and heavily scented. The fruit consists of small crimson pomes with stony cells. It flowers in May and June. Double pink and crimson-coloured flowers are borne by cultivated varieties. Nearly sixty visitors have been observed on the wild tree.

ORDER XXVII. SAXIFRAGEAE.

This order contains two tribes, viz. *Saxifrag'eae*, in which there are three genera, *Saxifraga*, *Chrysosplenium* and *Parnassia*; and *Ribesi'eae* with one, *Ribes*.

TRIBE I. *Saxifrag'ae*.

Saxif'raga umbro'sa, *London*¹ *Pride*. Fl. f., (5.) 5. 5 + 5. (2). We have twelve species of *Saxifraga* or Saxifrage, of which this one is often cultivated. Most of these are found on high mountains, but the London Pride, or St. Patrick's Cabbage, as it is also called, occurs on the W. and S.W. of Ireland. Its nearest continental abode is N. Spain and Portugal. There are a few other plants, as *S. Geum*, *Arbutus Unedo*, the strawberry tree, and a heath, *Erica medi-*

FIG. 18. *Saxifraga tridactylites*.

terranea, &c., which appear to indicate a former union between the West of Ireland and North Spain. Indeed, submarine soundings show that a comparatively moderate elevation of about 600 feet would unite the whole of the British Islands, including Ireland, with the Continent. *Saxifraga* illustrates degrees of adhesion of the receptacular tube; for

¹ Named after Mr. London, of the firm of London and Wise, who first introduced it into cultivation, in the early part of the eighteenth century.

while the sepals are inferior in *S. umbrosa*, they become half-superior in *S. granulata*, a species found in meadows, &c., and characterized by having numerous little bulbs: a double flowering form is often cultivated; while *S. tridactylites* (Fig. 18), a little plant growing on the tops of walls, &c., with *cuneate*, i. e. wedge-shaped, 3-5-fid, sticky leaves, has the ovary completely inferior. Its fl. f. is therefore {(5.) 5. 5+5. (2.)}.

Fig. 18 (1) is an entire plant, natural size; (2) is a flower showing the numerous glandular hairs which often catch insects, which may be found dead all over the plant; (3) is a vertical section of a flower showing the two-celled inferior ovary with the cup-like honey-disk on the top, and the two styles arising from the middle. The petals and stamens are consequently epigynous. (4) Is a transverse section of the inferior ovary, showing the axile much enlarged placentas carrying many ovules; (5) is a stamen; (6) a ripe fruit, forming an inferior capsule, dehiscing at the top; (7) a vertical section of the fruit, showing the central axile placenta, most of the seeds have escaped; (8) and (9) are two views of a seed; and (10) a vertical section of a seed, showing the straight embryo in a mass of endosperm.

TRIBE II. Ribesi'ae.

Ri'bes Grossula'ria, *Gooseberry*. Fl. f., {(5.) 5. 5. (2.)}. (Fig. 19.) This is only indigenous in N. England, ascending to 1,000 ft. It has 1-3 spines under the leaf-buds. It is the origin of the numerous garden forms. A new race has lately been established without spines. As a rule the red currant, black currant, and gooseberry will neither cross nor succeed in any way as scion and stock; but a hybrid has been secured between the gooseberry and black currant; and the gooseberry has been even grafted on the plum-stock. Fig. 19. 1, represents a flowering branch; (2) is an entire flower; (3) a vertical section showing the saucer-shaped, honey-secreting continua-

tion of the receptacular tube, the lower part of which invests the ovary (*b*, 2 *b*). This makes the petals (*a*) and stamens perigynous, as they are inserted at some distance *around* the styles, notwithstanding the ovary (*b*, *b*) being inferior and the calyx superior; (4) is a transverse section of the ovary composed of two carpels, the two edges of each uniting with those of the other; so that the two opposite parietal placentas (*a*, *a*, 5 *a*) consist of the united margins of the two carpels; (5) is a fruit with its succulent wall, each of the many

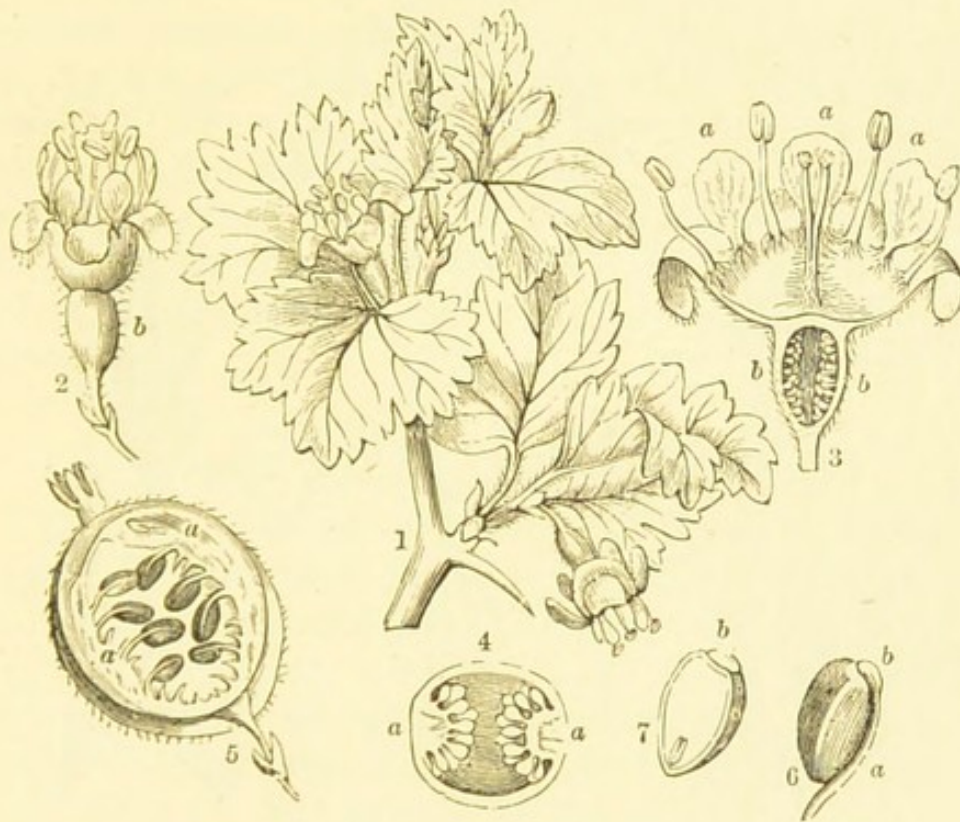


FIG. 19. *Ribes grossularia*.

seeds being invested by a pulpy skin. This pulp is really the outermost coat of each seed. The persistent tuft of withered sepals, &c., at the top (5) shows that the gooseberry is an inferior fruit; (6) is a seed attached to a long stalk called the funicle or 'little cord.' The part adherent to the seed (*a*) is called the raphe, while the spot at (*b*) is known as the chalaza of the seed; (7) is a vertical section showing the very small embryo in a mass of endosperm.

ORDER XXVIII. CRASSULACEAE.

Three native genera and one introduced plant comprise this order, all of which have thick fleshy leaves.

Cotyle'don Umbili'cus, *Pennywort*. Fl. f., (5). [(5. 5 + 5.) 5 scales; 5. This plant is easily known by its usually peltate, orbicular fleshy leaves, and racemes of small drooping greenish flowers. It is abundant on rocks and walls, more especially in the W. of England.

Se'dum al'bum, *White Stone-crop*. Fl. f., [(5). 5. 5 + 5.] 5 scales; 5. (Fig. 20.) We have six species of

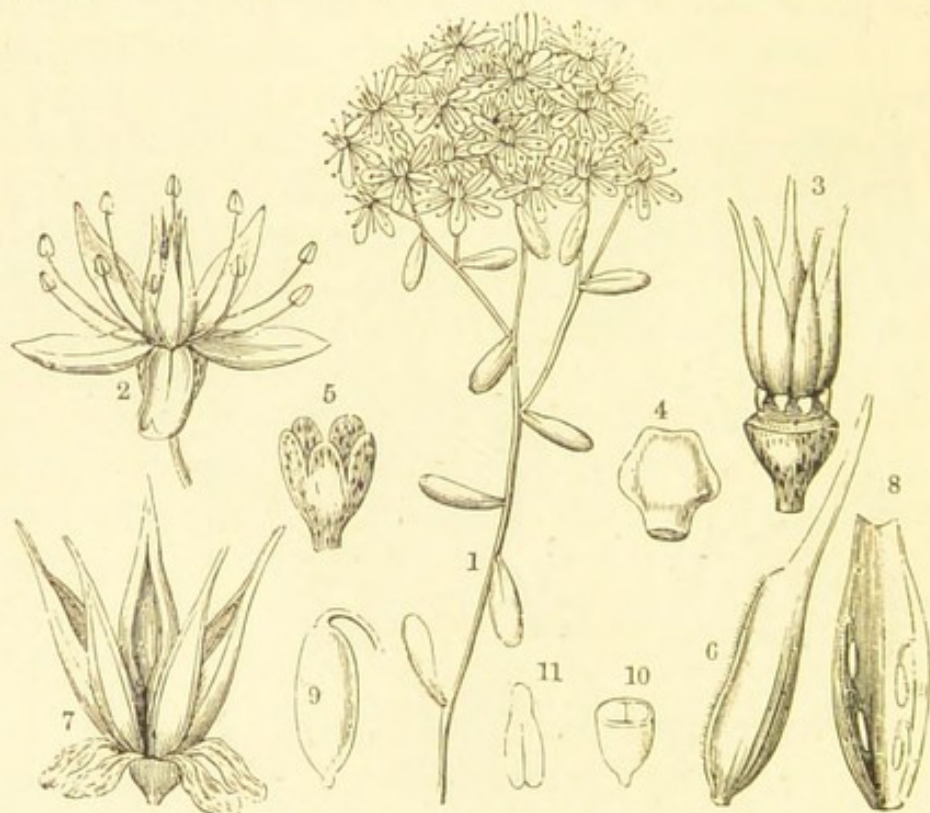


FIG. 20. *Sedum album*.

Sedum; the present has white flowers and occurs wild on the Malvern Hills and Somerset, but is a garden escape elsewhere. Fig. 20. 1, represents a flowering stem with the fleshy leaves; (2) is an expanded flower; (3) represents the five free carpels; (4) a honey-secreting scale; (5) the gamosepalous calyx; (6) is a carpel; (7) the five follicles dehiscing by the ventral sutures; (8) the same showing the pendulous ovules (9); (10) a transverse section of a seed; (11) the exalbuminous embryo. *Sedum acre*, Biting stone-

crop or Wall-pepper, is a small tufted plant growing on walls, &c. It has yellow flowers; the leaves are small and fleshy and acrid to the taste. *Sedum Telephium*, Orpine, is a large plant growing to two feet in height. It has oblong toothed fleshy leaves, and dense masses of rosy-coloured flowers. It is often cultivated, but found wild in hedge-rows.

SEMPERVIVUM TECTO' RUM, *House-leek*. Fl. f., (12). 12. 12 + 12. 12 Gl; 12. This is not a native, but long cultivated. It grows on tops of walls, roofs of houses, &c.: it produces its radical leaves in a rosette or *rosulate* manner, sending up a tall flowering-stem bearing a corymbose or paniced cyme of dull-purple flowers. These are remarkable for having their whorls of the highest number of parts considered as 'definite,' or in twelves. The sepals are very slightly coherent, and the inner whorl of stamens are peculiar in being more or less imperfect and transformed into carpels.

ORDER XXIX. DROSERACEAE.

Three species of *Drosera* or Sundew occur in England, remarkable for their insectivorous powers.

Dros'era rotundifo'lia, *Round-leaved Sundew*. Fl. f., 5 or 6. 5 or 6. 5 or 6. (3). (Fig. 21.) Sundews are only found in boggy places growing among bog-moss. They are small herbs with bright red glandular hairs all over the leaves, (1, 2), and (3) a hair much magnified showing its terminal gland. The flowers vary in the number of parts, the corolla is white (5). They are sometimes cleistogamous; (2) represents one of the round leaves covered with its numerous glandular hairs, those on the circumference being longer than those on the middle; (4) is a fringed sheath formed by the stipules at the base of the petiole; (6) represents a vertical section of the pistil, with three of the sepals. The ovary is unilocular, as the three placentas are parietal. The styles and stigmas are six in number (6, a), as two belong to each of the

three carpels; (7) is a dehiscent capsule; (8, 9, 10) are seeds; (8) shows the loose testa or outermost coat of the seed. This contains a sort of kernel (9) filled with a relatively large quantity of albumen, at the base of which is a minute embryo (10). The peculiarity of the British and many foreign species resides in the power of catching insects and absorbing the nourish-

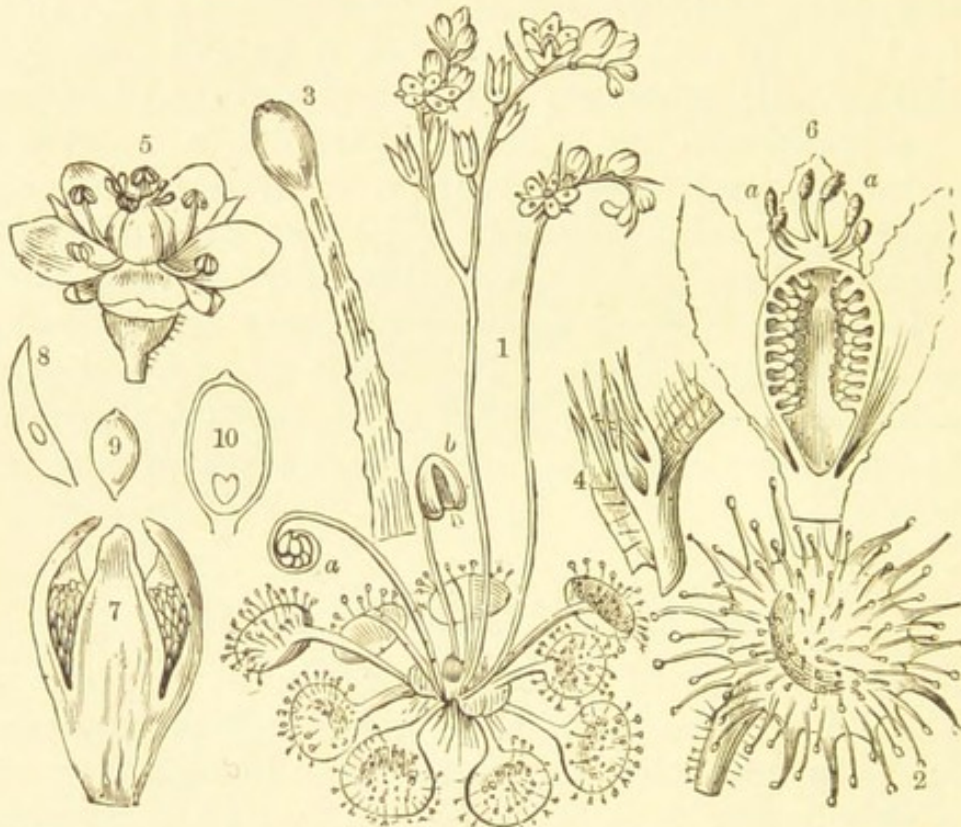


FIG. 21. *Drosera rotundifolia*.

ing matter from them. This is done by means of the glandular hairs. It is an interesting experiment to transfer some plants with moss to a bowl, keeping them well moist. Then, if a minute fragment of hard-boiled egg or biscuit be placed upon the middle of the leaf, after some hours the hairs, or tentacles as they have been called, bend over and bring their head-like glands down upon the object; a fluid is secreted which gradually dissolves the egg, &c., and its nourishing matters are absorbed. The cells of the glandular hairs are red at first, but become paler, from above downwards, when consuming food; for the colouring matter, instead of being uniformly

distributed through the cells, now becomes (as seen under a microscope) aggregated into minute globules, leaving the rest of the cell clear. After all the nourishment has been extracted, the uniform red colour is resumed, from below upwards throughout the tentacles, which now spread away as before, and any undigested débris, as of a fly, &c., is left behind¹.

ORDER XXXI. LYTHRARIEAE.

Two genera, very different in appearance, represent this order. They are both frequenters of moist places; and while the purple loosestrife grows to a height of 5 feet, the water-purslane is not more than about 6 inches high.

Lythrum Salicaria, *Loosestrife*. Fl. f., [6 Br. ; (6), 6. 6 + 6.] (2). (Fig. 22.) A tall plant, with opposite lanceolate leaves and glomerules of purple flowers, in the form of spiked racemes (1). The flowers vary in symmetry: for sometimes the central flower will differ from the lateral ones in the number of parts, so that if the former be 6- or even 7-merous, then the lateral may be 5- or 6-merous respectively. The chief peculiarity resides in the polymorphic condition of the flowers, depending upon the lengths of the style and stamens. (1) represents the terminal portion of the spikate inflorescence; (2) a single flower of the long-styled form, as the globular stigma extends beyond the tallest stamens; (3) shows the calyx-tube with the narrow, pointed bracteoles adherent to it, between the broader sepal-teeth. The tube of this flower is so like an expansion of the green calyx, that it is often called a calyx-tube; but theoretically it is probably a receptacular tube, at all events in part, so that the stamens are perigynous. (4) is the pistil with a curved or declinate style; (5) a transverse section of the ovary showing the large axile placentas; (6) is a ripe capsule within the persistent calyx-tube, dehiscing above (*a*), each carpel carrying away half

¹ Numerous other details on the insectivorous habits of these plants will be found in Darwin's *Insectivorous Plants*.

the style (*a*). (8) is a seed in longitudinal section, showing it to be exalbuminous; (7) is the embryo extracted, (*a*) being the cotyledons.

There are three different forms of flowers, always on separate plants respectively. They are called the long-styled, mid-styled, and short-styled flowers; corresponding with these, the twelve stamens are in two sets of different lengths. In no individual flower are the anthers on a level with the stigmas, but each kind of style can be matched by two kinds of stamens

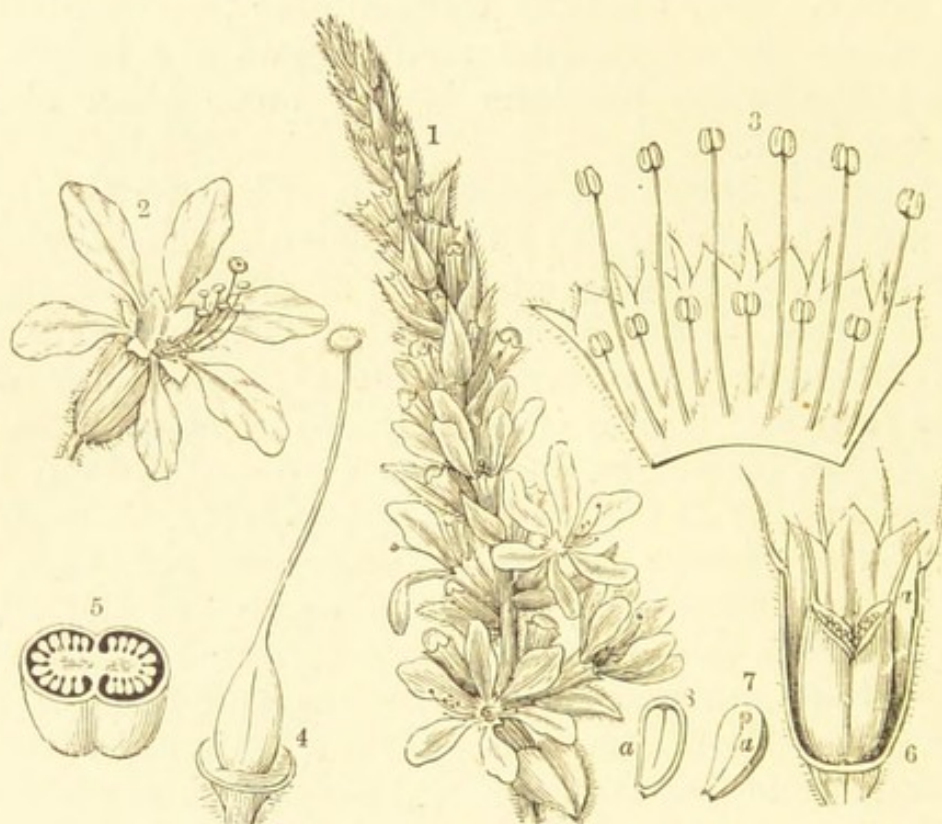


FIG. 22. *Lythrum Salicaria*.

of other flowers, always on different plants. By intercrossing in every way possible, Darwin found that the mid-styled form was most prolific in seed-bearing, i. e. when correctly pollinated by pollen from stamens of the same length as the style, the other two kinds being less fertile. When he pollinated long-styled forms with pollen from the shortest stamens, or vice versa, little or no seed was secured.

This plant has been a popular drug for its astringent properties. The henna of the Egyptians, *Lawsonia*

alba, has been used from time immemorial, till to-day, for staining the hands, feet and nails of an orange colour. It belongs to this family. It is the camphire of the Song of Songs.

ORDER XXXII. ONAGRARIEAE.

Three native genera, and one introduced, comprise this family. It also includes the *Fuchsia*¹.

Epilobium angustifolium, *Rose-bay* or *French Willow*. Fl. f., {4. 4. 4+4. (4)}. This genus, or willow-herbs, so called from the narrow, willow-like leaves, contains ten British species, all easily recognized by the 4-merous pink flowers on long stalk-like ovaries. The rose-bay is often cultivated for its conspicuous flowers, forming bright crimson racemes more than a foot in length. The honey is secreted, in this and the next species, by the fleshy summit of the ovary, over which the expanded bases of the filaments form a dome, protecting it from rain. In young flowers, the stamens when discharging the pollen hang downwards, and thus furnish a support upon which humble-bees suspend themselves while they insert the proboscis between the bases of the filaments. At a later stage, after the pollen has been shed, the four stigmas mature, and spreading themselves out are placed in the direction in which a bee will come. Self-fertilization is thus next to impossible in this species.

This plant illustrates numerous other cases where a flower has no front petal upon which an insect can alight; or, if it have one, the stamens have somehow become more suitable for it to rest upon. As examples, the loosestrife (Fig. 22), the horse-chestnut, and rhododendrons may be mentioned. In these cases it is not the corolla but the stamens and style which furnish the landing stage. These latter then assume one or other of two conditions. They either hang at first straight downwards, and the insect suspends itself upon them, as in larkspur, aconite, and rose-bay; or

¹ A South American genus. Hedges are made of it in Cornwall.

the filaments bend downwards and then turn the anthers upwards. They are then said to be declinate. If a front petal exist at all in such a case, it is mostly affected by atrophy and becomes smaller than the others, as in *Veronica Chamaedrys*; or it may disappear altogether, as in the horse-chestnut. The curvature of the declinate stamens, and of the style, which is often bent parallel with them, represents an effort to meet the strain in supporting what is a considerable weight when a large humble-bee rests upon

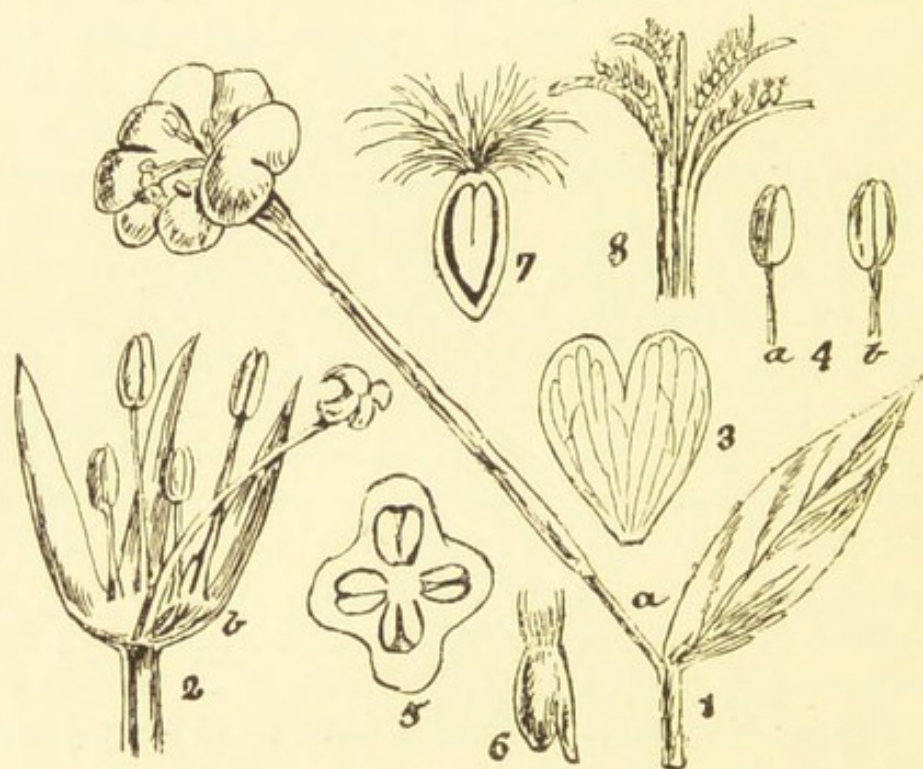


FIG. 23. *Epilobium hirsutum*.

them. It may be observed how boughs of trees often assume precisely the same form.

E. hirsutum, *Codlins and Cream*, *Hairy Willowherb*. This is one of our commonest plants by watersides, growing to five or more feet in height, with softly hairy, willow-like leaves and numerous rose-purple, 4-merous flowers (Fig. 23. 1). The inferior ovary is very long and might easily be taken for the pedicel; the latter, however, will be seen at the base to be more slender (1, a). The receptacular tube, which of course invests the long ovary, expands

above it into a honey-secreting disk (2, *b*), on the circumference of which stand the petals and stamens. These whorls are consequently perigynous; (3) represents a petal, (4, *a*) a back, and (4, *b*) a front view of a stamen; (5) is a section of the ovary; (6) is an ovule with the tuft of hairs arising on the chalazal end, where the raphe or cord (on the right) terminates; (7) is a section of a seed showing the exalbuminous embryo. When ripe the inferior capsule dehisces by four long valves (8), liberating the eight rows of seeds, which are closely packed. As the tuft of silky hairs spreads, it aids in forcing the seeds out, and enables them to be borne away by the wind.

The other species are small plants, of which perhaps the hairy *E. parviflorum* and the smooth *E. montanum* are the commonest. The latter is often seen on walls, cottage roofs, waysides, &c. The flowers scarcely expand, and the anthers will be found bursting round the mature stigmas. Hence it is quite self-fertile. The first three species mentioned have four separate stigmas. In the last they cohere into a club-shaped structure.

Circaea lutetiana, *Enchanter's Nightshade*. Fl., f., {2. 2. 2. (2)}. A slender herb with a creeping stem; occurs in damp woods and waste places in gardens. It is at once known by its di-merous flowers. The English name has by some extraordinary mistake, before the sixteenth century, been transferred from the mandrake, called *Circaea* by the Greeks, or Circe's plant, as the root was used as a love philtre. Cross-fertilization is secured in the same way (as will be described) in *Veronica*. The two stamens and style hang downwards, and together form a landing-place for a fly. It alights on the style and drags the two stamens under it, bringing the anthers and stigmas together, the honey being secreted by a fleshy ring surrounding the base of the style. It cannot be easily self-fertilized.

Oenothera bienensis, *Evening Primrose*, from North America, and *O. odorata*, from Patagonia, are garden

escapes, which have established themselves in certain places. They both have large yellow 4-merous flowers, with long calyx-lobes. The flowers of the first species open at night as well as by day, being attractive to night-flying moths. Ten visitors have been seen. Fig. 24 illustrates another species, *O. fruticosa*, also from North America, but the structure is the same: (1) shows a complete flower with the large inferior ovary, the calyx (or receptacular tube) being prolonged above it like a pipe (*a*) and then ter-

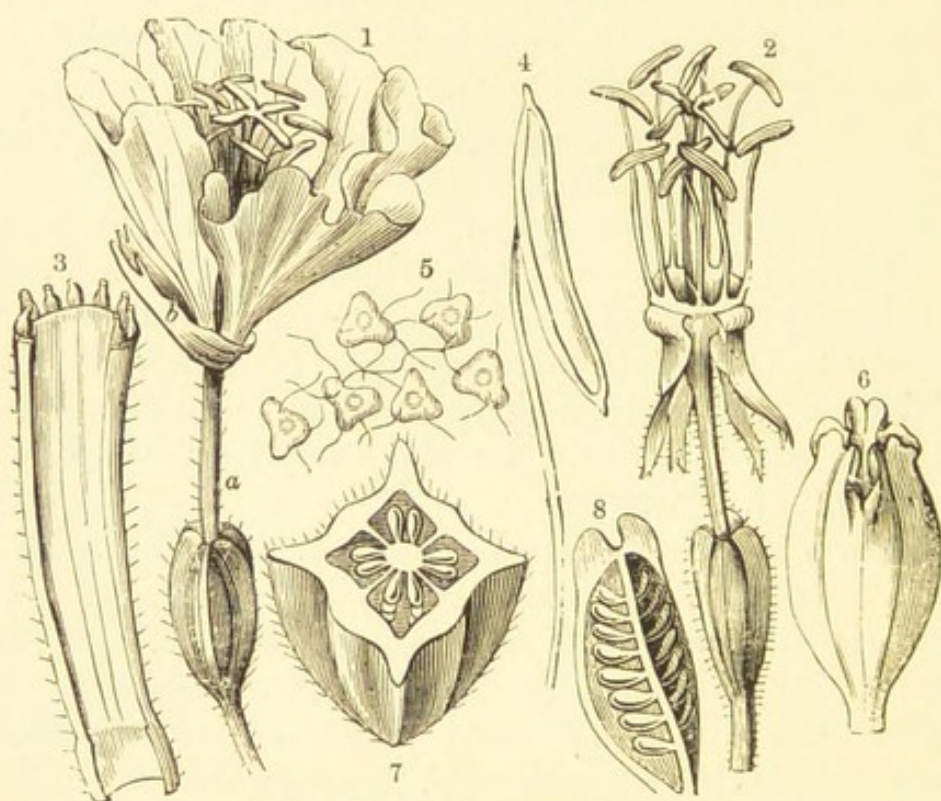


FIG. 24. *Oenothera fruticosa*.

minated by the sepals, which cling together, on the left (*b*); (2) has the corolla removed, showing the stamens perigynous round the rim of the tube. The style runs up the tube and terminates in four stigmas (1 and 2); (3) is the tube split down, showing the bases of the eight stamens on the top; (4) is a single stamen, showing how the filament is inserted at a point in the middle of the anther as in (2). As the anther can swing about as on a pivot, it is said to be versatile; (5) is the peculiar triangular-shaped pollen-

grains, connected by a sort of glutinous hairs which makes them cohere in masses; (6) is the ripe inferior capsule dehiscing from the top; (7) a transverse section of the inferior ovary, showing four cells, the axile placenta and two rows of seeds in each chamber; (8) is one valve of the capsule.

ORDER XXXIII. CUCURBITACEAE.

A single plant, the bryony, represents the cucumber and melon family in this country. It is a large order, chiefly of hot climates, especially the East

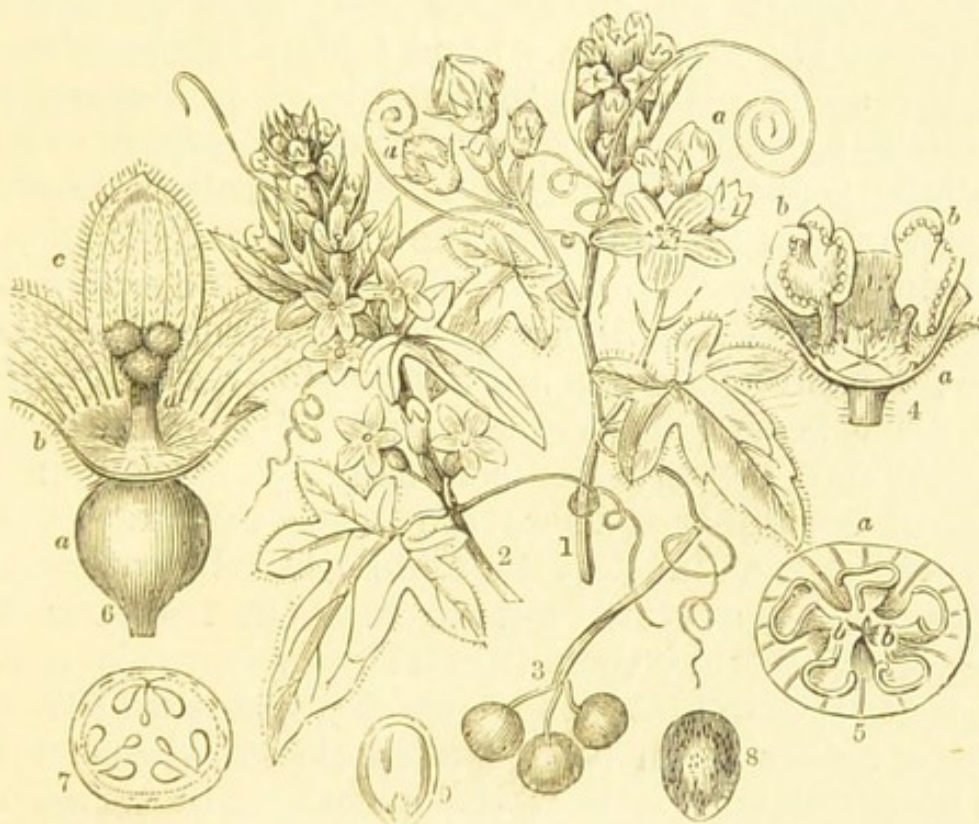


FIG. 25. *Bryonia dioica*.

Indies. The majority are more or less suspicious; an allusion to the dangerous character of the 'squirting cucumber' is made in 2 Kings iv. 39. This is the *Ecbalium agreste*, a common weed in the East. It and the colocynth are used by us as medicines.

Bryo'nia dioi'ca, *Bryony*. Fl. f., m. (5). [(5). (2f) + (2f) + 1.] o.; f., {(5). (5). o. (3)}. (Fig. 25.) The bryony climbs by means of long tendrils, which project out straight before seizing anything; but as soon

as the curved tip succeeds in doing this, by means of a motion called 'circumnutation,' or a continual 'bowing around' till it has come in contact with something, the tendril then forms a series of close coils, some turning one way and some another, there being always approximately the same number of coils either way. This is necessary, as the strain would be too great and liable to snap the tendril if it attempted to coil in the same direction throughout. The coiling allows a certain amount of play, so that the plant is not torn away from its support by the wind.

