C. T. Hahn.

SOUTH AFRICAN FLOWERING PLANTS

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FOR THE USE OF BEGINNERS, STUDENTS AND TEACHERS

BY

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INTRODUCTION

THE objects of the present book are (1) to enable Beginners in Botany to take some interest in the wild plants of Cape Colony and elsewhere, and to show them how they are to be studied. The number of plants in South Africa is so great that all that can be done is to understand the structure of a certain number only, and the phenomena of their plant life.[1]

But to be merely able to distinguish plants by the structure of their flowers, or to know their names, is by no means enough. We require to know, if possible, why their leaves, as well as their flowers, are so different from each other. This leads to the study of their habits in association with their surrounding conditions; and we find that the structures of roots, stems, leaves, etc., are just what is best for the plant, whether it be living in a dry country like South Africa, or in a humid one as England, or entirely in water.

[1] The plants that I selected have been approved of by Dr. Schonland, who kindly suggested a few more which I have incorporated; and I take this opportunity of thanking Professor MacOwan for numerous suggestions which I have embodied.

We shall then see how every plant is *adapted* to its position in life, and how it has *acquired* the peculiarities which characterize each kind respectively.

(2) The Student who may be somewhat more advanced, and may be working by himself, should carefully dissect every flower he meets with. Then let him write down the particulars of structure, as well as make sketches of the different parts in his note-book. This procedure impresses the details strongly on the mind, which is apt to forget minute points of structure after examining many flowers.

When he discovers that there are often an immense number of "species," such as the different kinds of Heath—of which botanists reckon the amount to be some five hundred—he may wonder how Nature has made so many, as well as how the various shapes or forms of flowers have arisen. So I have added sections dealing with these matters.

It is most important to understand clearly the structure of flowers, because the classification of plants is almost entirely based upon it; and although they look so different, flowers can be easily grouped upon a few very simple "elements of variation," as one might call them.

(3) I have entitled this book as also intended for Teachers as well as Beginners and Students, because it is most important that they should encourage their pupils to look at plants and their flowers themselves,

and understand their relations to the surroundings; and not merely regard the practical school lesson in Botany as *only* concerned with *structure.* This latter is usually done by means of the *Floral Schedule,* an invention of the late Rev. J. S. Henslow, formerly Professor of Botany in the University of Cambridge, England. It is an admirable means for securing *accuracy* both in observation and recording.

But I should like the teacher to do much more, and show the pupils (who, if young, should be entirely taught practically without any book) *why* one plant is hairy or woolly; why another is quite smooth; why some flowers are "regular," others "irregular;" how it comes about that some plants are spiny, others not at all, etc.

Then such matters as insectivorous habits and climbing powers, parasitism, epiphytal modes of life—not to add the various adaptations in flowers for wind-, insect-, and self-pollination—should each and all in turn be discussed in the lesson as occasion arises.

All these and other additional matters to the "lesson proper" will excite the interest and enthusiasm of the pupils.

Another thing which the teacher should do is to encourage the pupils to bring to school all the examples they can find of the various parts of the plants treated of in any particular lesson—such as adaptations of flowers for pollination, of fruits and seeds showing special contrivances for dispersal. Thus they would be accumulating materials for the School Museum.

Of course, all success depends upon the teachers, who must teach *con amore*, advise, encourage, and reward the children's efforts by any means they may think best.

If they do this, they will find the subject not only interesting to themselves, but fascinating to their pupils.

The school should have a small Museum of Fruits and Seeds, and a Herbarium of dried plants of the neighbourhood, containing selected *types* of the different *genera*, when such have many *species*. The pupils should be encouraged to collect the specimens, which should be properly dried and mounted under the superintendence of the teacher.

The teacher, or elder pupils, should make enlarged drawings of everything of importance in the structure of flowers. These should be inserted with and by the side of the dried specimens. Wall-drawings and the blackboard should be freely employed.

It is impossible to make Botany so simple that a child will be able to follow the details without assistance. It is, indeed, quite a mistake to suppose that it can be written like a Story-book, or even like History. Botany requires a considerable *effort*, as much as any other subject—say, Grammar—taught at school. In fact, the teacher should in all cases provide the pupils with the flowers described whenever they can do so, in order that they may see for themselves the details in each case.

The pupils should be taught how to make "Floral Diagrams," of which there are several examples in this book. The best way is to procure a flower only half-opened, so that it can be seen how the sepals or petals overlap one another; then the exact positions of the stamens and honey-glands, with the relative positions of the cells of the ovary, must be carefully added.

One other item should be carefully observed, and that is, the insistence upon the *correct spelling* of every botanical term, especially when it is used for the first time. It should be written large upon the blackboard, and copied some half-dozen times by the pupils.

The reader will find many statements repeated in this book. Experience has taught me the advisability of the use of repetition.

In order to start fair with a general knowledge of plant structure, it is necessary to begin upon some common plant, and examine all its parts in order. For this purpose I have selected the common South African Sorrel, *Ox'alis cer'nua,* and shall devote the first sections to a description of this plant.

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THE PLANT AND ITS PARTS.

The Vegetative Organs of Ox'alis cer'nua, the South African Sorrel.—To be a botanist, it is not enough to *read* about flowers, but you must always examine the living plants themselves;[1] so, as soon as you can, get each of the plants referred to in this book, and compare it with what I have to say about it.

One of the commonest flowers which appears after the rains is the yellow-flowered *Ox'alis* called *cer'nua,* because of its drooping flowers, as that is the meaning of the Latin word *cer'nua* (Fig. 1).

Dig the whole plant up, and we will begin by studying those parts which keep the plant alive and enable it to grow, and indeed, in the case of this plant, to multiply it as well. Botanists call all such parts

[1] It is advisable for the beginner to be provided with a penknife and a pocket-lens, for dissecting and examining the smaller parts of flowers.

as roots, stems, branches, leaves, and bulbs the *Vegetative Organs*, since any part of a plant which has something to do is called an *Organ*.

It is usual to call the flowers and fruit the *Reproductive Organs*, as their use is to make seed with which

FIG. 1.—I. *Ox'alis cer'nua* at day-time. Flowers and leaflets spreading.

to raise new plants; but this *Ox'alis* can and does also propagate itself by means of little *bulbs*, which are formed upon a long underground stem, and so this process is called *Vegetative Multiplication*.

If a plant of this *Ox'alis* be growing among loose stony soil, the tuft of leaves arises from the top of a long slender stem which has grown straight up from a bulb. From this slender stem true roots arise of a fine thread-like character, and spread horizontally.

A bulb of this plant consists of two or more tiny,

FIG. I.—II. At night, flowers closed; leaflets depressed.

thick, and fleshy *scales*; they are really shortened and thickened leaf-stalks, without any blades, which contain a quantity of nourishment, chiefly starch, for the bud which is in the middle to live upon when it begins to grow, and until it has produced roots of its own.

The leaf consists of the stalk, or *Petiole*, and the *Blade*, which has three *Leaflets*. Such make a *compound* leaf (Fig. 1).

Simple leaves have only one blade.

Their behaviour at sunset should be watched, for while they are spread out horizontally by day (I.) the three leaflets drop down at night (II.), so that they hang, back to back, against the stalk. Many plants with compound leaves fold their leaflets up. This is called the "sleeping of leaves." Its object is to avoid injury from chill, as the blades, being heated by day, part with the heat at night more quickly and to a greater extent if the blades be horizontal than when they stand erect or hang downwards.

In England, as the weather is often cold when the trees open their buds, the expanding leaves are always either pressed together, or one half of a blade is folded upon the other half, like a sheet of note-paper. The leaves then place themselves for a time in a vertical position, by the stalk curling downwards or upwards. For it appears that the *upper* surfaces must be particularly protected, as well as the whole leaf, by being placed erect or pendulous.

In tropical countries, where very intense heat occurs, leaves behave very much in the same way in order to avoid the excessive heat, just as they do to avoid a chill from great cold in England.

When the dry season comes on, the underground stem of the *Ox'alis* may continue to grow downwards almost as fine as a thread; but after a certain distance, it suddenly increases in size, forming a short rod-like structure, from 1½ to 2 inches in length, which terminates below with a bulb.

The use of this rod is to store up water, so that when the time comes for the bulb to start into growth, it will have a supply of water to draw from, until it can get it from the rain by means of the roots in the soil.

This long erect underground stem, which can grow

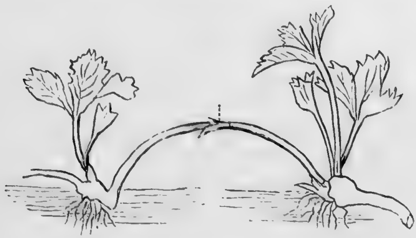


FIG. 2.—Runner of Strawberry (*Fraga'ria ves'ca*).

first upwards and then downwards, enables this plant "to climb up," so to say, between the loose stones of walls built up without mortar. This is often the case in Malta, where *Ox'alis cer'nua* abounds. Many of the stones of the walls there are fringed all round with the little green leaves.

When growing in a wet, rich soil, it will produce long *runners, i.e.* branches creeping along the ground; but they do not root at the *nodes*, or joints, as may be seen in the strawberry runners (Fig. 2).

The runners of the *Ox'alis* make little bulbs instead, so that plants soon spread over the ground, and in a few years cover large spaces.

To show how extensively it can spread, a few bulbs were sent to the Botanic Gardens in Malta in 1804; it has multiplied to such an extent that this plant now covers large tracts in Malta, not only by the roadsides, but forms "lawns" in front of houses instead of grass. Some of the fields show a mass of golden yellow colour in January, for it flowers there from December to May, the dry season being the reverse of that at the Cape.

Not only is it abundant in Malta and the adjacent island of Gozo, but it has found its way to Egypt, Algiers, and Morocco; and from Gibraltar to the Greek Islands, as Zante.

It has thus spread during a hundred years all round the Mediterranean Sea, by means of its little bulbs, as *Ox'alis cer'nua* has never been known to bear any pods with seeds in the northern hemisphere, as it does at the Cape.

The Uses of the Vegetative Organs.—We must first consider the use of the fine thread-like roots. These serve to draw up water and some mineral matters called "salts" from the soil, by means of which plants are partially nourished. Some plants have roots specially constructed to store up prepared food made by the leaves; the garden carrot, parsnip, radish, and turnip do this. In these it is principally sugar.

The stem, excepting the runners, is entirely underground in *Ox'alis cer'nua.* Its use is to develop leaves and flowers as well as to produce the little bulbs for multiplying the plant.

The leaf is one of the most important parts of a plant, for by means of it the plant can "digest" its mineral food, which has been partly drawn up by the roots, dissolved in water; but it also takes in and lives upon the impure air (*called carbonic acid gas*) which we breathe out of our lungs, and as long as the sunlight lasts, leaves and other green parts of plants continue to purify bad air by breathing out in exchange the pure air (*oxygen gas*) which we require to breathe in.

This process of *Assimilation*, as it is called, consists in decomposing carbonic acid, which is made up of the two elements *Carbon* and *Oxygen*, of which the plant retains the carbon, uniting it with the elements of water, and so makes *starch.* The oxygen is, as stated, set free into the atmosphere. If some very delicate leaf of a water-plant or of a moss which has been exposed to bright sunlight for some hours be brushed over with a camel's-hair brush dipped in tincture of iodine, the leaf will turn to a violet colour. This indicates the presence of starch. If a slice of potato be treated in the same way, it turns of a violet colour too, as starch has been stored up in the cells to a very large extent in potatoes.

There is another important use of leaves, called

Transpiration. The water absorbed by the roots by ordinary leafy plants is usually in excess of the plant's requirements, except in dry countries like South Africa, as the amount of mineral matters taken up is extremely minute. This water is disposed of under sunlight by means of the leaves. It is not the same thing as *Evaporation,* which is caused by heat. If a few fresh leaves be put into two tumblers, and one be placed in the sun, upside down, on a table, the other being put in total darkness, dew will quickly appear upon the inside of the first tumbler, but not on the other.

Cape Colony being remarkable for drought, nature adopts various means, as we shall see, to stop the too great loss of water, and to store it up in various ways against the dry season. Leaves can also absorb dew by means of the hairs with which many are provided.

Reproductive Organs.—The flowering process of plants is called the *Inflorescence.* The flowering shoots of some plants bear only one flower at a time, as the Rose and Water-lily; but others have many grouped together in several ways on a common stem. Thus each flower of *Ox'alis cer'nua* has its own little stalk or *Pedicel;* but all the *pedicels* proceed from the end of the main stalk, or *Peduncle,* together. Such an arrangement is called a *simple Umbel.* If they radiate *twice,* it is called a *compound Umbel,* as in the carrot.

Now let us examine a flower. First there is the green *Calyx*, composed of five little pointed pieces called the *Sepals*. Then follows the yellow *Corolla* of five *Petals*. Observe that they are alternate in position with the sepals. Next come two sets of *Stamens*, one set of five being shorter than the other set. Each stamen consists of a thread-like stalk, or *Filament*, bearing a two-chambered *Anther* at the top. These two chambers, or *Anther-cells*, contain a powder called *Pollen*. The continuation of the filament between the two cells is called the *Connective*.

In the middle of the flower is the green *Pistil*. This is composed of five *Carpels*, which are united below into a bag-like *Ovary*. In this will be found five chambers, called the *Ovary-cells*, each containing two rows of *Ovules*, which are destined to become *Seeds*. The projections upon which the ovules are situated are called the *Placentas*. Above the ovary arises a rod-like structure called the *Style*, which branches near the top, each branch terminating in a knob-like *Stigma*.

Such are the parts of the five *Floral Whorls*. In most flowers there are only four whorls, but *Ox'alis cer'nua* happens to have two whorls of stamens instead of one only, as is usually the case in flowers.

In addition to the actual parts of a flower making up the floral whorls, there are contrivances for secreting honey. These are knobs called *Glands* on the *Floral Receptacle*, the name given to the enlarged end of the flower-stalk, or pedicel.

Sometimes a complete ring is formed all round within the flower. This is called the *Disc,* from which the honey may be poured or "secreted" as we say. Honey may also occur in some part of the floral whorls themselves. Thus, it is at the bottom of the sepals in *Abu'tilon*, *Hibis'cus*, and Mallow, or in "pockets," "spurs," and other processes on the petals. Occasionally the stamens supply it, and not infrequently the external base, or it may be the top of the ovary which provides the honey. In all flowers, however, it is just where the insects can most easily reach it.[1]

The Uses of the Reproductive Organs.—Let us now see what are the uses of all these parts. The calyx *was* of use before the flower opened, as its five sepals wrapped up the young stamens and pistil, and so protected them in the bud. The corolla is of use for making the flower very bright, and easily seen by insects which come for honey or pollen as food. The stamens shed the dust-like pollen from the anthers, and this powder is a most important substance, for without it there can be no seed; since it is found that some of the *pollen-grains* must be applied to the top of each stigma, which is rough and sticky so as to retain

[1] In all cases the teacher should make the pupils write down every technical term, so that the correct spelling be ensured *at once;* for if an error is made at starting, it is very apt to cling to the pupil for a long while. The teacher must decide as to the number of technical terms to be learnt at each lesson. I would suggest not more than four or five at most, at least for the younger pupils.

it. When the pollen-grains have become fixed upon the stigma, they begin to grow by sending out little tubes, called the pollen-tubes (Fig. 3).

The tubes grow down the style (Fig. 4, *c*) till they reach an ovule (*gm*) within the ovary (*d*). In the

Fig. 3.—Pollen grains putting out their pollen-tubes: A, Teasel; B, Gourd.

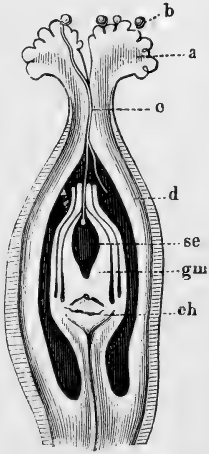


Fig. 4.—Longitudinal section through the ovary of *Polyg'onum Convol'vulus* at the time of flowering: *a*, stigma; *b*, pollen grains; *c*, pollen-tube; *d*, wall of the ovary; *gm*, the erect ovule; *se*, its embryo-sac; *ch*, chalaza: two pollen-tubes have penetrated through the style, one of which has entered the ovule, the other, not.

figure the ovary contains only one central ovule, so the pollen-tube passes directly downwards into a little hole at the upper end of it. It carries down a *fertilizing* body which meets another in what is called the *Embryo-sac* (*se*), a large cell or chamber within the ovule. This ovule has two coats as shown in the figure, called the *Primine*, the outer, and *Secundine*, the inner. These surround the solid central body in which lies the embryo-sac (*se*).

The ovule stands upon a stalk called the *Funicle;*[1] where this terminates in the ovule, that part of it is called the *Chalaza* (*ch*).

The result of the fusion of the above-mentioned two bodies, each of which is known as a *Nucleus,* is the formation of the *Embryo.* To understand the parts of an embryo, take a bean or an almond, soak it in water to remove the skin, or *Testa.* The whole of the body within is the embryo. It will easily split in half, but the two halves, called *Cotyledons,* are united by little stalks, because they are really leaves, but having to store up nourishment, they take quite a different form. Still, in many plants, when they have surrendered all their food to the germinating plant, they turn green, as in mustard and cress. Next observe a little bud nestling between the cotyledons. This is the *Plumule,* which will grow into the stem above ground. Lastly, there is a little tail protruding at one edge. This is the *Radicle.* It is not the root, which is only formed from the end of it when it germinates.

In many seeds, as we shall see, the embryo lies buried in *Albumen,* or *Endosperm* (Figs. 8, 10, 26, 35), a tissue abounding in starch, etc., upon which it lives when it begins to grow; but in beans, peas, mustard, and cress, the embryo carries its own food in the tissue of the cotyledons. While the ovule enlarges and becomes the seed, the ovary has its part to do; for its wall (*d*)

[1] *I.e.* "a little cord."

keeps pace with the growing seed and embryo within it; so that when it is quite ripe, it is called the *Pericarp*, and takes on a variety of forms, as shown by the innumerable sorts of *Fruits* in nature. The application of the pollen to the stigma is called *Pollination*, and the formation of the embryo is called *Fertilization*. The former may take place, but the latter does not always follow.

There are different ways by which pollination may be secured. First, by means of the wind. This applies to several plants with inconspicuous flowers, which have the pistil in one, and the stamens in another flower. This is called "Wind-pollination." Secondly, the pollen may be unwittingly carried off by bees and other insects; sometimes even birds, as the South African sun-birds do it; and then, when they visit other flowers of the same kind, the stigma hits them just where the pollen will be on their heads or elsewhere. This is called the *Crossing* of flowers, and is described as *Insect-pollination.*

Lastly, the pollen may be applied to the stigmas of the same flower in consequence of the anthers being situated in close contact with them. Such is called *Self-* or *Close-pollination.*

If it be asked which of the three kinds of pollination is the best, the question is, what do we mean by "best"? There are only two matters which concern a plant—one is to live a healthy life till it dies, and then to leave an abundance of good seed.

The first, or a healthy life, follows all three methods equally well, provided the outside conditions be all that are required.

As to the quantity of seed set, as the chance of not being pollinated by insects or the wind is always present, but never so in the last, the probability of their being the best off would seem to lie with self-fertilized flowers. When we look to see what happens in Nature, we find such to be by far the most prolific. Shepherd's-purse and Chickweed, imported from Europe, are examples. If they be allowed to grow and seed in a garden, they will soon smother everything in it.

Crossing, whether by insects, or if it be done artificially, as practised by florists, has the effect of *stimulating* the plant to produce larger and more brightly coloured flowers. Consequently, it is much practised in gardens, but it is often done *at the expense of fertility;* for it is found that after some years the amount of good seed, which will reproduce the best flowers, diminishes, so that the experimenter gets to the end of his tether, and he may even lose his whole stock altogether from the seed entirely failing.

I will now describe more in detail each of these three methods of pollination. There is a fourth, namely, when the pollen is conveyed by water, as of the sea-grass, a submarine flowering plant, but it is very rare for flowers to be fertilized in this way.

METHODS OF POLLINATION.

Wind-pollination.—The chief thing all beginners have to do, in order to understand the ways of plants, is to study their flowers, and to learn how it has come about that there are so many different sorts of sizes, shapes, colours, scents, etc. We shall see as we go along how this is due to the various means by which they get pollinated.

There are, as we have seen, three methods of securing pollination: by means of the wind, by the aid of insects, and by self-pollination.

In the case of wind-pollination, the stigmas are often long and hairy, so that they can easily catch the pollen and hold it. Look out for any grass that may be in flower, and examine its two feather-like stigmas. *Clifford'tia* (Fig. 5) is a good example. This last-named

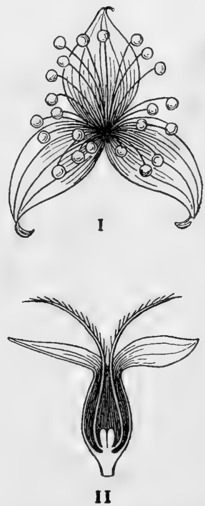
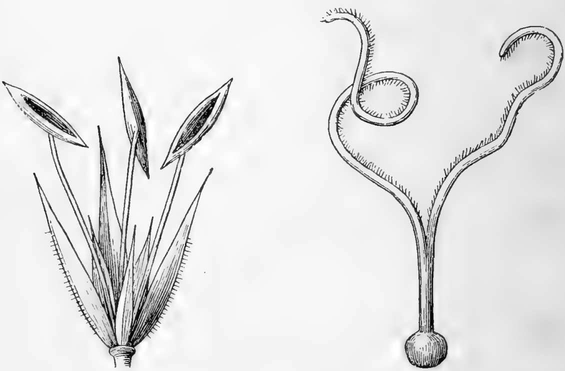


Fig. 5.—*Cliffor'tia.* I. Male flower. II. Vertical section through female flower.

plant requires two figures, because the many stamens are all in one flower (I.), and the pistil (II.) is in another. Moreover, they are not even on the same plant; and as the flowers have nothing to attract an insect, they must depend upon the wind.