The flowers are peculiar. They grow in cymose clusters. The male (1, 4, 5) and female (2, 6) are never on the same plant; both are green in colour, the latter being rather the smaller, and recognizable by its globular inferior ovary (6, *a*). The corolla affords an exception to the rule of the division *Calyciflorae*, in being gamopetalous (6 *c*). The stamens are five, but coherent by their filaments in two twos, with one free; the three stigmas are divided (6 *d*). The fruit is a scarlet berry (3); the structure of it requires explanation. It may be conveniently studied in a slice of cucumber. There are three carpels (7), the margins of each meet in the middle, but do not remain there, they now turn outwards. On reaching the circumference they then turn slightly inwards again, so that the ovules are now directed towards the centre, as shown in (7). The whole chamber is filled up by cellular growth of the carpel, so that the fruit becomes a solid mass. The seed (8) is exalbuminous, the embryo being rather large (9).

Being dioecious, the female flower requires the aid of insects. Honey is secreted by the dish-like receptacular tube above the ovary (6, *b*); and is accessible in the male flower between the stamens (4, *a*; 5, *b*). The sinuate or S-like anthers enable the insect to be dusted both on its sides and above; while minute spheres of gummy matter (4 *b*) along the anther enable the pollen to stick to the body of the insect.

The bryony, like many wild members of the family, is poisonous; the berries have more than once proved injurious to children who have eaten them.

ORDER XXXIV. UMBELLIFERAE.

With few exceptions, all members of this order are easily recognized by their twice radiating or compound umbels, with or without bracts, forming the general involucre at the first branching, and bracteoles forming the partial involucre or involucl at the second branching or pedicels. This umbellate inflorescence gives the name to the order. They are all herbs mostly with hollow stems, the leaves being exstipulate, but sheathing at the base, and generally more or less compound. There is much uniformity in the flowers, so that the genera are dependent to a great extent upon the fruits or cremocarps. The fl. f., {5 or 0. 5. 5. (D; 2)} will answer for all¹. The calyx is generally wanting, as is so often the case when flowers are much crowded together. It is present, however, as five small teeth in *Sanicula*, *Eryngium* and *Oenanthe*. The honey is secreted by two fleshy masses (D), formed by the top of the ovary, and is therefore easily accessible. Consequently the order is much visited by short-tongued insects. A characteristic feature is the presence of essential oils, which occurs in tubes all over the plant, and is located in vittae or pores in the seed-vessels or mericarps. These give the peculiar flavours to carraway, celery seed, &c. Many genera are very poisonous, such as the Spotted Hemlock (*Conium maculatum*), Fool's Parsley (*Aethusa Cynapium*, Fig. 26), Water Hemlock or Cowbane (*Cicuta virosa*), Water Dropwort (*Oenanthe crocata*), and Fine-leaved Water-Dropwort (*Oenanthe Phellandrium*). Other genera are harmless and useful, as the root of carrot and parsnip; the blanched leaf-stalks of celery (though as a wild plant, if not poisonous, would probably be very harmful to be eaten raw), the

¹ The general structures of the flower and fruit in this order are given under 15. *Anthriscus* and 19. *Aethusa*.

leaves of fennel and parsley, and the fruits of carraway, anise, cummin and dill. A group, principally natives of Persia and Afghanistan, yields gum-resins known as asafoetida, ammoniacum, galbanum, &c.

Artificial key to the principal Genera.

Flowers, white, bluish, or pinkish :

Leaf, simple.

- Leaf peltate ; creeping plant Hydrocotyle, 1.
 Leaf palmately nerved ; fls. in hds. ; woods ... Sanicula, 3.
 Leaf palmately nerved spinous ; fls. in hds. ; seashores
 Eryngium maritimum, 2.

Leaf, more or less compound, pinnate or sub-pinnate at base.

- Leaflets large ; mericarps flat, winged ... Heracleum, 32.
 Umbels sub-sessile ; aq. plant... .. Apium nodiflorum, 9.
 Umbels pedunculated ; aq. plt., submerged leaves dissected
 A. inundatum, 9.
 Umbels pedunc. small ; aq. plt., subm. l. generally none
 Sium, 10.
 Stem wiry, leaflets bi-serrate ; brts. and brtles. few ; hedges
 Sison, 11.
 Stem wiry, leaflets serrate-lobed ; brts. and brtles. none ; pastures Pimpinella, 15.

Flowers, yellow :

- Mericaip wings pressed together Peucedanum, 31.

Leaf, bipinnate or sub-pinnate at base.

Flowers, white :

- Low herb, much spreading by rhizomes ... Aegopodium, 14.
 Erect herb, glabrous ; frt. without ridges
 Anthriscus sylvestris, 20.
 Erect herb, glabrous ; frt. winged ; wings separated
 Angelica, 30.
 Erect herb, glabrous ; stem spotted ; frt. with crenated ribs
 Conium, 5.
 Erect herb, glabrous ; frt. with corky ribs ; brtles. pendulous
 Aethusa, 25.
 Erect herb, hispid ; frt. with curved spines ... Caulalis, 35.

Flowers, yellow :

- Glabrous Smyrnium, 6.

Flowers, greenish :

- Glabrous ; strongly smelling Apium graveolens, 9.

Leaf, tripinnate or decomposed.

Flowers, white :

- Segments linear, serrated Cicuta, 12.
 Segments linear, entire ; globular tuber ; brtles. 1, 0
 Conopodium, 16.
 Segments linear, entire ; globular tuber ; brtles. ∞
 Carum Bulbocastanum, 10.
 Segments linear ; frt. very long-beaked ... Scandix, 18.

Segments flat, narrow ; frt. spinescent	...	Daucus, 34.
Segments flat, 2-3 lobed ; aq. plt.	...	Oenanthe, 24.

Flowers, yellow :

Segments linear. Meadows	...	Silvaus, 26.
Segments sub-filiform. Maritime plt.	...	Foeniculum, 22.
Segments fleshy. Maritime plt.	...	Crithmum, 23.

1. *Hydrocotyle vulgaris*, *Pennywort*. This is a small plant creeping among moss and grass, &c., by water-sides ; easily recognizable by its orbicular pettate leaves. The umbels are minute, axillary and sessile, or very shortly stalked. The flowers are very small and of a pinkish-green colour. The fruit has no vittae.

2. *Eryn'gium marit'imum*, *Sea Holly*. This and *Sanicula* have their flowers in heads. It is a large herb with very glaucous shiny leaves. The flowers are in dense bracteolate heads, surrounded at the base by a whorl of rigid bracts. The flowers are bluish in colour. They have distinct sepals, and strongly incurved petals. A hollow honey-disk replaces the usual cushions of other umbellifers. It is a great favourite with bees ; twenty-four insects have also been noticed as visiting it. It is common on sandy seashores all round our coasts.

5. *Coni'um macula'tum*, *Hemlock*. This has tall, smooth, glaucous, spotted stems and bipinnate leaves, with the ultimate segments lanceolate and toothed. It has a strong odour. The flowers are sometimes wholly male or wholly female. The fruit has prominent wavy or crenulated ridges. It has several times been taken for parsley and used in soup. Death has occurred sometimes within an hour. No other umbellifer has a smooth and spotted stem.

9. *A'pium grave'olens*, *Celery*. Common by ditches, marshy places, &c., especially near the sea. It may be detected by its strong odour. The leaves are pinnate or 3-foliolate. The flowers are greenish-white. It is said to be poisonous in the wild state, but of course not so when etiolated or blanched in cultivation. In Malta, however, it is never blanched, the green leaves being used in soups.

18. *Scan'dix Pec'ten-Ven'eris*, *Shepherd's Needle*. A cornfield and garden annual. It has finely divided leaves, and is remarkable for the fruits being elongated, from 1-3 ins. in length.

20. *Anthriscus sylvestris*, *Beaked-Parsley*. Fl. f., {0. 5. 5. D; (2)}. As this species is perhaps the commonest, occurring in hedges, and open meadows, hence sometimes called sheep's parsley, it may be taken as a type. There are no bracts (involucre) at the base of the primary rays, but bracteoles (involucel) are present at the base of the secondary rays or pedicels. Each flower has an inferior ovary, with two grooves indicating the line of junction of two smooth carpels, called the commissure. When ripe they separate there. The calyx is wanting, or is said to be obsolete. The five petals are incurved in bud with inflexed points. These and the five incurved stamens rise from the summit of the ovary (which is invested with a receptacular tube) and from beneath a double, white honey-disk, from the internal edges of which two short styles arise. When the fruit matures, the whole is called a cremocarp, because when the two carpels separate (called mericarps) they hang upon two slender threads which are borne by a central cord, like the letter Y. The word cremocarp means 'suspended-fruit,' while mericarp signifies divided-fruit. A vertical section will reveal a single albuminous seed suspended from the top of the commissural side of the mericarp.

22. *Foeniculum officinale*, *Fennel*. Known by its very finely divided leaves and peculiar scent. It occurs in several places wild by the sea, though it may be an escape in other localities.

23. *Crithmum maritimum*, *Samphire*. A fleshy herb with 3-nately compound leaves and dark green flowers, grows on maritime rocks. It is often used for pickling. The fleshiness is due to the salt spray.

25. *Aethusa Cynapium*, *Fool's Parsley* (Fig. 26). A common annual in fields and gardens, recognizable

by its 3-nately pinnate leaves, pendulous bracteoles (1, *a*), and white flowers (2). Its name is derived from a Greek word signifying 'burning,' as it is a poisonous plant. The fruit has ten prominent ridges (8), five on each carpel (10 *a*). These are called primary ridges, and are usually present in some degree on the fruits of this order. If there be other ridges in the interstices between them, as occurs, though rarely, in some genera, as the carrot, these latter are called secondary ridges. If a transverse

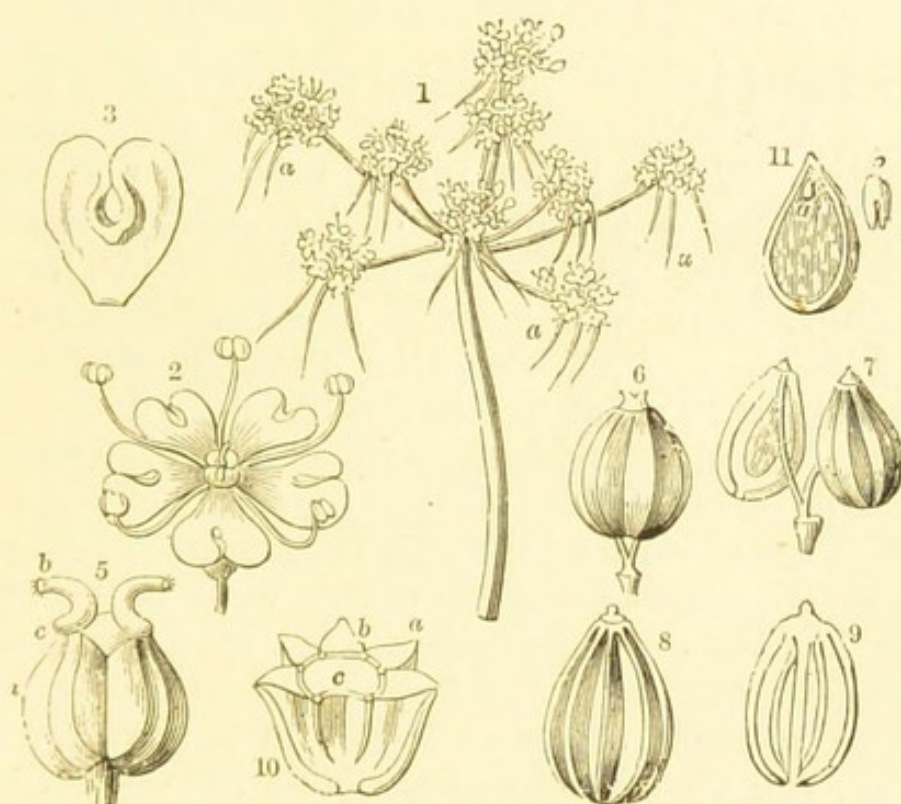


FIG. 26. *Aethusa Cynapium*.

section be made of a carpel, six holes (10, *b*) filled with oil may be detected: four in the spaces between the ridges and two on the inner surface. These oil-sacs are called vittae. This is the usual number, but in some plants they are numerous (*Smyrniium*, Alexanders); in others (as *Hydrocotyle*, Pennywort) there are none. Other points to be noted in the figure are as follows: (2, 3) shows the petals to have an inflected point. The proboscis of an insect glides down this little gutter and reaches the honey-disk in

the middle. (5) is the inferior ovary (*a*), the calyx being obsolete (at *c*); (*b*) are the two styles (these are not very accurately drawn). (6) is a ripe fruit or cremocarp. (7) the two mericarps are separating from the Y-shaped carpophore, or 'fruit-carrier,' which consists of the two coherent placentas of the two carpels. (8) is the outer side of a mericarp, showing the prominent ridges; and (9) the commissural surface, showing two long tubular vittae. (11) is a vertical section of a cremocarp revealing the albuminous seed (10 *c*) with a minute embryo (11, *a, b*) at the top.

31. **Peuced'anum** (**Pastina'ca**) **sati'vum**, *Parsnip*. This is especially common in chalk and limestone districts. It has hairy pinnate leaves and yellow flowers. This is the origin of the garden vegetable, which has been eaten since the time of the Romans. The one known in the trade as 'The Student' was raised from seed of the wild plant by Professor J. Buckman in 1847, at the Agricultural College, Cirencester. The mericarps are winged, the two wings at each side being closely pressed together.

32. **Herac'leum Spondy'lium**, *Hogweed*. This is a common coarse-growing plant, with a few large-lobed leaflets on a pinnate leaf. It flowers rather late, about August. The flowers are white, the outer ones, as is often the case with others, have irregular petals. 120 visitors have been observed on this plant. The vittae, conspicuous on the ripe mericarps, form long, bag-like brown stripes, especially on the inner commissural surface. Each mericarp has lateral wings.

34. **Dau'cus Caro'ta**, *Carrot*. This is the origin of the garden carrot. It is common by roadsides, in meadows, &c. It has finely divided leaves and rather massive umbels of white flowers, the central flower is often purple. The fruit is spiny, having a row of barbed bristles down both the primary and secondary ridges. Vittae are below the secondary ones. When the fruit is ripening the umbels close up, suggesting the term 'birds' nests' given to them in the country.

ORDER XXXVI. CORNACEAE.

One tree or bush and one herb represent this order, known as the Cornel, Dogwood, Dogberry or Prickwood.

Cor'nus sanguin'ea, *Cornel*. Fl. f., {4. 4. 4. (2)}. This is a common tree or large bush growing in hedges, &c. It has opposite entire leaves and dense-flowered cymes of cream-coloured 4-merous flowers. It has black berries. A second species *C. sue'cica*, a herb, is found in alpine moors in the North of England and in Scotland.

DIVISION II. GAMOPETALAE.

ORDER XXXVII. CAPRIFOLIACEAE.

This order has two tribes, with five genera. In the first, *Sambuceae*, the corolla is small, rotate, or 'wheel-like,' because of its short tube. In the second, *Lonicereae*, the tube is elongated. The structure of the flower is the same in all.

TRIBE I. *Vibur'num Op'ulus*, *Guelder-rose*. Fl. f., {5. [(5). 5.]. (3)}. (Fig. 27.) The flowering cymes are peculiar in that the outermost flowers have large white corollas, but no stamens or pistil; they are therefore neuter; while the central perfect flowers (1, 2) are small and inconspicuous. Under cultivation the latter become neuter also, thus producing large globes of white, but quite infertile flowers. (1) is an entire flower, (2) the same cut vertically; the base of the style is enlarged as a honey-secreting organ; it has three blunt stigmas (4). There are three carpels, but one or two may become arrested and only one seed be developed, as shown in the diagram (3). (5) is the seed, and (6) the same cut vertically, showing the minute embryo at one end with the large mass of endosperm.

V. Lanta'na, the wayfaring tree, has all the flowers perfect. The leaves are simple and rough. The fruit

in both species is a drupe, being scarlet in the former and black in the latter species.

Sambu'cus ni'gra, *Elder*. This has compound leaves. The cymes being umbellate, i. e., on radiating peduncles. *S. Eb'ulus*, the dwarf elder, is herbaceous and local. It is sometimes called dane-wort, being supposed to have been introduced by the Danes. The anthers are extrorse, i. e. burst outwards, and as there is no honey in the elder it is not much visited by insects, but wind-pollination is easily accomplished.

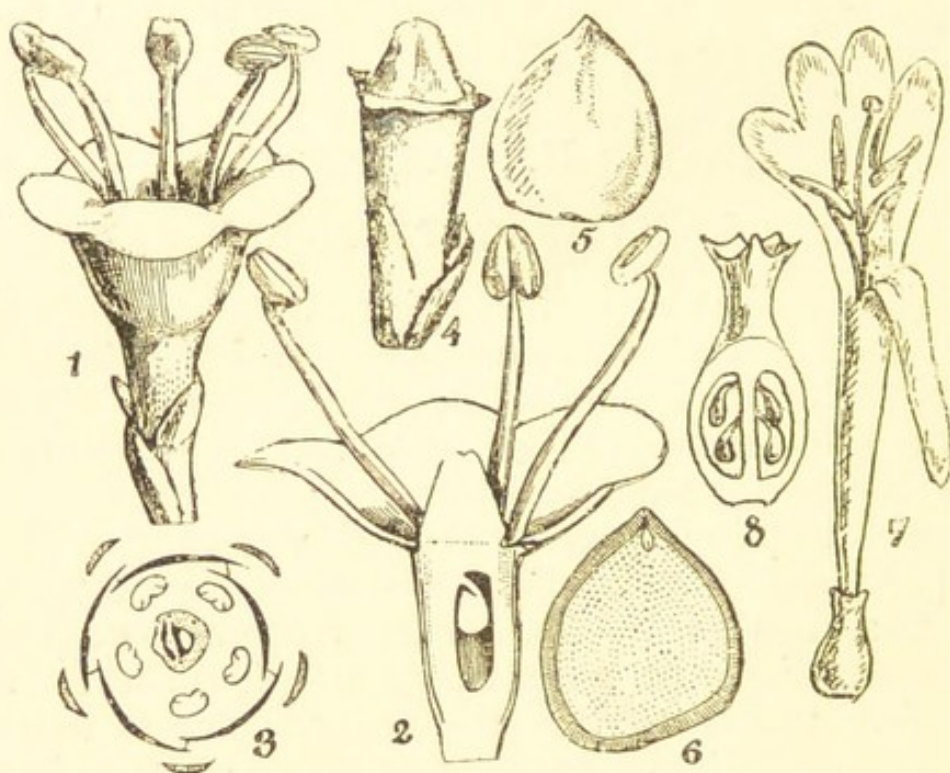


FIG. 27. *Viburnum Opulus* (1-6): *Lonicera* (7, 8).

TRIBE II. *Lonice'ra Pericly'menum*, *Woodbine* or *Honeysuckle* (Fig. 28). In this genus the flowers are in glomerules or 'sessile cymes,' similar to 'heads,' which are 'sessile umbels,' as in the *Compositae*. The corolla has a long tube, the lobe of one petal being separated more deeply than the other four (1). The anther is versatile, 'easily turning,' being attached to the filament at a point in the middle (2). This is commonly the case in grasses. The ovary is at first three-celled (3, 4); but in the fruit it is usual in all

members of this order for the ovules to be arrested in two cells. The berries are scarlet (5). The seed is albuminous (6, 7). Having a long tube to the corolla, the flower is adapted to nocturnal lepidoptera or moths and sphinxes which have a long proboscis. Moreover, the tube only becomes filled to past the middle, in the evening, with honey. On warm calm evenings insect-visits are so abundant that on the following day all the flowers are found to have had

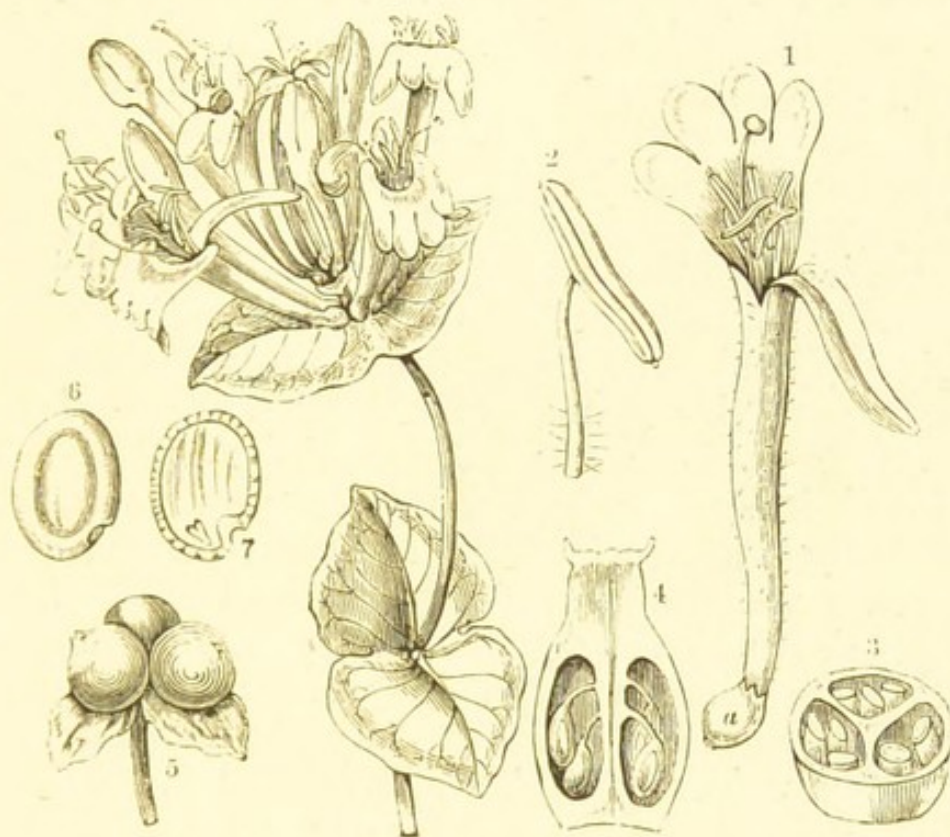


FIG. 28. *Lonicera Periclymenum*.

their pollen entirely removed. On the other hand, on days following cool, windy evenings, the flowers display abundant pollen, which is then gathered by bees and flies. Another genus, *Linnaea borealis*, found in fir plantations from York to Ross, creeps along the ground, with flowers $\frac{1}{3}$ in. long. It was named after Linnaeus by Gronovius. It is represented on the wall of the staircase of the Linnean Society's rooms, Burlington House.

ORDER XXXVIII. RUBIACEAE.

All the English genera are included in the tribe *Stellatae*, as they are herbs with leaves in whorls, hence the name of the tribe, or 'star-like.' We have only four genera, two having rotate corollas, *Rubia* and *Galium*, and two with tubular ones, *Asperula* and *Sherardia*.

Ru'bia peregrina, *Madder*. Fl. f., {5. [(5). 5.] (2)}. This is a perennial herb, scrambling over hedges, &c., chiefly near the sea on the West and South of England. Its leaves are 4-6 in a whorl. It has recurved prickles on the angles of the stem and on the midrib and margins of the leaves. The cymes of the flowers are paniced. The flowers are small, yellowish in colour. The fruit consists of small globose black berries. It takes its name from *ruber*, Latin for red, as species of this genus have supplied the scarlet dye known as madder from the earliest times. The chemical ingredient has, however, now been made artificially from coal tar. The scarlet mentioned in Scripture was obtained from an insect allied to the cochineal, from oak trees of Palestine; but where it is said that ram and badger skins were dyed *red* (Exod. xxv. 5), the LXX version says 'dyed with madder.'

Ga'lium ve'rum, *Lady's Bedstraw*. Fl. f., {0. [(4). 4.] (2)}. The genus *Galium* has eleven British species. This, and one other, *G. Cruciata*, Crosswort, with leaves 4 in a whorl, has yellow flowers. Three have greenish flowers, e. g. *G. Aparine*, Cleavers, all the rest being white-flowered. In the lady's bedstraw, so called as it was used in the Middle Ages for beds, the leaves are 8-12 in a whorl, less than 1 inch long, and linear. The long panicles of small golden flowers render it very conspicuous. It has the peculiar property of rennet, and is used in Devonshire, &c., for curdling milk.

G. Apari'ne, *Cleavers* (Fig. 29), is only too common. It has its leaves 6-8 in a whorl, $\frac{1}{2}$ -2 ins. long,

narrowly lanceolate, hispid all over and with setaceous points (7, *a*). The fruit is covered with hooks (4, 5), readily catching the hair of animals, which thus disperse it. It is said that the fruits roasted taste like coffee. This is not improbable, as the coffee tree belongs to the same order. It is usual to describe the whorls as 'leaves'; for there is no difference between the members. Strictly speaking only two are leaves. As a rule a bud will be seen, more or less developed into a branch, springing from the axil

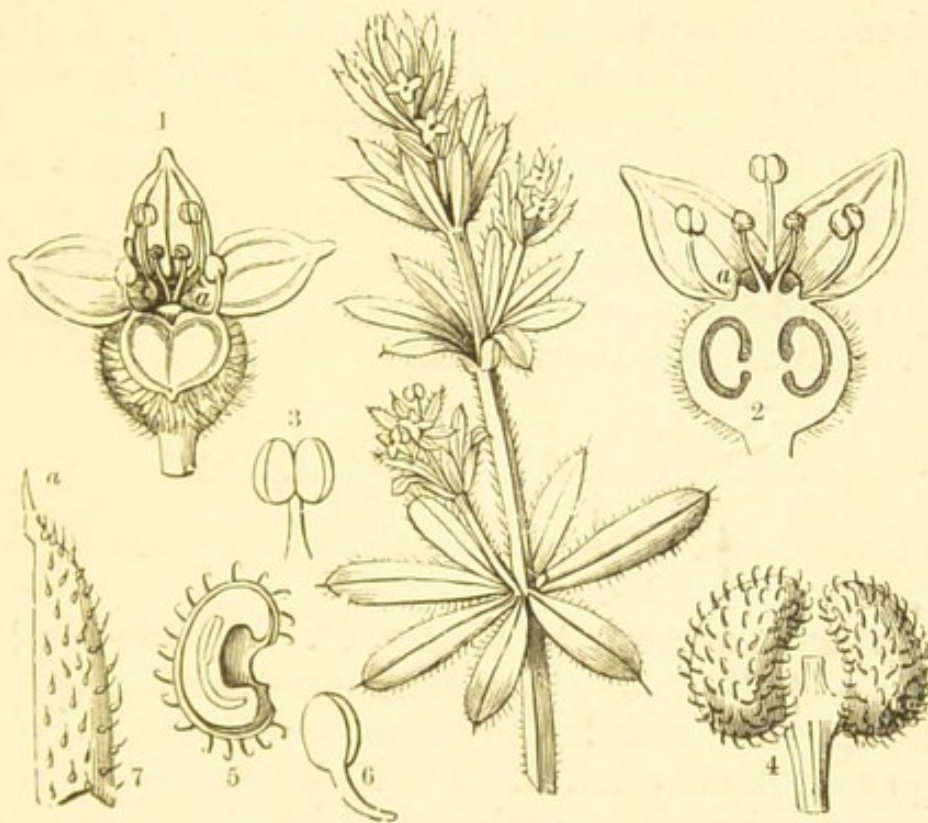


FIG. 29. *Galium Aparine*.

of the true leaf (see figure). This, and the one opposite, will be a leaf, but all the intermediate, whatever their number, though normally four, are stipules. (1) represents a complete flower; (1, 2, *a*) is the disk on the summit of the ovary. (2) is a vertical section showing the 2-celled ovary, each cell containing one ovule. (3) is one of the four stamens. (4) is a ripe fruit consisting of a pair of kidney-shaped nuts, bristly all over with stiff hooks, and

separated at the base by the hardened and widened axis, curving inwards above till their points nearly meet. (5) is a vertical section of one of the carpels, showing the albuminous seed and curved embryo. (6) is the embryo isolated. (7) is the apex of half a leaf, showing the point at the apex.

Asper'ula odora'ta, *Wood-ruff*. Fl. f., {0. [(4). 4.] (2)}. This herb has rather broad leaves, compared with the galiums, about 6-9 in a whorl. The corolla is funnel-shaped and not rotate, as in galiums. The whole plant is scented like new hay when drying.

Sherar'dia arven'sis, *Field-Madder*. Fl. f., {(4-6). [(4). 4.] (2)}. This is easily recognized by its whorled (4-6) leaves and lavender-coloured flowers. It is common in cornfields and waste places. The calyx-teeth are conspicuous in this plant, whereas they are wanting, being obsolete, in the other genera. The sepals are bristly with five or six points: the fruit is crowned with six short teeth.

ORDER XL. DIPSACEAE.

Two genera, *Dipsacus*, teasel, and *Scabiosa*, scabious, comprise this order.

Dip'sacus sylves'tris, *Teasel*. Fl. f., involucl; {(4?). [(4). 4.] 1}. The common teasel is a tall spinulose plant with opposite simple leaves and connate, forming a large receptacle often filled with water, the flowers in compact oblong heads with rigid bracts. Each flower has a separate bract, and a cupuliform involucl. The calyx-limb forms a small cup on the top of the inferior ovary. The corolla tube has four unequal lobes, and carries four stamens. The fuller's teasel, used for raising nap, has recurved bracts, and is probably a variety of this plant, being only known in cultivation.

Scabio'sa arven'sis, *Field Scabious*. Fl. f., involucl; {(5.) [(4). 4.] 1}. A common weed by fields, growing to 5 ft. in height, with softly hairy leaves and large flat heads of light purple flowers. The corolla is

irregular by the partial or total suppression of one of the front petals; the stamen adjoining also disappears, so that instead of being 5-merous, they are 4-merous.

S. succisa, *Devil's-bit-Scabious* (Fig. 30). Fl. f., {(5.) [(4.) 4.] 1}. Common in pastures. It has entire leaves (1); the involucre bracts are shorter than the corollas. The flowers are blue-purple, or occasionally white. (1) is a flowering head; (2) a flower. There is a bract



FIG. 30. *Scabiosa succisa*.

to each floret (2, *a*); in the axil of this is a cup-shaped involucre (2, *b*). This can be removed. Within it is the true superior calyx of five rigid purplish teeth (2, *c*, 4, 5 and 7 [two cut away]). The corolla is irregular, with four lobes (2, 3), in consequence of the suppression of one lobe; similarly, one out of five stamens is suppressed. The anthers are red-brown. (5) illustrates a very unusual condition of things, for the receptacular tube is not adherent to the ovary (*b*) except at the summit, where is the thickened rim or

disk. (*a*) is the pendulous ovule, the ovary (*b*) being cut open to show its position. A somewhat similar closely-investing but non-adherent receptacular tube is to be seen in the tribe *Poterieae* of the *Rosaceae*. (7) is a vertical section of a ripe fruit; the seed now completely fills the ovary-cell, which in turn is closely invested by the receptacular tube. It is albuminous, with a straight inverted embryo.

S. Columba'ria has pinnatifid cauline leaves, and involucrel bracts longer than the 5-lobed corollas; the anthers are yellow. It occurs in dry pastures and banks, &c.

ORDER XLI. COMPOSITAE.

This order is one of the largest in the world. All the British species are herbs, contained in forty-two genera. They are exstipulate and characterized by having their flowers (florets) in heads, hence they are known as Composites. There is very great uniformity in the structure, so that when a few types are thoroughly known, they supply the clue to many hundreds of others. Though it is so large an order, it is not remarkable for many uses to man. It supplies a few drugs, as chamomile and arnica; and some strong-scented plants, as wormwood, absinthe, and taragon. The Jerusalem artichoke furnishes edible tubers. There are also innumerable garden plants, as the sunflower, dahlia and chrysanthemum, &c. One group having all the florets ligulate, i.e. strap-shaped, has a milky juice partaking of the nature of opium, as in the lettuce and dandelion, and when blanched some of this group supply saladings, as the lettuce, endive, chicory, and dandelion. They constituted the 'bitter herbs' of olden times. The order is not, as a rule, credited with many poisonous plants.

The order is grouped into two series. I. **Tubuliflorae**, in which the disk florets are tubular, with a regular border; and II. **Liguliflorae**, in which all the florets have ligulate corollas.

Artificial key to the Genera.

Ray flts. ligulate ; disk tubular.

- | | |
|--|---------------------|
| Ray purple, disk yellow ; hd. $\frac{2}{3}$ in. ; plt. glabrous | Aster Tripolium, 2. |
| Ray purple, disk yellow ; hd. $\frac{1}{4}$ – $\frac{3}{4}$ in. ; plt. hairy | Erigeron acre, 3. |
| Ray white, disk white | Achillea, 13. |
| Ray white, disk yellow ; pap. o ; low herb ... | Bellis, 4. |
| Ray white or yel., disk yellow ; pap. o ; tall herb | Chrysanthemum, 16. |
| Ray white, disk yellow ; pap. o ; l. much dissected ; rec. naked | Matricaria, 15. |
| Ray white, disk yellow ; pap. o ; l. much dissected ; rec. chaffy | Anthemis, 12. |
| Ray yellow, disk yellow ; ray few fld. ; anthers tailless ; pap. white | Solidago, 5. |
| Ray yellow, disk yellow ; ray many fld. ; anthers tailed ; pap. all pilose | Inula, 6. |
| Ray yellow, disk yellow ; ray many fld. ; anthers tailed ; pap. with outer scales | Pulicaria, 7. |
| Ray yellow or o, disk yellow ; l. alt pinnatifid | Senecio, 21. |
| Ray yellow or o, disk yellow ; l. opposite .. | Bidens, 11. |
| Cottony herbs ; ray inconspicuous ; hds. 2-sex. ; rec. flat, naked | Gnaphalium, 8. |
| Cottony herbs ; ray inconspicuous ; hds. 2-sex. ; rec. conical, scaly | Filago, 10. |
| Cottony herbs ; ray inconspicuous ; hds. dioecious | Antennaria, 9. |
| L. large, to 3 ft. diam., after fls. ; hds. monoec ; purple | Petasites, 19. |
| L. large, to 3 ft. diam., after fls. ; hds. monoec ; yellow | Tussilago, 20. |

Florets all tubular.