There are other families besides Grasses which have no attractions, such as the "Sedges" and the family



I. II.

FIG. 6.—*Res'tio.* I. Male flower. II. Pistil of female flower.

called *Restiaceæ.* This latter abounds in Cape Colony and Australia, but is quite unknown in England. Fig. 6, I. is a male flower with stamens only; II. is the pistil of the female flower, having two very long hairy stigmas. They belong to a *Res'tio*, the genus which gives the name to the family. Pines and their kith and kin, such as the Yellow-woods and South African "Cedars," have an enormous amount of pollen.

The stamens and stigmas not being together, the latter can only be pollinated by the wind blowing the pollen on to them. In a high wind the pollen may often be seen forming a perfect cloud of a yellow colour dispersing on the breeze. Indeed, occasions have occurred when ignorant people thought it must be sulphur from some volcano, but it was only pollen from some neighbouring pine trees!

FIG. 7.—*Plumba'go.* Stamens, honey-glands, and pistil.

Insect-pollination.—Flowers which are regularly visited by insects possess various means of attracting them, such as bright colours or by being white. It is sometimes the scale-like *Bracts,* as they are called, outside flowers, as of "Everlastings," which are coloured. Sometimes the calyx is white or coloured, as of *Clem'atis* and *Anem'one.* Generally it is the corolla which invites them.

Besides colour, there is often a sweet scent, as in roses, etc. Some flowers, such as of the Stapelias of the Karroo, smell like putrid meat, so that flies come and lay their eggs upon the corollas by mistake! They never, however, turn to grubs. Then, again, many flowers secrete honey. This is done by what are called *Glands, i.e.* small knob-like growths on the floral receptacle as in *Plumba'go* (Fig. 7), or else by a disc which is a thick ring all round the flower, as in *Rhus* (Fig. 8). These secrete liquid honey, and it is easy to imagine an insect thrusting its head into the middle of the flower of *Rhus,* when the pollen from the five anthers would fall upon it.

Now let us examine a peach blossom. You will notice that there is a sort of cup round the pistil in the middle (Fig. 9). This cup has grown out of the flower-stalk, and carries the sepals, petals, and stamens on the rim. You will notice that it is

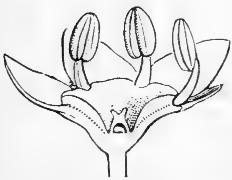


FIG. 8.—*Rhus.* Vertical section of male flower.

FIG. 9.—*Peach.* Vertical section of flower.

thickened inside at the bottom. This is the honey-disc, of an orange colour.

If you get any flower of any one of the numerous kinds of *Mesembrian'themum,* as the Hottentot Fig, you will find that the cup has *grown on to the surface of the ovary* (Fig. 10), so that by cutting the flower down as in the figure, the sepals, the many petals, and many stamens are all standing on a level with the top of the ovary, two cells of which are seen cut through. The honey will be found to be secreted on the top of the ovary, just within the innermost stamens, and the bee standing on the flower burrows down among the stamens to get in.

Once more, examine the flower of the common *Roel'la* (Fig. 11). The top of the ovary (which is united to the "cup" as in the last) secretes the honey; but it is carefully covered over with the broad bases of the five filaments, which make a dome over it.

FIG. 10.—*Mesembryan'themum.* Vertical section of flower.

The way in which bees secure the honey is by entering the flower head downwards, clinging to the style in the middle. Now, the anthers were at first pressed against the style, the hairs of which "collect" the rough pollen (III.). The anthers then shrivel and fall down, as shown in I. The stigmas are not yet ready to receive the pollen; but as soon as the style is well covered with pollen, the stigmas spread out, as shown in II. A bee which has visited No. I., and got well dusted with pollen on its underside, now flies to the flower No. II.; and, alighting on the outspread stigmas, dusts them with the pollen brought from No. I.

No. IV. is a *Diagram* of the flower. It is supposed to stand for the cut edges of the parts of a flower cut

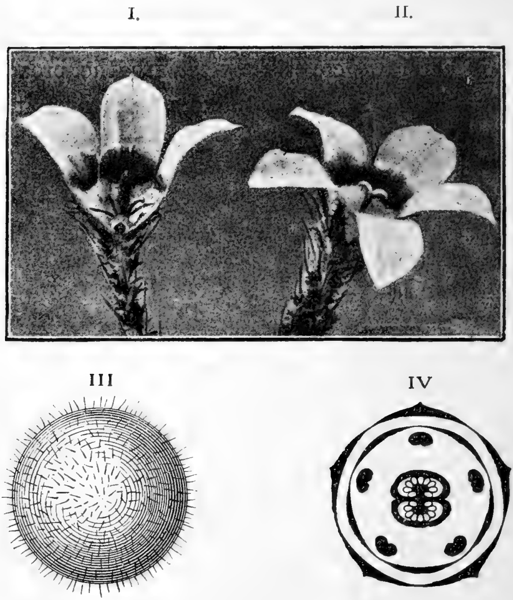


FIG. 11.—*Roel'la cilia'ta.* I. Section of flower in its first (male) stage, one stamen removed (½). II. Flower in its second (female) stage (½). III. Pollen grain. IV. Diagram of flower.

across, to show their relative positions. The outer brackets stand for the sepals, and, being all united in one circle, shows that the five sepals are *coherent.* The smaller brackets stand for the petals, which are also coherent. The black spots represent the anthers, and the central figure shows that the ovary has two cells; the margins of the two carpels have met in the middle;[1] and the enlarged placentas are covered with ovules.[2]

It is a very usual occurrence with conspicuous flowers, constantly visited by insects, to have the pollen ready to be taken away *before* the stigmas are prepared to receive it; so that such flowers *must* be "crossed," or they would set no seed, unless the pollen remains in the flower long enough, *i.e.* until the stigmas are mature. The former condition, we shall see, is what occurs in *Pelargo'nium.*

All the flowers thus far referred to have the parts of each whorl exactly alike, and they are, therefore, said to be *Regular.* Whenever this is the case, the insects can visit the flower on any point of the circumference, and the honey-glands are situated at regular intervals, as in *Plumba'go,* or else the *disc* runs all round the flower, as we have seen in *Rhus.* There are a great number of flowers in which the corolla, especially, is *Irregular,* in that the petals are not all the same in size or shape. This is easily seen in the flower of the Sweet-pea (Fig. 46), and of Polygalas (Fig. 36), in which South Africa abounds. But as that

[1] This will be fully explained hereafter.

[2] Pupils should always be taught and encouraged to draw *diagrams* of flowers. It is best to observe the flower when half expanded, as it can then be seen how the sepals and petals overlap one another, respectively.

flower is very complicated, I will not now describe it. We will begin with *Pelargo'nium*, or "Heron's-bill," of which South Africa has some 160 different kinds or *species.*

Get a blossom of the largest kind you can find, such as the one here figured (Fig. 12). You will notice that the petals which stand up at the back are

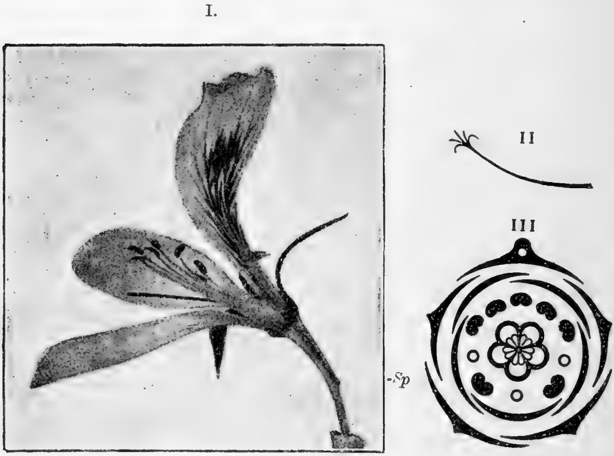


FIG. 12.—*Pelargo'nium cuculla'tum.* I. Section through flower, 2½ sepals and 2½ petals being removed; *Sp*, hollow spur of upper sepal. II. Style and stigmas of a flower in the second (female) stage. III. Diagram of flower.

larger and often streaked with a deeper colour than the other three. It is a usual thing for irregular flowers to be streaked or spotted in certain places only; but they occur just over the passage leading to the honey; hence they have been called "honey-guides," or "path-finders," showing the insects where they are to search without any hunting.

In some kinds of *Pelargo'nium* the front petal is wanting, the nourishment required to make it having been drawn away in order to enlarge the back petals.

Next we notice that only seven stamens bear anthers, as shown in the plan or diagram (III.); the three little rings stand for three filaments, which bear no anthers. Now observe how, instead of the filaments standing round the pistil, as in regular flowers, they all bend downwards in front. Next notice how the style stands out underneath the stamens like a rod with a blunt end (I.). The meaning of this is that although the anthers are quite ready to shed their pollen, the five stigmas are not ready to receive it; so that the flower must invite an insect to take the pollen away and put it upon the stigmas of some other flower of the same kind of *Pelargo'nium* which are ready to receive it (as shown in Fig. 42, II.).

The slanting, or *declinate*, stamens afford a good landing-place for the insect to stand upon. It thus gets dusted on its underside. But where is the honey to be found?

If you look well into the flower, at the back, you will find a hole just in front of the hindermost sepal, as shown in the diagram (III.). Now look at the stalk behind; and the hole leads into a long "honey-tube," or *Nectary*, which you can split down to the bottom.

But this is not all. As soon as the anthers have shed their pollen, they shrivel up and fall off. By this time the stigmas are ready, and the style curves upwards and spreads out its five stigmas (II.) just where the anthers stood; so that they sweep off the pollen from the next insect that comes, which has previously visited some other flower in the earlier stage.

You must look for flowers of *Pelargo'niums* in these two stages; you will easily detect them.

I. II.

FIG. 13.—*Duvernoi'a.* I. Flower. II. Ditto with bee.

Now you will understand how all the parts of the flower are fitted to receive the visitor, which, in return for the free gift of honey, pollinates the flowers.

Irregular flowers very often have their stamens grouped together but standing erect facing the front of the flower and not declinate.

Thus, those of a tree or shrub often cultivated in South Africa, and called *Duvernoi'a* (Adhatoda), shows this.

Look at Fig. 13, and you will see how the two anthers stand under the hood-like petal, at the back, with the stigmas close to and between them (I.). But the stigmas are not yet ready to receive the pollen. The large "lip," as the front petal is called, forms the landing-place for the bee. Unlike *Pelargo'nium*, the petals are all "coherent" into one piece and not *free*. The use of their all being joined is to add strength to the corolla so as to bear the weight of the insect.