- | | | | |
|--|-----|-----|----------------|
| L. opp. ; heads minute ; flts. pink | ... | ... | Eupatorium, 1. |
| L. opp. ; heads large ; flts. yellow | ... | ... | Bidens, 11 |
| L. alter. ; heads minute ; flts. yellowish | ... | ... | Artemisia, 18. |
| L. alter. ; heads large ; flts. yellow | ... | ... | Tanacetum, 17. |
| L. alter. ; inv. brts. hooked ; flts. red | ... | ... | Arctium, 22. |
| L. alter. ; inv. brts. pinnate-spinose ; flts. purple | ... | ... | Carlina, 22. |
| L. alter. ; pap. short ; plt. not prickly ; flts. purple or blue | ... | ... | Centaurea, 25. |
| L. alter. ; pap. long ; plt. not prickly ; flts. purple | ... | ... | Serratula, 26. |
| L. alter. ; pap. pilose ; plt. prickly ; flts. purple | ... | ... | Carduus, 27. |
| L. alter. ; pap. plumose ; plt. prickly ; flts. purple | ... | ... | Cnicus, 28. |

Florets all ligulate.

Fruit, long-beaked.

- Pappus pilose; heads 1-2 in. diam.; glabrous Taraxicum, 39.
Pappus pilose; heads $\frac{1}{2}$ - $\frac{3}{4}$ in. diam.; glabrous Lactuca, 40.
Pappus plumose, white; prickly plt. Picris echioides, 34.
Pappus plumose, white; recept. chaffy Hypochaeris, 37.

Pappus plumose, brown ; plt. hairy *Leontodon*, 38.
 Pappus plumose, brown ; plt. glabrous *Tragopogon*, 42.

Fruit, not beaked.

Pappus o ; hds. blue, $1-1\frac{1}{2}$ in. diam. *Cichorium*, 31.

Pappus o ; hds. yellow, $\frac{1}{4}$ in. diam. *Lapsana*, 33.

Pappus pilose, white ; l. amplexicaul ; hds. 1-2 ins.

Sonchus, 41.

Pappus pilose, white ; l. not amplexicaul ; $\frac{1}{4}-\frac{3}{4}$ in.

Crepis virens, 35.

Pappus pilose, brown *Hieracium*, 36.

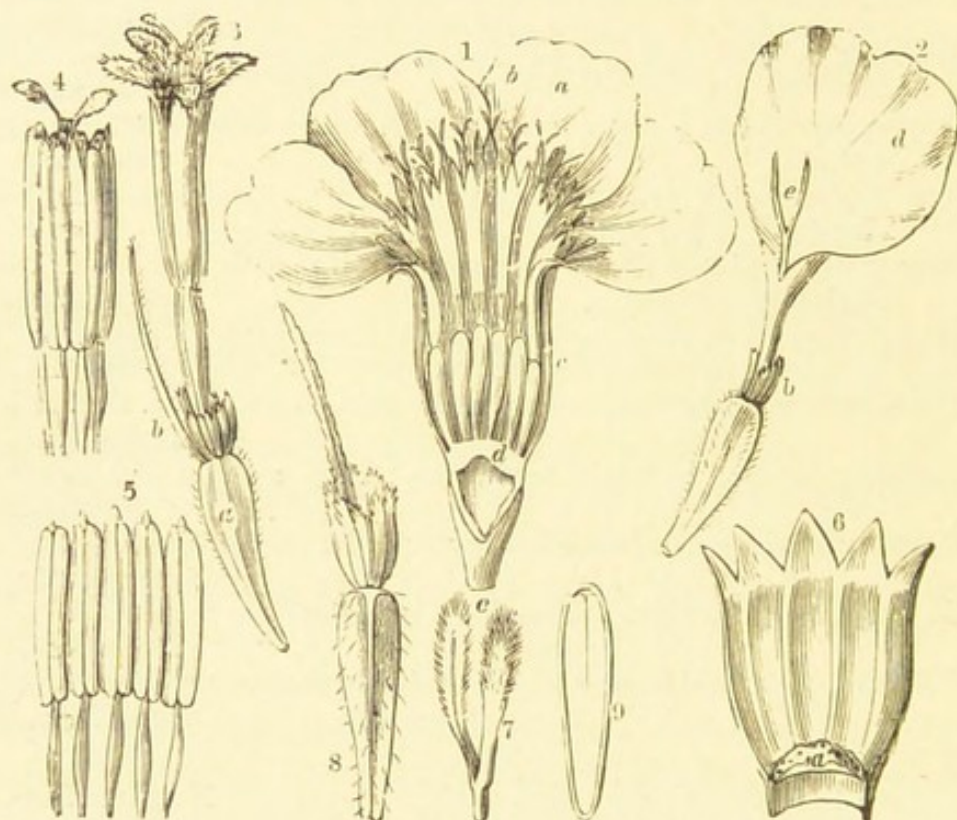


FIG. 31. *Tagetes patula*.

SERIES I. *Tubuliflorae*. *Tagetes patula*, *French Marigold*, introduced from Mexico in 1593. In order to facilitate the study of the minute flowers or florets of this family, Fig. 31 represents those of a common garden plant, *Tagetes patula*, the French Marigold; as they are particularly large in that flower. Beginning from the outside, we meet with a very exceptional peculiarity, in that the bracts of the involucre cohere into a tube (1 c, 6). A similar occurrence is met with in the teasel family, *Dipsaceae*, and in *Euphorbia*. (1 d, 6, a) is the general receptacle which carries all the

florets. The next point to notice is that the circle of florets on the circumference, the so-called ray florets, have broad flat limbs to the tubes of the corollas (1 *a*, 2 *d*); while the central or disk florets have small tubes with a five-toothed border (1 *b*, 3). The first are called ligulate, or strap-shaped; the latter tubular. The former have lost two petals in the production of the broad strap. Below the corolla is the very obvious inferior ovary (3, *a*), terminated above by the rudimentary calyx (2, *b* and 3, *b*). In the disk florets one of the sepaline rudiments appears as a bristle (3, *b*, 8). As mentioned under scabious, the calyx of flowers growing crowded is often aborted or represented by minuter structures than usual. In the *Compositae* it is often wanting altogether, as in the daisy. In others it appears as minute scales (2, *b*), or as a few stiff bristles (*Bidens*), or as numerous slender bristles or hairs. In these latter cases it is called the pappus, familiar to all in the 'down' of thistles and dandelions.

With regard to the stamens and pistil, it will be found that ray florets in the *Compositae*, as a rule, have a style and forked stigma only (2, *e*) and no stamens, so that they are female. On the other hand, the disk florets are (with very rare exceptions) bisexual. (4) represents the stamens with the included style and exerted stigmas, extracted from the corolla-tube of (3). The five free filaments (4, 5) are inserted on the corolla-tube just where it is seen to contract in (3). The five long anthers cohere by their edges, so that they form a cylinder. They are quite free in the early state of the bud, but become united as they grow by the secretion of a sort of mucilage which sticks them together, so that the union is not congenital as between the petals of the corolla, though they are called syngenesious. The pollen is shed into the tube of anthers because they burst inwards; and in order to extract it the style grows so that the stigmas push the pollen out at the top. The two arms of the stigma being at first pressed together, but spread out on arriving outside the anther-tube, their upper or inner surfaces (that

of the *left-hand* branch *c* in (7) are stigmatic. (9) represents a vertical section of a fruit (8), a sort of inferior achene, with the erect embryo without any albumen. The fl. f. is given under 4, *Bellis*.

4. *Bel'lis peren'nis*, *Daisy*. Fl. f., disk floret, {o. [(5.) (5 a.)] (2)}; ray floret, {o. (3.) o. (2.)}. The heads have outer white or pink ray florets with ligulate or strap-shaped corollas, apparently enlarged at the expense of the stamens which are wanting (Fig. 32. 2). The central or disk florets have regular yellow

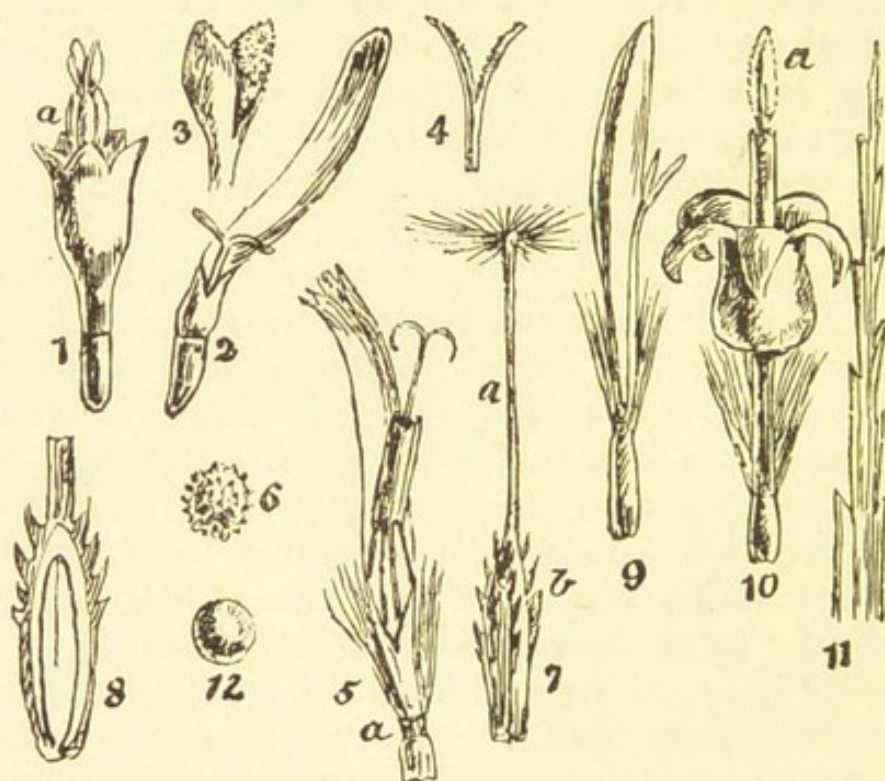


FIG. 32. *Bellis* (1-4); *Taraxacum* (5-8); *Petasites* (9-11); *Artemisia* (12).

corollas (1). The stamens cohere by their anthers into a cylindrical tube (1, *a*), the cells bursting inwards. The ovary is 1-celled, but the style which passes up the tube of the anthers carries two stigmas (3 those of disk fl.), (4 of ray fl.). Hence there are two carpels. A 'double' form is cultivated. In this the yellow disk florets have been converted into ligulate ones resembling the ray florets. In passing from one to the other the corolla always loses two petals and all the stamens. The calyx, which should

stand on the top of the ovary at the junction seen in (1) is arrested or obsolete.

7. *Pulicaria dysenterica*, *Flea-bane*. A common wayside plant, in hedges, &c., conspicuous by its downy leaves and numerous large yellow flowers, 1 in. diam., the ray florets being twice as long as the disk; the anthers are tailed. The pilose i.e. hair-like pappus has an outer row of short scales.

8. *Gnaphalium uliginosum*, *Cud-weed*. A small much-branched herb, under a foot high, densely covered with a pure white down. The linear leaves are woolly or tomentose. It bears numerous small heads clustering among the leaves, and conspicuous for their bright-shining pale-brown involucre. The ray florets are inconspicuous, and female; the disk florets are perfect, with anther-cells, tailed. The general receptacle is flat and naked. Another species, *G. sylvaticum*, is not uncommon in woods. It is an erect herb, with heads almost sessile, or clustered in the axils of the linear leaves.

11. *Bidens cernua*, *Bur-Marigold*. This and another species, *B. tripartita*, occur in wet places, usually with yellow rayless heads. They are annual glabrous herbs with opposite leaves; sessile and undivided in *B. cernua*, but petioled and 3-cleft in *B. tripartita*. In the former species the heads droop, while they are erect in the latter. Instead of a pappus there are 3-4 stout barbed bristles. This plant furnishes a good study in adaptation; for the anatomy of the stem and roots undergoes profound, but easily observed changes, according as the plant grows completely in water or upon dry ground.

12. *Anthemis arvensis*, *Corn Chamomile*. This is a strongly-scented herb with twice-pinnatifid leaves and heads having a white ray and yellow disk florets. The general receptacle is seen to be covered with chaffy scales if the florets be removed. It occurs in fields and waste places, but is rather local. There are two other species, *A. Cotula*, Stinking May-weed, and *A. nobilis*, Chamomile. This species is common

near the sea. It is the source of the medicinal chamomile flowers, which are usually collected from the cultivated double variety, in which all the florets are white, like those of the ray.

13. *Achille'a Millefo'lium*, *Yarrow*, *Milfoil*. A perennial herb with very finely dissected leaves, the leaflets and linear-acute segments being very close-placed. The white or pink heads are numerous, $\frac{1}{4}$ in. diameter, arranged in a corymbose manner.

15. *Matrica'ria Chamomil'la*, *Wild Chamomile*. This resembles the genus *Anthemis*, but the receptacle has no chaffy scales. It has much-divided leaves, and heads with a white ray and yellow disk. It is used medicinally in Germany instead of the true chamomile, *Anthemis nobilis*. It is very abundant in neglected ground.

16. *Chrysan'themum seg'etum*, *Corn Marigold*. We have three species of this genus. The corn marigold, an annual, has toothed, glaucous smooth leaves, and heads with both ray and disk florets of a golden yellow. *C. Leucanthemum*, the Ox-eye Daisy, is a perennial, and has large heads with a broad white ray and yellow disk; and *C. Parthenium*, Fever-few, is a perennial, with short white ray florets and a yellow disk.

17. *Tanace'tum vulga're*, *Tansy*. A somewhat shrubby plant with much-divided, 1-2 pinnatifid leaves. The heads are numerous, about $\frac{1}{3}$ in. diam., corymbose in arrangement and of a dull yellow, the ray flowers female; the disk, male; the whole plant is very strong-scented.

18. *Artemis'ia vulga'ris*, *Mugwort*. This genus has four species. They are all more or less aromatic and characterized by their minute heads. The mugwort has broad leaves, white and woolly below. The heads are also woolly. It is very common in hedgerows, growing from 2 to 4 feet in height, bearing heads in crowded paniced spikes. *A. Absinthium* is a local plant known as wormwood; while *A. maritima* occurs in salt marshes. This is the only genus of the *Compositae* known to have smooth pollen grains

(Fig. 32. 12). The general form is as represented in (Fig. 32. 6).

19. *Petasi'tes vulga'ris*, *Butter-bur* (Fig. 32. 9-11). This is an extensively creeping plant with rounded leaves, often 3 ft. in diam., growing by river-sides, &c. The leaves are cottony below. The inflorescence is in a spike-like form, the heads purplish. The male heads have a few female florets; the ray florets are female (9), with a few male ones (10) in the disk. In this and its ally, the coltsfoot, the corollas of the male florets are bell-shaped above the tube (10), having the two style arms coherent into a club (10, a), by means of which the pollen is ejected. The calyx is represented by a pilose pappus (11).

20. *Tussila'go Far'fara*, *Coltsfoot*. This is well known for its round leaves, produced after the yellow heads have appeared in early spring. It creeps extensively by an underground stem, rapidly covering waste ground. The florets much resemble those of the butter-bur.

21. *Sene'cio vulga'ris*, *Groundsel*. There are nine species of *Senecio*. This common species is a familiar weed in any garden. It bears very small cylindrical heads of yellow flowers. It is usually without a ray. Unlike most conspicuously flowering plants of this order, the style arms generally remain concealed within the anther-tube, so that it is self-fertilizing, and is consequently extremely prolific.

S. Jacobae'a, *Ragwort*. A tall perennial herb, with golden-yellow heads in a dense corymb; only too common by roadsides and poor pastures, &c. The leaves are pinnatifid, the heads being sometimes 1 in. diameter.

25. *Centaure'a ni'gra*, *Knapweed*. An almost woody herb, common by roadsides, &c., with entire or lobed leaves and heads, 1-1½ in. diam., having an involucre of bracts with a broad, dilated, dark-brown appendage, terminating with a pectinate or comb-like margin. The pappus-scales are very short, unequal or none. The florets are purple, the outer ones often

larger and neuter. In this and other species the ray florets remain tubular like the disk, but the throat and limb are much enlarged, the number of teeth or segments being often more than five, while the stamens and pistil are both suppressed. *C. scabiosa*, Hard-head, has deeply pinnatifid leaves, with entire or lobed segments. The bracts of the involucre have a brown pectinate tip and margins; the pappus is as long as the fruit. This species is common in dry pastures and waste places. *C. Cyanus* is the Common Bluebottle or Cornflower, with bright blue heads, common in cornfields and frequently cultivated.

27. *Car'duus cris'pus*, *Thistle*. This genus has three, and *Cnicus* eight species, all of which are popularly known as thistles; but while the first has a pilose pappus, in the second it is plumose, and the heads are more often subdioecious. The leaves are spinous-toothed in most species, and the stem is often 'winged.' The corollas are always tubular, without a ray, red or purple, rarely white. In *C. crispus* the leaves are cottony below, usually pinnatifid; the heads less than 1 in. diameter, with webbed spiny bracts to the involucre; they are crowded and subglobose in form. *C. nutans*, the Musk-thistle, has large, solitary, pendulous heads with crimson florets.

28. *Cni'cus lanceola'tus*, *Spear-thistle*. This genus differs from *Carduus* in being usually more or less dioecious and in having a plumose pappus. The present species is common in waste places. Its stem is winged, the leaves pinnatifid. The heads are few together, ovoid, $1\frac{1}{4}$ in. long and $\frac{3}{4}$ – $1\frac{1}{2}$ in. diam. The involucreal bracts are numerous, subulate with a terminal white spine. The receptacle is hairy. *C. acaulis* is a usually stemless species, as the head is mostly sessile when it grows on gravelly or chalky pastures, as on the down of Sussex, &c. It bears a single crimson head. If it happen to grow in damp or shady places among herbage, the flowering stem elongates and may bear several flowers. *C. arvensis* is a very troublesome species because of its exten-

sively creeping habit by means of its long underground rhizomes.

SERIES II. *Liguliflorae*. 31. *Cichor'ium In'tybus*, *Chicory*. A tall wiry plant with heads usually in pairs, 1-1½ in. diam., with florets all ligulate and light blue. It is not uncommon in many places, especially on a chalky soil, and when cultivated has a large tap-root. This, roasted and ground to powder, constitutes the chicory of commerce. It is also cultivated as a salad plant, being blanched. It then constitutes the 'Barbe de Capucin' and 'Witloof' or Brussels chicory. Another species, *C. Endivia*, a native of the Mediterranean regions, is the endive of gardens. It was used for its supposed medicinal properties by the ancients. These species, as well as others of the *Compositae*, such as dandelion, &c., constituted the 'bitter herbs' of Scripture¹.

33. *Lap'sana commu'nis*, *Nipple-wort*. A very common weed in waste and cultivated ground, bearing small yellow flowers, ¼ in. diam. It has no pappus. The involucral bracts are few, 1-seriate, and erect.

35. *Cre'pis vi'rens*, *Hawk's-beard*. A small glabrous herb very common on waste ground, roadsides, &c. The upper cauline leaves are long, sagittate, and sessile, with a toothed margin; the lower leaves being runcinate, i. e. with recurved teeth. The pappus is pilose and white.

36. *Hiera'cium muro'rum*, *Hawkweed*. This genus contains ten species and many varieties. They all have heads entirely composed of ligulate yellow florets, and are readily recognized by the tawny-coloured pilose pappus on a truncated fruit. Plants with similar flowers either have none (*Lapsana communis*, *Nipple-wort*) or a white and feathery one (*Picris*), or a pilose pappus of white simple hairs, (*Crepis*). The hawkweeds illustrate the difficulties systematic botanists occasionally meet with; for

¹ *Plants of the Bible* (Pres. Day Primers), p. 38.

whereas one sees thirty species, another recognizes only four, regarding the others as varieties. Sir J. D. Hooker observes 'that the sequence of its forms represents to a considerable extent the spread of the forms in altitude and area in the British Isles.' This means that the forms have been developed under the various conditions of the localities in which they are prevalent, respectively.

38. *Leon'todon hir'tus* and *L. hispidus*, *Hawk-bit*, are common herbs with narrow sinuate-toothed radical leaves, and scapes with a single head. They frequent pastures and waste places. The receptacle is naked, and the pappus plumose and brown.

39. *Tarax'acum officina'le*, *Dandelion*. The leaves of this common plant vary greatly according to the soil, being broad and runcinate to very narrow and pinnatifid. There is a short neck to the pappus (a continuation of the receptacular tube which is adherent to the ovary) (Fig. 32. 5, *a*). This elongates in fruit, and carries the then spreading pilose pappus (7, *a*). Short bristly points are also developed near the top of the inferior ovary (7, *b*), which serve to anchor it when the wind has conveyed it away like a parachute. (8) represents a long. sect. of a ripe fruit, called a cypsela, showing the erect exalbuminous seed.

40. *Lactu'ca*. We have five species of lettuce, none of them very common; one, *L. Scariola*, is apparently the origin of the garden lettuce, of which the flowers can be studied. One species, *L. alpina*, formerly known as *Mulgedium*, differs from all the rest, which have yellow flowers, by being blue. It ascends from 2,000 to 3,000 ft. in Forfar and Aberdeen; being a member of our arctic flora. It extends from the arctic regions to Siberia, and on Alpine Europe. Lettuce was grown as a salad plant, and used as a sedative by the ancients, as the milky juice partakes of the nature of opium.

41. *Son'chus olera'ceus*, *Sow-thistle*, is an annual, brittle herb, with lanceolate, $\frac{1}{2}$ amplexicaul, sharply toothed, hairless leaves, having rounded auricles at

the base. The yellow flowering heads, $\frac{3}{4}$ –1 in. diam., are crowded.

S. arven'sis, *Corn sow-thistle*, common in cultivated fields, has a glandular hispid inflorescence. It grows from 2–4 ft. in height. The head is $1\frac{1}{2}$ in. diam. It has a long, white silky pappus.

42. *Tragopo'gon praten'sis*, *Goat's-beard*. A glaucous herb, with a stem 1–2 ft. high; the leaves are slender, gradually contracted upwards from above the dilated sheath. The heads, $\frac{1}{2}$ –2 in. diam., yellow, included in an involucre of about 8 flat bracts. The fruit has a very long beak, with a feathery tawny-coloured pappus.

T. PORRIFO'LIUS, *Salsify*, occurs in meadows, &c., but is nowhere truly wild. It has large purple flowering heads.

ORDER XLII. CAMPANULACEAE.

This contains two sub-orders, *Lobelieae*, represented by one genus, *Lobelia*; and *Campanuleae*, containing five.

Jasi'one monta'na, *Sheep's-bit*. Fl. f., {(5). (5). (5, a). (2).}. This is a common hispidly pubescent plant on heathy pastures and mountain-sides, growing from 6–18 in., much branched from the base. It bears heads of lilac-blue flowers. The corolla is deeply cleft to the base, the lobes being at first coherent. The stamens are free from the corolla, and the anthers are only just united by their bases. The inferior capsule constituting the fruit dehisces above, within the calyx-lobes.

CAMPAN'ULA RAPUNCULOI'DES. Fl. f., {(5). (5). 5. (3)}. (Fig. 33.) There are six species of campanula. *C. rotundifolia*, the Hare-bell, is common in heaths and pastures. *C. Rapunculus*, Rampion, has an edible fleshy root. *C. Trachelium* and *C. glomerata* are often cultivated as well as foreign species, e. g. *C. medium* from C. Europe, as Canterbury bells. Fig. 33 (1) is a flower from which the calyx and corolla have been removed. It shows the inferior ovary (a). The five

stamens (1 and 2), with broad bases to the filaments, form a dome-shaped chamber, protecting the honey-secreting upper surface of the ovary, the honey being obtained by insects passing their proboscis between the filaments. The anthers are represented in (1) as shrivelled, because they shed all their pollen very early, which is caught or collected by hairs all over the style; the stigmas at that time being quite immature and pressed together, are unable to be pollinated as represented by (4). Subsequently the stigmas

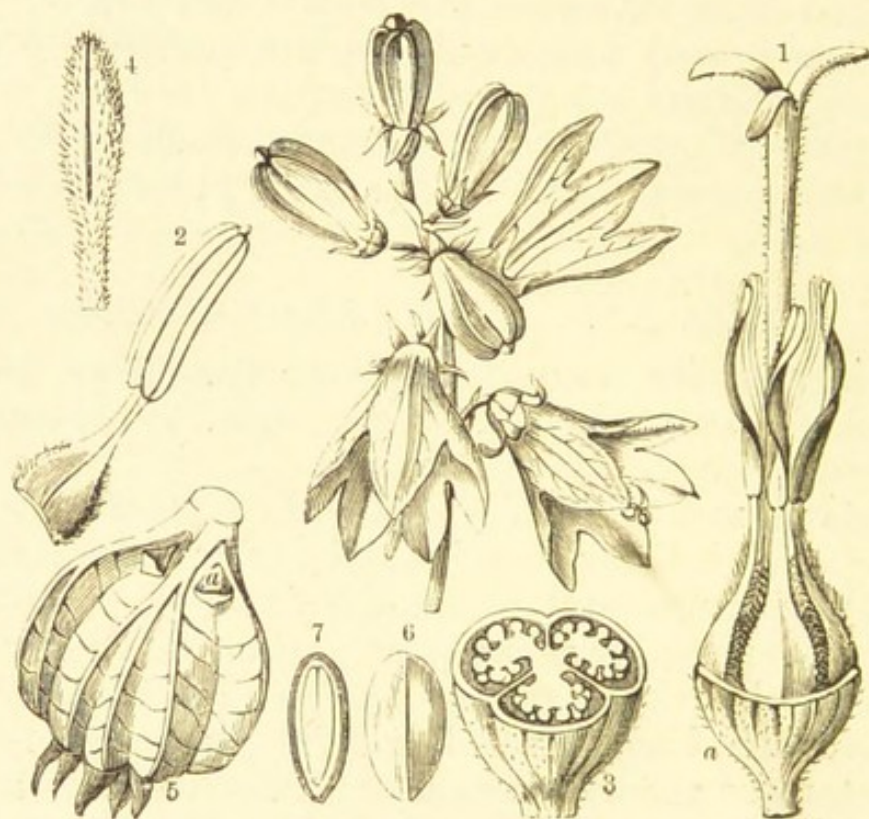


FIG. 33. *Campanula rapunculoides*.

spread out (1), and bees crawling head downwards into the flower, grasp the style, and so smear their bodies with pollen from it. Then, on entering another flower, the projecting stigmas are pollinated. (3) is a transverse section of the inferior ovary (1, *a*), showing the enlarged axile placentas and numerous ovules; (6) is a seed, and (7) the same, cut vertically, revealing a thin layer of endosperm with a straight ovule. The lobes of the corolla should have been drawn a little more reflexed. (5) Fruit, dehiscing by pores (*a*).

ORDER XLIII. ERICACEAE.

This order contains two sub-orders, **Vaccinieae** with one genus, *Vaccinium*, and **Ericaceae** with nine.

All the numerous kinds of *Rhododendron* and *Azalea* of our gardens are members of this order. Much hybridization has been effected between N. American, W. Asian, and Indian species, as well as between some seven species from the Malay islands. These latter constitute the scarcely hardy greenhouse rhododendrons.

Vaccin'ium Myrtil'us, *Whortleberry* or *Bilberry*. Fl. f., {(5). 5. 5 + 5. (5)}. This genus differs from all others of this order in having an inferior ovary (Fig. 34. 7); but they all agree in having the stamens free from the corolla, a peculiarity confined to this order and *Campanulaceae*, among flowers with a gamopetalous corolla. The flower is pendulous, and the anthers (as in all others) dehisce by pores (8), which are at first pressed against the style, thus preventing the escape of the pollen until they have been dislocated by an insect. The anthers are provided with tail-like appendages (8) in this species, as also in *V. uliginosum* (occurring in mountain-bogs); but they are wanting in *V. vitis-Idaea*, the cowberry of woods and heaths on the west side of England, and in *V. Oxycoccus*, the cranberry of Scotland. The corolla is globose (7), but in the cranberry it is rotate, i. e. wheel-like, having a short tube and a flat border or limb resembling a wheel. The last-named is found in peat bogs, usually among bog-moss. It has pink flowers. The berries are excellent eating; those of the cowberry are often mixed with them for sale.

Arbutus Une'do, *Strawberry-tree*. Fl. f., 5. (5). 5. (5). This evergreen tree occurs in woods at Killarney, Muckross, and Bantry. It bears panicles of white sub-globose flowers, and orange-scarlet globose berries with a rough surface. They are edible, and used for making wine in Corsica. In the young state

of the flower, the pointed tip of the anther is fixed against the style by a gummy exudation. This acts as a pivot, so that as the filament elongates it inverts the anther, and then presses the lower ends of the cells against the style. As they dehisce by pores at that place, the pollen is prevented from escaping until dislocated. Each anther carries a 'tail' at the back of the pore.

This tree is found in the south of France and north of Spain, so that its presence in Ireland is probably

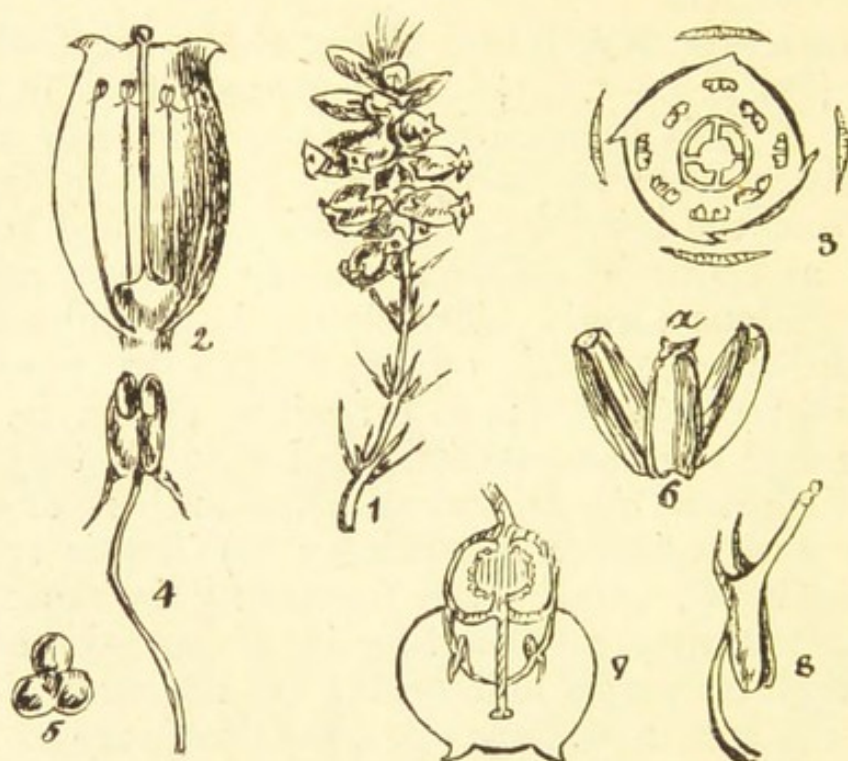


FIG. 34. *Erica* (1-6); *Vaccinium* (7, 8).

a remnant of a flora which once extended across the Channel when Ireland and Spain were united.

Eri'ca cine'rea, *Heath*. Fl. f., 4. (4). 4 + 4. (4). The leaves are whorled in threes (Fig. 34. 1) with short leafy branches in the axils. The corolla is ovoid in form. The stamens dehisce by pores, which are at first adpressed against the style, but they are all dislocated on the entrance of an insect, which clings to the 'tails' and pulls them asunder. (2) shows a section of the corolla with the free stamens and pistil. (3) is a diagram of the flower. (4) a stamen, and (5)

a tetrahedral pollen-grain. The fruit is a capsule bursting by four valves, which have the central axis in the middle (6, a). *E. Tetralix*, the cross-leaved heath, usually occurs as isolated plants among the mass of *E. cinerea*, and differs from it in having pink globose corollas, the common heath being crimson purple. *E. ciliaris* and *E. vagans* are two species only found in Cornwall, and the former in Dorset as well. They reappear in the west of France, and form part of the so-called Norman flora, which is continued in the Channel Islands and south-west of England in diminishing numbers, pointing to a former land surface in connexion with the Continent. One other species, *E. mediterranea*, occurs in boggy heaths of Mayo and Galway, in the south-west of France, and in Spain. It may therefore be associated with the strawberry-tree as a relic of the continuation of the old Spanish flora, which extended from the Pyrenees to the south-west of Ireland.

Calluna vulgaris, *Ling.* Fl. f., 4. (4). 4 + 4. (4). The leaves are very minute and closely imbricated, giving a tetragonal appearance to the branches. The calyx is petaloid and pink, the corolla being shorter than the sepals. The fruit is a capsule, and differs from that of *Erica* in the way it bursts; for in the latter genus it dehisces loculicidally (through the back) and septifragally (across the septa), but in *Ling* it is septicidal (down the septa) and septifragal.

As the heaths have flowers which hang down, the stamens and style are situated vertically; but in *Calluna* the flowers are almost horizontal, consequently there is a slight tendency for the style to curve upwards. This illustrates the first indication of *declination*, as described under *Epilobium*, so that the smaller insects can only reach the honey on the lower side. About twenty visitors have been seen. The remarks here made, and those under *Epilobium*, hint at the probable method of making flowers adopted by nature; that these and other differences in the structures of flowers in adaptation to the action of

insects when visiting them are the actual outcome of the process itself. The fact is that the living matter of plants or protoplasm is of identically the same nature in plants as in animals; and just as a muscle increases with use, so does the protoplasm of plants respond and cause the structure which contains it to adapt itself by growth in various ways to the weights, thrusts, &c., which it receives. Hence the declination of stamens and styles is due to a response to the weight of an insect standing upon them; for the curvature thus acquired is the best mechanically for supporting the insect upon them. Innumerable correlations or coincidences corroborate this view. Thus all irregular flowers are so situated, as a rule, quite close to the stem, that they can only be visited on one side; whereas all regular flowers can be approached from all sides. This will be well seen in the order *Scrophularineae*¹.

ORDER XLVI. PRIMULACEAE.

This order contains eight genera. They all have the peculiarity of the stamens being adherent to the tube of the corolla on a line with the middle of the lobes (Fig. 35. 2), instead of being between them.

This is due to the suppression of an outer whorl, sometimes represented by antherless staminodes (as in *Samolus*). The ovary is 1-celled, the ovules being attached to a free-central placenta; the stigma being globular, there is no apparent clue to the number of carpels, excepting the number of teeth or valves with which the capsule bursts.