Now turn to figure (II.), and it is easy to see how the bee's big body exactly fits the flower, as if the latter were made specially for it; and so, too, it is believed to have been, for flowers have the power of altering, not all at once, but in several generations. How many are necessary is unknown; but that if the same kind of insect habitually visits the same kind of flower, this gradually becomes adapted to it, as has evidently been the case here.

Notice how the bee's legs grip the ridges on the lip; so that it can rest comfortably while it is rifling the flower of its honey, which is secreted by a gland at the bottom.

There are many more wonderful contrivances than this. One of the commonest kind of South African herbs is the *Lobe'lia*. It is obvious that the corolla is very irregular (Fig. 14). The stamens have their anthers coherent into a tube (I. and II.), through which passes the style of the pistil. Up the middle of the stamens stands the pistil (I.). It has two stigmas pressed together with a hairy fringe below them (III.). Now, as the style elongates, the fringe sweeps out the pollen, which is shed inside the anther-tube (I. and II.), and so brings it out at the top. Not till then do the two branches of the stigma spread out, just as in *Roel'la* (Fig. 11). Although the pollen cannot readily fall on the spread-out sticky

I. II. III.

FIG. 14.—*Lobe'lia.* I. Vertical section of flower. II. Stamens, anthers closed over stigma. III. Style and stigmas.

stigmas, which are *above* the fringe, on which will be the pollen, yet it has got it out all ready for an insect to carry it off to some other flower in which the stigmas are outspread to receive it.

Precisely the same method occurs in the "florets" of the so-called "Flowers" of the great family of Composites, as will be seen from the figures given of that family.

The *Sal'via*, or Sage, of which there are several kinds occurring in South Africa, has a more wonderful contrivance still. Fig. 15 (I. and II.) will explain it. There is a large lip to the corolla which supplies the landing-place for a bee. Then the stamens, of which there are only two perfect, together with the style, are concealed under the hood at the back (II.; this hood is removed in I.). To understand the structure of the stamens, the first thing to note is

FIG. 15.—*Sal'via*. I. Corolla, the hood removed. II. Ditto with bee.

that the very short filament seen arising from the front part of the corolla-tube springs from the tube to which it is "coherent." At the upper end of the filament is a curved rod bearing one anther-cell at the top, while the other is at the bottom; hence the curved rod is really the "connective." The bottom anther-cell has no pollen, or is abortive, as we say. Now, the rod-like connective swings up and down on a sort of pivot, where it is attached to the filament;

and as the pivot is not in the middle of the rod, but much nearer the lower end, if you touch the spoon-like, empty anther-cells and force them downwards a little way, the two upper anther-cells will swing down a very long way, as shown by their positions at the end of the dotted lines in Fig. 15 (I.).

This is exactly what a bee does. It alights on the lip, puts its head down to reach the honey at the bottom of the tube of the corolla, depresses the lower anther-cells, and the upper ones filled with pollen come down and strike the bee on the back, giving it a shower of pollen in so doing (II.).

On its retiring the anthers swing back again into the place under the hood.

Then the forked stigma projecting forwards is pretty sure to hit the bee just where it has received the pollen from some other flower.

In the Desert near Cairo there are some Salvias, but as there are very few insects, the Salvias have learnt to do without them, for the two stigmas have grown very long, and curl backwards till they are touching the anthers, which thus pollinate them at once. This is called "self-fertilization," of which I shall say more presently.

The common yellow-flowered *Ox'alis cer'nua* described in the introduction is remarkable for having three kinds of flowers. Though the corollas are the same in each, the stamens and styles are of different lengths, so that they have been called the "short-styled," "mid-styled," and "long-styled" flowers. These three different kinds are always on different plants (Fig. 16).

No experiments have been made with this plant, but the celebrated Mr. Charles Darwin tried all sorts

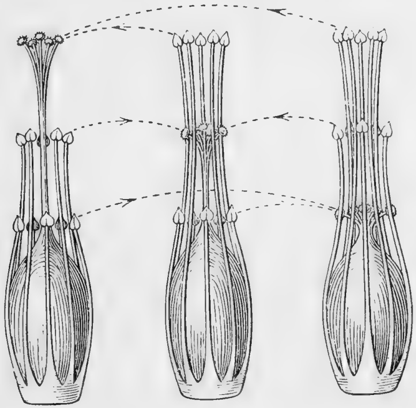


FIG. 16.—Trimorphic stamens and pistils of *Ox'alis cer'nua*. The arrows indicate the legitimate combinations.

of combinations of pollinations between three similar kinds of flowers of an English plant of a very different family. He found that the best way was to cross each pistil with pollen from the stamens of the same form, as shown by the arrows in the figure. When he pollinated the tall styles with the shortest stamens, he got little or no seed; but by pollinating the mid-styled form by either, he got a certain amount. Moreover, of all sorts of crosses the mid-styled proved to be the most prolific.

The form of this *Ox'alis* described as occurring in the Northern Hemisphere around the Mediterranean Sea is the short-styled form only. It might be thought that the pollen must fall upon the stigmas; and no doubt it does, but it cannot *fertilize* the ovules, though it may *pollinate* those stigmas.

This impotence to fertilize has been discovered in other flowers. Thus there is a kind of flax, wild in England, which has not three, but only two forms of flowers, which will not set seed unless they be crossed. If pollen be placed upon the stigma of the same flower, it fails to set seed, but it sets the full amount, *i.e.* ten seeds, if used for the other kind.

As an example to show that these differences can be broken down, an Englishman, who settled in Pennsylvania of the United States of America, took a plant of this flax with him. As he had only one kind, it never set any seed for fourteen years. In the fifteenth year he was surprised to see a rod of pods on one branch. Examining the flowers, he found that the style and stamens were the *same* length, and that the anthers were pollinating the stigmas, producing self-fertilization. Why they suddenly acquired this power he could not find out.

In this respect it became like the true Flax plant, which supplies the fibre for making linen; for this species has not two forms of flowers, and can set seed on its own account.

I will describe one more example. The common Lucerne is now grown so extensively in the Colony that you will probably have little difficulty in procuring some flowers. The little purple flowers belong to the pea and bean family; there are five petals—the large one at the back is called the "standard," the two at the side are the "wings," and the two (coherent) petals form a boat-like structure, called the "keel."

The stamens and single carpel are lying concealed within the keel. If you thrust a pencil-point down the groove of the standard, in imitation of a bee, the flower suddenly explodes, for the stamens rise up and curl towards the standard; so that if a bee is in front of it, it gets a shower of pollen.

Some of the Polygalas, of which you can easily get flowers, as they are very common, behave in the same way. The blossoms are not unlike that of a pea in appearance, though their real structure is very different.

A great many other ways of pollinating flowers by insects exist; and you will find it a very interesting amusement to examine all sorts of flowers and trying to discover how it is done in each case.

Self-pollination.—We must now turn to the third method of pollination—that is, by a flower's own stamens. As a general rule, such flowers as are never, or very rarely, visited by insects are small, inconspicuous, often without any corolla or any honey, possessing nothing, in fact, wherewith to attract insects. Sometimes they are open, but they often remain closed as buds; but the anthers, being actually resting upon the stigmas, the pollen at once pollinates them. Such plants as Shepherd's-purse (Fig. 33), Groundsell, Chickweed, Knot-grass (Fig. 87), imported from Europe, as well as native kinds, all of which are now common weeds in the Colony, illustrate this method very well.

It may be noticed what a large quantity of pods and seeds these self-pollinating and self-fertilizing plants yield; so that it is no wonder how they will smother the flowers in a garden if they be not exterminated when in flower or before. There is a little plant, a common weed by roadside and waste places, throughout the Colony, called "All-seed." This well shows what an advantage self-fertilization is to plants.

It must also be added that by far the greater number of flowers, even when very specially adapted to insects, can still pollinate themselves as well. It is a curious fact that the violet never bears seed with its sweet-scented, purple flowers in England, though it may do so in some warmer countries, yet after the flowering is over, if you search below the leaves, you will find numerous tiny buds. Every one of these sets a quantity of seed, but they never open. Indeed, the anthers do not burst, but the pollen-grains set to work to make their tubes while *inside* the anther-cells, which they actually penetrate, and so get to the stigma, upon which the anthers are closely applied.

There are a great many other plants of various families which possess these self-fertilizing buds, termed *Cleistogamous*, a word meaning "concealed union." Another common flower which is self-fertilizing is that of *Cas'sytha* (Fig. 17), a plant which is remarkable for its leafless, thread-like stems, which are *parasitic* upon the bushes about which it entwines itself in a tangle-like mass; but I shall have occasion to describe this flower and the plant's peculiar habit later on.

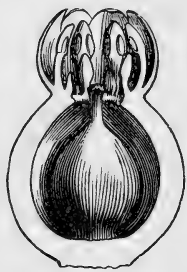


FIG. 17.—*Cas'sytha.* Vertical section of flower.

It often happens that a flower invites insects at first, then turns to self-pollination afterwards. Thus, in many flowers when in bud, the anthers are all turned inwards; but when the flower expands, the filaments bend outwards ready to dust the insect visitor as soon as it comes. Afterwards, the filaments curl inwards again, and the pollen can drop upon the stigmas of the pistil in the middle of the flower (see Fig. 10 of the peach).

One of the British Clovers, of which Fig. 18 is an illustration, is a case in point. It is particularly adapted to some wild "humble-bees" in England, and in unfavourable seasons, when such bees are scarce, much clover fails to produce seed.

When it was first introduced into our Colonies in the Southern Hemisphere, complaints arose of its failure, so the English humble-bee was imported. This was said to overcome the difficulty. But it appears to have failed only in some places; for in others reports were received that there was no difficulty in getting seed, but whether by native bees or by acquired self-fertilization was not stated.

FIG. 18.—Clover.

It may be mentioned that it was thought at one time that self-fertilization was injurious, and that plants habitually setting seed by their own pollen grew weaker and weaker, and finally died out. This was due to an error of observation. They are mostly insignificant flowers; but for health, vigour, and abundance of good seed, the plants are not to be surpassed. Moreover, self-fertilizing "weeds" are far more widely dispersed over the globe than the plants which display brighter and larger flowers, but are dependent upon the capricious visits of insects for fertilization.

Mr. Darwin made a large number of experiments in "crossing" some and "self-fertilizing" others, artificially, of the same kinds of plants. He then compared the offspring in all sorts of ways, as to heights and fertility. He generally found that with the first two or three generations the "crossed" plant beat the "self-fertilized."

But he rarely continued the experiments for a sufficient number of years. For crossing is a *temporary stimulus*; and after a few years the continually self-fertilized gradually gain upon the intercrossed, and then far outstrip them in fertility.

Florists corroborate this result. By constantly crossing to procure finer flowers, after a time fertility rapidly decreases, and it is often next to impossible to get the finest flowers to set any seed at all. Just as pigeon-fanciers say the best pigeons always die in the nest, so a certain florist lost his whole stock of valuable primulas from this cause.

On the other hand, self-fertilizing weeds as Groundshell, Shepherd's-purse, Black Solanum, Chickweed, etc., are sturdy little plants, terribly prolific, and an intolerable nuisance in the garden.

THE STEMS AND FOLIAGE OF PLANTS

Characteristic of Dry Regions.

As we are going to study plants of a region characterized by great drought, we will now pay a little attention to the general features of the vegetative organs of the natives of such a country, as their special adaptations to a dry soil and air, and a paucity of water during the summer, are very pronounced both in the stems and leaves of many plants.

After the rainy season, plants which maintain a show of foliage only during the period of seasonal rains, and dry off with the advance of drought, exhibit quite a different sort of leaves from those borne by plants which persist all the year round, and therefore have to withstand a long period of drought. Take the many species of *Ox'alis*. They have thin and bright green leaves; but think of the shrubs in January. They bear leaves almost leathery in character, such, for example, as the Sugar-bush and Wagen-boom. Their toughness is due to the thick skins they have, which prevent water escaping too quickly in the dry summer.

Plants growing in dry places, which cannot get enough water, are often unable to make full-sized leaves. The result is that while the "mid-rib" and the side ones are developed, the pieces of the leaf which ought to fill up the interspaces are not formed, so that the whole leaf may be deeply cut down in appearance. There is a common shrub used for hedges about Cape Town and elsewhere, the leaves of which are like a double comb. It is called *Ha'kea*, and came from Australia. It is a member of the same family as the Sugar-bush.

One general result of a dry climate is to reduce the size of the leaves greatly. Hence so many plants in the Colony look like heaths, of which there are some 500 different kinds; but as one goes eastwards to Port Elizabeth and beyond, the climate is moister, and they are much less numerous, partly from this, as well as other causes, till they cease to occur altogether.

The next thing to notice is, how often leaves are hairy. Thus those of the silver tree are densely clothed with silky hairs. In many cases the hair makes a coating of wool, as on some of the Everlastings. The use of hair is to reduce the heat from sun, to lessen the loss of water, and also to absorb dew for the benefit of the plant when the rain or dew falls.

Another result of drought is the hardening of the woody parts so that the tips of leaves are often sharp pointed; and the shoots also are checked in their growth, and end in sharp spines, as in the Kei-apple tree, and of the tree shown on Fig. 19.

But besides this hardening effect of drought and heat, many plants have adopted a plan of storing up the water when the rain falls. Thus the very common plants known as *Mesembrian'themum* have thick, fleshy

FIG. 19.—Spines of *Celas'trus buxifo'lius*, L.

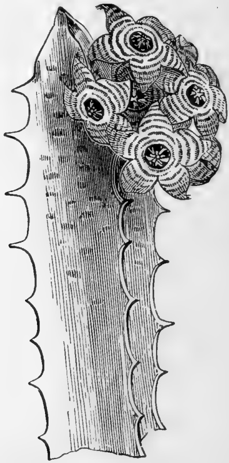


FIG. 20.—*Stape'lia.* Stem and flowers.

leaves, full of water, and protected by a thick skin; one species, called the "Ice-plant," is covered with little bladder-like projections on the leaves, each of which is like a miniature bottle of water without a neck. Many of the *Cras'sula* family are similarly provided; while others, as the fleshy *Euphorbias* and *Stapelias*, store up water in their stems (Fig. 20). Hence all these and many others always look fresh and green during the very hottest months.

There is yet another plant which must be mentioned, and that is the *Aloë*. There are many kinds in Africa. They have thick, massive, sharp-pointed leaves a yard or more in length, forming a huge rosette. If one cuts a leaf across, it will be seen to be full of a soft mass abounding in fluid. This is water held in reserve, while special vessels contain a resinous substance, which, when boiled down, the drug called "bitter aloes" is made out of it.

Now, in Mexico similar plants grow, in just the same kind of places, dry and rocky, and they are called "American Aloes," but when the flowers are in blossom they prove to be of quite a different family; so just as the Mexican *Cac'tus* resembles the South African *Euphorbias,* so the *Aga've,* as it is called, resembles the *Aloë* of Africa, showing that quite different plants can put on precisely the same forms, when growing in similar climates, because those forms are best suited for them under the circumstances.

A substance often secreted on the surface of plants in dry countries is wax. It forms the "bloom" on grapes and plums, and on the Cape "Wax-berry;" but on the surface of leaves it helps to prevent the loss of water. Dr. Marloth, of Cape Town, thus describes a very remarkable instance. The plant is known as *Sarcocau'lon,* a word meaning "fleshy stem." He says "the stems will burn even when green, because the outer bark consists of cork well saturated with wax.[1] On the older branches this layer is about one-tenth of an inch thick; but if one extracts the wax, the layer is composed of several years' growth, glued together by the wax, and forms a solid mantle entirely enveloping the stem." Palms, which mostly live in hot, moist countries, do not as a rule produce wax; but there is one called the "Wax-palm," which happens to grow on the mountains of South America.

[1] It appears to be more like copal, and brittle, being soluble in alcohol.

THE ORIGIN OF THE VELD AND KARROO PLANTS.

We now enter upon a new botanical field altogether. It is nothing less than to discover how Nature makes new plants out of old ones.

Consequently we have to consider what happens when fruits and seeds have been carried away to more or less great distances from their old homes.

Of course we all know that the climates, by which we mean different amounts of heat or cold, dryness or moisture, different kinds of soil, as sandy, clay, rocky, or limestone, slate, granite, etc., make up the "surroundings" of the plant which has to live among them. Just as one tribe of man lives comfortably in the hot, damp forests of Central Africa, another in drier velds, etc., so do some plants thrive best in one kind, others in another kind of soil and climate; but the question is, supposing a plant suited for the dry veld or Karroo be suddenly transported to a damp or wet bog, will it live?

If we took the Water-lily out of a lake and planted it in our garden, would it thrive and grow and blossom just as well? Probably the result would be that it would be dead in a week or more. How, then, are we to account for plants being *suited* to their surroundings, so that we can talk of water plants, veld plants, Karroo plants, desert plants, Alpine or high mountainous plants, and even Arctic and Antarctic plants? That is to say, when we study all the plants found in these very different kinds of surroundings, we find they can live and thrive there; but many of them will *not* live at all if transferred from one place to another, especially if the heat and cold, wet and dry surroundings, be very different in amount.

The Distribution and Evolution of plants all over the world is done as follows:—

First, we have to disperse the fruits and seeds; as when they were first brought by birds, wind, or water into Cape Colony, for they could not have come northwards out of the sea. The plants came from hotter, tropical and moister regions into a dry country, in which rain falls chiefly at certain seasons, and not at intervals all the year round, as it does in England. All those beautiful plants with bulbs, for which the Cape is so noted, many of which are cultivated in Europe and elsewhere, really *prefer* moisture; but a great number have spread into the dry regions of South Africa, where they now not only abound, but keep themselves alive during the long dry weather. The way they do it is by *making bulbs.* Though the flowers and green leaves seen after the rains die, the bulbs remain, because the thick scales of which they are composed store up water which keeps them from drying up, and enables them to start into growth when the proper time comes round.

It is not only nearly all the lily-like plants which have bulbs, but many make them, which one would not expect to find doing so, as certain kinds of Pelargoniums, which frequent dry and rocky places. All others of this kind of plant, growing in good soil and plenty of moisture, never have any bulbs at all.

Sometimes it is the underground stem which swells into a globular mass, looking much like a bulb; such is called a *corm.* This occurs in the numerous kinds of *Glad'iolus.*

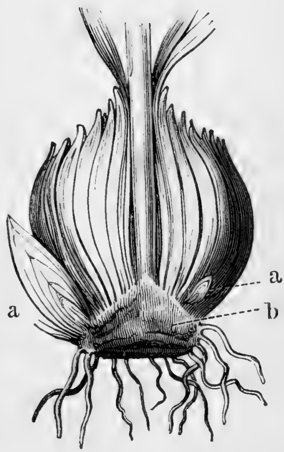


FIG. 21.—Tunicated bulb of the Onion: *b*, plate or disc; *a*, bulbils.

As plants with bulbs and corms are very abundant in Cape Colony, it will be as well to illustrate and explain their differences.

Fig. 21 is the bulb of an onion cut down through the middle, showing the thick, conical base of the stem, *b*, and the central flowering stem at the top. Two leaf-blades are seen, one on each side of it. All the rest are the bulb-scales; they completely wrap round each other, and are called *tunicated*, so, when cut across they look like rings. They are really the bottom parts of the leaves without the blades above. *a, a* are little bulbs or bulbils, which, when sufficiently large, will fall off and become new plants. The bulk of the bulb is therefore composed of bulb-scales. There is a kind of onion growing in the intensely hot sand of the desert near Cairo, which, to keep the innermost scales fresh, hardens the outer ones till they feel like wooden coverings. The temperature of the sand may be 130° Fahr.

Many bulbs have scales which do not surround the stem, but grow like the scales of a fir-cone, overlapping one another, as do those of lilies.

A corm, as shown in Fig. 22, of a *Glad'iolus* consists mainly of the globular base of the stem, *b*; the scales, being dried up, form a thin covering, *d*, *c* being the flowering stem in the middle. The new corm, *b*, is formed on the top of the old one, *a*. This supplied the nourishment for the flower, and then shrivelled. The fresh leaves then set to work to make starch, which is stored up in the cells of the new corm, which keeps getting larger to receive it.

Fig. B is the corm with the skins removed; *a*, *b*, *c*, *d*, are the same as in Fig. A, but *y* is a bud on the top of the new corm, which will flower next year;

z is an extra little corm arising from the new one; *x* are the roots.

Some of the corms are edible, and called "Uintjès." The cultivated leek is an instance of a plant which has a bulb when wild, but has lost it under cultivation.

In many plants the roots swell into nodules, and

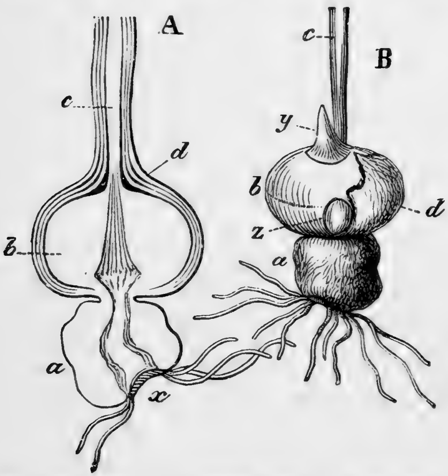


FIG. 22.—Corm of *Glad'iolus*. A, Longitudinal section: *a*, last year's, *b*, this year's corm; *c*, flower stem; *d*, scales; *x*, roots. B, After removal of the enveloping scales: *y*, bud, which will develop into next year's corm; *z*, bulbil.

act as reservoirs of water and nourishing matters. Fig. 23 illustrates a South African kind of *Aspar'agus* which has swollen nodules on its roots, most probably for this purpose.