Primula ve'ris, Cowslip. Fl. f., (5). [(5). 0 + 5.] (5). (Fig. 35). The primrose (*P. vulgaris*), oxlip (*P. elatior*), cowslip, as well as *P. farinosa*, the Bird's-eye Primrose of York and Lancashire, have dimorphic flowers. In one, the pistil has a short style, the

¹ The reader is referred to the author's little book, *The Making of Flowers* (S.P.C.K.), or the larger work, of which that is an epitome, *The Origin of Floral Structures* (International Scientific Series), vol. lxiv; also *The Origin of Plant Structures* (same series), vol. lxxvii.

anthers being situated at the entrance to the corolla-tube; in the other, the style is long, the globular stigma occupying the position of the anthers of the previous kind. The stamens are now low down (2), their anthers being on the same level as the stigma in the first kind. These differences of height point to the proper or legitimate mode of pollination by intercrossing, for when this is artificially and carefully effected, more seed is set than when the stigmas are illegitimately crossed, i.e. with pollen from stamens

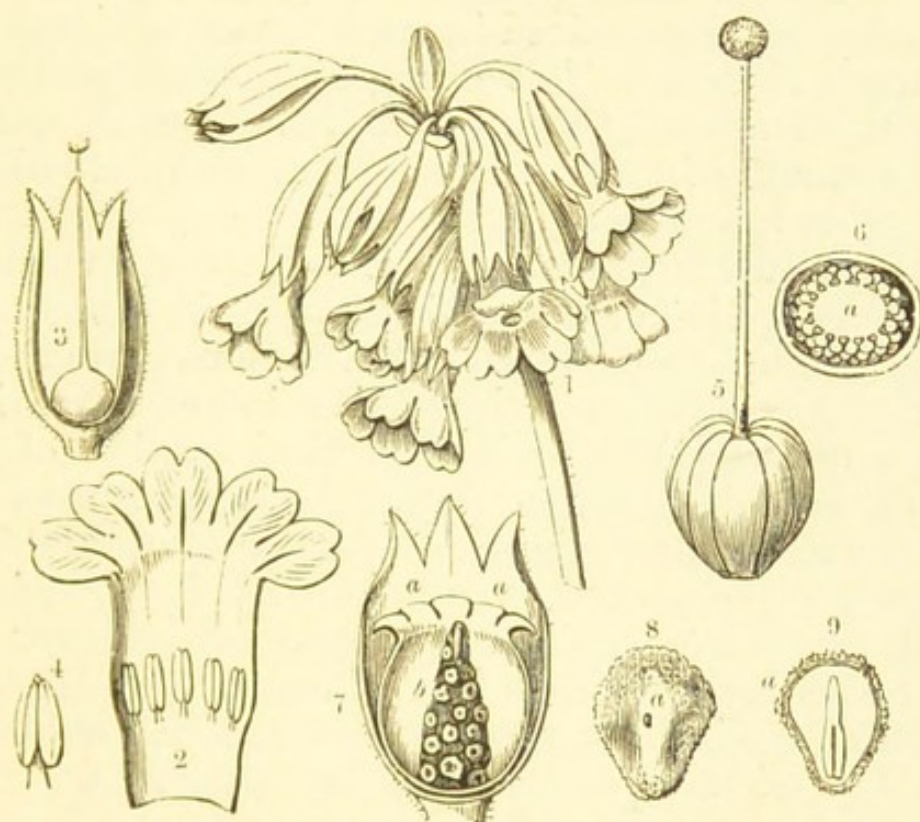


FIG. 35. *Primula veris*.

of a different length to the styles. As bees, however, only visit flowers in a haphazard way, the full value of such intercrossing is not secured in nature. The short-styled form, upon the stigma of which pollen can fall, appears to yield most seed; but this is of course illegitimately¹.

Müller adds another observation to this method of self-fertilization, viz. 'that pollen-collecting bees are

¹ *Origin of Floral Structures*, p. 205.

only able to secure their pollen in the short-styled flowers; they learn to recognize the long-styled plants at a distance and to avoid them, and thus never perform cross-fertilization, but very often self-fertilization, by causing the pollen to fall on the stigma below.

These differences must not be regarded as absolutely fixed, though tolerably constant in nature, the two kinds never occurring on one and the same plant; for under cultivation the stamens and style sometimes grow to the same length in a flower, and so it becomes homomorphic. This is then self-fertilizing. Such a condition may be noticed in garden auriculas and the Chinese primrose. This change is probably similar to the difference between *P. farinosa* and *P. scotica* only occurring in Orkney, Caithness, and Sutherland. Both these have mealy foliage and lilac-coloured small corollas, and are probably varieties one of the other, but *P. scotica* is homomorphic.

These details can be seen in the various parts shown in Fig. 35 of the cowslip. The inflorescence is a simple umbel (1). (2) is a vertical section of the corolla of a long-styled form; for the stamens are low down, and the stigma would just protrude from the orifice, as shown in the middle flower of (1). (3) is the calyx, the corolla removed to show the pistil with the long style (5). The ovary (5) is represented as having ten vascular cords: five correspond with the mid-ribs of the carpellary leaves, five with the margins, and the capsule bursts by ten teeth (7, a). The placenta (6, a and 7, b) is free-central, recalling that of the members of *Caryophylleae*, but the origin is different. The five carpels might be compared to the leaves of the sow-thistle, which have rounded appendages at the base called auricles. Now suppose five of such leaves, united by their edges, the auricles being projected into the middle of the chamber, to be coherent and swollen into a central mass; and lastly, this to be the only ovuliferous part. Such appears to be the origin of the free-central placenta of *Primulaceae*. (7, b) represents this central column in the

capsule, surrounded by the calyx (*a*). (8) is a seed which is attached at a central point (*a*) and has the embryo (9) embedded in endosperm, and lying in a direction at right angles to a line pointing from it to the point of attachment (9, *a*); an unusual position, for the embryos usually point towards or in an opposite direction to the point of attachment of the seed.

Anagal'lis arven'sis, *Scarlet Pimpernel*. Fl. f., (5). [(5). 5]. (5). A small annual with opposite leaves, and one axillary flower to each, on a long slender peduncle; the corolla is scarlet or rarely blue. This last variety occurs in limestone districts of Gloucestershire, &c., and is much commoner in the Mediterranean region, as at Malta, flowering rather earlier, while the scarlet one is less abundant there. *A. tenella*, the Bog Pimpernel, is a small creeping perennial in marshes and wet meadows. Its corolla is rosy with dark veins.

Sa'molus Valeran'di, *Brook-weed*. Fl. f., {(5). [(5). 5 stds. + 5.]} (5){}. This is a small herb growing on wet ground, with obovate¹ or spatulate leaves, and racemes of very small flowers with white corollas. It differs from the other members of this family by having the ovary partially sunk in a receptacular tube; hence it is more or less inferior. It has also five stump-like rudiments of stamens or staminodes, thus showing why the stamens are always opposite to the petals in this order; one whorl, the outer, being in most genera totally suppressed.

ORDER XLVII. OLEACEAE.

The privet and the ash are our only representatives of this order, which takes its name from the olive, *Olea europaea*. The familiar garden lilac is another member.

Ligus'trum vulga're, *Privet*. Fl. f., (4). [(4). 2]. (2). Like all the members of this family, this has opposite leaves. It has white flowers in small but dense clusters. The two stamens easily indicate the order (Fig. 36. 1,

¹ A leaf is ovate when broader towards the base, or egg-shaped; obovate, when the broader part is towards the apex; spatulate, the shape of a spatula, i.e. broad above but tapering slightly below.

7, 8). The calyx has only a rudimentary limb represented by four points (2). The four lobes of the corolla are valvate in bud, having the edges induplicate or folded inwards (1). The fruit is a small black berry (5), which yields a rose-coloured dye, and an oil, used for cooking in Germany. The seed has a hard endosperm (6). The white-scented flowers attract nocturnal lepidoptera in greater abundance than insects by day; but the flower is readily self-fertilized.

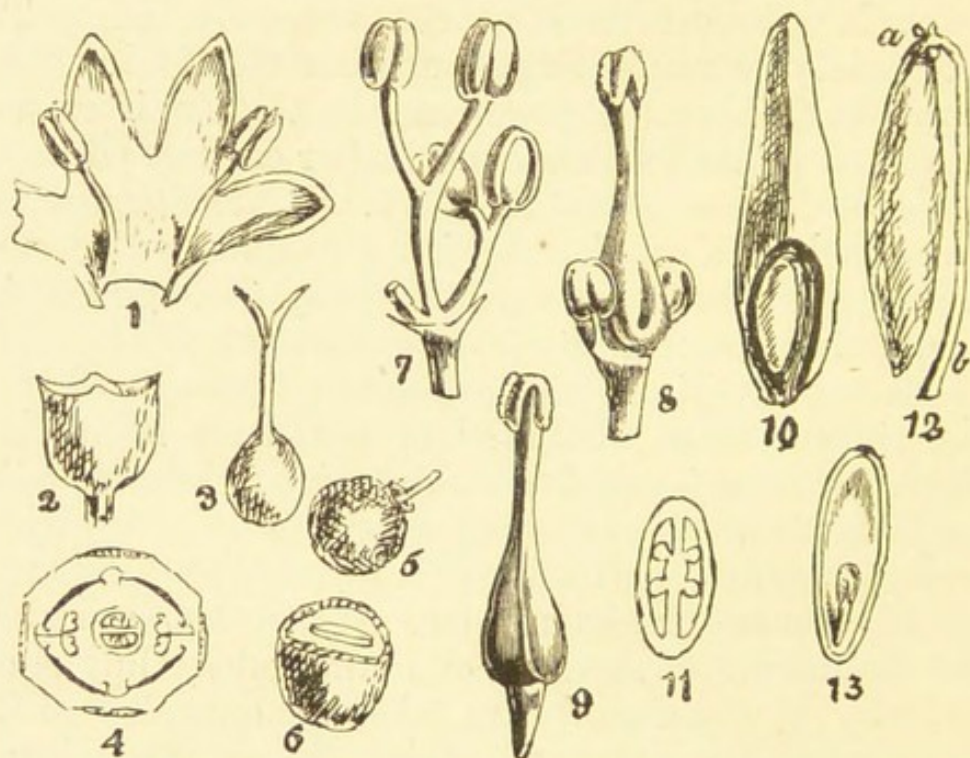


FIG. 36. *Ligustrum* (1-6); *Fraxinus* (7-13).

Fraxinus excelsior, *Ash*. Fl. fs., o. o. 2. (2); f., o. o. o. (2); m., o. o. 2. o. The ash has compound pinnate leaves with flowers in clusters, devoid of calyx and corolla. They may consist of two stamens and a pistil (Fig. 36. 8), or of a pistil alone (9), or of two stamens only (7). Sometimes the stamens are represented by staminodes. The fruit is a 1-winged samara (10). As one ovary-cell becomes aborted and one seed only out of four ovules (11) matures, three ovules are arrested (12, *a*). The single seed is attached to the long placenta (12, *b*), which breaks away from

the middle of the ovary (12, *b*). The seed is albuminous (13). As the flowers have no calyx or corolla, it might be thought that the ash should be placed in the *Incompletae*, but as the two stamens and pistil agree entirely with the privet, lilac, and olive, and moreover a species called the flowering ash (*F. Ornus*) of Italy, &c., has both calyx and corolla, their absence in our English tree is not considered sufficient to displace it. The flowering ash is the tree which yields the non-crystallizable sugar known as manna.

ORDER XLIX. GENTIANEAE.

This order contains five terrestrial and two aquatic genera, the white *Menyanthes*, Buck- or Bog-bean, and the yellow *Limnanthemum*. The leaves are always opposite and entire in the former, but alternate in the latter.

Chlo'ra perfolia'ta, *Yellow Centaury*. Fl. f., (8). [(8). 8.] (2). An erect glaucous herb, with broadly connate leaves and golden yellow flowers in a cymose group; the parts of the whorls are usually eight, but they may vary to six. It is common on chalky soils.

Erythrae'a Centau'rium, *Centaury*. Fl. f., (5). [(5). 5.] (2). This is a very variable plant in size of stem and leaves, easily recognized by its pink flowers in terminal cymes; the anthers being spirally twisted when dehiscing, enable an insect to be dusted in any way.

This plant was formerly much used in medicine, and even now can be substituted for gentian-root; two alpine species, *G. lutea* and *G. purpurea*, being in our pharmacopoeia.

Gentia'na Pneumonan'the, *Gentian*. Fl. f., (5). [5]. 5]. (2). (Fig. 37.) There are about 180 species of gentian, many of which occur on the Alps of Switzerland. Five species are indigenous. This one occurs in moist heaths, as near Swanage, but is local. It has elongated, tubular, dark blue corollas, 1-2 in. in length.

The stamens (1, 3) have rather broad filaments where they are united to the corolla, and as they project

inwards they divide the space into five divisions, which are penetrated by insects' proboscides for the honey secreted at the bottom and by the base of the ovary. The anthers are protandrous, the two stigmas (2) not being early matured; but the latter subsequently curl outwards, and are readily dusted by the bee entering an older flower than the first visited. The anthers are at first sub-coherent, but separated by the style and stigma growing up the middle.

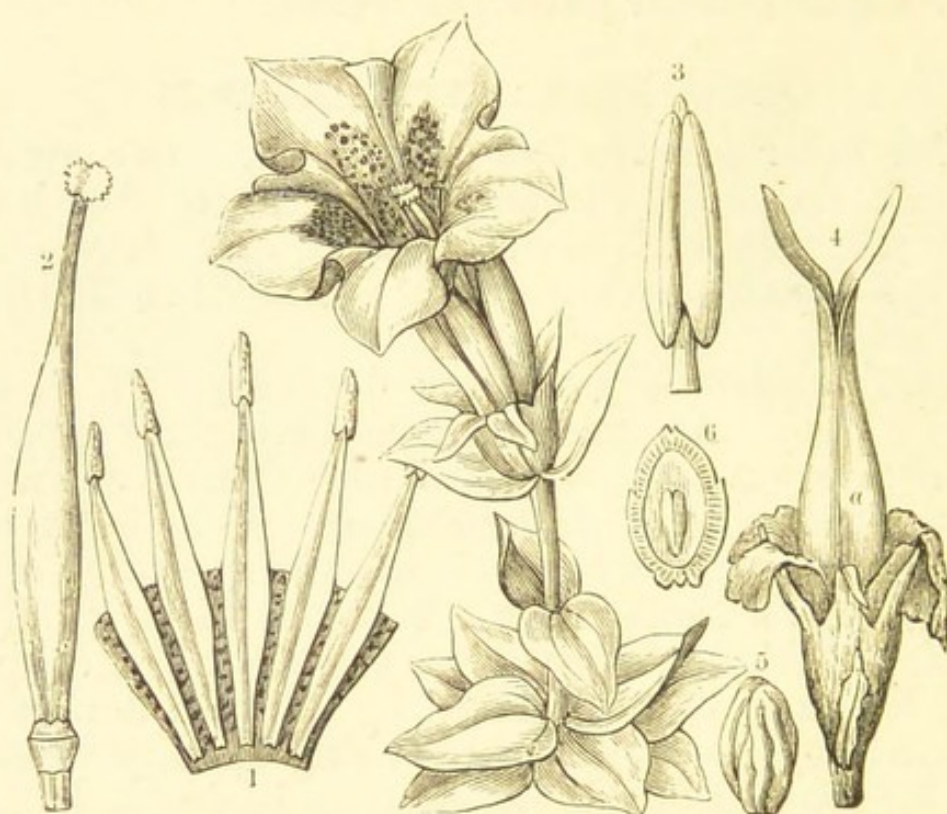


FIG. 37. *Gentiana Pneumonanthe*.

Moreover, the anthers burst outwards, thus aiding in dusting the humble-bees, which appear to be the only visitors. (4, *a*) represents a ripe capsule commencing to dehisce above. The two placentas are parietal. (5) and (6) represent the albuminous seed with a straight embryo.

ORDER LI. BORAGINEAE.

This order comprises eight genera, all being herbs, and generally with very rough or hispid and alternate leaves. The flowers are arranged in scorpioid

or curled racemes; they are always regular, excepting *Echium*, and have the same fl. f., (5). [(5). 5]. (2). The pistil is peculiar in having the ovary deeply 4-lobed, as in the *Labiatae*, the style arising from the base in the centre. Each lobe closely invests a single pendulous ovule, and finally breaks away, forming a nutlet containing a suspended seed.

E'chium vulga're, *Viper's Bugloss*. A tall, rough herb, growing to 3 feet in height, and bearing numerous flowers on paniced racemes. The corolla in this, as in some other genera, is red or red-purple on first expanding, but changes to a deep purple or bright blue on maturity. It is somewhat irregular, having the five stamens declinate, which, after discharging the pollen, retire backwards when the stigma develops, standing where the mature anthers had previously been. More than seventy insects have been observed to visit this species in Germany; the great majority come for honey only. The female bees, with abdominal collecting brushes, without any effort sweep up the pollen with their abdominal brushes, filling them after a few visits. *E. plantagineum*, our only other species, has dark blue-purple flowers, and is only found in Cornwall and Jersey and the Mediterranean region, being a member of the Norman flora which touches the south-west of England. It is really the most distant fragment of the Mediterranean flora.

BORA'GO OFFICINA'LIS, *Borage*. This is a common Mediterranean annual, with a bright blue rotate corolla, often found in waste ground, as it has been long cultivated. The throat of the corolla-tube is closed by notched scales. Each stamen has a horn-like structure growing from the filament. The nutlets are rugose. Honey is secreted by the fleshy base of the ovary. The anthers meet and form a pendulous cone, in the apex of which the pollen collects. An insect hangs suspended below the flower and thrusts its proboscis between two stamens, the cone thus opened allows the pollen to escape. The style only grows out beyond the cone of anthers, and

develops its stigma after the anthers have shed their pollen. It is not quite clear what the use of the horn-like projection from the back of the stamen may be. Müller thinks that it helps to force the anthers back to reform the cone.

Sym'phytum officina'le, *Comfrey*. This is a coarse perennial herb, with large decurrent leaves and drooping flowers in terminal and scorpioid racemes, yellowish-white or purple. The corolla is tubular, but dilated upwards, with five spear-like scales alternating



FIG. 38. *Anchusa officinalis*.

with the five stamens. These are thought to aid insects in some way, but the real use is obscure. It is a common plant by water-sides.

ANCHU'SA OFFICINA'LIS, *Alkanet*. This is an introduced plant, and rather rare. It has violet-blue flowers. Fig. 38 represents the curled inflorescence, usually but wrongly described as a scorpioid cyme in text-books; but a cyme is definite; the order of flowering being 3. 2. 3. 1. 3. 2. 3 (see p. 171). This is indefinite, and is really a peculiar form of raceme. It will be noticed that the flower-buds form two ranks

in the coiled-up extremity, but they become separated lower down. This coiling suggested the name of scorpion-grass to forget-me-nots. (1) shows a corolla laid open, revealing the scales or corona and the adherent stamens alternating in position with the petal-lobes; (2) is the gamosepalous calyx; (3) is a pistil showing the deeply 4-lobed ovary, the style arising from the base and terminating with two stigmas, as there are really only two carpels. When ripe the four quarters break asunder into four rough indehiscent nutlets (4). (5) is a section of a nutlet having a thickened ring (*a*) round the point of attachment. When in position the radicle (*b*) pointed upwards, as the embryo was suspended. Hence (5) should be reversed in position.

Myoso'tis palus'tris, *Forget-me-not*. This and *M. caespitosa* are aquatic species, but *M. arvensis* and others are terrestrial. The corolla is rotate in form, or like a wheel, and bright blue, with a little yellow corona in the mouth of the tube. The first two species are more or less devoid of hair, while the others are very hairy. This difference between aquatic and terrestrial species is common. Aquatic and terrestrial buttercups differ in the same way, though there are exceptions to the rule in other plants, as in the genera *Hypericum* and *Epilobium*.

ORDER LII. CONVULVULACEAE.

Two genera of climbing plants represent this order. The one *Convolvulus* is a stem-twiner; the other, *Cuscuta*, is a parasite, not only twining about its host, but penetrating the latter by means of special roots developed in the interior of suckers called haustoria.

Convol'vulus arven'sis, *Small Bindweed*. Fl. f., 5. [(5). 5.] (2). This very common and troublesome weed has hastate or sagittate, entire leaves, and pink funnel-shaped flowers, contorted in bud. It has an extensively creeping underground stem, rendering the plant difficult to eradicate. *C. sé'pium*, the large white-flowered convolvulus, is common in hedges.

C. Soldanella, with reniform or kidney-shaped leaves and large pink flowers, occurs on sandy sea-shores. It rarely climbs, but runs extensively under the sand. The funnel-shaped corolla of the bindweed is yellow at the base internally, and marked with five radiating white streaks. Such marks, often of a different colour from that of the petals generally, as in a pansy, are called 'path-finders,' as they guide the insect down to the honey. The habit of closing both in the evening and rainy weather marks out this species as adapted for diurnal insects. The orange-red under-surface of the ovary secretes honey, which is sheltered by the broad bases of the stamens, which leave five narrow openings leading to it. The stamens approach the style above, forming a column with it, so that the five slits between the filaments are the only means of access to the honey. The anthers, which are extrorse, i. e. burst outwards; so that by crawling into the flower head downwards, and clinging to this central column, the insect must get dusted below. In their absence self-fertilization is easy. The above method of reaching the honey is imitated in other flowers, as the *campanula* and *crocus*. About twenty visitors have been observed. With regard to *Convolvulus sepium*, Müller observes that he found all the flowers closed on a dark night, but all open on moonlight nights. *Sphinx convolvuli* is the usual visitor. As this insect is rare in England, this may account for the rarity of this large flowering species setting its seed.

Cus'cuta Epi'thymum, Dodder. A parasitic plant with yellow or pink thread-like stems, attached to furze, thyme, ling, &c., by means of circular disks on the stem (haustoria), from the centre of which a root penetrates into the host. It has no leaves nor any green tissue whatever, consequently it must live entirely on prepared nutrition within the host. The flowers occur in dense clusters, the corolla being urceolate or pitcher-shaped, and containing a ring of scales within it, below the insertion of the stamens. The honey is secreted by the lower part of the ovary,

and sheltered by the scales. It is visited by a few insects, but is also self-fertile.

ORDER LIII. SOLANACEAE.

Three genera, all herbs, represent this order, characterized by containing some very deadly poisonous plants, viz., *Hyoscyamus*, *Solanum*, and *Atropa Belladonna*, dwale or deadly nightshade. They all have the same Fl. f., (5). [(5). 5.] (2).

Hyoscy'amus ni'ger, *Henbane*. This is an herb growing 1-2 feet, with divided leaves, very clammy, and powerfully smelling with a fetid odour. The flowers are sub-campanulate, dull yellow, and usually veined with purple; the anthers are also purple. The calyx-tube is persistent, closely adpressed to the capsule. This is constricted in the middle, and dehisces with a lid or in a *circumscissile* manner. The ovary is two-celled, with large placentas in the middle carrying numerous seeds. The whole plant is poisonous, producing delirium and death.

Sola'nium Dulcama'ra, *Bitter-sweet* or *Woody Nightshade*. This is a climbing herb with a somewhat woody stem, scrambling over hedges, &c. It has ovate-cordate or 3-5 partite leaves, and spreading cymes of purple or occasionally white flowers; they usually spring from the middle of an internode, or are opposite to the leaves. The corolla is rotate in form; the anthers large and yellow and subsyngenesious, dehiscing by pores at the apex. The berry is ovoid scarlet, and rarely yellow. The berries are poisonous.

S. ni'grum, *Black Nightshade* (Fig. 39), is an annual with small white flowers, found in waste places, growing from 6-24 inches. The flowers droop, the anthers are not coherent (1, a), and the berries are globular and usually black (3); the variety with scarlet berries is known as *minia'tum*, found in Kent and the Channel Islands, but commoner in the Mediterranean regions. The berries have proved fatal in several cases.

(2*) represents the calyx and pistil, the corolla

being removed. (2 **) is a transverse section of an ovary with the much enlarged axile placentas carrying numerous ovules. (4 and 5) are seeds showing the coiled cotyledons of the embryo, which is surrounded by endosperm.

The potato is the tuber of *Solanum tuberosum*, a native of the higher ground of Peru. Its use as a food consists in the large amount of starch (15 per cent.) it contains, the nitrogenous matters being insignificant (1-2 per cent.); consequently it is valueless as food

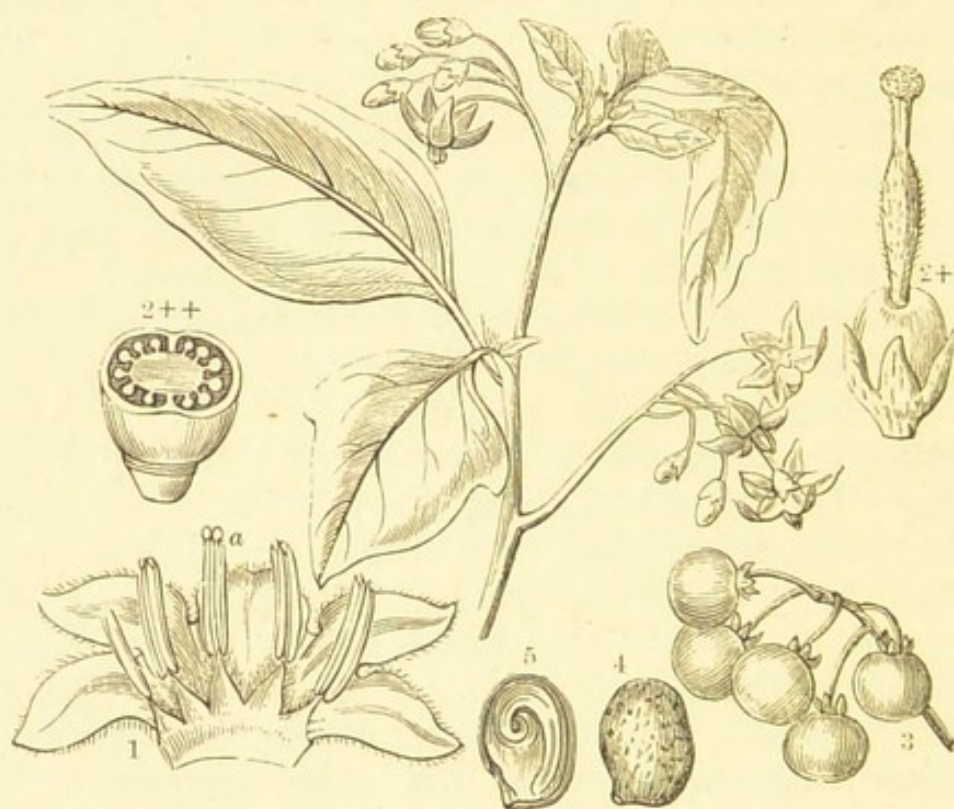


FIG. 39. *Solanum nigrum*.

for restoring the human frame. It is thus the exact opposite in composition to peas, beans, and other leguminous seeds.

ORDER LV. SCROPHULARINEAE.

Fourteen genera represent this order in Great Britain, best known by the peculiar shapes of their corollas. They are all herbs with the general fl. f., 5 or (5). [(5). 4.] (2). One genus, *Veronica*, has a binary or quaternary arrangement (4). [4. 2.] (2).; and

one, *Verbascum*, has five stamens. Many are poisonous; especially the foxglove, though used in medicine; the seeds of the mulleins (*Verbascum*) share in the dangerously sedative properties. Many are cultivated as ornamental plants, such as the snapdragon, which occurs wild in South Europe as on the rocks of Malta. The *Mimulus luteus*, introduced in 1826, has established itself in many rivers.

Artificial Key to the Genera.

Cor. rotate; st. 5	...	...	...	...	...	<i>Verbas'cum</i> , 1.
Cor. personate, spurred; st. 4	...	...	...	...	...	<i>Lina'ria</i> , 2.
Cor. personate, saccate; st. 4	...	...	...	...	...	<i>Antirrh'i'num</i> , 3.
Cor. personate, sub-globose; st. 4 with stde.	...	...	...	...	...	<i>Scrophula'ria</i> , 4.
Cor. ringent, yellow; stigs. flat, irritable; st. 4...	...	...	...	...	...	<i>Mimulus</i> , 4*
Cor. ringent, yellow; calyx inflated	...	...	...	...	...	<i>Rhina'n'thus</i> , 11.
Cor. ringent and bracts purple; calyx not inflated	...	...	...	...	...	<i>Bart'sia</i> <i>Odonti'tes</i> , 9.
Cor. ringent, yellow; tube long	...	...	...	...	...	<i>Melampy'rum</i> <i>pratense</i> , 13.
Cor. ringent, purple; calyx crested	...	...	...	...	...	<i>Pedicularis</i> , 12.
Cor. ringent, white, yellow throat...	...	...	...	...	...	<i>Euphra'sia</i> , 10.
Cor. large, tubular	...	...	...	...	...	<i>Digita'lis</i> , 7.
Aquatic herb; cor. $\frac{1}{16}$ in., pink or white...	...	...	...	...	...	<i>Limosel'la</i> , 5.
L. orbicular; cor. minute, pink and yellow	...	...	...	...	...	<i>Sibthor'pia</i> , 6.
Cor. 4 partite; st. 2	...	...	...	...	...	<i>Veron'ica</i> , 8.
Leafless, white parasite	...	...	...	...	...	<i>Lathrae'a</i> , 14.

1. *Verbas'cum Thap'sus*, *Mullein*. Fl. f., (5). [5. 5.] (2). There are five species of mullein, all very woolly, and bearing yellow flowers, excepting *V. lychnitis*, in which they are whitish. This is a tall herb growing to 3 ft. or more, with decurrent leaves, producing a sort of wing to the stem; it is a common feature in thistles; and bears a dense woolly spike of bright yellow flowers. The corolla is rotate. The stamens are five, instead of four, which is the usual number in this order, but the posterior three are smaller than the two anterior, indicating the tendency to arrest, which is completed in the posterior stamen being usually absent, and the two front or anterior stamens being longer than the other two in the great majority of the genera. *Verbascum* is remarkable for the number of wild or natural hybrids which occur between the different species. They are usually

indicated by combining the two specific names thus, *Thapso-Lychnitis*, *Thapso-nigrum*, *nigro-Lychnitis*, &c. 'Intermediate' species have long been recognized by botanists in many other genera, and these are now considered to be true hybrids, which doubtless constitute a considerable number of what have been previously described as distinct species. Docks and willows are plants among which several hybrids have been recognized. Hybrids are usually quite as fertile, sometimes more so, than their parents.

2. *Linaria vulgaris*, *Toad-Flax*. Fl. f., (5). [(5). 4.] (2). This is a perennial herb with very narrow or linear leaves, flowering from July to October, with spikes of irregular yellow personate (i.e. with the mouth closed) and spurred corollas. A variety with two to five spurs is not infrequently met with, called *Peloria*, a word meaning 'monstrous.' The stamens are of different lengths, the anterior being longer than the posterior pair; but in the *pelorian* variety the complete number, five, may be restored and all of equal length. The honey is in some cases secreted by a gland at the base of the ovary, in others it appears to be actually formed in the tube of the spur; while in others no honey was observed at the base of the flower.

3. *ANTIRRHINUM MAJUS*, *Snapdragon*. This genus only differs from *Linaria* in the corolla being gibbous or bulging at the base, instead of a spur; in fact, it represents the early stage of the flower of the toad-flax, before the spur has elongated. If the front of the corolla be cut away an oval hole will be seen between the bases of the two front stamens, through which the honey is poured into and collected by the pouch. The snapdragon is really a Mediterranean plant, forming large masses on walls in Malta, &c., but it has been so long cultivated here that it has become naturalized on walls. Under cultivation this has assumed a great variety of colours. *A. Orontium* is a small annual, 6-18 ins. in height, occurring in corn-fields. The corolla is red, as in the large snapdragon.

4. *Scrophularia nodo'sa*, *Figwort*. Fl. f., (5). [(5).

4, st.] (2). We have four species, the two commonest being this and *S. aquatica*, occurring in ditches, edges of ponds, &c. They grow to 4 ft. in height, have square stems with opposite leaves. The flowers are small in panicle cymes. The corolla tube is swollen, bearing short lobes. The stamens are four, but the fifth represented as a small purplish scale at the back of the corolla. In most of the flowers of this order the stamens are at the back, so that insects get dusted on the thorax, but in the figwort they are on the front just over the lip, so that the wasps, which are the principal visitors, crawl over the anthers and get dusted on the abdomen. Sometimes the petaloid scale resumes the function of an anther. This would then dust the insect on the back. Being protogynous, the flowers are cross-fertilized before the pollen is removed. Self-fertilization, however, succeeds perfectly.

4*. *MIM'ULUS LU'TEUS*. A sub-aquatic herb, which has become naturalized by many rivers, having been introduced from South America (Chili) in 1826. It has opposite leaves and large solitary yellow flowers. The corolla is two-lipped, the mouth being open (and not closed and personate, as in the snapdragon) is called ringent, i. e. 'gaping.' The stigma consists of two flaps, which lie expanded, but if they be gently touched with some pointed instrument they immediately collapse together. The familiar musk-plant, *M. moschatus*, a native of Columbia, was introduced in 1826. The 'giant musk' is a hybrid between these two species, having the large flowers of the former combined with the scent of the latter.