Fig. 24 shows an elongated form of root. This closely resembles the swollen end of the underground stem of *Ox'alis cer'nua*, described above.

It is, then, by making bulbs, etc., that so many plants can manage to "adapt" themselves to endure the dry season.

FIG. 23.—*Aspar'agus undula'tus.* Rhizome, with nodulose roots.

Similarly, it is by "acquiring," as we say, fleshy stems, as of *Euphorbias*, or fleshy leaves, as of the

Hottentot fig and many others, that they can live and thrive in South Africa.

The peculiarities of leaves, mentioned in the last chapter, have likewise all been acquired in adaptation to the prevailing drought.

It was Darwin who gave us the clue to the "origin

FIG. 24.—*Anthe'ricum*, with long fleshy roots.

of species" as above described. He called this influence of the surroundings "the direct action of the conditions of life," the result, or effect, of which was, that *all* the plants affected by it varied alike, *i.e.* in adaptation to the new conditions of life, and so a "new variety" would arise.

THE STRUCTURE OF FLOWERS.

THE next matter for consideration is to discover how differences can arise in the structure of flowers. These may be grouped under the following headings: Number, Cohesion, Adhesion, Insertion, and Form.

Number.—With regard to the number of parts in each whorl, they may vary from one to twelve—all such numbers are said to be *definite* (see Figs. 6, 7, 8, 12); but if there are more than twelve, sometimes very many, such are regarded as being *indefinite* (Fig. 9, stamens many; Fig. 10, petals and stamens many), and is represented by the mathematical symbol for infinity, ∞. Some numbers are commoner than others, as fives and threes; fours are less common, and twos are rare. The multiples of these occur, so that there may be eight, ten, or twelve in a whorl.

Any one, two, or more whorls may be wanting altogether; so that a flower may be reduced to stamens (Figs. 6, I.; 8), or a pistil only (Figs. 5, II.; 6, II.). On the other hand, the calyx and corolla may exist without the stamens or pistil. Such a flower is then said to be neuter, as of the garden Hydrangeas.

If a flower has a pistil without any stamens, it is called *female* (Fig. 5, II.); and if there be the latter without any pistil, it is said to be *male* (Figs. 5, I.; 6, I.). Such flowers are *unisexual.*

If both these organs are present the flower is *bisexual.* If the sexes are in separate flowers on the same plant, this is said to be *monœcious,*[1] as the Fig-tree, *Myri'ca, Euphor'bia,* and Melons; if they be on separate plants, such are called *diœcious,*[2] as *Res'tio* (Fig. 6) and the English stinging nettle (*Urti'ca dioi'ca*), naturalized at the Cape, as well as *Cliffor'tia* (Fig. 5).

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 they have different numbers the whorls are called *unsymmetrical.*

If a flower has both stamens and a pistil, it is said to be *perfect,* whether it has a calyx or corolla or not; but without these it is *incomplete.*

Freedom and Cohesion.—All parts of a flower really partake of the nature of leaves, as may be proved by the "green rose," in which every petal, stamen, and carpel is replaced by a small green leaf. And as leaves on a long shoot are all separate, so a flower has been constructed by shortening the stalk and bringing all the leaves to the, usually, enlarged end of it, now called the *floral receptacle.* So, all parts of the flower, like leaves, were quite free and separate. This was

[1] *I.e.* "one-housed." [2] *I.e.* "two-housed."

undoubtedly the original condition of flowers, and can be now seen in *Ranun'culus, Knowlto'nia,* and *Anemo'ne.*

Hence, in looking for such a condition, one turns to the family *Ranunculaceæ,* to which these three plants mentioned belong, as best illustrating it; and this *Order* or *Family* always stands first in the usual systems of classification. Thus *Ranun'culus pinna'tus,* or *Knowlto'nia,* has five free sepals, five or more free petals, ∞ free stamens and ∞ free carpels, every one of these parts ultimately falling off by itself.

Now, starting from an original freedom, any one or more whorls may have its parts grown together, respectively, into a single piece. They are then said to *cohere.* Thus, in Heaths, while the four sepals are very nearly, and the eight stamens are all quite, free from each other, the four petals and the four carpels have cohered together, in each case. In *Roel'la* the five sepals cohere and the five petals cohere, as shown in Fig. 11, I., II., and the diagram IV.

In the common plant, *Struth'iola virga'ta,* with white, scented flowers, of the order *Thymelaceæ,*[1] and of any plant of the large order *Proteaceæ,*[1] the four sepals are coherent into a short or long tube, the tips of the sepals being alone free, constituting the *limb.* As there is no corolla in these plants, the flowers are said to be *incomplete.*

[1] Illustrations will be found under these families.

Again, the filaments of the stamens may cohere,[1] as in most flowers of the pea family, *Leguminosæ,* in which the anthers are free, but in the great family well known for its Everlastings (*Compositæ*), this condition is reversed, in that the filaments are free from each other, but the anthers alone cohere, forming a little cylinder (Fig. 67, II., III.), through which the style passes. It is the same in *Lobe'lia* (Fig. 14, II.).

In the majority of flowers the carpels of the pistil cohere. This is easily seen by cutting the ovary across, when two or more cells will be usually seen. In the many bulbous plants[2] the ovary will almost invariably be found to have three cells. In *Pelargo'nium* there are five (Fig. 12, III.), and in the bell-like flower of *Roel'la,* only two (Fig. 11, IV.).

In some few flowers there is only one ovary-cell, though it may be composed of two or more carpels. This is explained by taking, say, three pea-pods, splitting them down, along one edge only, called the *placenta,* which carries the peas; then placing the three together, edge to edge, a hollow chamber would be formed having three rows of peas (really six, each being composed of two). In some such ovaries there is only one ovule which arises at the base of one of the placentas; so it appears to spring from the middle

[1] The ten stamens of *Ox'alis cer'nua* are slightly joined at the base of the filaments (Fig. 16).

[2] For figures, see under the family *Liliaceæ.*

of the chamber. This always occurs in Composites, and also in *Polyg'onum* (Fig. 4).

In most flowers, as of *Pelargo'nium*, the carpels are united and already closed up, like unopened pea-pods, being coherent side by side; so that the rows (of two in each) now stand in the middle (Fig. 12, III).

Adhesion.—The second change is seen when one whorl is united to another and a different whorl, in which case they are said to *adhere*. Thus the stamens of *Struth'iola* (*Thymelaceæ*), or of *Leucosper'mum* (*Proteaceæ*),[1] appear to grow upon the inside of the tube of the calyx. They really arise from the stalk or receptacle, but the filaments are *adherent* in various degrees from bottom to top of the sepals by their filaments.

The almost universal condition prevails of the stamens being adherent to the corolla whenever this whorl has its parts coherent, as in all Composites, *Convol'vulus*, and the potato blossom. Heaths and *Roel'la* (Fig. 11, IV.), however, represent two families in which the stamens are quite free from the corolla.

Receptacular Tube.—The third peculiarity among the changes of structure in flowers resides in a peculiar growth of the receptacle. This end of the flower-stalk is often or generally enlarged, as in *Ranun'culus*, and very much so in a strawberry; for the receptacle of this fruit swells into a great rounded mass, and carries

[1] See under these orders for figures.

many separate carpels as minute seed-like fruit, called *achenes.*

In many flowers, including the strawberry, the floral receptacle expands *horizontally*, as in *Rhus* (Fig. 8), forming a sort of dish, so that the sepals, petals, and stamens are carried outwards to a little distance away from the pistil, and so stand "around the ovary;" the technical term for the petals and stamens (but *not* for the calyx) is then *perigynous.*[1]

The space between the perigynous stamens and pistil is occupied by a honey-secreting surface, forming a little trough in the blackberry (*Ru'bus*).

As this expansion of the floral receptacle often takes the form of a cup or tube, as in the flower of the peach (Fig. 9), rose, and *Cliffor'tia* (Fig. 5), it is called the *Receptacular Tube,* on the elevated rim of which are the sepals, petals, and stamens. The single carpel, in the case of the peach and plum, and the many carpels of the rose, remain quite free at the bottom of the cup.

A still further advance is seen in an *adhesion* between this *tube* and the *ovary* of the pistil within it.

This occurs in apples, pears, loquats, in the "florets" of the *Compositæ*, in *Roel'la* of *Campanulaceæ*, etc. In these cases it will be noticed that the parts

[1] If there is no such outgrowth, the petals and stamens arise from, or are "inserted" upon, the receptacle, below the ovary, as in *Pelargo'nium.* They are then said to be *hypogynous*, that meaning "under the ovary."

of the flower (sepals, petals, and stamens) appear to spring from the top of the ovary of the pistil. This is well seen in Fig. 10, which is a vertical section of the flower of *Mesembrian'themum*; the interpretation, however, is as stated. In these cases botanists speak of the calyx as being *superior* and the ovary *inferior*, while the petals and stamens are described as *epigynous*.[1]

Honey-glands, etc.—A fourth peculiarity in the majority of flowers is the provision for supplying honey or "nectar" to insects. This is done by a superficial group or layer of "cells," forming a *gland*, which pours out this sweet fluid. It may occur on any part; but it is always just where the insect can most readily reach it with its tongue or proboscis.

A few examples will illustrate this. In *Abu'tilon* and *Hibis'cus* it is the base of the calyx which secretes it. A difference in the appearance of the surface at that place is easily perceptible to the eye if the calyx be turned backwards. The English Lime tree has little boat-like sepals, each of which is full of honey, much sought after by bees. In South Africa, *Grew'ia*, of the same family as the lime (*Tiliaceæ*), has a nectary at the base of the petals, just as in *Ranun'culus*.

In some few plants the stamens secrete it.

[1] *I.e.* "upon the ovary." In all flowers in which there is no such adherent receptacular tube the calyx is "inferior" and the ovary "superior" (Figs. 5, 8, 9).

It is, however, the floral receptacle which is the usual source of honey. In the *Plumba'go* (Fig. 1) there are five glands swelling up between the stamens; and if the flower be looked at from above, it will be seen that there are five passages, down which the insect's proboscis would go, directly over the glands.

In *Gera'nium* there are also five little knob-like glands (Fig. 41, I.), of which one stands in front of each sepal; but in *Pelargo'nium*, of the same family, there is a single honey-tube or nectary at the back of the flower running down the pedicel, as described above (Fig. 12).

In some flowers a complete thick ring within the corolla completely surrounds the pistil. This is called a *Disc*, and is characteristic of a large group of families known as *Disciflorœ*, of which, for example, *Rhus* (Fig. 8) and the wilde Kastanien (*Caloden'dron*) belong. Again, of the Labiate family, *Leono'tis Leonu'rus*[1] has a thick, ring-like disc below the four-lobed ovary. It is rather elevated on the anterior side, just where the proboscis of an insect will reach it.