7. *Digitá'lis purpu'rea*. *Foxglove*. Fl. f., 5. [(5). 4.] (2). (Fig. 40.) The tall foxglove occurs in most counties of England, and is often cultivated. The corolla is an inflated tube (1), red and spotted within. The four anthers stand close together with the stigma in the middle, but they mature in succession, the upper pair first, then the lower pair, and finally the stigma. In this, as in the four preceding genera, the insect which visits the flower for honey, which is

secreted by the receptacle at the bottom of the corolla tube or by the base of the ovary, gets dusted on the back, and as a rule the stigma is not ready when the anthers of the same flower burst, self-fertilization is for a time prevented, if not altogether. (1) represents a complete flower, the calyx being polysepalous (4), a rather unusual condition in this order; (2) shows the two long and two short stamens, the fifth being suppressed. It represents the last stage of the flower in which all four anthers (3) have burst and shed their

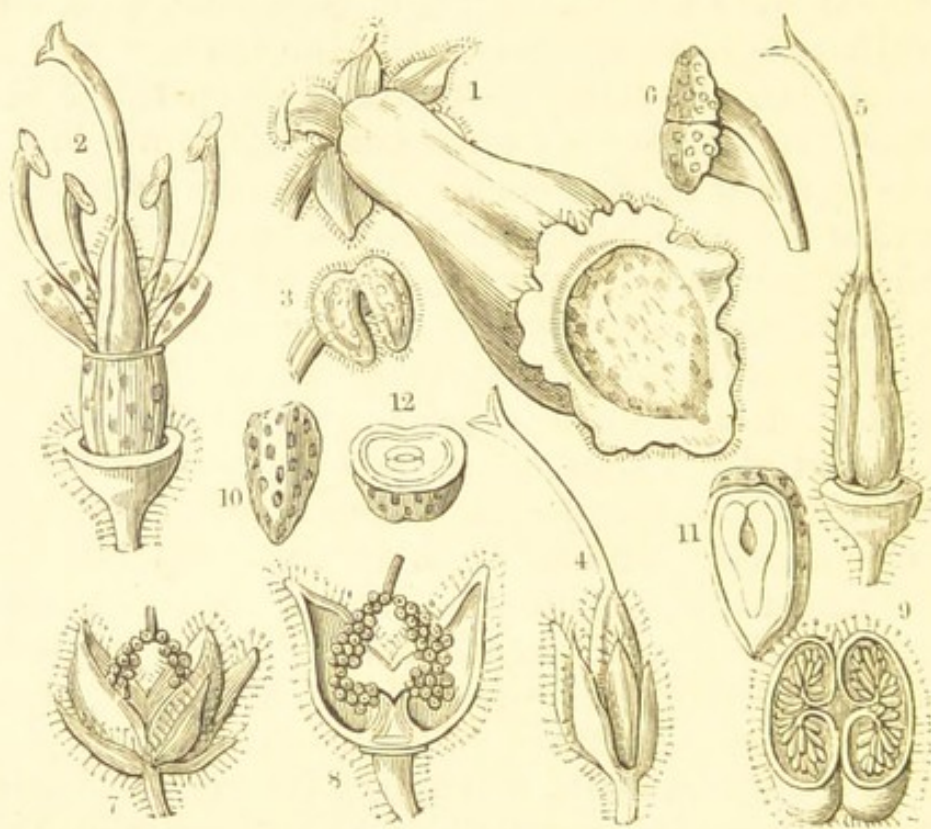


FIG. 40. *Digitalis purpurea*.

pollen, and the two lobes of the stigma are now spreading to receive the pollen, as in (6). (4) is a pistil with the persistent calyx, removed in (5); (7) is a dehiscent capsule surrounded by the persistent calyx; (8) is a vertical section of the capsule more enlarged and showing the numerous seeds on the axile placentas; (9) a transverse section of the capsule; (10), (11) and (12) are seeds. The embryo is straight, embedded in albumen.

8. *Veronica Chamædrys*, *Germander Speedwell*.

Fl. f., (4). [(4). 2.] (2). This is a perennial with bright blue flowers in long racemes, each flower being in the axil of a bract. If this species be compared with the annual, *V. hederacfolia*, a common garden weed, having a single flower in the axil of every leaf, these two species will illustrate the origin of a raceme; for if the leaves in the latter be reduced to the bract-form, it would at once pass from being a 'one-flowered axillary inflorescence' to a many-flowered bracteate raceme. Hence, what quantity of flowers go to make up an inflorescence is really regulated by the presence of leaves or bracts as the case may be. With regard to the fertilization of the germander speedwell, the two stamens spread away from the style, and each has a little bend in the filament, at the base where it is united to the corolla, constituting a sort of hinge. When an insect wishes to alight it seizes the two stamens and style, dragging them together under its body to form a support. It thus gets dusted just where the stigma of another flower will strike it. A very similar method of pollinization will be seen in the enchanter's nightshade (*Circaea*). The front petal, not being required to support the insect, is the smallest of the four. Of other species, *V. Beccabunga*, with opposite ovate leaves and bright blue flowers on axillary racemes, and *V. anagallis*, with opposite, narrow, pointed leaves and racemes of small lilac or white flowers, grow to a large size in water. They are both quite glabrous, as is the general rule with aquatic plants.

9. *Bart'sia alpina*. This and the five remaining genera of this order are remarkable for being parasitic upon other plants, in that their roots, when coming in contact with those of grasses, &c., attach themselves to the latter, and then drive root-like suckers or haustoria into the host-plants, from which they derive their nourishment. As the first four of these genera have green leaves they can live to some extent as non-parasitic plants, but experiments show that their powers of assimilation are mostly enfeebled; for having

acquired the property of parasitism they seem to require the aid of the host, or else decomposed organic matter, upon which they are often saprophytic, to secure complete nutrition and vigour. They are all herbs, usually small with ringent corollas. *Bartsia alpina* is one of our arctic plants of subalpine meadows, ascending to 3,000 ft. in Scotland. Not only is it parasitic, but it bears small conical buds at the base, the scales of which are provided with what are believed to be insectivorous glands. *B. Odontites* is a very common plant, with opposite leaves and dull purplish red bracts and flowers, frequent among grass by roadsides. *B. viscosa* is viscid and bears yellow flowers. It only occurs in the South and West of England, and is a member of the Mediterranean flora.

10. *Euphra'sia officina'lis*, *Eyebright*, is a small herb with a white or lilac and purple-veined corolla. The anthers are deep red and fringed. There are two forms, representing different degrees of development of the style; one with a larger corolla and the stigma long exserted; the other with a smaller corolla and the stigma close to the anthers. These forms correspond with their methods of fertilization; the former being more entomophilous, the latter more inclined to self-fertilization.

11. *Rhinan'thus Crista-gal'li*, *Yellow-rattle*. This is very common in poor pasture land, as it is a cause of the enfeebled state of the grass. It has yellow flowers in an inflated calyx: a tall sub-species, *major*, is not infrequent in cornfields. It is parasitic on grass and corn.

12. *Pedicularis sylvat'ica*, *Lousewort*. This and *P. palustris* have pink or white flowers. The leaves are pinnately lobed, much cut, resembling some fern leaves. The calyx is crested.

13. *Melampy'rum pratense*, *Cow-wheat*. This genus has four species. This one is common in woods, &c., bearing narrow leaves and small yellow long-tubed corollas.

14. *Lathrae'a squama'ria*, *Toothwort*. This is a

greenless fleshy root-parasite. The degradation of structure and function is complete ; for it has lost its leaves and powers of assimilation. It attaches itself to the roots of hazel, but is also a saprophyte, and is insectivorous as well, for the numerous white thick scales which are crowded all over the rhizome or underground stem have cavernous spaces within them, formed by the folding back of the tip of the scale. On the surface of these hollows are numerous glands of two sorts: one appears to emit threads which capture very minute insects, while the others act as absorbents of the nutritious matters dissolved out of the prey.

ORDER LVI. OROBANCHEAE.

This order contains one British genus, with six species. They are all greenless parasites, brownish-red or violet colour.

Oroban'che ma'jor, *Broom-rape*. Fl. f., (2) + (2). [(5). 4.] (2). The name is given from this species, which attaches itself to the roots of broom and grows to 1-2 ft. high. It is entirely brown with yellow and purplish flowers. *O. minor* is perhaps the commonest species, running into several varieties. It is found on clover, often doing considerable damage if numerous, on ivy, on *Picris* (*Compositae*), &c. It is protogynous ; but the stigma arches over the stamens, and can so get dusted by self-pollination.

ORDER LVII. LENTIBULARINEAE.

Two genera represent this order, remarkable for their insectivorous habit¹. They are either aquatic (*Utricularia*) or marsh-plants (*Pinguicula*).

Pingui'cula vulga'ris, *Butterwort*. Fl. f., (5). [(5). 2.] (2). They are herbs with rosulate leaves, i. e. arranged in rosettes, quite entire and yellowish-green. The margins are incurved, giving a spoon-like form. The scapes have a single purple and spurred flower,

¹ A full account of these plants will be found in Darwin's *Insectivorous Plants*.

somewhat resembling a violet. The capsule is ovoid or sub-globose. It is abundant in damp places in the West of England. The surface of the leaf is covered with microscopic stalked button-like glands, composed of four, eight, or sixteen radiating cells. If any object, as a piece of hard-boiled white of egg or a dead fly, be placed upon a leaf, after some hours the margins roll over it, so that it lies between two layers of glands, above and below. These now secrete acid and fermentative fluids, dissolving out the nutritious nitrogenous matters, and absorb them into the leaf. After everything of value has been extracted, the leaves expand again, the indigestible parts being left behind. The leaves are used in Lapland for curdling the milk of the reindeer, hence the English name. *P. lusitanica* is a smaller species, with pale lavender flowers. It has a similar construction, the leaves being adapted to catch minute thrips. It is tolerably common in the heath near Swanage, and ranges from Hants to Cornwall. It occurs in France, Spain, and Portugal, and is therefore one of the Norman flora, which just reaches the South-west of England. *P. alpina* occurs in Skye and Ross, and is a member of the arctic flora.

Utricularia vulga'ris, *Bladderwort*. Fl. f., (2) [(5). 2]. (2). This is a submerged aquatic plant, with finely dissected leaves, bearing ovoid traps at the bases of and upon the leaf-segments. The flowers are irregular and spurred, on erect aërial peduncles. The corolla is bright yellow. The stigma is irritable, just as described in *Mimulus*. The little traps are provided with flap-like lids, which can be lifted up by a water-creature which enters the trap, but it cannot be again raised from the inside. The animal soon dies. Then some curious structures, consisting of groups of four large cells projecting from the inner surface, perform the function of absorbing such nutritious matters as the dead animal may supply¹.

¹ See Darwin's *Insectivorous Plants* for a long and interesting description of the minute structure and method of nutrition.

ORDER LIX. LABIATAE.

Seventeen genera represent this order in Great Britain. There is considerable uniformity, in that they are all herbs with square stems and opposite leaves. The majority are strongly scented in consequence of the presence of glandular hairs containing ethereal oils. Hence several are used as kitchen herbs, as thyme, sage, marjoram, mint, &c. No member of the order is poisonous, and several yield perfumes, as lavender, thyme, patchouli, &c. The inflorescence consists of axillary glomerules or sessile dichotomous cymes. The two opposite ones together resemble a whorl, called a verticillaster or false whorl. The order of blossoming of the flowers in a glomerule is as follows: 3. 2. 3. 1. 3. 2. 3; No. 1 being exactly over the petiole of the leaf. The glomerule may be reduced to one flower only, as in *Scutellaria*. In *Clinopodium* it becomes stalked or pedunculated. It may then be seen that it is a reduced cyme, as is well illustrated in *Stellaria Holostea* of the *Caryophylleae*. The flowers are always irregular, the calyx often partaking of the irregularity with the corolla, which is lipped in front, the anterior petal (often notched as if it were composed of two) being enlarged as a landing-place for insects. The two posterior petals together form a hood (Fig. 41. 1, *b*); when the flower is said to be bi-labiate or two-lipped, the two lateral petals being sometimes atrophied to mere points, as in the dead-nettle. There are four stamens in all the genera excepting *Lycopus* and *Salvia*; of these four, the anterior pair are always the longer; except in *Nepeta*; the fifth, posterior, stamen, which should be present to complete the symmetry, is suppressed, just as in the *Scrophularineae*. Occasionally a flower is to be found perfectly regular and funnel-shaped, with the fifth stamen restored, all five being of the same length. Such is called a reversion to the primitive type, from which irregular flowers have descended. The pistil has a deeply divided ovary, ripening into four nutlets,

each containing one erect seed. The style arises from their very base in the middle and is therefore called gynobasic, as in the *Boragineae*. In consequence of their great uniformity, the fl. f. is the same for every genus, excepting *Salvia* and *Lycopus*, which have two instead of four stamens. Fl. f., (5). [(5). 4.] (2).

Artificial Key to the Genera.

Calyx \pm 2-lipped.

Corolla with distinct hood and lip (i.e. 2-lipped).

St. 2, connective elongated ... *Salvia*, 6.

St. 4, erect, post. pr., longer; cal. 15 ribbed ... *Nepeta*, 7.

St. 4, erect, ant. pr., longer; cal. 13 ribbed ... *Calamintha*, 5.

St. 4, spreading, do., longer; cal. 10 ribbed ... *Thymus*, 4.

Calyx, upper lip flat; fil. 2-fid at top ... *Brunella*, 8.

Calyx, upper lip pouched, fil. simple ... *Scutellaria*, 9.

Calyx tubular, densely woolly plant ... *Marrubium*, 11.

Calyx 5-toothed, sub-regular.

Cor. sub-regular, very small; st. 4, spreading ... *Mentha*, 1.

Cor. sub-regular, very small; st. 2 ... *Lycopus*, 2.

Calyx teeth small; fls. within imbricated coloured bracts

Origanum, 3.

Calyx teeth very broad; anth. glabrous; cor. $\frac{1}{2}$ in. long

Ballota, 15.

Calyx teeth very narrow; anth. hairy; cor. 1 in. long

Mellittis, 10.

Calyx teeth very narrow; anth. glabrous

Stachys, 12.

Calyx teeth spinous; anth. ciliated, valves transverse

Galeopsis, 13.

Cor. hood. 2-partite, yellowish; st. exserted ... *Teucrium*, 16.

Cor. hood. wanting, blue; st. exserted ... *Ajuga*, 17.

1. *Men'tha sylves'tris*, *Horse-mint*. The genus *Mentha* has seven species, and a large number of sub-species, according to Hooker's arrangement. They are strong-scented; more than one has the odour of peppermint, as the common water-mint, *M. aquatica*, and the true peppermint, *M. piperita*. The horse-mint is rare in England, being the commonest in the East, as Palestine, where it is cultivated. It is the species alluded to in Scripture (Matt. xxiii. 23). A variety, *M. viridis*, is cultivated in gardens. The peppermint is also a doubtful native. *M. aquatica* is softly hairy, with ovate leaves, the glomerules large, pale lavender in colour, the pedicels and flowers very hairy. It is a common plant by watersides, and very strong-scented.

4. *Thy'mus Serpyll'um*, *Thyme*. A small prostrate wiry herb, frequenting dry banks, &c., strongly scented. The leaves are very small and quite entire, the margins often being revolute. This feature is common in plants of hot districts, as deserts, and tends to protect the lower surface against radiation and loss of water.

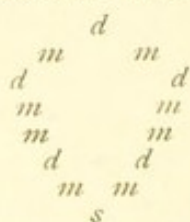
Thyme has a rather more decidedly two-lipped corolla, but agrees with mints in the corolla being very small, and in the stamens spreading, so that it has departed somewhat less from the labiate type. More than thirty insects have been seen visiting it. In all the mints and in thyme with exserted anthers, the corollas are so small that any large insect, as a bee, crawling over a glomerule, gets dusted indiscriminately and not in a definite manner, as in large-flowered labiates, the blossoms of which are entered separately, as of *Salvia* or *Lamium album*. The still slightly irregular flowers of mint and thyme, as well as the unequal lengths of the two pairs of stamens, show that they have descended from some such flowers as the dead-nettle; just as all the Labiatae have descended from regular flowering forms.

5. *Calamin'tha officina'lis*, *Calamint*. In this species the inflorescence is a loose cyme, and not a true glomerule; the calyx is not bulging at the base, as in *C. Acinos*. Basil Thyme. The anther-cells are rather widely separated by a broad connective. This illustrates the first stage in the development of the long curved connective of *Salvia*. Some labiates have the stamens like the letter T, the stem being the filament, the cross-bar the connective, bearing an anther-cell at each end. If this could oscillate at the point of junction, the stamen of *Salvia* is obtained. Another common species, *C. Clinopodium*, is softly hairy, and has hemispherical dense glomerules. The flowers are accompanied with many long, ciliated bracteoles. The calyx is also ciliated.

6. *Sal'via Verbena'ca*, *Clary*. Fl. f., (5). [(5). 2, 2 stdes.] (2). This is a herb 1-2 feet, growing in dry pastures. The leaves are wrinkled on the surface.

The glomerules are 3-flowered on long bracteate spikes. The corolla is purple. The chief peculiarity in the flowers of this genus—of which *S. officinalis*, Garden Sage, will supply flowers for examination—resides in the structure of the stamens, of which there are only two perfect, the other pair being rudimentary staminodes. They have very short filaments, which support a curved, oscillating connective; at each end of which is an anther-cell, as explained under 5. *Calamintha*. The two upper ones contain pollen, but the lower anther-cells are usually empty and spoon-like. When an insect alights on the lip, its head depresses the two lower abortive anther-cells. This causes the upper ones to come down and strike the bee on the thorax or back. On retiring, the anther-cells return to their previous position within the posterior hood. The forked stigma projects forward and strikes the bee on the spot just where the pollen from a previous flower had been deposited. A variety called *clandestina*, which usually does not open its corolla, has the stigmas curling between the anther-cells, and is thus self-fertilizing.

The distribution of the cords or ribs on the calyx is interesting. It will be seen that it is somewhat two-lipped or bi-lobed. It has five ribs corresponding to the teeth or mid-ribs of the sepals. Then, two 'marginal' cords occur where the three posterior sepals are united; and there are two marginal cords in front, together with a supernumerary cord between them in the front. Lastly, there are a pair of marginal cords at each side. Hence if *d* stand for the five dorsal or mid-ribs, *m* for marginal cords, *s* for the extra one in front, the arrangement may be represented thus—



The question arises, how has this come about? It appears to be an instance of adaptation to bear the weight of the insect. The cords are added *just where the strain would be felt*; for their use is to support the corolla-tube, which, in turn, carries the bee.

It may be here added that the irregularity of this flower, as well as of all others, has arisen in all probability in a similar way, by a slow adaptation to the constant insect-visitor; the form having at last been acquired which is best suited to support the insect¹.

7. *Nep'eta Glecho'ma*, *Ground Ivy*. A procumbent herb with orbicular-reniform leaves, with deeply crenated margins and 3-6 fld. whorls of small blue-purple flowers, blossoming in early spring. It is common on shady banks, &c. The flowers are dimorphic, the larger being bisexual, the smaller female only. Another species, *N. Cataria*, Cat-Mint, has pubescent leaves and white flowers. It is, however, rare. This is the only genus in which the posterior pair of stamens are longer than the anterior pair.

8. *Brunel'la (Prunella) vulga'ris*, *Self-heal*. This plant has a creeping and rooting stem, terminating in dense glomerules with blue flowers. It is common in pastures. The calyx is flattened at the back. The filaments are cleft at the top, one branch being antheriferous.

14. *La'mium al'bum*, *White Dead-nettle*. Fl. f., (5). [(5). 4.] (2). As this is one of the commonest, and easy of examination, it may be taken as a type for study. It is a perennial herb, with annual erect flowering stems, arising from a creeping subterranean stem. The leaves are cordate and serrate, resembling in shape those of the stinging nettle (*Urtica*), hence the English name. Being opposite on a square stem increases the resemblance. The calyx is nearly regular, while the corolla is very irregular; the five petals may be detected by their alternation with the five teeth of the calyx, as follows: the lip in front, though notched, is one petal; the hood behind consists of two; while the remaining two are represented by small points, one on either side of the tube. The four stamens have their anthers arching under the

¹ The arguments and facts in support of this suggestion will be found fully given in the writer's *Origin of Floral Structures* and *The Making of Flowers*.

hood. The two anterior pair of filaments, which cross over to the back, are the longer. This is the rule, the only exception being in *Nepeta*, in which genus the posterior pair are the longer. The deeply 4-lobed ovary is the most characteristic feature, together with the gynobasic style and forked stigma. If a calyx from which the corolla has fallen be squeezed at the base, the four nutlets will readily escape and will break asunder if nearly ripe. *L. purpureum* is a common weed in waste places, having its verticil-



FIG. 41. *Ballota nigra*.

lasters sub-terminal and crowded. The corolla is red-purple. *L. amplexicaule*, Henbit Dead-nettle, is a corn-field weed with deeply-crenated broad and sessile leaves; glomerules of small red flowers which are often cleistogamous, the stigmas in which curl back between the anther-cells, which mature together with them, so that it is self-fertilizing. It is one of the most widely-spread labiates in foreign countries.

15. *Ballo'ta ni'gra*, *Black Horehound* (Fig. 41). This is a perennial, coarse, fetid herb, growing to

a large size in hedgerows. It has very hairy, ovate-crenate leaves. The glomerules are dense-flowered and turned to one side or secund. (1) is a complete flower showing the broad border or limb to the calyx (*a*). This is ten-ribbed, i. e. five cords correspond to the mid-ribs of the calycine leaves and five are additional strengthening ribs running up the coherent margins. The corolla is a dull purple, the lip (*c*) being veined with white. (2) shows the stamens inserted upon the corolla, the two outer, i. e. anterior pair, being the longer, as is always the case, except in the genus *Nepeta*. The anther-cells are separated (3); this is the first stage towards the conditions seen in *Calamintha* and *Salvia*. (4) is the pistil showing the ovary to be deeply four-lobed, each lobe containing one erect ovule. The style arises from the base and is called gynobasic; the stigma is forked (5). (6) is the ripe fruit consisting of four nutlets still coherent, (7) being a separated nutlet. (8) is a transverse section showing the albuminous seeds with an erect embryo (*a*) in each.

16. *Teucrium Scorodonia*, *Wood Sage*. This grows in stony places, especially heaths and dry hedges, &c. The leaves are strongly crenated, darker above than below. The flowers are small, yellowish-green, on elongated spikes, a terminal and several axillary ones making a sort of panicle. The stamens are erect and carry their mature anthers forward, while the style is undeveloped. After shedding the pollen, they wither and retire backwards; the stigmas, now mature, occupy the same position as the anthers did at first.

17. *Ajuga reptans*, *Bugle*. An almost glabrous herb with a creeping stem: common in pastures. It bears an erect flowering-stem 6-12 ins.; corolla, blue-purple, occasionally white or rosy. The hood is reduced to a notched lobe; the lower petal is spreading and 3-fid. Hence the filaments are quite exposed.

DIVISION III. INCOMPLETAE.

ORDER LXI. CHENOPODIACEAE.

This order contains six genera of herbs; and as there is no corolla the flowers are inconspicuous. Two, *Chenopodium* and *Atriplex*, abound in waste places; while *Beta* (Beetroot) and the remaining three are maritime plants frequenting salt marshes.

Chenopodium album *White Goosefoot*. Fl. f., (5).
o. 5. (2). (Fig. 42.) A common herb, with rhombic,

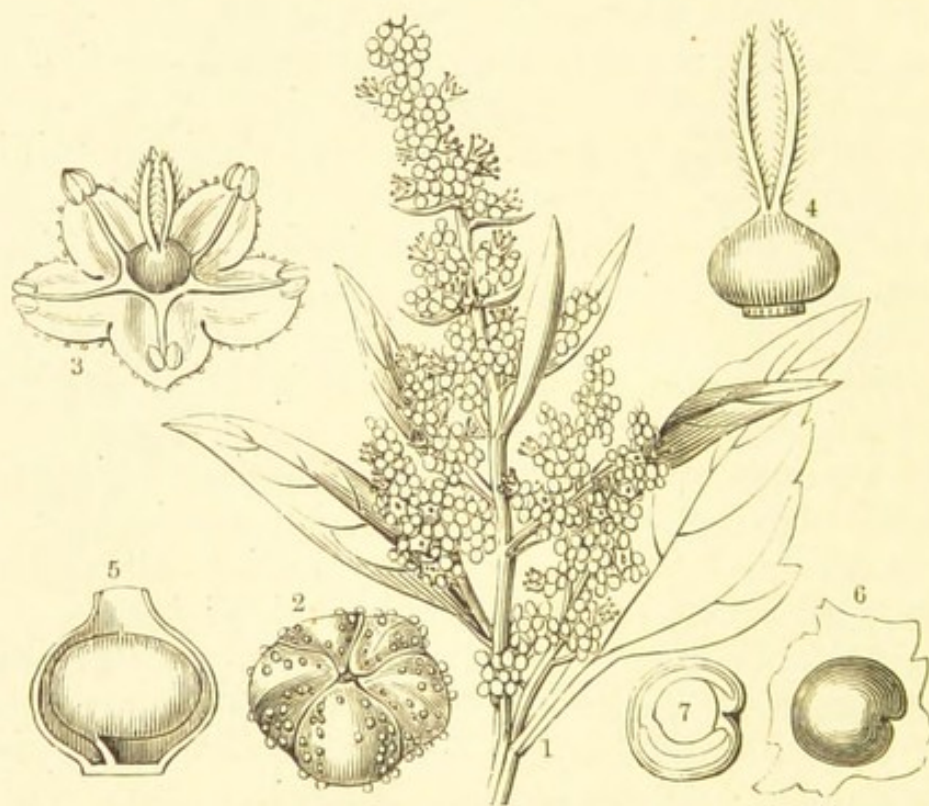


FIG. 42. *Chenopodium album*.

toothed leaves, more or less mealy. This is due to minute water-cells. The flowers are minute, in panicles (1); the calyx (3) has the sepals somewhat keeled (2). The five stamens, as is usually the case in the Division *Incompletæ*, are opposite, i.e. in front of the sepals. This shows that the intermediate whorl, or corolla, is wanting. The pistil has two styles (4), but a single ovarian chamber (5), with the ovule attached to the bottom by an oblique cord or funicle. The seed-vessel

forms a thin membranous bag, bursting irregularly when mature, and contains a single black, flattish seed (6). (7) shows a section of the seed with the embryo coiled round the albumen: a condition also seen in most of the *Caryophylleae*, as Chickweed.

Be'ta marit'ima, *Beetroot*. Fl. f., [(5). o. 5.] D; (2-4). A glabrous perennial common by the sea. It has a rootstock tapering into a vertical root. The flowers are in clusters of two or three, and sessile. There is a thick disk within the flower, into which the ovary is sunk. It is the origin of garden beet and mangold wurzel, by the naturally perennial habit having been changed to a biennial, and the tap-root much enlarged.

A'triplex pat'ula, *Orache*. Fl. f., m., (5). o. 5. o; f., 2. o. o. (2); bisex., 5. o. 5. (2). The general appearance of orache resembles the goosefoots, but the flowers are polygamous, and as a rule it is the female flowers only which bear seed.

Salicor'nia herba'cea, *Marsh Samphire*. Fl. f., o. o. 2. (2). A small herb, 6-18 ins., with no leaves, the stems consisting of fleshy joints, in which the minute flowers are sunk. Each has a rounded, fleshy, turbinate bract, two stamens and a pistil. It is sometimes pickled, as well as burnt for barilla or impure carbonate of soda.

Sal'sola Ka'li, *Saltwort*. Fl. f., 5. o. 5. (2). A sea-side woody plant, with short prickly leaves and minute green flowers. In the fruiting state the sepals develop broad horizontal wings concealing the fruit. It derives its name from the alkalis it contains.

ORDER LXII. POLYGONACEAE.

This order contains three genera, of which *Rumex*, Dock, and *Polygonum* are common everywhere; but the third, *Oxyria*, Mountain Sorrel, only occurs by mountain streams, and is a remnant of the Arctic flora, being only found on high mountains and in the Arctic regions.

Polyg'onum avicula're, *Knotgrass*. Fl. f., [5. o.

7 or 8]. (3). (Fig. 43.) This little weed is extremely abundant by roadsides and waste places. It has very small pink and green flowers, sessile in the axils of the leaves (1). (2) shows the base of a leaf with the fringed ochreate (boot-like) stipule (*a*), which sheaths the stem and petiole. It is drawn split open in order to remove it. (3) is a flower in which the anthers and stigmas are seen to be of the same height, or homomorphic; so that this species is perfectly self-fertile, there being no honey-glands to attract insects. In

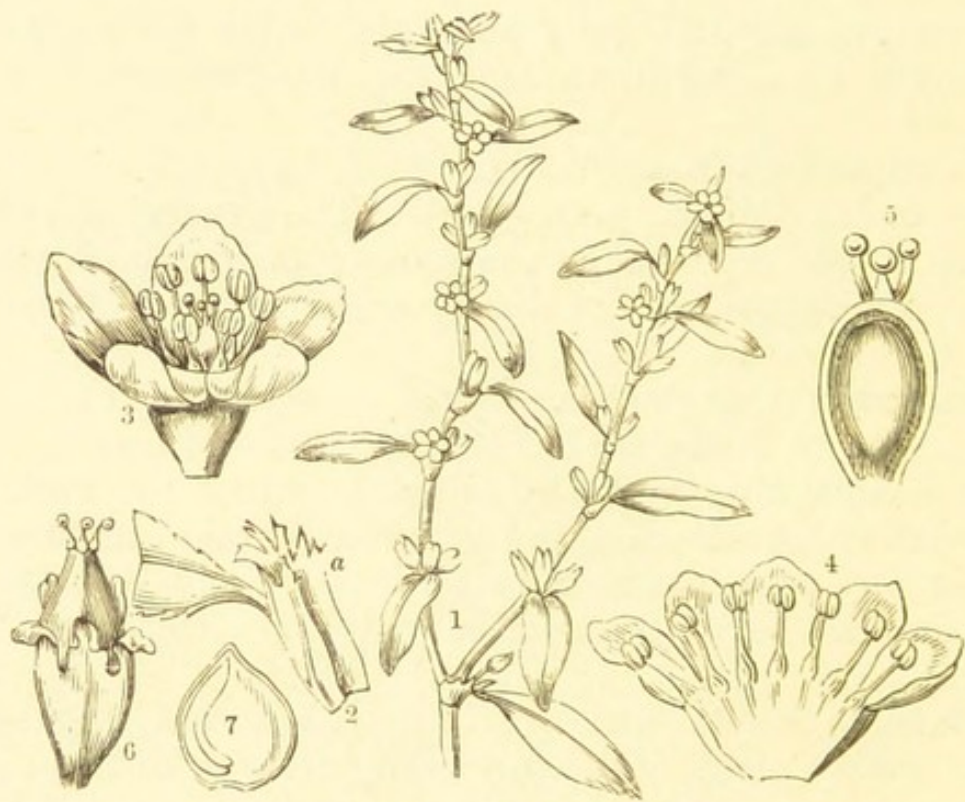


FIG. 43. *Polygonum aviculare*.

another species, *P. Bistorta*, Bistort, the calyx is red; there are honey-glands, while the buckwheat, also of this family, has dimorphic flowers like those of the primrose; (4) is the flower laid open to show the stamens adherent to the base of the sepals, or rather the brim of the receptacular tube; (5) is the pistil composed of three carpels, as indicated by the three styles and stigmas, but having only one ovarian chamber and one erect ovule; (6) is the ripe fruit invested by the persistent calyx; (7) is the seed seen in section show-

ing the embryo and albumen, the radicle pointing upwards.

Ru'mex obtusifo'lius, *Dock*. Fl. f., 3 + 3. o. 3 + 3. (3). There are six species of Dock about equally common on waste ground, two frequenting wet places, ditches and river-sides, and one a rare species occurring in marshes, called golden dock. Two others are known as sorrel and sheep's sorrel. The species of dock are distinguished by differences in the sepals and by the presence or absence of oval tubercles on them. The present species or broad dock is known by its obtusely-tipped leaves, cordate at the base, and erect panicles of flowers.

Ru'mex aceto'sa, *Sorrel*. Fl. f., m., 3 + 3. o. 3 + 3. o; f., 3 + 3 o. o. (3). This and *R. Acetosella*, occurring in dry pastures, sandy heaths, are dioecious. The leaves are hastate, or sagittate. The sorrel is used as a pot-herb, is acid in taste, as it abounds in binoxalate of potash.

ORDER LXIV. THYMELACEAE.

One genus, *Daphne*, with two species, represents this order; both low shrubs, occurring in copses and hedgebanks, but not very abundantly. They are peculiar for having an acrid juice, as well as a tough fibrous bark. That of *Lagetta lintearia*, when teased out, appears like lace, hence the name of the lace-bark tree of the West Indies. The berries of both the species of *Daphne* are very poisonous.

Daph'ne Laure'ola, *Spurge Laurel*. Fl. f. [4. o. 4 + 4.] 1. The leaves are coriaceous or leathery in texture, and evergreen. The flowers are fascicled or clustered in the upper axils, and green.

D. Meze'reum (Fig. 44) differs from the preceding in that the flowers have a coloured calyx, are fragrant, and blossom before the leaves are fully developed. It is an acrid and poisonous plant. (1) is a flowering branch, the terminal cluster of leaves beginning to be developed; (2) is a flower cut open to show the adherent stamens (4*) and the one carpel which alone

constitutes the pistil; (3) is a vertical section of the ovary, showing the single pendulous ovule (*c*). The orifice, called the foramen or micropyle, through which the pollen tube will pass, is very large at (*b*). A curious bag-like structure envelops the lower end (*a*). This is really the lining of the ovary which has separated from it, and clings more or less closely to the ovule (*c*).



FIG. 44. *Daphne Mezereum*.

(4) are ripe berries, of course superior fruits, and therefore differing from gooseberries and currants, which are inferior; (5) is a berry cut open, showing the seed from which (6) is the embryo extracted. Both these species of *Daphne* are powerfully acrid poisons. Children have been frequently poisoned by eating the berries. The properties appear to be akin to those of monkshood and the deadly nightshade.

ORDER LXVI. LORANTHACEAE.

A single plant, the familiar Mistletoe, represents this order in this country.

Vis'cum al'bum, *Mistletoe*. Fl. f., *m.*, 4. o. 4. o;

f.; {(4). o. o. 1.}. An evergreen parasitic shrub with jointed internodes and opposite, narrow, thick leaves, with axillary and terminal clusters of sessile flowers. The male flower consists of four fleshy sepals, with an anther in front of each, opening by several pores. The female has an inferior ovary, with four sepals on the summit. The berry is white, globose, with a very viscid juice. The embryos 1-3 are green; if two, they often may cohere by their cotyledons. It occurs most frequently on apple-trees, rarely on the oak.

ORDER LXVIII. EUPHORBIACEAE.

Three genera represent this order in Great Britain, *Euphorbia*, Spurge, *Buxus*, the Box, and *Mercurialis*, Dog's Mercury. It is really a very large order indeed, containing many poisonous but other useful plants. Tapioca is starch extracted from a very poisonous plant known as the cassava. The oil of the seeds of some plants, as the croton oil, is powerfully active, though that of the castor-oil plant is mildly so.