The use of the receptacular tube is also to secrete honey. Thus, where it is free from the pistil, its upper or inner surface, as of the cup of the peach flower (Fig. 9), has a thickening which secretes it.

When the receptacular tube is adherent to the ovary (Fig. 1), then it is usually the top of the ovary, the only part of it exposed, or the base of the style

[1] See figure under *Labiatæ* (IV.).

which swells into a honey-secreting body, as of the Umbellifers.[1]

Regularity and Irregularity.—The fifth and very important point, referred to under Insect-pollination, to note, is that while all flowers are supposed to have been at first *regular*—that is, the parts of each whorl were exactly alike—many flowers are now *irregular*, in having the parts of one or more whorl of different forms. Thus, a flower of *Gera'nium* or *Ox'alis* is perfectly regular, but that of *Pelargo'nium* (all these being of the same family) is irregular, since the petals are not all of the same size and shape. Similarly, the corolla of *Duvernoi'a* (Fig. 13), *Lobe'lia* (Fig. 14), and *Leono'tis* are highly irregular, having a sort of "hood" behind and a "lip" in front. That the ancestors of irregular flowers had regular corollas is to be inferred from the fact that flowers of these plants are sometimes produced with a trumpet-shaped corolla, having a limb of five equal-sized lobes, thus being perfectly regular. Thus Fig. 25 is a regular flower of a *Sal'via*, which

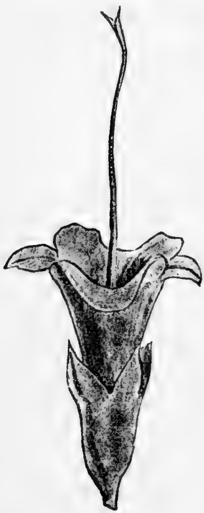


FIG. 25.—*Sal'via*, with regular calyx and corolla.

[1] Observe the two oval bodies below the two styles in the middle of the flower of *Bu'bon*.

should be compared with the usual form (Fig. 15, II.).

Moreover, the fifth or posterior stamen is restored in these flowers, being usually wanting in all such irregular flowers, as of Labiates.

Degradations.—As a sixth condition, it must be observed that in a large number of plants some or more of the floral whorls are wanting.

In *Struth'iola* and *Pro'tea*, for example, there is no corolla, only a calyx (white, green, or of some other colour), stamens, and pistil. In others, even the calyx is suppressed, as in Euphorbias, in which, indeed, one stamen only represents a male flower. These degradations are regarded in most cases as indicative of their having descended from plants which possessed both calyx and corolla; but these whorls have been lost in their evolutionary history.

A few incomplete flowers are thought to be possible descendants of primitive types, representing the earliest stages, when Nature had not yet contrived to make either a corolla or calyx. Such, *e.g.*, is the wax plant (*Myri'ca*), of which there are eight species in South Africa. *Casuari'na*, the "Beefwoods" of Australia, is perhaps another; and the willows and poplars of England are descendants of some very early types; but the majority of incomplete flowers are undoubtedly degradations from more complete flowers.

Form.—In endeavouring to speculate as to how and why flowers are so different in their shapes and colours, why they vary in the numbers of their parts, or why some one or more may differ in size or shape from the rest of the parts of one and the same whorl, one asks, what are the *causes* which have given rise to the infinite diversity which exists among flowers?

Again, we see some flowers with all their parts perfect, their corollas very large, brightly coloured or white, often strongly scented, and producing much honey. On the other hand, many flowers are exceedingly minute, with a very small corolla, or even none at all, totally wanting in scent, and producing no honey.

Collectively, in many instances, one describes these latter features as "degradations," since in many cases they have "rudimentary organs," as they are called, being of no use now, but representing ancestral states, when they doubtless were possessed of perfect functions. Thus a remnant of a pistil often exists in male flowers.

To try and solve this problem we must observe what goes on in Nature. The first thing to note is that insects are habitual visitors of many flowers, either for pollen or honey, or both as food. As they generally visit the more conspicuous flowers, which are white or coloured, or else discoverable by their scent, as Mignonette, one concludes that there is some "correlation" between such flowers and insects.

On the other hand, innumerable small flowers may be, and indeed are, never visited at all; in these one observes very minute petals or none. Moreover, they may have no honey-glands at all. Very often the flower-buds do not open, and yet they can produce plenty of seed.

In looking for correlations between flowers and insects generally, one observes that nearly all regular flowers are either terminal, *i.e.* at the ends of flowering stems, or, at least, they are so situated that insects can extract the honey from any point of the circumference.

On the other hand, irregular flowers are mostly so placed upon the stems that they can only be approached from one side, *i.e.* in front.

In addition to this fact one finds a great number of features all in correlation to the presence of insects. Thus, *e.g.*, in *Sal'via* (Fig. 15, II.) there is the strengthening of the calyx to support the slender tube of the corolla, since the front petal is greatly enlarged to carry the weight of the insect; while the stamens and style are modified and the honey-gland developed, so that all are in adaptation to the insect-visitor.

If no petal happens to be in front, then the stamens and style are "declinate," *i.e.* inclined downwards and then upwards, thus forming a convenient and sufficient resting-place instead, as in *Pelargo'nium* (Fig. 12).

In regular flowers, as of the group *Discifloræ,* the circular, fleshy, honey-secreting disc, as in the wilde Kastanien tree, or the five separate honey-glands in

Geranium, can be reached from any parts; but in the Labiates, etc., a single gland is often developed at only one spot, at the bottom of the canal or passage, down which the proboscis of the insect finds itself conducted.

When, therefore, one finds not one only, but many points of coincidence in all the four whorls of a flower, as well as in the position of the honey-glands, one is quite justified by "inductive evidence," *i.e.* the accumulation of many points of agreement, in concluding that some one common cause has brought about these many correlations or adaptations in unison together.

Moreover, since Evolution forbids the idea of any structure being formed at first in anticipation of the needs of another being, and as there is no evidence of spontaneous evolution without external agencies, we are driven to the conclusion that it is the *insects themselves* which first stimulate or irritate the flower, and then all the above adaptations follow suit *in response* to the irritations. Such is the theory based on these and many other facts. It is that the living *Protoplasm* is endowed with a power to respond to the mechanical forces brought to bear upon the several organs of the flower by the insect itself, *i.e.* by its weight and thrusts.[1]

We know from Nature and from experiments that such a response is common enough everywhere in the

[1] This is more fully explained in my works, "The Origin of Floral Structures" (International Scientific Series: Kegan Paul, Trench, & Co.), and a little book, "The Making of Flowers" (S.P.C.K.).

vegetative system of plants, wherever organs are subjected to strains; and assuming that it is equally so in flowers, we have a key to the origin of all the phenomena of floral structures in plants, in that they are supposed to be the direct results of the superficial irritations set up by the insects themselves.

Next, with regard to the inconspicuous flowers. If conspicuous flowers cease to be visited by their usual insects—as by the seeds having been carried away into other districts or countries—then the cessations of the irritations is presumably sufficient to account for the degradations in such flowers. All the above-mentioned correlations, having been brought into existence through the irritating action of insects, will now presumably degenerate when the cause ceases to act. Just so the eye—the result of the stimulus of light upon animal protoplasm—atrophies until the owner becomes blind in continual darkness, as do animals at the bottom of a very deep sea or in pitch-dark caves.

But while degradations may go on in one direction in flowers, fresh adaptations arise in others, which bring about self-fertilization instead. The corolla, not being wanted, dwindles or disappears; but the anthers (no longer stimulated to develop themselves in advance of the stigmas) mature simultaneously with these, and remain closely applied to them as they are in bud; hence the result is a sure and certain pollination with an abundance of seed.

CLASSIFICATION.

When we gather a quantity of wild flowers, there is at once seen to be a very great amount of differences in their shapes, sizes, and colours; so that it may seem to be a difficult matter to arrange them. When, however, we come to examine them carefully, strong points of likeness will easily be found between many as well as unlikenesses; so that botanists can make many groups of flowers of which the resemblances exceed the unlikenesses. The next way to understand how this is done is to examine for yourself as many flowers as you can, and then write down their points of structure as I shall explain; and what all beginners must aim at is to be able to recognize the *Families*, or *Natural Orders*, as botanists call them. If they be large, they are often divided into Sub-orders,[1] Tribes, and Sub-tribes. Then it will be seen how the Orders are divided into *Genera*,[2] and these into *Species*. It is as well to begin with the last two terms, as all classification is really built up upon them.

[1] "Sub" is often added to words to mean "somewhat."
[2] *Genera* is the plural of *Genus*.

I have taken the common *Ox'alis cer'nua* as an example of a flowering plant in general. Now, there are several kinds of *Ox'alis,* so like *O. cer'nua* in the structure of the flower and fruit, as well as the leaf (this being mostly *trifoliate, i.e.* of three leaflets), that botanists agree to call them all by the same name, *Ox'alis;* but they differ in having their corollas red, purple, white, or streaked, as well as yellow. Again, in some the peduncle or main flower-stalk carries only one flower, as *O. gla'bra* with a violet-purple corolla.

Again, like *O. cer'nua,* a species may have an umbel of flowers, but of a flesh-colour instead of yellow, such as *O. liv'ida.*

I have mentioned only one or two points of difference, but there are others. If they amount to, say, five or six, then botanists maintain that any two with so many differences should be regarded as *distinct species.* With less than that, they should be recognized as *varieties* only. Since, however, all the important points in the structure of the flowers and fruits is the same, they all constitute one *Genus.* Hence is the necessity of giving two names to every plant, the "generic," as *Ox'alis,* and the "specific," as *cer'nua.* Botanists have now named upwards of a hundred species of the genus *Ox'alis* in South Africa alone, while there are other species elsewhere. In England there is one with white flowers called the wood-sorrel.

The student must learn the true meaning of these two words, *Species* and *Genus*, for they lie at the root of all classification. He is familiar with the fact that there is an immense number of different kinds of Heath. Without being a botanist he recognizes that there is a strong likeness among them. They constitute a *genus*, but each of the different kinds is a *species*. There are many South African genera besides the Heath, which have a large number of species, as *Aspal'athus* (*Leguminosæ*), *Moræ'a* (*Irideæ*), *Di'sa* (*Orchideæ*).[1]

The question is, how must we distinguish one species from another? It is not enough to do so by a *single*, *two*, or *very few* features, but they must be compared throughout the entire plant, and then each species will be known by a *collection of constant*[2] *features* called their "specific characters."

How do these differences arise? The answer is that all plants possess "variability" or the power to change; and this power is brought into action by changes in the external conditions of the plant; so that when the seeds of any plant get transplanted by wind, birds, etc., to a distance where the soil and atmosphere are different, the seeds germinate, but grow up slightly different from the parent, and more in harmony with the new conditions; the next generation carries on the "adaptation;" then, after a few years, the

[1] See these families for figures.
[2] *I.e.* by heredity.

plant is greatly changed in general appearance, and botanists call it a new species.[1]

Then, whatever was the orginal species of *Eri'ca*, or Heath, which came to South-West Africa, it has been probably long extinct; but as its seeds became scattered about and found different conditions in different places, the plantlets grew up, altering their features, and so gave rise, first to "varieties;" then these became "species," as the degrees of differences increased which finally qualified them to become species. It is a common thing to find South African species of the many bulbous plants, as Orchids, etc., to be localized in particular spots, probably where they were originally evolved.