Euphorbia Pep'lus, *Petty Spurge*. Fl. *f.*, *m.*, o. o. 1. o; *f.*, o. o. o (3). (Fig. 45) is a common species, taken to illustrate the genus. (1) is the terminal part of a plant bearing inflorescences in the forks of the branches as (*a*). (2) is an inflorescence enlarged, consisting of a coherent cup-like involucre (3, *b*) with crescent-like glands (*a*) on the rim (3, *a*). This contains many male flowers (3, *c*), (4) and one female (2 *b*). (3) exhibits the interior of the involucre, showing numerous stamens of different lengths (*c*), indicating different degrees of development. Each stamen (4) has a joint in the apparent filament (*a*); but the interpretation is that (*b*) represents a pedicel, and (*c*) the true filament. Hence each stamen is all that exists to represent a male flower. In some species there is a little lacinated bract at the base of each stamen. (5) is a section of the 3-celled ovary. (6) a fruit which separates elastically into three valves, liberating the seeds and throwing them to a distance. The seeds (7) are slightly downy, pale straw-coloured, and

spotted with purple. There is a white protuberance at one end called a caruncle (*a*). (8) shows that the seed is albuminous and contains a straight embryo.

All the Euphorbias have a milky poisonous juice. Village children have been known to rub their arms with the juice of the petty spurge to raise an eruption, in order to escape going to school! There is a foreign species often cultivated called the caper-spurge. The fruit closely resembles that of the nasturtium (*Tropaeolum*), and has been pickled instead of it. In a

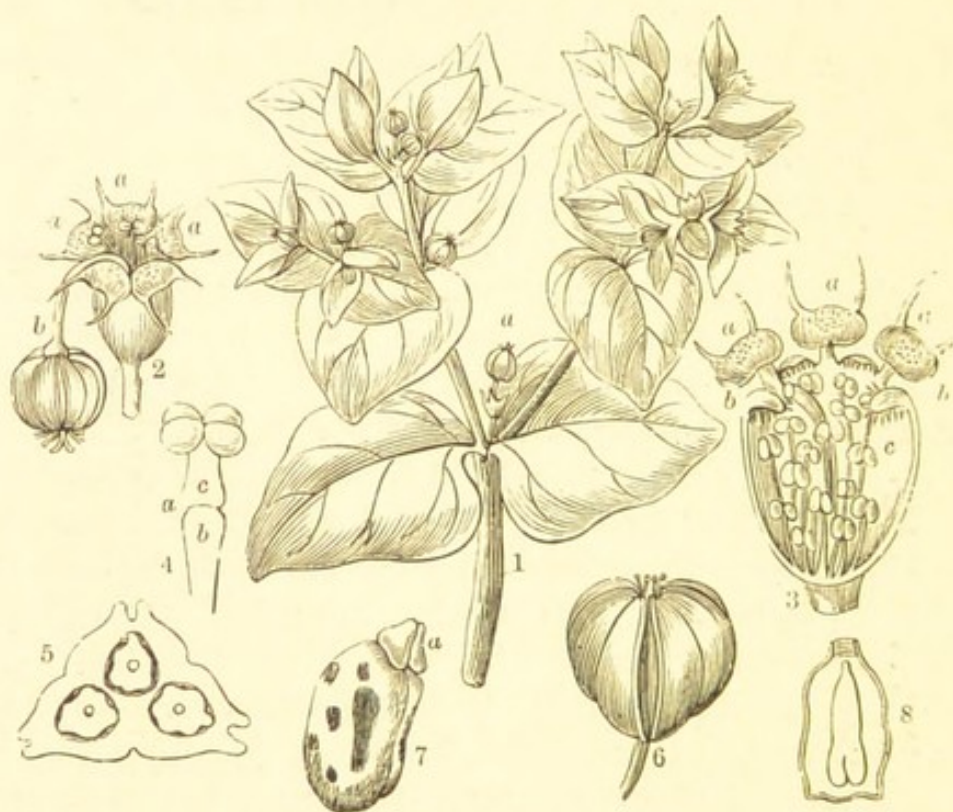


FIG 45. *Euphorbia Peplus*.

fresh state it is very acrid; but of course the acridity is reduced by pickling; but as capers and the harmless nasturtium are easily procurable, the caper-spurge should never be used. A child has been known to have been poisoned by eating the leaves of *E. Peplus*.

Buxus sempervirens, *Box* Monoecious. Fl. f., *m.*, 4. o. 4. o; *f.*, 3 brts.; 4. o. o. (3). An evergreen shrub or small tree with opposite, small obtuse leaves, remarkable for the epidermis being free from the

underside except round the edge. It is a native of chalk hills, as at Boxhill. The wood is of slow growth and very close-grained, hence it is admirably adapted for wood engravings, mathematical instruments, &c. It is imported from the Levant for these purposes. A dwarf form is used for edging in gardens. The box is mentioned in Scripture—‘They have made thy benches of ivory inlaid in box-wood’ (Ezek. xxvii. 6), in allusion to the luxuries of the Tyrians.

Mercuria’lis peren’nis, *Dog’s Mercury*. Dioecious. Fl. f., *m.*, 3. \circ . \pm 9. \circ .; *f.*, 3. \circ . 2 stdes. (2). It is a herb with opposite leaves and minute stipules, and grows in shady places, spreading much, by means of its slender underground stem. The male flowers are in slender spikes, the female on short stalks. Both male and female flowers are occasionally found on the same plant. *M. annua*, a small herb, occasionally occurs in cultivated ground, but it is more common in the Mediterranean regions. Its leaves are sometimes boiled as a pot-herb, but it is decidedly unwholesome, as several people have been poisoned by eating it as a salad. The dog’s mercury will yield a dye resembling indigo and woad.

ORDER LXIX. URTICACEAE.

Four genera only are included in this order: the elm tree, nettles, pellitory, and hop.

UL’MUS CAMPESTRIS, *Common Elm*. Fl. f., [(5). \circ . 4-5.] (2). A large tree with oblique, distichous, rough leaves. The roots send up numerous suckers. It is an introduced tree, and the obovate samaras fall without ripening their seeds. The seed is above the centre of the samara. In the indigenous species, *U. montana*, Mountain or Wych Elm, the seed is in the centre of the samara, and the leaves are larger, often 3 ins. in diameter. The distichous or 2-ranked and horizontal leaves of the elm, as also of the nut, lime, &c., are due to the habit of growth. For in some cases, as the common laurel (*Prunus Lauro-cerasus*), it may be observed that when a shoot

grows vertically, its leaves are arranged spirally round the stem; but when the laurel has its shoots spreading horizontally, as is usually the case, then they form two ranks, and are said to be distichous. Ivy exhibits similar differences between the leaves on the stem climbing up a wall and the free growing shoots at the top.

Urti'ca dioi'ca, *Stinging Nettle*. Dioecious. Fl. f., *m.*, 4. ○. 4. ○; *f.*, 4. ○. ○. 1. A coarse herb, 2-4 ft., with square stems and opposite, stipulate leaves, covered with hairs, many stinging. The male inflorescence consists of loose panicles, the female is in more compact panicles. The stamens are highly elastic, being curved inwards in bud; they spring backwards, curving outwards, on the expansion of the sepals, thus facilitating pollination, which is affected by the wind, the flower being anemophilous or 'wind-loving.' The young shoots are an excellent substitute for spinach. The other two species, *U. urens* and *U. pilulifera*, are annuals, occurring in cultivated ground or waste places, the latter only in E. England, near the sea. It is a common species by the Mediterranean, recognizable by the female flowers being in little spherical heads. This and *U. urens* are monoecious. The sting consists of a long pointed hair with a globular base filled with the irritating substance, the nature of which is unknown. When it enters a pore of the skin, the tip is broken off and the fluid injected.

Parieta'ria officina'lis, *Pellitory*. Polygamous. Fl. f., *m.*, (4). ○. 4. ○: *f.*, (4). ○. ○. 1. (Fig. 46.) This is an herb with lanceolate leaves (1), generally growing on walls, with numerous small clusters of green flowers in the axils of the leaves (1). As a rule three, or more rarely as many as seven, flowers are included in a 3-7 lobed involucre. (2) is a male flower; such generally has a rudimentary pistil, without a style. The stamens are elastic, as in nettles, and spring outwards on the opening of the calyx (2, 3). (3) is a bisexual flower, and (5) a female flower. (6) is the pistil, consisting of a single carpel. The

stigma is a tuft of hairs; such is of common occurrence with flowers like the present, which are adapted to wind fertilization. This is facilitated by the elastic filaments, which violently eject the pollen on springing outwards as soon as the expanding calyx liberates them. (7) represents a section of the ovary, showing the single erect ovule. The fruit is an oval shining

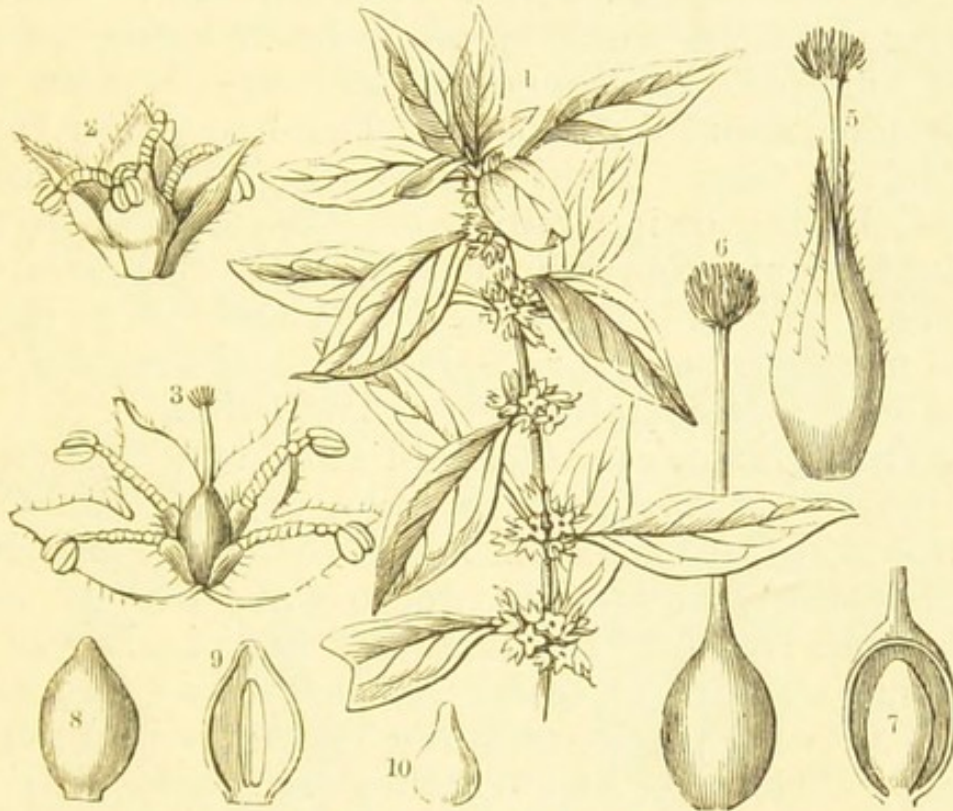


FIG. 46. *Parietaria officinalis*.

blackish grain (8), which contains a single albuminous seed (9). (10) is the embryo.

ORDER LXXI. CUPULIFERAE.

This order derives its name from the involucrel 'cup' or 'cupule' which surrounds the fruit. The six genera of trees comprised in the family are all monoecious, the male inflorescence at least being in the form of a catkin or unisexual spike. The genera are grouped in three tribes, each containing two.

TRIBE I. *Betuleae*. *Betula alba*, *Birch*. Fl. f., m., brs.; 1. o. 2. o; f., br.; o. o. o. (2). Both male and female flowers are in catkins. In the male, the

scales are peltate with 2-bracteolate flowers, each containing two stamens. The anthers have very short divided filaments. The female catkins consist of groups of three bracts having three pistils. When ripe, each pistil becomes a round, flat samara, the scales being deciduous. This familiar tree, called the 'queen of the forest' for its elegance, is conspicuous by its white bark, which peels off in ribbon-like pieces until the trunk be old, when it becomes corky and rugged. The branches are very slender, and therefore useful for brooms. The leaves are rhomboidal in form. *Betula nana*, the Dwarf Birch, a small bush growing only from one to three feet in height, occurs on the mountains of Northumberland, Peebles, and from Perth to Sutherland. It is one of the most northern shrubs in the arctic regions, and is a good representative of our arctic flora.

Alnus glutinosa, *Alder*. Fl. f., m., br.; (4). o. 4. o; f., brs.; o. o. o. (2). The bract or scale has three flowers in the male catkins. The female are short, with entire scales, with two to three smaller inner bracteoles; each of the latter has two pistils. In the fruiting state these scales become woody and cone-like; they are persistent after the small wingless nuts escape. This tree frequents watery places, and is at once recognizable by the dark little cone-like fruits. The alder is said even to make the ground swampy by retaining moisture about the roots. The bark and young shoots are used for tanning purposes, while the wood forms a good charcoal for gunpowder.

TRIBE II. **Quercineae**. **Quercus Robur**, *Oak* (Fig. 47. 1-4). Fl. f., m., (4-7). o. 10. o; f., involucre; {(5?). o. o. (3)}. The male catkins are very lax and slender. Each male flower consists of a calyx of several coherent sepals with about ten stamens (4). The female flowers are very minute, one flower being in each involucre (1, 2). This is composed of numerous minute bracts, which ultimately become the cup or cupule. The calyx is superior, but scarcely visible (1, a). The ovary is 3-celled with two ovules

in each cell (3), but when ripe (the acorn) it is 1-celled and 1-seeded by the arrest of development of the other five ovules. This well-known timber tree is familiar by its acorns. We have two varieties, one, *Q. R. sessiliflora*, with petioled leaves and very short peduncles; the other, *Q. R. pedunculata*, has sessile leaves and long peduncles.

Fa'gus sylvat'ica, *Beech*. Fl. f., *m.* (4—7). o. 8— ∞ . o.; *f.*, 4-lobed involucre (cupule); {(4—5). o. o. (3)}. The male catkins are globular; the female inflores-

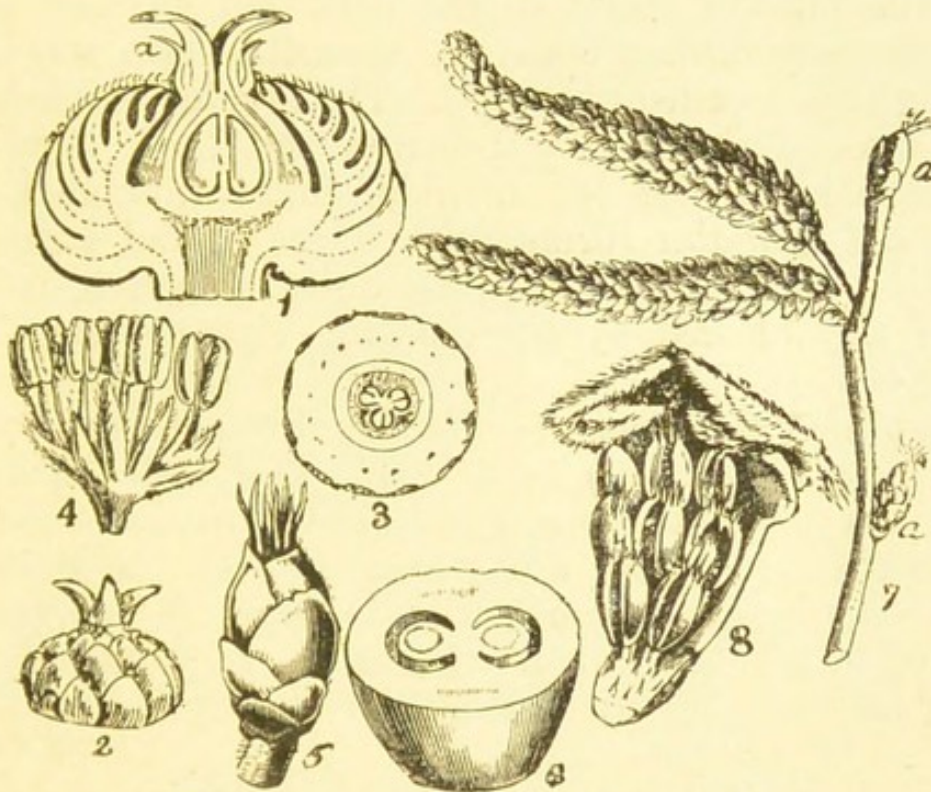


FIG. 47. *Quercus* (1-4); *Corylus* (5-8).

cence is small, the hairy involucre becomes a deeply 4-lobed, woody cup, containing usually two 3-corned fruits 'masts,' each containing a single seed with folded cotyledons. There is a variety with 'cut' or deeply lobed leaves sometimes cultivated; but both kinds of leaf may appear on the same tree. It seems to arise by a deficiency of nutriment, but once formed it can be perpetuated. When a cut-leaved shoot was grafted upon the ordinary beech, all the leaves subsequently produced on the new shoots became cut-leaved on the same side of the stem.

TRIBE III. **Coryleae.** **Cor'ylus Avella'na**, *Hazel*. (Fig. 47. 5-8.) Fl. f., *m.*, br.; $\circ. \circ. 8. \circ$; *f.*, (2-3 br.); $\{ (?) \circ. \circ. (2) \}$. The male catkin consists of numerous imbricating bracts (Fig. 47. 7), each with two minute ones within, and carrying eight 1-celled anthers on short filaments (8). The female catkins resemble minute cones with purple thread-like stigmas protruding from the apex (7, *a*, 5). Several flowers, each invested by a cup-shaped involucre (leafy cupule in fruit), are included within the 'cone.' In maturing, the minute scales of the cone fall off, and one or two more flowers come to maturity; two stigmas belong to a 2-celled ovary (6). The involucre enlarges and the inferior ovary becomes the nut. Several varieties have been found under cultivation, such as long and globular forms, with white or red kernels, showing that hard shells are quite as much influenced and altered by surrounding circumstances as softer tissues.

Carpi'nus Bet'ulus, *Hornbeam*. Fl. f., *m.*, br.; $\circ. \circ.$ abt. 9. \circ ; *f.*, br.; $\{ (?) \circ. \circ. (2) \}$. The male catkins have ovate bracts; the female have 3-lobed bracts, the two lateral lobes much smaller than the middle one. The bracts become much enlarged in the fruit, and have a small nut in the axil. It is usually a small tree, common in Epping Forest.

ORDER LXXII. **SALICINEAE.**

This order contains two genera of trees, the willows and poplars. They are both dioecious. The former are excessively variable, and have produced numerous hybrids in the wild state.

Po'pulus al'ba, *White Poplar*. Fl. f., *m.* (invol. cup), $\circ. \circ. 6-10. \circ$; *f.* (invol. cup), $\circ. \circ. \circ. (2)$. A tall tree, with leaves more or less lobed, broadly ovate, white and cottony beneath. The male catkins have jagged hairy scales, each containing a flower, consisting of a smooth-edged involucral cup, upon the inner surface of which are attached 6-10 stamens, with purple anthers. The female catkins are shorter. The cap-

sules on dehiscing liberate numerous silky-haired seeds. The only other indigenous species is *P. tremula*, the Aspen. A small tree, with nearly orbicular leaves; their oscillation by the wind is due to the petiole being flattened at the middle of its length. *P. nigra*, the Black Poplar, is introduced. This has broadly oval or rhombic and pointed leaves, with a serrate margin. The Lombardy poplar is a variety of this species, which was introduced from the East.

Sa'lix Capre'a, *Common Sallow* or *Goat Willow*

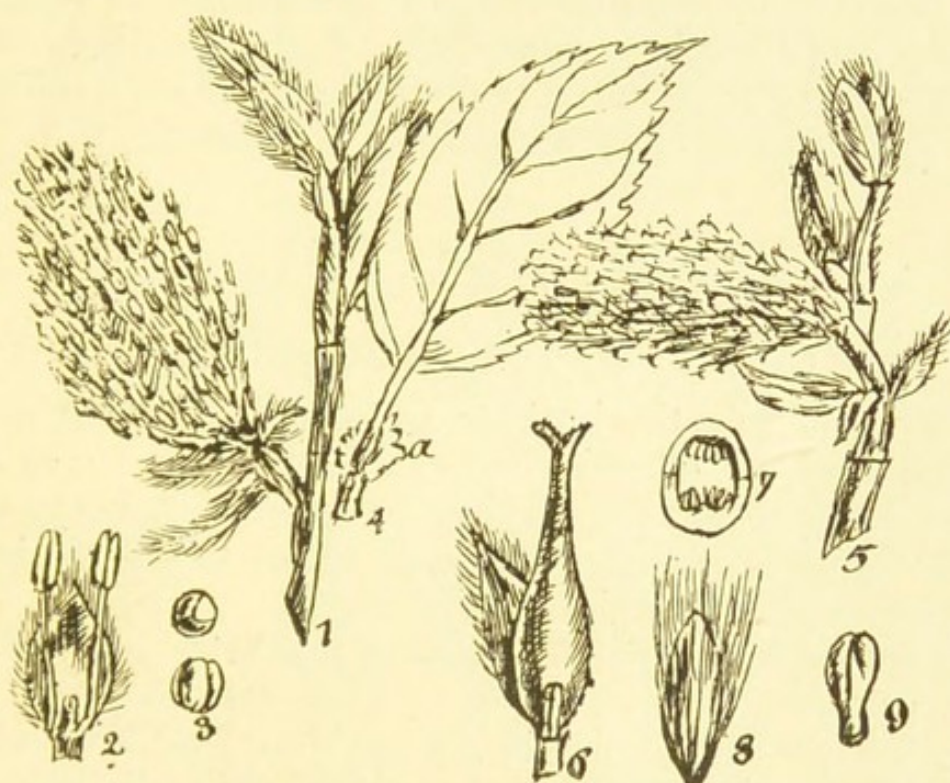


FIG. 48. *Salix Caprea*.

(Fig. 48). Dioecious. Fl. f., *m.*, br.; gl., o. o. 2. o.; f., br.; gl., o. o. o. (2). Almost all the willows have narrow leaves, but in this species they are rather broad with conspicuous stipules (Fig. 48. 4, *a*). The male catkins are erect, with silky bracts (1), each flower having a gland and two stamens (2); (3) pollen. The female catkins consist also of bracts, each having a similar honey-gland, with a pistil (5, 6). The ovary is one-celled, with two parietal placentae (7); the ovules are numerous, and develop a silky tuft at one end (8). The embryo is without endosperm (9). Branches of

the male are used for decorative purposes under the name of 'palm,' as they blossom about the time of Palm Sunday. Like roses and blackberries, willows have numerous varieties, which some botanists have described as species, so that where one sees some forty, others would reduce them to fifteen. *S. viminalis*, the Osier, is a useful species, long cultivated for the pliant shoots, used for basket work, &c. Several species become dwarf and creep along the ground, especially in alpine regions. Thus *S. reticulata* and *S. herbacea* are both found on our loftiest mountains as well as in the arctic regions and alpine Europe. Such may therefore be regarded as remnants of the arctic flora, along with some saxifrages, *Dryas octopetala*, &c.

SUB-CLASS II. GYMNOSPERMAE.

ORDER LXXIV. CONIFERAE.

The Scotch fir, the juniper, and the yew are the only representatives of this order. They differ from all other dicotyledons by having no pistil or ovary, the ovules being exposed; hence the term 'naked-seeded,' as *gymnospermous* signifies.

TRIBE I. *Abieti'neae*, *Pi'nus sylves'tris*, *Scotch Fir*. Monoecious. (Fig. 49. 1-6.) This tree is wild in a few places from York to Sutherland, but cultivated elsewhere. The leaves are acicular or needle-like, in pairs; the male catkins, $\frac{1}{4}$ in., yellow, consisting of stamens with broad connectives above the anther-cells (Fig. 49. 1). The female are recurved when young, consisting of 'carpellary' scales (2, 3), carrying two inverted ovules, each scale having a membranous bract exterior to it (3, *a*). The cones, about $1\frac{1}{2}$ in. in length, are mature in the second or third year, with woody scales, each having 2-winged seeds (4) at the base. The seed is albuminous (5), and the embryo polycotyledonous (6).

TRIBE II. *Cupressineae*. *Junip'erus commu'nis*, *Juniper* (Fig. 49. 7-12). Monoecious or dioecious.

This is a tree or bush with leaves whorled in threes, either sharp-pointed and glaucous, or minute and adpressed against the stem. The male catkins are very small and ovoid, the anther-scales being green with about four cells (7). The female consist of scales coherent below, but open above to the bottom (8, 9); an ovule standing at the base of each (9). The fruit is a berry (10), the scales having closed up above. The seeds have a hard shell (11), with masses of resin

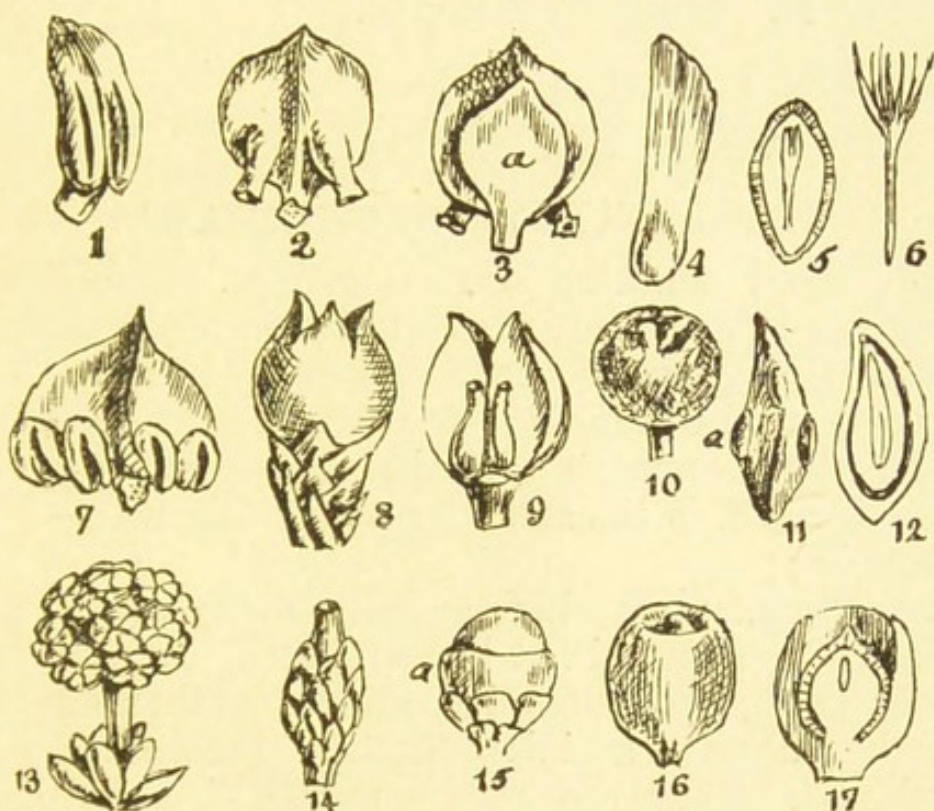


FIG. 49. *Pinus* (1-6); *Juniperus* (7-12); *Taxus* (13-17).

(11, *a*) on the surface. They are albuminous, with a dicotyledonous embryo (12).

TRIBE III. *Taxineae*, *Taxus bacca'ta*, *Yew* (Fig. 49. 13-17). Dioecious. A tree or shrub with dark green, linear, short leaves, arranged spirally, but twisted to become horizontal. The male catkin is composed of a cluster of peltate many-celled anthers, surrounded by oval scales (Fig. 49. 13). The female flower consists of a single naked ovule surrounded by oval scales (14); within these is a ring-like disk (15, *a*). This gradually enlarges until it forms a large scarlet fleshy cup (16), in the middle of which is the very

poisonous stony seed. The leaves are very poisonous to cattle. One variety, the Irish yew, has the leaves spreading in all directions. It was first discovered a century ago on a rock called Carricknamaddon, 'The Rock of the Dog,' Co. Fermanagh, Ireland. It still grows at Florence Court, and is the source of all the specimens in existence.

CLASS II. MONOCOTYLEDONS.

DIVISION I. PETALOIDEAE.

SUB-DIVISION I. EPIGYNAE.

ORDER LXXVI. ORCHIDEAE¹.

This order contains sixteen genera. The flowers are curiously modified; the full description of a typical form is given under the commonest species, *Orchis maculata*, and *O. Morio*. The following is a selection of the more common orchids. Excepting *Cypripedium*, the fl. f. is the same for all, as follows:—{3. 3. 1, 0 + 0. (3.) }

It is not a family which supplies many uses to man, except as garden and hot-house plants. Many foreign species being epiphytes, i. e. attaching themselves to trees by adhesive aërial roots, they become so-called air-plants. They are not parasites, i. e. living by absorbing nutriment from the tree itself, like the mistletoe. The root-tubers, by means of which terrestrial orchids often propagate, used to be collected for making salep, a mucilaginous drink due to the presence of bassorine, a form of starch to be found in them. Vanilla pods, which are succulent, supply the flavouring essence known by that name; and the dried leaves of one orchid in Mauritius, a species of *Angraecum*, is used for making a tea.

¹ The pollination by insect agency in the remarkable flowers of this order is an interesting study. Much information will be found in Darwin's *Fertilization of Orchids*; and some observations on the peculiar degeneracy of their flowers, by the present writer, in *Origin of Floral Structures*, pp. 172, 280, 319.

Artificial Key to the Principal Genera.

Brown saprophyte ; fls. grey	...	...	...	Neottia , 4.
L. two, sub-opp. ; fls. green	...	...	...	Listera , 5.
Fls. spirally arranged on a spike, white, 6 ins., pastures				Spiranthes , 7.
Fls. racemose, dull purple ; woods	...	...	...	Epipactis , 9.
Fls. spiked, white, 1-2 ft.	...	...	...	Cephalanthera , 10.
Fls. spurred, ovary twisted ; vis. disks in one pouch				Orchis , 11.
Fls. not spurred, ovary straight ; vis. disks in two pouches				Ophrys , 13.
Fls. spurred, ovary straight ; vis. disks not in pouches				Habenaria , 15.
Fls. not spurred, ovary straight ; labellum slipper-like ; stamens 2				Cypripedium , 16.

4. **Neot'tia Ni'dus-avis**, *Bird's-nest Orchis*. This is a brown-scaled and greenless saprophyte found in dry, especially beech, woods. The 'nest' consists of numerous club-shaped adventitious roots. The superficial tissue of these have large cells filled with a yellowish protoplasmic matter, about which the mycelium of a fungus is coiled. It seems to be symbiotic in its nature, which is a common feature with saprophytes. Each of the roots can 'bud' at the end, and give rise to a rhizome and flowering stem ; a method of vegetative multiplication independent of seed.

5. **Lis'tera ova'ta**, *Tway-blade*. A slender-stemmed herb with two nearly opposite ribbed oval or sub-orbicular leaves. The roots are a mass of fibres. The flowers are small and green in a raceme, sometimes a foot long in the fruiting stage. The lip is elongated and cleft. The pollen is powdery. The rostellum is tongue-shaped, and consists of parallel chambers filled with fluid. When an insect has licked up the honey from a groove on the labellum its head comes in contact with the top of the rostellum, and also the top of the anther. The moment the former is touched, two drops of fluid escape, and glue the pollen-masses to the insect's head. It now retreats and withdraws them. The rostellum then moves downwards, allowing space for another insect to enter and thrust the pollen against the stigmatic surface.

7. **Spiran'thes autumnal'is**, *Lady's Tresses*. A small plant, 4-8 inches, growing in dry pastures. The

small flowers form a single row, arranged in a spiral manner on a pubescent stem, and are very sweet-scented.

9. *Epipac'tis latifo'lia*, *Helleborine*. This occurs in woods, growing from 1-3 feet high. The leaves are usually broad (hence the specific name), but are very variable. The flowers are racemed, green marked with yellow, white, or purple. The orifice over the oval lip is broad, as it is fertilized by wasps. Both the colour and form of the orifice resembles that of the flower of *Scrophularia*, which is also visited by wasps.

10. *Cephalan'thera pal'ens*, *White Helleborine*. This occurs in woods and copses in chalky districts. It grows 1-2 feet high. The flowers are cream-white, the terminal lobe of the lip is yellow; they do not expand, as the flowers are mostly self-fertilized.

11. *Or'chis macula'ta*, *Spotted Orchis*. Fl. f., {3. 3. 1,0 + 0. (3).}. A herb, 6-18 inches, with or without black blotches on the leaves. The flowers sessile in the axils of bracts. The inferior ovary is twisted, so that the three-lobed lip or labellum is in front instead of its true position on the posterior side. There are three outer leaves to the perianth (sepals), and three inner, i. e. two petals arching over the top while the third is the spurred labellum. There is one anther on the summit of the column, this latter consisting of the style and filament coherent. At the base of the anther and projecting over the cavity leading down into the spur, is a small round pouch or *rostellum*, a modified stigma; the stigmas (really only two out of the three) form a glistening sticky surface at the back of the cavity, and below the little pouch. If a pencil-point be gently thrust down the orifice as if making for the spur, and be allowed to press lightly against the pouch, it will force it open. Holding the pencil thus for a few seconds and then withdrawing it, one or both of the pollen-masses or *pollinia* will be withdrawn erect upon the pencil-point. This, it will be seen, is a club-shaped mass of pollen

grains, all of which are united by an elastic network, tapering below in a little stalk or *caulicle*, and terminating in a circular foot, the viscid disk. This last was standing over gum when in the pouch; and on depressing the front of the pouch the gum was exposed, and so fixed this viscid disk upon the pencil.

In about thirty seconds the pollinia will be observed to bend forwards at a point near the foot until they lie parallel to the pencil-point. If now an attempt be made to make the pencil enter a flower as before, it will be found that while the point passes in the direction of the spur, the clubbed ends of pollinia strike the stigmatic surface. On withdrawing it a large quantity of pollen will remain adherent to it. If the pollinia be gently pulled, it will be seen that the caulicle is very elastic, and will finally break sooner than the viscid disk will separate from the pencil; for the gum, when once it is exposed to the air, sets hard, and is excessively tenacious. Of course the above experiment illustrates the method of pollination by insects, which come to suck the sweet juice in the spur, though there does not appear to be any honey.

Or'chis Mo'rio, *Green-winged Orchis* (Fig. 50). This is taken to illustrate the floral details. They agree in all essential features with those of the spotted orchis, with which they may be compared. (1) is the front view; (2) a side view of a flower; (*a*) is the petal called the labellum; it is really the posterior petal, because since the ovary is twisted (2, *e*) the whole flower is inverted. (1; 2, *b*) is the spur; (1, *e*; 3, *f*) shows the orifice leading down into it; (*c*, *c*) are the two lateral sepals, and (2, *c*⁺) the (falsely) posterior one; (*a*, *d*, *d*) are the three petals. These two whorls are generally regarded as the outer and inner series of the perianth. The twisted ovary (2, *e*) upon which the perianth stands is, of course, inferior, and sessile in the axil of a bract (2, *f*). The petals form a little hood under which is the single two-celled anther (3, *a*; 4). On opening the two vertical slits the

pollen is discovered (not as a loose powder) with the grains all united by fine elastic threads into a club-shaped mass (3, *g*; 4, *g*). The threads coalesce to form the slender stalk or caulicle, terminating below in a circular disk which is highly glutinous (4, *d*). These disks are invisible at first, because they are hidden by a little bag (3, *d*; 4, 5, *a*) which keeps the gummy matter moist and ready for action, as explained under *Orchis maculata*. The stigmatic surface is a broad, shiny, glutinous patch indicated by (3, *e*),



FIG. 50. *Orchis morio*.

behind the bag which is called the *rostellum* (*d*). (5) is a back view of the pollinia or pollen-masses, the anther having been removed, and showing the broad connective. The whole is cut off from the top of the ovary, as indicated by the sub-triangular section (*b*).

13. *Ophrys apifera*, *Bee Orchis*. The English name is derived from the fact of the labellum being brown and resembling a humble-bee; the sepals are

pink or white. The column is rather long and erect over the horizontally projecting labellum. The caulicles of the pollinia are bent, so that a slight shake, as by the wind, causes the heavy club-shaped masses of pollen to fall down. The viscid disks remaining fixed in the pouch, the pollen swings backwards and forwards, readily striking the stigmatic surface. Hence this plant is self-fertilizing. As a rule orchids can set no seed unless they be fertilized by insects, as the pollen masses cannot escape from the anther-cells. Nevertheless, some foreign orchids are cleistogamous and never open their buds at all, being perfectly self-fertile; and whenever this is the case, such orchids are always the most abundant. We have two other species of *Ophrys*, *O. aranifera*, the Spider Orchis, and *O. muscifera*, the Fly Orchis; so called from their resemblances to these insects. They occur in copses and chalk downs.

15. **Habena'ria conops'ea**, *Fragrant Orchis*. An orchid with rose-red or purple flowers, remarkable for the long and slender spur and being sweet-scented. Another species, *H. bifolia*, is the Butterfly Orchis. This grows to 18 in. in height, occurring in wet meadows, and heaths, &c. The flowers are 1 in. from the upper sepal to the tip of the lip; white, but tinged with green; very fragrant. This genus is closely allied to *Orchis*, but has the viscid disks more or less exposed.

16. **Cypripe'dium Cal'ceolus**, *Lady's Slipper*. This is now a very rare plant wild, but is not infrequently cultivated. The fl. f. {(2), 1. 3. std. + 2, o. (3)}. The large slipper-like, inflated, pale yellow lip, $1\frac{1}{2}$ in. long, gives the name to the species. The sepals, of which two under the lip are coherent, are red-brown. Unlike other genera of orchids, this has two stamens, belonging to the second whorl, the first or outer being absent. In others this whorl is wanting, the single stamen belonging to the outer series.

ORDER LXXVII. IRIDEAE.

This order contains four native genera and one, crocus, naturalized. The only common member is the flag.

Iris Pseud-a'corus, *Yellow Flag*. Fl. f., {[(3. 3.) 3.] (3). }. This is not uncommon by river banks, ditches, &c., and recognizable by its long sword-shaped, *ensiform* leaves and golden-yellow flowers. The three outer leaves of the perianth, the 'falls,' droop; the three inner, much smaller, being erect. The three styles in the middle are broad and *petaloid*, the stigma being a little horizontal ledge below the apex of the style. A stamen stands below each of the three styles, its anthers dehisce outwards, being extrorse. The honey is secreted by and at the bottom of the perianth, i.e. on the top of the ovary, and can be reached by an insect passing its proboscis down a minute channel on either side of the stamen. In so doing the pollen is shed upon its back. The stigma, something like the lip of an inverted spoon, can now scrape it off the bee. The reader should make transverse sections, beginning at the bottom of the perianth-tube. This will show the arrangements of the parts and the honey-chambers.

CRO'CUS VER'NUS, *Purple Crocus*. Though not a true British plant, crocus is so largely cultivated that a description is not unadvisable. The fl. f. {[(3. 3.) 3.] (3). }. The anthers are arranged around the style and burst outwards, the fringed stigma standing above them. Hence a bee must crawl downwards grasping this central column, and so gets dusted on the abdomen. On flying to another flower it alights on the stigma, and so transfers the pollen to it. It is interesting to see how plants of widely different families may have their flowers constructed on the same principles; for if the reader will turn to *Convolvulus*, it will be seen that in both that flower and crocus, the corolla or perianth tapers inwards, giving no foothold to an insect, so that it is compelled to enter by holding on to the extrorse anthers. Again,

in *Campanula*, it enters in the same way, but now the anthers have already transferred their pollen to the collecting hairs of the style.

ORDER LXXVIII. **AMARYLLIDAE.**

Three genera only represent this order, the daffodil, snowdrop, and snowflake. The only difference between this and the Lily family is, that while the former has an inferior, the latter has a superior ovary.

Narcis'sus Pseu'do-narcis'sus, *Daffodil*, *Lent Lily*. Fl. f., $\{[(3. 3.) 3 + 3.] (3)\}$. It is a local plant, but very abundant in places, growing in copses and pastures. The six-leaved yellow perianth has an extra outgrowth, called the *corona*, proceeding from the interior. Many varieties have appeared under cultivation, as well as hybrids with the foreign Poet's Narcissus, *N. poeticus*, with a very short purple-edged corona. The bulbs, and indeed every part of this plant, are powerfully emetic; even the flowers have had dangerous effects, parts of them having been swallowed by infants. *N. poeticus* is even more poisonous than the daffodil. The scent, though pleasant, may produce a deleterious stupor, indicated by the Greek name *narke*, signifying stupor. The snowdrop possesses similar properties though in inferior degree. One plant is used in South Africa for poisoning fish. Numerous hybrids have been raised between daffodils and other forms of narcissus.

Galan'thus niva'lis, *Snowdrop*. Fl. f., $\{3. 3. 3 + 3. (3)\}$. This is supposed to be wild in Hereford and Denbigh, but is naturalized in various places. It has long been cultivated, both single and double. The flowers arise singly, the sepals being white, but the petals green at the ends.

Leuco'jum aesti'vum, *Snowflake*. Fl. f., $\{3. 3. 3 + 3. (3)\}$. This occurs in wet meadows and among osiers, &c., but is local. The stem grows to 18 inches, and carries from about two to six flowers, both sepals and petals having a green spot at the tips. It is often cultivated.

ORDER LXXIX. DIOSCOREAE.

We have only one plant to represent this order, the black bryony. It includes the yam of tropical countries.

Ta'mus commu'nis, *Black Bryony*. Dioecious. Fl. f., *m.*, [(3. 3.) 3 + 3]. \circ ; *f.*, {(3. 3.) \circ . (3)} $\}$. This is a stem-climber, growing to great lengths over hedges, bearing large long-petioled, ovate-cordate, acuminate glossy leaves. These are peculiar in having netted or reticulated veins, resembling those of a dicotyledon rather than of a monocotyledon. The flowers are small and green, but the berries are bright scarlet. The large fleshy root is black on the outside, and has been used by quacks as a cathartic medicine, but it is very dangerous. The berries are emetic, and children should be cautioned against them.

SUB-DIVISION II. HYPOGYNAE.

ORDER LXXX. LILIACEAE.

Eighteen genera are included in this order, which only differs from the *Amaryllideae* in having a superior ovary.

Artificial Key to the Principal Genera.

Shrub, with flat cladodes, st. (3 <i>f</i>)...	...	Ruscus, 1.
Herb, with subulate cladodes, st. 3 + 3	...	Asparagus, 2.
Fls. racemed, Per. (3. 3.), white; Frt. berry	...	Convallaria, 5.
Fls. umbellate, Per. 3. 3, white	...	Allium, 7.
Fls. racemed, Per. 3. 3, blue	...	Scilla, 9.
Fls. racemed, Per. (3. 3.), white; Frt. capsule	...	Ornithogalum, 10.
Fls. large, solitary, Per. 3. 3, purple, chequered	...	Fritillaria, 11.
Fls. large, solitary, Per. 3. 3, yellow	...	Tulipa, 12.
Fls. large, solitary, Per. (3. 3.), purple (autumn)	...	Colchicum, 15.
Fls. small, racemed, Per. (3. 3.), yellow	...	Narthecium, 16.
Fls. small, racemed, Per. (3. 3.), green	...	Tofieldia, 17.
Fls. small, solitary, Per. 4. 4, green; Frt. berry	...	Paris, 18.

1. **Rus'cus aculea'tus**, *Butcher's Broom*. Subdioecious. Fl. f., *m.*, (3. 3). (3*f*) \circ ; *f.*, (3. 3). (std.) (3). This is the only British monocotyledon with a woody stem, all others being herbs. The stem is cylindrical, but the branches are flat, coriaceous, and sharp-pointed, the true leaves being represented by minute pointed scales,

from which the flat flowering branches, called cladodes, arise. The flowers arise from the middle of the cladodes. The filaments are purple, and cohere into a tube round the ovary: in the female flowers they are present, but without anthers. The fruit is a scarlet berry.

2. *Aspar'agus officina'lis*, *Asparagus*. Fl. f., [(3. 3). 3 + 3.] (3). The leaves consist of minute scales only, bearing in their axils tufts or fascicles of needle-like branches or cladodes. The flowers are small, pendulous and green, often with stamens only. It has a stout creeping underground stem, from which the flowering annual shoots arise. Though a rare wild flower, found on the coasts of Wales, Cornwall, &c., it has been cultivated from very early ages by the ancients, but has not changed much except in size from the wild plant.

5. *Convalla'ria maja'lis*, *Lily of the Valley*. Fl. f., [(3. 3). 3 + 3.] (3). This occurs in various woods, but is not common. It has long been cultivated for its racemes of white bell-like little flowers, which are highly sweet-scented. It has a creeping underground stem, by which it spreads greatly.

7. *Al'ium ursi'num*. *Ramsons*. Fl. f., 3. 3. 3 + 3. (3). (Fig. 51.) There are seven British species of *Allium*, all having strong-smelling bulbs, &c. This species has broad ovate-lanceolate leaves, which have their stalk twisted so that the true lower side is uppermost; the tissues are altered, and differ in tint accordingly. The flowers form an umbel issuing from two membranous scales, often called a spathe (1, a). Each flower has six leaves to the perianth, forming an inner and an outer whorl with six stamens (3, 4), one opposite each perianth-leaf (2). (5) represents the pistil; while (6) shows that the ovary is three-celled, with two rows of ovules down each corner of the axile placentation, corresponding to the two margins of each carpel which meet in the middle. (6*) is a dehiscing capsule bursting down the backs of each ovary cell; it is therefore loculicidal. (7) is a seed, and (8) the same cut open to show the small

embryo (*a*) embedded in a mass of albumen. Several species of *Allium* are cultivated, as onions, garlic, chives, shallot, &c. The common onion appears to have been cultivated in Chaldea, possibly 5000 B.C. It and garlic were part of the payment of the builders of the Great Pyramid, and are mentioned in Scripture as cultivated in Egypt (Num. xi. 5). Indeed, it was worshipped in Egypt, and onions were invoked by the Egyptians when taking an oath! The chive, *A. Schoenoprasum*, is wild in some north and west

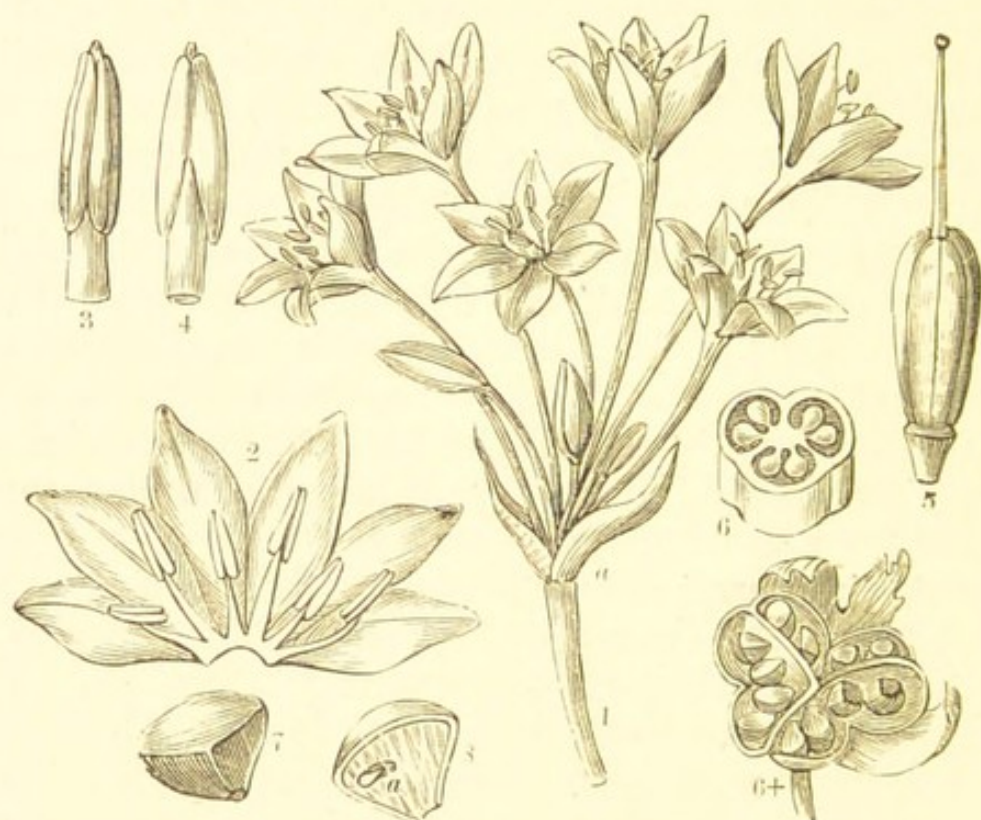


FIG. 51. *Allium ursinum*.

counties of England and Wales, but the leek (*A. Ampeloprasum*) is a native of the Mediterranean regions.

9. *Scilla nutans*, *Bluebell*. Fl. f., [3. 3. 3 + 3]. (3). This familiar wild flower is the commonest in the order, occurring in thousands in woods, &c. The bulb bears a solitary raceme of blue pendulous flowers, each associated with two linear, coloured bracts. The bulbs are very acrid, and probably the leaves also, as the acidity appears to reside in the viscid juice. It belongs to the same genus as the medicinal squill, common on rocks in the Mediterranean regions.

15. *Col'chicum autumn'ale*, *Meadow Saffron*. Fl. f., [(3 + 3). 3 + 3.] (3). This is not uncommon in several places, but local. It has a large corm with broad leaves, appearing in spring; but the pale purple crocus-like flowers follow in the autumn. The anthers burst outwards, extrorse, while the capsule dehisces septicidally, each carpel separating entirely. The whole plant is poisonous, containing a principle called *veratrin*. The genus *Veratrum*, allied to this, supplies a drug used by English doctors. The bulbs and seeds have been eaten for onions with fatal results.

17. *Tofield'ia palus'tris*. This is a little plant found in mountain rills and bogs. The leaves are from 2 to 3 in. long; the scape 4-8 in. high, with a short dense raceme or spike of pale-green flowers.

ORDER LXXXI. JUNCEAE.

The Rush family is represented by two genera, the true rushes, *Juncus*, with eighteen species, and the wood-rush, *Luzula*, with six. They are mostly perennial herbs, frequenting moist places; with grass-like leaves in *Luzula*, and rod-like or reduced to sheaths in *Juncus*. The flowers are green or brownish, in clusters; the perianth being dry and scarious, or coriaceous.

Jun'cus effu'sus, *Rush*. Fl. f., 3. 3. 3. (3). In this species the stems are soft, 1-3 ft. in height, growing in circular tufts. The surface is easily separable from the continuous pith, composed of star-shaped or stellate cells, forming a soft spongy mass. These stems were formerly used for the wicks of rushlights. The leaves are reduced to pointed sheaths at the base of the stem. The flowers occur in dense tufts below the summit. Several species of *Juncus* are alpine, but a small one, *J. bufonius*, an annual, with setaceous, i. e. awl-like channelled leaves, is very common. The inflorescences have elongated peduncles, and the flowers are generally cleistogamous.

Lu'zula campes'tris, *Wood-rush*. Fl. f., 3. 3. 3 + 3. (3). (Fig. 52.) This genus has grass-like leaves (1)

with hairy or ciliated margins, and the present species abounds in meadows, flowering very early in April. It is strongly protogynous, the twisted stigmas being mature some time before the six anthers. (2) is a flower showing the exterior bracts (*a, a*), the stigmas already elevated and well developed¹, while the anthers are still more or less immature below. (3) is a flower seen from above. (4) is the pistil of three carpels, as indicated by the three stigmas, but the ovary

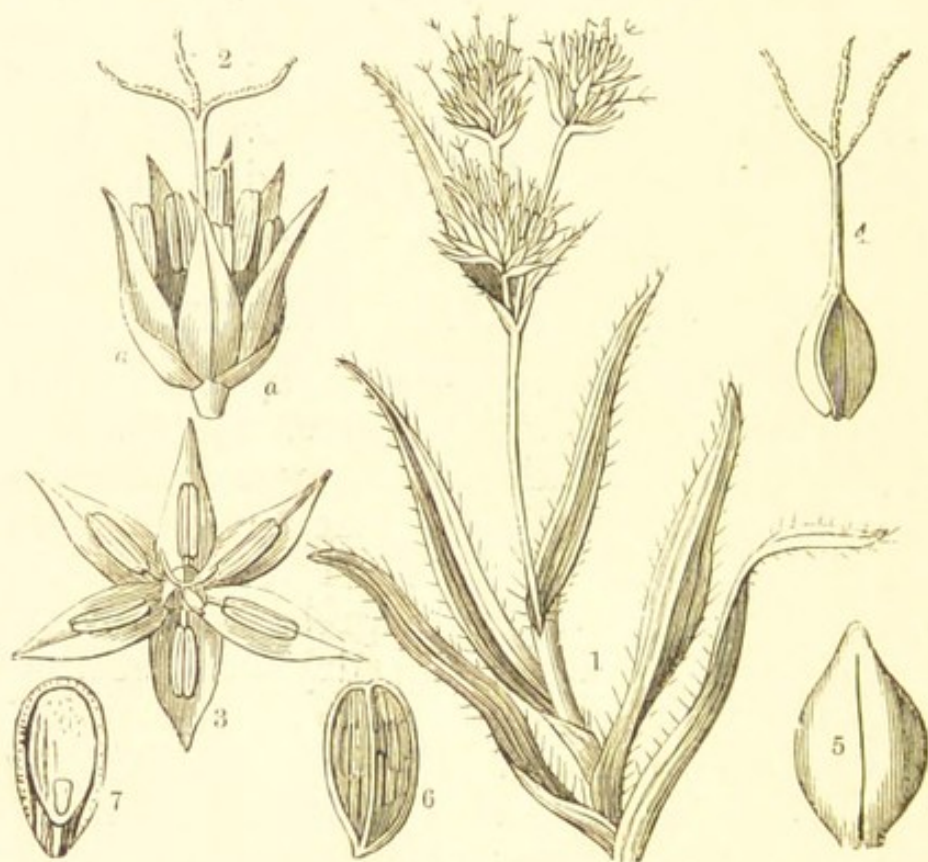


FIG. 52. *Lazula campestris*.

is only one-celled with three basal ovules. (5) is the ripened nut-like fruit, which contains three albuminous seeds (6, 7), with a minute embryo at the base (7).

ORDER LXXXIII. TYPHACEAE.

This order consists of aquatic plants, of two genera only; both of which are represented in this country, the bur-reeds and reed-maces.

¹ The stigmas should have been drawn spirally twisted.

Sparganium ramosum, *Bur-reed*. Monoecious; Fl. f., m., 3. \circ . 3 + 3. \circ .; f., 3. \circ . \circ . (2). (Fig. 53.) This is a large branching herb with long leaves, about one inch broad. The inflorescences are in globular heads (Fig. 53. 1); female below (b, b), and male above (a, a). This plant is closely allied in the structure of the flowers to the trees known as screw-pines, growing in tropical saline swamps at the mouths of rivers. The fossil fruits of trees allied to that genus are found in the London clay in the Isle of Sheppey, indicating



FIG. 53. *Sparganium ramosum*.

that this country was tropical in the 'Eocene' period. Fig. 53 supplies the principal details as follows:— (2) is a male flower having three stalked leaves to represent the perianth (a), and six stamens (2, 4, 5). (3) is a female flower consisting of a perianth of three leaves rolled round the pistil, and sessile. The pistil has two spreading stigmas (3), but only one ovary-cell, from the summit of which hangs an ovule. The fruit contains one seed (6), consisting of a mass of endosperm (7) with a minute embryo at one end (8).

Typha latifolia, *Reed-mace*, *Cat's-tail*, or *Club-rush*, also often called *Bul-rush*. Monoecious. Fl. f., m., 3. o. (3 f) o.; f., 3. o. o. 1. This is common in rivers, lakes, &c. It has long linear leaves, the stems being 3-7 feet high, terminating in dense cylindrical dark brown inflorescences, the female below, and the male above.

These two plants, as well as the duck-weed (*Lemna*), illustrate the great degradations which some aquatic plants have undergone, not only in the vegetative organs, as explained above, but in the flowers as well. The perianth is thus reduced to three jagged scales in the bur-reed, and to mere hairs in the reed-mace, while in the duckweed there is no perianth at all.

ORDER LXXXIV. AROIDEAE.

Only two genera represent this large tropical order, the familiar 'Lords and Ladies' (*Arum*), and the sweet-flag (*Acorus*). Members of this order have generally an acrid and often a very poisonous juice, represented however by an agreeable aromatic pungency in *Acorus calamus*, the Sweet-flag. It is thought to be the calamus of Scripture¹. It is a somewhat rare plant, but grows by the edge of Virginia Water.

Arum maculatum, *Cuckoo-pint*, *Lords and Ladies* (Fig. 54). This is a low herb with tubers bearing at first small leaves with elliptical blades (1, a), then large hastate ones with a reticulate venation (1, b), sometimes having black blotches, hence its specific name. The inflorescence consists of a spadix (2, the spathe is cut away) enveloped by a large sheathing bract or spathe. This is convoluted and contracted above the base, as indicated by the curved lines (2, f). It finally opens above, exposing the pale or dark purple club-shaped end of the spadix (2, a). This spadix bears, from below upwards, first, sessile, fertile pistils without styles (2, e; 3, 8); then, pistils which are abortive with short styles (2 d; 4); thirdly, naked

¹ Exod. xxx. 23. *Plants of the Bible* (Pres. Day Primers), p. 79.

sessile 4-celled anthers (2, *c* ; 6), and, lastly, a ring of abortive pistils (?) with long styles (2, *b* ; 5). In the first stage of expansion the stigmas only are mature ; a disagreeable odour attracts certain flies, when they fertilize the pistils, if they have come from another plant, laden with pollen. In the second stage the stigmas wither, when a drop of honey appears in the middle of each stigma. In the third stage the anthers dehisce and shed their pollen upon the floor of the chamber within the spathe (2, *g*). The insects then

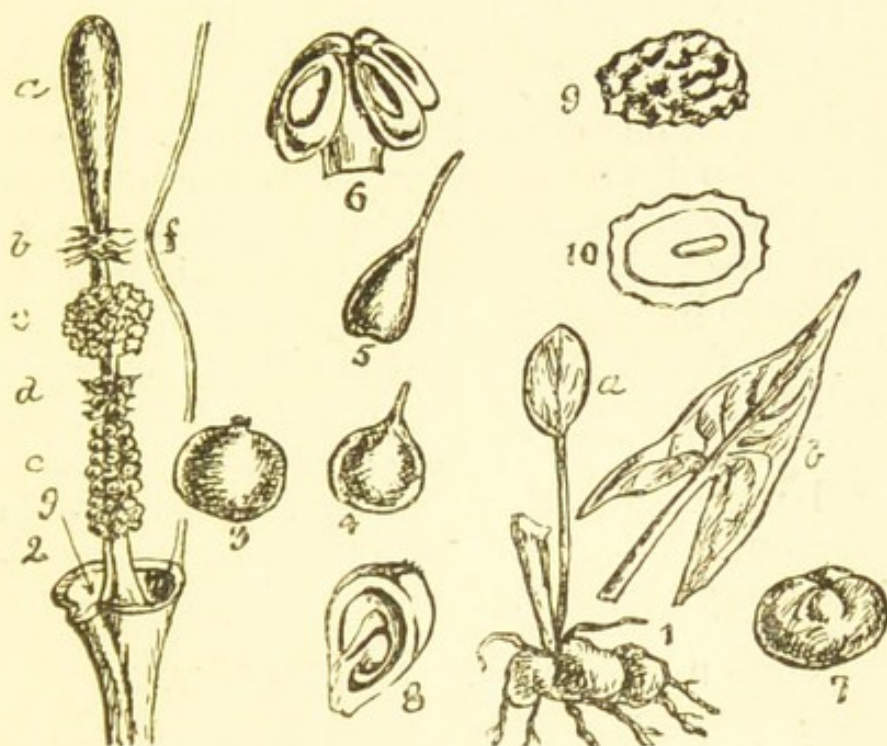


FIG. 54. *Arum maculatum*.

get dusted all over with it. Finally, as the bristling styles (*b*) at the contracted part of the spathe (*f*) wither, the flies escape and proceed to enter another spathe, and so fertilize other flowers. In the fruiting stage, the spathe and the terminal club, together with the stamens, fall off, leaving a dense mass of scarlet berries (7). Each fruit contains about three seeds (9). They are albuminous (10). This plant is no exception to the rule, for it is poisonous. Children have more than once died from eating the berries. The tubers are also poisonous, but like those of the tapioca plant,

are rendered harmless by boiling. In the Isle of Portland they were formerly collected and eaten; the large quantity of starch extracted from them was called Portland sago; true sago being the starch obtained from the pith of palm-trees growing in the East Indian Isles.

ORDER LXXXV. LEMNACEAE.

Only two genera, both represented in Britain, comprise this order, one of which is the smallest flowering plant known (*Wolffia*).

Lem'na mi'nor, *Duckweed*. There are four species of duckweed. This plant consists of a minute floating obovate frond¹, having hair-like pendulous roots and a cleft at one point on the edge, where the inflorescence arises. This consists of a two-lobed spathe, in which are three flowers (2 *m*, and 1 *f*), consisting of two stamens and one carpel, each representing a separate flower. The fronds continue to multiply vegetatively by budding at the side, the young being soon freed from the parent. *L. trisulca*, the ivy-leaved duckweed, has flat lanceolate fronds, which arise crosswise from the older ones. *L. gibba* resembles *L. minor* above, but has spongy tissue below, consisting of large cells.

ORDER LXXXVI. ALISMACEAE.

This order consists of marsh or aquatic plants, and contains five genera; four have a distinct calyx and corolla, the former being green; while one genus has petals and sepals of the same rose-red colour (*Butomus*).

Alis'ma Planta'go, *Water Plantain*. Fl. f., 3. 3. 3 + 3. ∞. (Fig. 55). This plant is common in ditches, streams, &c. It has ovate lanceolate, five to seven ribbed leaves, hence its name (2). The inflorescence grows to 3 feet in height, consisting of a much-branched cymose panicle of pink or rose-petalled flowers (1). (3) is an open flower showing the rather

¹ There is no distinction between leaf and stem; these two organs are so degraded as never to be differentiated in duckweeds.

peculiar position of the stamens, in that these are in three pairs, more or less in front of each sepal; a small honey-gland lies between the two stamens of each pair (*a*). This may perhaps account for the dislocation of the stamens. The carpels are numerous, arranged in a somewhat triangular form, as best seen in the fruiting stage (6). Each carpel (5) has but one ovule arising from the base (*a*). The style is elongated (4, *a*). The ripe achenes contain one exalbuminous seed (7, 8),

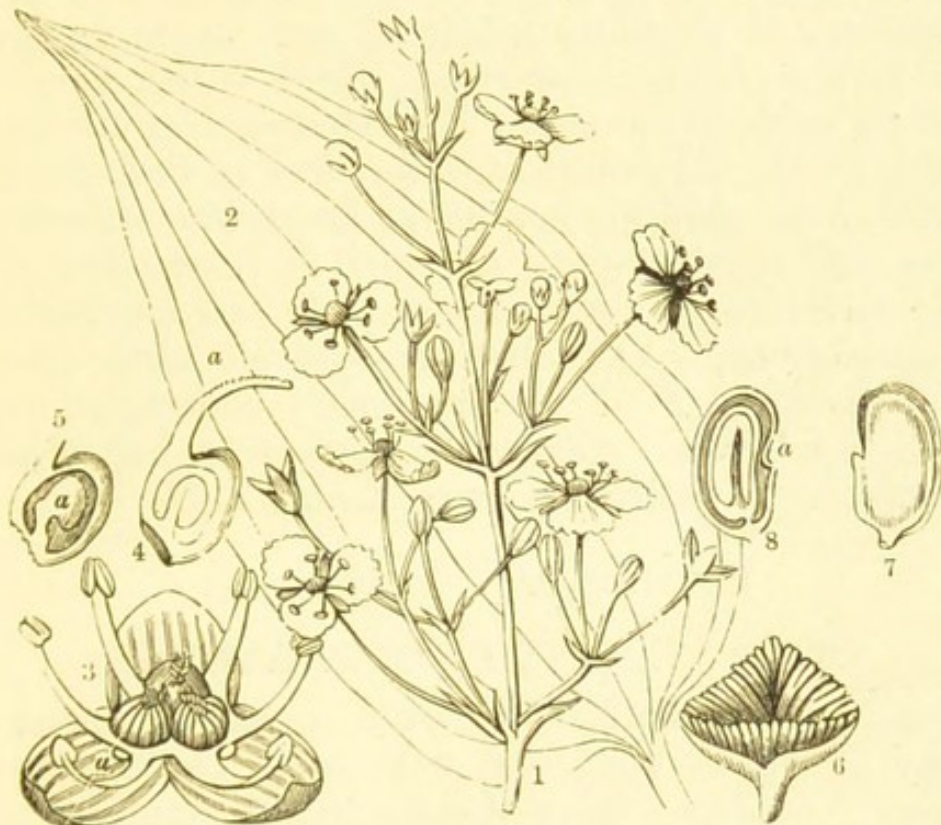


FIG. 55. *Alisma Plantago*.

with a curved embryo (8, *a*). To be without endosperm is characteristic of aquatic monocotyledons.

Sagittaria sagittifolia, *Arrow-head*. Monoecious. Fl. f., *m.*, 3. 3. ∞ . \circ .; *f.*, 3. 3. \circ . ∞ . In deep water the leaves are long and linear, being really phyllodes; near the surface they develop elliptical blades, but finally when in the air they take the sagittate or arrow-headed form. The inflorescence is a cymose panicle of white flowers arranged in whorls, the lower ones being female, the upper male.

ORDER LXXXVII. **NAIADACEAE.**

Seven genera of water or marsh plants are contained in this order, the most representative being the Pondweeds (*Potamogeton*), with twenty-one species.

Potamogeton na'tans, *Pondweed*. Fl. f., [(4). o. 4.]
4. This species has sub-coriaceous, broadly-lanceolate leaf-blades floating on the surface of water; the submerged are often reduced to phyllodes or flattened petioles, without blades. The inflorescence is a spike consisting of a stout peduncle, and dense-flowered, each flower being quaternary, fours being very unusual in monocotyledons. The other species are recognizable by the very marked differences in their foliage; thus, *P. heterophyllus* has linear lanceolate submerged leaves, the floating being oblong; *P. lucens* has elongated translucent wavy leaves; *P. crispus* has distichous, opposite and alternate leaves, with crisped serrulate edges; *P. densus* has closely-compacted opposite entire leaves. Lastly, *P. pectinatus* has slender filiform stems, with very long linear leaves.

DIVISION II. **GLUMACEAE.**ORDER LXXXVIII. **CYPERACEAE.**

Nine genera comprise this order, which consists of grassy or rush-like herbs, with often three-cornered stems. The leaves have sheaths closed round the stem (i. e. not 'split' opposite to the blade, as in grasses).

Scir'pus lacus'tris, *Bulrush*¹. Fl. f., Bristles, o. o. 3. (2-3). A tall plant, throwing up stems sometimes 8 ft. in height; they are usually leafless, but with leaf-scales at the base. The flowers are grouped in ovoid spikelets, the spikelets being in paniced clusters. The brown scales of the spikelets are called glumes, which are imbricated all round the axis, each, excepting a few at the base, containing a flower. This consists of

¹ The bulrush of Scripture is the *Papyrus antiquorum*, also of this order, the stems of which furnished the material for paper; see *Plants of the Bible* (Pres. Day Primers), p. 123. The word 'bul-rush' is really 'pool-rush.'

a circle of 4-6 bristles, surrounding three stamens, and a pistil of 2 or 3 carpels, having the styles coherent, but the long stigmas free.

Erioph'orum polysta'chion, *Cotton-sedge*. Fl. f., ∞ hairs; o. o. 3. (3). This plant, miscalled cotton-grass, frequents boggy ground, &c. It has rigid somewhat three-angled stems, narrow grass-like leaves; the inflorescence consisting of umbellate spikelets. The hairs surrounding the flowers elongate in the fruiting stage, and form a long white, silky pendulous mass.

Ca'rex hir'ta, *Sedge*. Monoecious. Fl. f., m., o. o. 3. o;

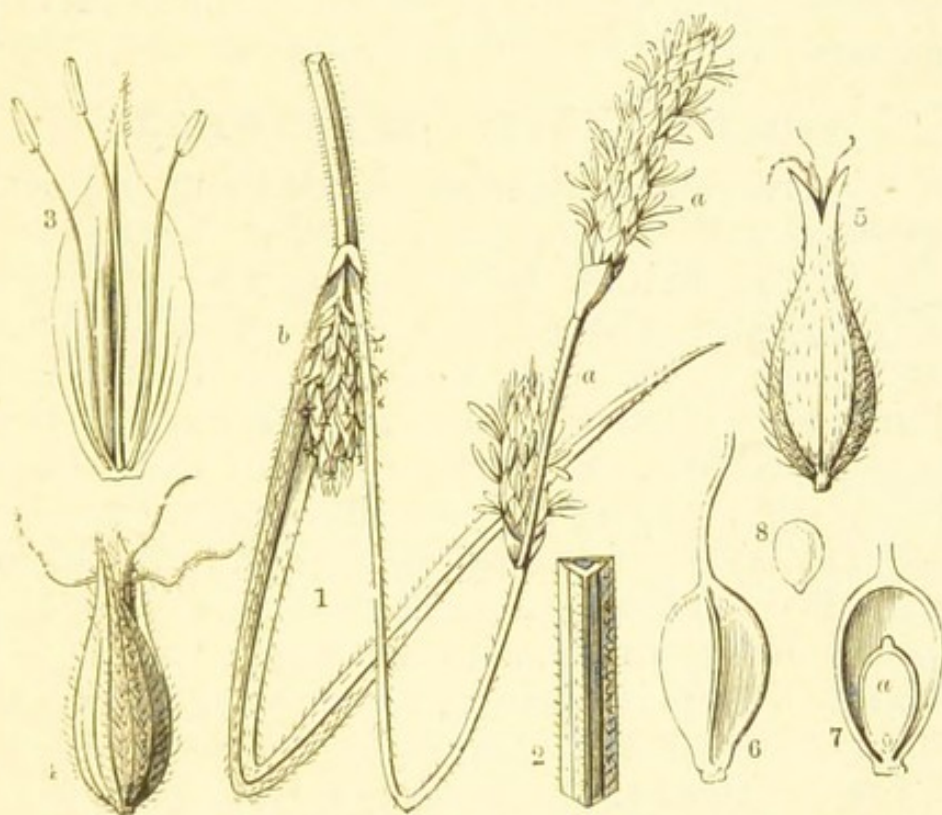


FIG. 56. *Carex hirta*.

f., (2). o. o. (3) (Fig. 56). This genus has forty-three British species. They are low herbs, with grass-like leaves, and inflorescences of spikelets or diminutive spikes, arranged in various ways; the female being below and the male above; the same order prevails if both sexes be in the same spikelet. This species has flat and hairy leaves; the bract being leafy (1, b). The female spikelet (1, b) is sessile in the axil of the long bract by itself, but the male (1, a) are usually

two or three together. It occurs in damp copses, &c. (2) is a portion of the three-angled stem; (3) is a male flower consisting of a bract or glume, as it is called in this order and in grasses, with three stamens in its axil; (4) is the female flower, consisting of a pistil of three carpels, as shown by the three stigmas, invested by a bottle-shaped perigone, apparently composed of two opposite glumes coherent by their margins; (5) is the ripened fruit within the perigone; (6) the three-cornered fruit extracted from it; (7) is the ovary cut vertically to show the single albuminous erect seed (*a*). It contains a minute embryo buried in the midst of the endosperm; (8) is the embryo removed.

ORDER LXXXIX. GRAMINEAE.

Of this order, which contains in all about 300 genera of grasses with some 3,200 species, there are 48 genera in the British Isles. It is very difficult to classify, because there is not only great uniformity in the foliage, &c., but also in the flowers. The beginner should study some large flowering species, such as wheat, oat, and barley; he will then see how ordinary grasses agree or differ from such types. All grasses are herbs, excepting such giant forms as bamboos, with a cylindrical stem, hollow except at the nodes, the leaves linear, with the sheath 'split' to the node, from which it springs, terminating above with a little membrane, the ligule. The flowers are grouped in spikelets, themselves forming spikes, panicles, &c. The usual elements of a flower of a grass are an outer boat-shaped 'flowering' glume, an inner two-keeled glume, called the pale; two minute scales, the lodicules, three stamens, and a pistil of two coherent carpels, having two feathery styles and stigmas. Such florets may be many in a spikelet (*Bromus*, Fig. 57), or few, as three (wheat and oat) or only one (cat's-tail). In nearly all cases the spikelet has two empty involucreal glumes at the base. The value of this order resides chiefly in the many species included in cereals; some of which, as wheat, have been so long cultivated that

the original wild plant is unknown and untraceable. The fodder grasses are also numerous; while sugar-cane and bamboos for constructive purposes are invaluable.

Artificial Key to the principal Genera, &c.

Spikelets, one-flowered; Panicle spicate.

- Empty glumes, 4; stamens, 2; meadows *Anthoxan'thum*, 6.
 Pan. long, dense, white; sea-side ... *Ammoph'ila*, 18.
 Pan. long, dense, empty gls., connate, palea o ... *Alopecu'rus*, 8.
 Pan. long, dense, empty gls., free, pointed or awned *Phle'um*, 10.

Spikelets, one-flowered, awnless; Panicle loose.

- Spikelets about 12; empty gl. equalling flg. gl.; 1-2 ft.; woods *Mel'ica*, 35.
 Spikelets, very many; empty gl. equalling flg. gl.; 4-5 ft.; woods *Mil'ium*, 9.
 Spikelets, very many; empty gl. exceeding flg. gl.; 1-2 ft.; meadows *Agros'tis al'ba*, 12.

Spikelets, one or more flowered, in a simple or compound spike.

- Sp., 3 together, in a notch on a flat spike ... *Hor'deum*, 47.
 Sp., unilateral; flowers imperfect; heaths ... *Nar'dus*, 46.
 Sp., fixed sideways; empty gls. equal ... *Agropy'rum*, 44.
 Sp., fixed sideways; empty gls. unequal ... *Brachypo'dium*, 42.
 Sp., fixed edgeways ... *Lo'lium*, 43.

Spikelets, two or more flowered, in loose panicles, awned.

- Pan. purple; flg. gl. with long hairs; tall aq. plt. *Phragmi'tes*, 29.
 Awn inserted below the middle, long, twisted ... *Ave'na*, 25.
 Awn inserted below the middle, short, not or slightly tw. *Ai'ra*, 20.
 Awn of lower male fl. long, exserted ... *Arrhenath'erum*, 26.
 Awn slightly exserted; flg. gl. small, hyaline ... *Agros'tis*, 12.

Spikelets, many-flowered.

- Awn exserted, attached below the notched tip ... *Bro'mus*, 41.
 Awn (if present) terminal; pan. more or less unilateral *Festu'ca*, 40.
 Awn (if present) terminal; with pectinate, empty gls. *Cynosu'rus*, 31.
 Spikelets tufted in parallel groups; spreading ... *Dac'tylis*, 36.
 Awn very short; pan. soft, white; upper fl. male *Hol'cus*, 23.
 Sp. broadly ovate, obtuse, awnless ... *Bri'za*, 37.
 Sp. rather acute; flg. gl. compressed, awnless ... *Po'a*, 38.
 Sp. linear, very long, many-fld.; aq. plt. ... *Glyce'ria*, 39.
 Sp. many-fld.; Flg. gl.; convex, awned ... *Festu'ca*, 40.
 Flg. gl. acute, awnless, tips of gls. violet-brown; heaths *Moli'nia* 33.

6. *Anthoxan'thum odora'tum*, *Vernal Grass*. A common grass of meadows, scented with the odour of woodruff or new hay. It illustrates floral degradation; for a spikelet consists of two unequal outer

involucral glumes, then follow two empty flowering glumes, awned, the awn being a prolongation of the mid-rib; the rest of these two florets is wanting; then follows the flowering glume of the true flower with a minute pale. There are no lodicules, only two stamens, and the usual pistil.

8. *Alopecu'rus agres'tis*, *Fox-tail Grass*. The spikelets of this grass form a long tapering dense spike; the outer, pointed, empty, or involucral glumes are coherent below to nearly the middle, but are not awned, though the flowering glume has an awn.

10. *Phle'um praten'se*, *Cat's-tail Grass*. The spikelets of this grass form a long, blunt-ended spike; the outer glumes are not coherent and somewhat truncated above, but terminating in points or awns; the flowering glume being awnless.

18. *Ammoph'ila arundina'cea*, *Marram Grass*. A coarse grass, 2-4 ft. high, on sand hills by the sea; producing long, contracted, almost spike-like panicles. The spikelets are large and one-flowered. The root-stock is widely creeping, binding the sand together.

23. *Hol'cus lana'tus*, a very soft, tomentose grass, growing in copses, waysides, &c., 6-24 ins. The leaves are flat, soft, with the sheaths somewhat inflated. The panicle with spreading branches is from 2-5 ins. in length, the spikelets are two-flowered; awnless. The less common species, *H. mollis*, has awns. The terminal flower is male.

25. *Ave'na fat'ua*, *Wild Oat*. A corn-field grass, and thought to be the origin of the cultivated oat. It bears a large loose panicle of pendulous spikelets. A spikelet has two large outer glumes, containing about three florets, two being perfect, the terminal one rudimentary, consisting of a flowering glume and pale only. The flowering glumes have long, bent, and spirally-twisted awns. *Avena sativa*, the cultivated oat, is a convenient plant for examination, as the parts are somewhat large.

29. *Phragmi'tes commu'nis*, *Reed*. A perennial stout water-reed, growing from 6-10 ft. in height, and bear-

ing large drooping panicles of purplish hairy spikelets. It is almost cosmopolitan, being found in all the continents and Australia.

36. *Dac'tylis glomera'ta*, *Cock's-foot Grass*. This is common in pastures, &c., 2-3 ft. high. It is a coarse perennial grass, with a panicle of spreading branches, with the spikelets compacted, one over the other, and somewhat one-sided or secund and laterally compressed. The spikelets are 3-5 flowered.

37. *Bri'za me'dia*, *Quaking or Dodder Grass*. This has spreading panicles of broadly ovate or cordate shaped obtuse spikelets, on slender pedicels. Each spikelet has about eight florets. It is common in meadows, &c.

38. *Po'a an'nua*, *Meadow Grass*. A small annual, 6-12 ins., with subacute waved leaves, and spreading panicles of flattened, many-flowered spikelets, the branches being two-nate or in half-whorls. This species occurs in all waste ground, and enters largely into the composition of the London parks; being often cleistogamous it seeds profusely, easily becoming perennial in wet ground and in high altitudes. Two species, *P. praten'sis* and *P. trivia'lis* occur in meadows; *P. nemora'lis* in woods; *P. alpi'na* on lofty mountains; and *P. bulbo'sa*, remarkable for its tuberous nodes, which act as reservoirs of water when it grows in arid districts, but are often not developed in watery situations. It most resembles the small species *P. alpina*.

39. *Glyce'ria flu'itans*, *Manna Grass*. A tall grass, often aquatic, with the long floating leaves; the panicle 1-2 ft. long, with spikelets $\frac{1}{4}$ -2 ins. in length. The empty glumes are unequal, with torn lips. The two lodicules are sub-coherent, an unusual condition in grasses.

40. *Festu'ca ovi'na*, *Fescue Grass*. There are nine species in this genus, the present one frequenting dry hilly pastures, &c. It is a small grass, 3-24 ins., with glaucous, setaceous leaves. The panicle is sub-unilateral; the spikelets 3-12 flowered, purplish; the

flowering glumes are convex, mucronate, or shortly awned. It is a very variable species, but one of the most abundant of grasses.

41. *Brómus mol'lis*, *Brome Grass* (Fig. 57). A pubescent grass, with an ovoid panicle (1), the spikelets (1, *a*) having 6–10 densely imbricate, pubescent, flowering glumes, nearly equalling in length the slender awn (3, *b*). (2) illustrates the structure of a node (*a*) of the stem or culm. This being hollow except at the nodes from which the leaf-sheaths arise. (3) is a single

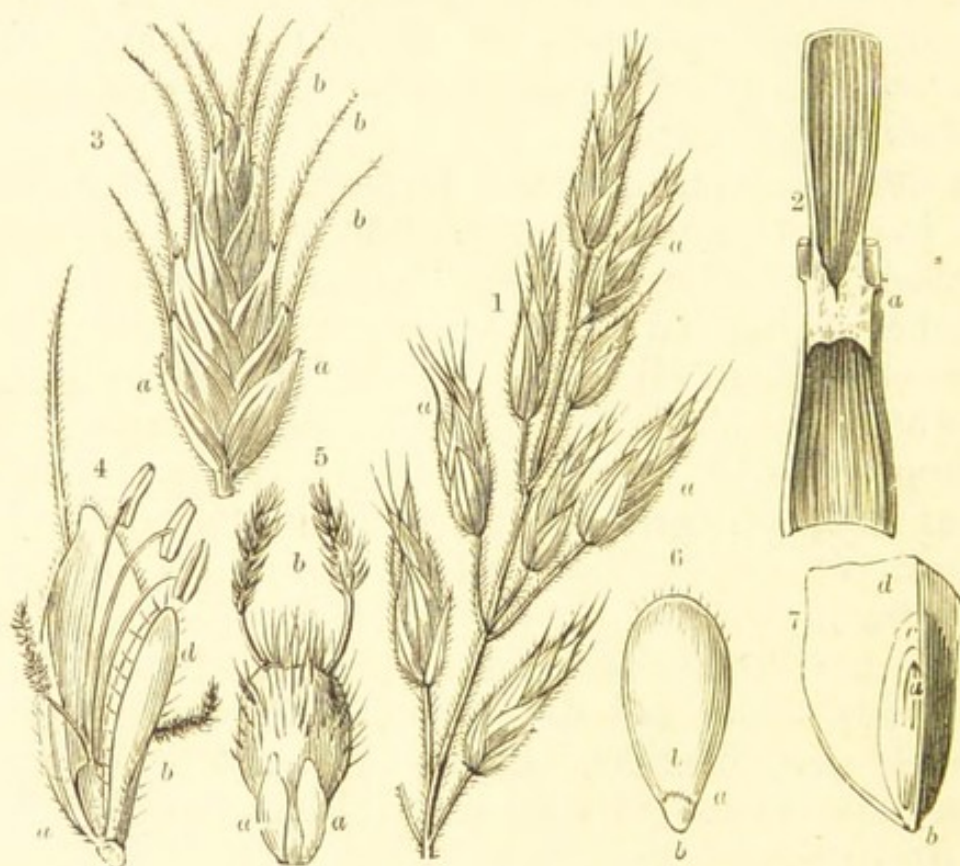


FIG. 57. *Bromus mollis*.

spikelet consisting of as many florets as awns, as each awn (*b*) is the prolongation of the midrib of a flowering glume. The two outer, empty or involucreal glumes are at the bottom (*a*) and without long awns. (4) is a floret laid open; (*a*) represents the flowering-glume with its awn (*c*). (*b*) is the pale, without any awn, but has two ridges, which are hairy (*d*). The pistil with its two long feathered stigmas (5, *b*) and three stamens are also to be seen,

but the lodicules are concealed. On removing the flowering-glume they are exposed (5, *a*) close to, and at the base of, the pistil. (6) represents a ripe grain consisting of a single seed closely invested by the pericarp; (*a*) indicates a depression, beneath which lies the embryo on the surface of the endosperm (*b*). (7) is a triangular piece cut out of the grain to show the embryo (*b* to *c*) lying at the base of the flowery albumen (*d*). (7 *a*) is the plumule, consisting of overlapping rudimentary leaves, which lie in a depression of the single cotyledon (*c*). This is sometimes called the sheath or scutellum. The chief use is to secrete a ferment by means of which it dissolves the endosperm (*d*) and absorbs the nutritive matters for the plumule and radicles. At (*b*) may be seen the adventitious roots beneath the surface. These details can be best studied in a grain of Indian corn, after it has been soaked in hot water.

43. *Lo'lium peren'ne*, *Rye-grass*. A common grass, many-flowered, with spikelets arranged on opposite sides of the axis in a spicate manner. Each spikelet has only one outer, very long glume, excepting the terminal one, which has two. The spikelets stand edgewise on the stem. The varieties *L. p. italicum* and *L. p. aristata* are cultivated forms not known wild. *L. festucaceum* is a bigener between *Lolium perenne* and *Festuca elatior*. *L. temulen'tum*, Darnel, is the only other British species. It is a tall plant, 2-3 ft. high, an annual, occurring in cornfields. It has similar inflorescences to rye-grass, but much larger. It is recorded as the only poisonous grass; but it has been eaten with impunity in Scotland when made into bread, and the Maltese feed their horses on the plant pulled up by the roots. The evil effects are probably due to an ergotized or fungoid condition of the grain, and not to the pure seed itself. It was called 'drunk' in the fourteenth century, and Gerarde (1597) says in his *Herball*: 'Among the hurtful weedes darnell is the first . . . new bread wherein darnell is, eaten hot, causeth drunkenness.'

'Rye' takes its name from the French *ivraie*, drunkenness. This plant is the 'tares' of the parable; and having broad wheat-like leaves, it would be impossible to distinguish it with certainty from wheat before the ears are produced.

44. **Agropy'rum** (**Trit'icum**) **re'pens**, *Couch* or *Quitch Grass*. A perennial grass with a much-creeping underground stem (whence the name, derived from the French *coucher*, to lie down), very troublesome on arable land. The spikelets are arranged as a spike, being placed sideways on the axis. *A. (Triticum) junceum* occurs on sandy shores and assists in binding the sand with its extensively creeping stems. *Triticum sativum*, Wheat, the origin of which is unknown. This is a convenient plant for examination, as the florets are large. The varieties are innumerable, a small grained example being found in the prehistoric dwelling-sites in the Swiss lakes. Great differences reside in the quality of the grain according to the country where it is grown; the English containing more starch or farinaceous matter, those of hot countries being harder and possessing a greater percentage of the nitrogenous principles or gluten; hence the whiter the flower the less nutritious it is.

46. **Nar'dus stric'ta**, *Mat-grass*. This is a small, rigid, perennial grass growing in heaths and dry pastures, with unilateral spikes; the florets being greatly degraded, for there are no outer, empty, or involucreal glumes; the spikelet consisting of a single floret, of a flowering glume and one-keeled pale. There are no lodicules, but three stamens, and only one stigma to the pistil. After ripening, the flowering glumes alone remain persistent. This degraded state is doubtless due to the poorness of the soil in which this species habitually resides.

47. **Hor'deum muri'num**, *Waybent* or *Barley-grass*. Everywhere common in waste places. It is an annual, with compressed awned spikes. The spikelets are grouped in triplets; the centre one being perfect, the two lateral abortive. Each of these three florets has

two bristle-like outer glumes. They are only one-flowered; the lateral spikelets contain only a flowering-glume and a pale to represent the floret. The anthers are not visible externally, as the florets are cleistogamous. There are four British species. *H. sylvaticum*, occurring in copses and woods on chalky soil, has the florets of the two lateral spikelets two-sexual, and the middle one male. *H. pratense* and *H. maritimum* agree with *H. murinum* in the sexual arrangements, but the former is perennial, while the latter is only in maritime localities. Cultivated barley, *H. distichon*, is unknown wild, and takes two principal forms; the two-ranked, in which the central spikelet of every group of three is fertile (this is the common form in England); or else the six-ranked, in which all three spikelets produce grains. This is the form commonly cultivated in warm climates and pulled green as fodder.

INDEX TO ENGLISH NAMES¹

[Principal Botanical Terms added in italics.]

- Aaron's beard, 81.
Achene, 24.
Adhesion of Fl. Orgs., 19.
Adventitious, 39.
Agrimony, 105.
Albumen, 24.
 Alder, 188.
 Alkanet, 158.
 Almond, 100.
Alternate, 16.
Anemophily, 105, 186.
Angio-sperm, 38.
Anther, 14.
Apocarpous, 98.
 Apricot, 100.
Arctic plts., 78, 104, 167, 188, 192.
Arrangement of Fl. Orgs., 15.
 Arrow-head, 211.
 Ash, 154.
 Asparagus, 203.
Auricle, 144, 152.
 Avens, 102.
 Azalea, 147.
 Baneberry, 49.
 Barberry, 57.
 Barley-grass, 220.
 Bartsia, 167.
 Basil thyme, 173.
 Beaked-parsley, 124.
 Bee orchis, 198.
 Beech, 189.
Bees, fertilization by, 93.
 Beetroot, 179.
 Bilberry, 147.
 Bindweed, 159.
 Birch, 187.
 Bird's-nest orchis, 195.
 Bistort, 180.
Bitter herbs, 134.
 Bitter-sweet, 161.
 Blackberry, 101.
 Black bryony, 202.
 Black horehound, 176.
 Black mustard, 67.
 Blackthorn, 99.
 Bladderwort, 170.
 Bluebell, 204.
 Bog-bean, 155.
 Borage, 157.
 Box, 184.
Bract, 65.
Bracteole, 102.
 Bramble, 101.
 Brome grass, 218.
 Brook-weed, 153.
 Broom, 93.
 Broom-rape, 169.
 Bryony, 119.
 Buck-bean, 155.
 Bugle, 177.
 Bulrush, 208, 212.
 Bur-marigold, 139.
 Burnet, 105.
 Bur-reed, 207.
 Butcher's broom, 202.
 Butter-bur, 141.
 Buttercup, 51.
 Butterwort, 169.
 Cabbage, 66.
 Calamint, 173.
Cambium, 39.
 Campion, 77.
 Canterbury bell, 145.
 Carnation, 76.
 Carrot, 126.
Caruncle, 74.
 Cat-mint, 175.
 Catsia, 91.
 Cat's-tail, 208.
 Cat's-tail grass, 216.
 Celandine, 62; Lesser C., 52.
 Celery, 123.
 Centaury, 155.
Chalaza, 117.
 Chamomile, 139, 140.
 Charlock, 67.
 Cherry, 100.
 Chickweed, 80.
 Chicory, 143.
Chill, avoidance of, 84.
 Chive, 204.
 Cinquefoil, 104.
Circumnutation, 120.
Circumscissile, 161.
Cladode, 203.
 Clary, 173.
Classification, 31, 40, 41.
 Cleavers, 130.
Climbing, 50, 119.
 Clover, 95.
 Club-rust, 208.
 Cock's-foot grass, 217.
 Codlins and cream, 116.
Cohesion of Fl. Orgs., 17.
 Coltsfoot, 141.
 Comfrey, 158.
 Common bluebottle, 142.
Compound leaf, 50, 101.
Conduplicate, 84.
Connate, 17.
Connective, 14.
Corn, 54.
 Corn chamomile, 139.
 Corn-cockle, 78.
 Cornel, 127.
 Cornflower, 142.
 Corn marigold, 140.
 Corn sow-thistle, 145.
Corymb, 65.
Corymbose, 106.
 Cotton sedge, 213.
Cotyledon, 37.
 Couch grass, 220.
 Cowslip, 150.
 Cow-wheat, 168.
Cremocarp, details of, 124.
 Crocus, 200.
 Cuckoo-pint, 208.
 Cucumber, 119.
 Cud-weed, 139.
Cuneate, 108.
Cycle, 16.
Cyme, 128, 158, 171.
Cypselis, 144.
 Cytisus, 90.
 Daffodil, 201.
 Daisy, 138.
 Dandelion, 144.
 Dane-wort, 128.
 Darnel, 98, 219.
Darwin on clover, 96.
 Deadly nightshade, 161.
 Dead-nettle, 175.
Declination, 116, 149.
 Dewberry, 102.
Diadelphous, 18, 90.
Diagrams, 22.
Dicotyledons, chars. of, 37.
Dimorphism, 85, 150.
Dioecious, 15.
 Disk, 18.
 Dock, 181.
 Dodder, 160.
 Doddergrass, 217.
 Dog's mercury, 185.
 Dropwort, 121.
 Drupe, 100.
Drupel, 102.
 Duck-weed, 210.
 Dwale, 161.
 Dyer's greenweed, 92.
 Dyer's weed, 69.
 Elder, 128.
 Elm, 185.
Embryo, 37.
Embryo-sac, 23.
 Enchanter's nightshade, 117.
Endogens, 39.
Endosperm, 24.
Entire leaf, 74.
Entomophily, 105.
Epicalyx, 102.
Epidermis, 21.
Epigynous, 21.
Etaerio, 54, 102.
 Evening primrose, 117.
Exogens, 39.
 Eyebright, 168.

¹ For list of Genera, see pp. 9-12.

Falcate, 106.
Fennel, 124.
Fertilization, 22; *by bees*, 93.
Fescue grass, 217.
Feverfew, 140.
Field-madder, 132.
Figwort, 164.
Filament, 14.
Fir, 192.
Flag, 200.
Flax, 85.
Flea-bane, 139.
Floral Formula, 34.
Flowering ash, 155.
Fly-orchis, 199.
Foliate, 33.
Follicle, 55, 110.
Food plants, 91.
Fool's parsley, 124.
Forget-me-not, 159.
Form of Fl. Orgs., 21.
Foxglove, 165.
Fox-tail grass, 216.
Fragrant orchis, 199.
French marigold, 136.
French willow, 115.
Fuchsia, 115.
Fumitory, 63.
Functions of plants, 28.

Gall, 62.
Genista, 90.
Gentian, 155.
Genus, 33.
Geranium, 87.
Gerarde, quoted, 101, 219.
Germander speedwell, 166.
Germ-cell, 23.
Gibbous, 65, 164.
Gland, 26.
Glaucous, 63.
Glomerule, 113, 128.
Goatwillow, 191.
Goat's-beard, 145.
Gooseberry, 108.
Goosefoot, 178.
Grass, 214.
Green-winged orchis, 197.
Ground ivy, 175.
Groundsel, 141.
Guelder-rose, 127.
Gymnosperm, 38.
Gynobasic, 172.
Gynophore, 70.

Hairy willow herb, 116.
Hard-head, 142.
Hawkbit, 144.
Hawk's-beard, 143.
Hawkweed, 143.
Hawthorn, 106.
Hazel, 190.
Heath, 148.
Helleborine, 196.
Hemlock, 121, 123.
Henbane, 161.
Henbit dead-nettle, 176.
Henna, 114.
Herb Robert, 88.

Hogweed, 126.
Homomorphic, 36, 152.
Honey-secreting organs, 26.
Honeysuckle, 128.
Hornbeam, 190.
Horned poppy, 63.
Horse-mint, 172.
House leek, 111.
Humble bees, use of, 95.
Hybridization, 30.
Hypogynous, 20.
Imbricate, 16, 49.
Inferior, 21.
Inflorescence and Bracts, 167.
Insectivorous plants, 111, 167, 169, 170.
Intercrossing Fls., 25, 56, 66, 77, 83.
Internodes, 16.
Involucre, 124.
Involucres, 51, 124.
Iris, 200.
Irritability of Protoplasm, 58.

Juniper, 192.

Key to Orders and genera, 42;
 to *Ranunculaceae*, 49; to
Caryophyllaceae, 74; to *Leguminosae*, 91; to *Rosaceae*,
 99; to *Umbelliferae*, 122;
 to *Compositae*, 135; to *Sero-
 phulariaceae*, 163; to *La-
 biatae*, 172; to *Orchideae*,
 195; to *Liliaceae*, 202; to
Gramineae, 215.

Knapweed, 141.
Knotgrass, 179.

Laburnum, 90.
Lace-bark tree, 182.
Lacunae, 54.
Lady's bedstraw, 130.
Lady's mantle, 104.
Lady's slipper, 199.
Lady's tresses, 195.
Larkspur, 56.
Laurel, 182.
Leek, 204.
Lent lily, 201.
Lesser celandine, 52.
Lesser spearwort, 54.
Lettuce, 144.
Lily of the valley, 203.
Lime, 284.
Ling, 149.
Lobes, 17.
Loculicidal, 73, 149.
London pride, 107.
Loosestrife, 113.
Lords and ladies, 208.
Lousewort, 168.
Lucerne, 94.

Madder, 130.
Mallow, 82.
Manna grass, 217.
Maple, 89.

Marram grass, 216.
Marsh marigold, 55.
Marsh samphire, 179.
Mat-grass, 220.
May, 106.
Meadow grass, 217.
Meadow pea, 98.
Meadow saffron, 205.
Meadow sweet, 101.
Menyanthes, 155.
Micropyle, 23.
Mignonette, 69.
Milfoil, 140.
Milkwort, 73.
Mint, 172.
Mistletoe, 182.
Monadelphous, 18, 90.
Monkshood, 56.
Monocotyledons, chars. of, 19, 38.
Monococious, 15.
Mouse-ear chickweed, 78.
Movements of Pl. Orgs., 58, 84,
 92, 94, 96, 112, 186, 187,
 197, 198.
Mugwort, 140.
Mullein, 163.
Musk, 165.
Mustard, 67.

Narcissus, 201.
Nectaries, 27.
Nectarine, 100.
Needle furze, 92.
Nettle, 186.
Nightshade, 161.
Nipplewort, 143.
Node, 16.
*Norman or Mediterranean
 flora*, 149, 164, 168.
Number of Fl. Orgs., 15.

Oak, 188.
Oat, 216.
Oblique leaf, 84.
Obovate, 153.
Oil in plants, 121.
Old man's beard, 50.
Olive, 153.
Onion, 204.
Orache, 179.
Orchis, 196.
Origin of flowers, 149.
Orpine, 111.
Ovary, 14.
Ovale, 15, 37, 84.
Ox-eye daisy, 140.
Oxlip, 150.

Panicle, 178, 186, 212.
Pansy, 71.
Pappus, 137.
Papyrus, 212.
Parasitic fly. pils., 160, 167,
 168, 169.
Parsnip, 126.
Pea, meadow, 98.
Peach, 100.
Pear, 106.
Pedicel, 13.

Pellitory, 186.
Peltate, 38, 123.
 Pennywort, 110, 123.
Pericarp, 23.
Pericycle, 39, 87.
Perigynous, 20, 103, 109.
Perisperm, 75.
Personate, 164.
Petals, 13.
Phalange, 18, 81.
Phyllode, 211.
 Pimpernel, 153.
 Pink, 76.
 Pistils, 14.
Placenta, 18.
 Plum, 100.
Plumule, 37.
Pollen, 14.
Pollination, 22.
Polygamous, 15.
Polymorphism, 113.
Pome, 106.
 Pondweed, 212.
 Poplar, 190.
 Poppy, 61: Horned P., 63.
 Potato, 162.
 Primrose, 150.
 Privet, 153.
Protandry, 56, 77.
Protophyty, 56, 99, 206.
Protoplasm, irritability of, 58.
 Purple medick, 94.

Quaking grass, 217.
 Queen of meadows, 101.
 Quitch-grass, 220.

Raceme, 57.
Radicle, 37.
 Radish, 69.
 Ragged Robin, 78.
 Ragwort, 141.
 Rampion, 145.
 Ramsons, 203.
Raphe, 117.
 Raspberry, 102.
Receptacle, 13.
Receptacular tube, 20.
 Red clover, 95.
 Reed, 216.
 Reed-mace, 208.
Reniform, 104, 160.
 Rest-harrow, 94.
 Rhododendron, 147.
Ringent, 165.
 Rose, 105.
 Rose-bay, 115.
Rotate, 127, 147.
Runcinate, 143.
 Rush, 205.
 Rye-grass, 219.
 Saffron, 205.
 Sage, 174.
Sagittate, 98, 211.
 Sainfoin, 90.
 St. John's wort, 81.

Sallow, 191.
 Salsify, 145.
 Saltwort, 179.
Samara, 89, 185.
 Samphire, 124: *Marsil S.*, 179.
 Saxifrage, 107.
 Scabious, 132.
Scape, 51.
 Scotch fir, 192.
 Sea holly, 123.
 Sea-kale, 68.
Secund, 177.
 Sedg, 213.
Seed, 23.
Self-Adaptation, 27, 53, 57, 60, 83, 94.
Self-Fertilization, 24, 68, 71.
 Self-heal, 175.
Sepal, 13.
Septicidal, 149, 205.
Septifragal, 149.
Septum, 61.
Setaceous, 205.
 Sheep's bit, 145.
 Shepherd's needle, 124.
 Shepherd's purse, 67.
Silicula, 68.
Siliqua, 66.
Simple leaf, 50.
Sleep of plants, 96.
 Sloe, 99.
 Snapdragon, 164.
 Snowdrop, 201.
 Snowflake, 201.
 Sorrel, 181.
 Sow-thistle, 144.
Spanish flora, 107, 148, 149.
Spathe, 203.
 Spear-thistle, 142.
Species, 29.
 Speedwell, 166.
 Spider orchid, 199.
Spike, 57.
Spikelet, 214.
Spine, 99.
 Spotted orchid, 196.
 Spurge, 183.
 Spurge laurel, 181.
 Squirting cucumber, 119.
Stamens, 13.
Staminode, 85, 165.
Stellate, 130, 205.
Stigma, 14.
 Stinging nettle, 186.
 Stinking may-weed, 139.
Stipules, 55, 72.
 Stitchwort, 79.
 Stock, 65.
Stoma, 54.
 Stonecrop, 110.
 Strawberry, 102.
 Strawberry-tree, 147.
Structure of flowers, 13.
Style, 14.
Subgenus, 37.
Subspecies, 29.

Sundew, 111.
Superior, 21.
 Sycamore, 89.
Symbiosis, 91, 195.
Symmetry, 15, 113.
Syncarpous, 98.
Syngenesious, 17.

Tansy, 140.
 Tares, 98, 220.
 Teasel, 132.
Testa, 37.
 Thistle, 142.
 Thyme, 173.
 Toad-flax, 164.
Tomentose, 139.
 Toothwort, 168.
 Traveller's joy, 50.
 Tree mallow, 83.
 Trefoil, 95.
Trifoliate, 95.
 Turnip, 66.
 Tway-blade, 195.

Umbel, 100, 121.
Unsymmetrical, 15.
Urceolate, 160.
Uses of Fl. Orgs., 22.

Valvate, 16, 49.
 Vanilla, 194.
Varieties, 29.
 Vernal grass, 215.
Versatile, 118, 128.
 Vetch, 97.
 Victoria regia, 59.
 Violet, 70.
 Viper's bugloss, 157.
Vittae, 121.

Wallflower, 65.
 Water-lily, 59.
 Water plantain, 210.
 Waybent, 220.
 Wayfaring tree, 127.
 Weld, 69.
 Wheat, 220.
 White dead-nettle, 175.
 White goosefoot, 178.
 White helleborine, 196.
 White mustard, 67.
 Whitethorn, 106.
Whorls, 13: *purpose of*, 22, 37.
 Whortleberry, 147.
 Wild chamomile, 140.
 Wild oat, 216.
 Willow, 191.
 Willow-herb, 116.
 Woad, 64.
 Wood anemone, 51.
 Woodbine, 128.
 Wood-ruff, 132.
 Wood-rush, 205.
 Wood sage, 177.

Yarrow, 140.
 Yellow-rattle, 168.
 Yew, 193.