On the other hand, the Bracken Fern (*Pte'ris aquili'na*), common over all the slopes of the Table Mountain range, is just like the English plant, and does not appear to have varied here any more than it has in Europe.

So, too, *Ox'alis cer'nua*, as mentioned, is common in various places all round the Mediterranean Sea; but it is known to have been introduced about 1804, so that after a hundred years or so it has never altered in the least in the Northern regions.

There is, in fact, no *necessity* for plants to change, if their constitution can accommodate itself to the new localities; but if it cannot, it must die.

[1] See above, p. 64.

How readily a species will change is often well seen under cultivation. Thus there are two species of *Ar'abis* (*Cruciferæ*) in Switzerland, one of which lives in crannies of rocks, and has thin "papery" leaves, and is called *A. anchoret'ica*; the other has thicker leaves, and is known as *A. alpi'na.* When, however, the former was grown in the public gardens at Kew, it assumed all the features of the latter. As another example, there is a spiny plant known as "Rest-harrow" in England, common in dry, waste places, called *Ono'nis spino'sa*; but plants raised from seed in a border kept constantly moist ceased to produce spines, and assumed the characters of the spineless species, *O. re'pens.*

Plants by the seaside often have somewhat fleshy leaves; but if they be grown far away inland, they will sometimes produce thin leaves like other plants of the same neighbourhood; and if garden-cress, etc., be watered with salt and water, their leaves then become fleshy, resembling maritime plants.

Many other such illustrations could be given; but these will be sufficient for the reader to understand that new varieties and species come into existence by the *power of adaptation* which the living *protoplasm* [1] of plants possess, in *response* to the direct action of the external conditions of life.

It is in consequence of this that *all* water plants of

[1] This is the name given to the living substance of animals and plants.

rivers, lakes, etc., *agree*, in possessing a number of peculiar features in common, which are the result of living submerged, though their flowers retain the generic characters by which the plants are at once distinguished.

As the beginner will understand the reasons for framing the higher groups, such as Families, after having studied the flowers themselves, I shall presently begin to describe the chief natural orders or families with the one which botanists always place first of all, namely, *Ranunculaceæ;* and this will supply us with materials for answering the question, How are plants to be classified?

It will be advisable, however, to give here a tabulated scheme of Classification to refer to. I shall follow in the main the arrangement given in the *Flora Capensis*, consisting of a description of every species in the Colony. It is being prepared at Kew, but is at present unfinished.

Phanerogamæ, or Flowering Plants.

Section I.	*Gymnospermæ*
„ II. . . .	*Angiospermæ*
Class I.	Dicotyledons
Division I. . . .	*Thalamifloræ*
„ *II.* . . .	*Discifloræ*
„ *III.* . . .	*Calycifloræ*
„ *IV.* . . .	*Gamopetalæ*
„ *V.* . . .	*Incompletæ*

CLASS II.	MONOCOTYLEDONS
Division I. . . .	*Petaloideæ*
" *II.* . . .	*Glumaceæ*

CRYPTOGAMÆ, OR FLOWERLESS PLANTS.

I will now add a few particulars about these classificatory terms, though they will be better understood after flowers have been examined belonging to each group.

First of all, the Vegetable kingdom can be sharply divided into two "Sub-Kingdoms," as they are sometimes called, namely, plants which bear flowers having stamens and pistils, and those which have none, but are provided with corresponding organs, which take the names of *antheridia*, *i.e.* "anther-like," and *pistillidia*, *i.e.* "pistil-like." The bodies corresponding to the anther and pollen-grains are called *microsporangia* [1] and *microspores*; [2] while those corresponding to ovules are called *macrosporangia*,[3] which produce *macrospores*.[4]

The macrospores escape from the macrosporangia in Cryptogams; [5] but they remain within them in Phanerogams and form seeds. Hence one fundamental difference between these two sub-kingdoms is, that one produces "spores," the other bears "seeds."

[1] *I.e.* little spore-vessels.

[2] *I.e.* little spores.

[3] *I.e.* large spore-vessels.

[4] *I.e.* large spores.

[5] Such plants as ferns, mosses, lichens, seaweeds, and fungi are "Cryptogams," with which I am not concerned in this book.

The next difference to be noticed is that between *Gymnospermæ*,[1] which includes the Kaffir Bread, the "Yellow-woods" and "Cedars" of South Africa—and *Angiospermæ*.[2] In the former the ovules are on the edges or base of a so-called *ovuliferous scale*. It used to be called a "carpellary" scale, because it seems to take the place of a carpel; but it is never closed over the ovules, which are quite exposed, and receive the pollen without any stigma on a style, down which the pollen-tubes can grow; but these at once enter a little hole, called the *micropyle* (*i.e.* little gate) in the ovule itself.

Gymnosperms and Cryptogams were the earliest terrestrial plants known, and composed our coal.

CLASS I. **Dicotyledons.**—All members of this group are known by the following characters, allowing for a few exceptions :—

1. The parts of some, if not of all the whorls of the flowers are generally in fours, fives, or many.

2. The wood of such as are shrubs or trees shows, when cut across, concentric circles, really the cut cylinders of wood, having a distinct pith, or *medulla*, in the middle and radiating *medullary rays* (well seen in oak-wood, and called the "silver-grain" by carpenters). Outside is a separable bark.

3. The leaves are net-veined, or *reticulated*. This means that the framework, composed of "ribs" and

[1] *I.e.* "naked-seeded." [2] *I.e.* "seeds in a vessel," or *pericarp*.

"veins" as they are fancifully called, of woody matter, branches indefinitely, the branchlets being all connected in an irregular net.

4. The embryo of the seed has two *Cotyledons*, or "seed-leaves," as seen in mustard and cress when germinating, as they then turn green, or in beans, peas, acorns, which remain underground.

5. When germinating, an embryo produces an *axial* or *tap-root*, as of the carrot, parsnip, radish, etc.

Division I. Thalamifloræ, i.e. the corolla and stamens arise from the *thalamos* (the old name for the *floral receptacle*, as the extremity of the flower-stalk, or *pedicel*, is now called), and are *polypetalous*, *i.e.* with all the petals separate or *free*. The petals and stamens are *hypogynous*, or "under the ovary," arising directly out of the receptacle.

Division II. Discifloræ.—The only difference between this division and the first is in the presence of several knob-like honey-glands, as in *Gera'nium*, or a thick ring or disc (from the Latin *discus*, a "quoit"), as in *Baros'ma*.

Division III. Calycifloræ.—The corolla is polypetalous as in the two previous divisions, but now stands on the edge of a *receptacular tube*.[1] This consists of an outgrowth from the receptacle below the pistil. It is sometimes dish-like, as in strawberry and

[1] This will be further alluded to under the Rose Family, in which it forms a characteristic feature. See above, p. 52.

blackberry, or cup-like, as in cherry and peach (Fig. 9). The sepals, petals, and stamens are on the rim; the petals and stamens are said to be *perigynous, i.e.* "around the ovary," as they are carried out to a little distance from it; but this word does not apply to the calyx.

If the receptacular tube be *adherent* to the *ovary,* then the petals and stamens are said to be *epigynous, i.e.* "upon the ovary" (Figs. 10 and 11).

Division IV. Gamopetalæ, i.e. the corolla has the petals "coherent," and is said to be *gamopetalous, i.e.* "petals united." The stamens are usually *epipetalous, i.e.* adherent to the corolla.

Division V. Incompletæ, i.e. the flower is "incomplete" in having no corolla. Sometimes there is no calyx as well. The stamens and pistil are often in different flowers.

Class II. **Monocotyledons.**—1. The parts of the whorls of the flowers are usually in threes.

2. The wood, as of asparagus and palms, is in separate cords running down the softer "ground tissue;" and there is no bark, and no cylinders of wood, as in Dicotyledons.

3. The leaves are, as a rule, "straight-veined," as of all grasses, lilies, etc.; or else slightly curved.

4. The embryo has only one Cotyledon, as seen in mealies or maize, and in an onion, which, when it germinates, appears above ground as a loop till the tip is freed from the seed.

5. The seed produces no permanent axial or tap-root; instead of it, or superseding it, *adventitious* roots arise in ascending series from out of the base of the stem, as seen in germinating maize or date. These two plants develop a temporary tap-root.

Division I. Petaloideæ, i.e. the *Leaves* of the *Perianth*, are petal-like, as of the Belladonna.

The term "Perianth" is mainly used for Monocotyledons, because the two whorls are mostly alike, the parts being called "leaves." The outer is sometimes regarded as the calyx and the inner as the corolla, whenever there are marked differences between the outer and inner whorl of the perianth, as in Orchids.

Division II. Glumaceæ, i.e. the leaves of the perianth, are chaff-like, and called *glumes*, from the Latin *gluma*, "chaff," as in *Res'tio*, Sedges and Grasses.

CLASS I.—DICOTYLEDONS.

DIVISION I.—THALAMIFLORÆ.

Ranunculaceæ.

THE BUTTERCUP FAMILY.

This natural order or family contains upwards of 1200 species of 30 genera in 5 tribes. They are almost entirely extra-tropical, many occurring in the cooler regions and on mountains.[1]

There are only five genera in South Africa, which will be sufficient to explain why they are grouped together.

Ranun'culus pinna'tus.—This is not an uncommon Buttercup, as the species are called in England, occurring in meadows, etc. It is a perennial herb, with very hairy leaves, more or less divided into three or five pieces or *segments, i.e.* in one or two pairs with a terminal one; such is described as being *pinnately* divided or *lobed*, meaning "feather-like." The stalk widens and forms a sheath at the base.

The flower has five reflexed sepals, five yellow petals, many or ∞ stamens, as botanists represent the word, and ∞ free carpels, constituting an *apocarpous* pistil. *All parts of the flower are perfectly separate or free.*

When the pistil becomes a fruit, the sepals, petals, and stamens fall off or are *deciduous;* but the carpels, by drying up, closely invest the seeds within them, so that they do not burst or *dehisce* in any way. They are called *Achenes.*

The accompanying figure (Fig. 26) will give all the details of the structure of the flower of any species of *Ranun'culus.*

[1] To give the reader some idea of the relative sizes of the orders, I will always add their approximate number of species and genera in each case.

In the flowering and fruiting shoot, (*a*) represents *Bracts*. These are rudimentary leaves reduced to one or a few segments only. (*b*) is the sepals of the calyx. The petal (1) shows the little notched flap in front of the honey-secreting nectary. (2*) is a front and (2) a back view of a stamen, showing how the *con-*

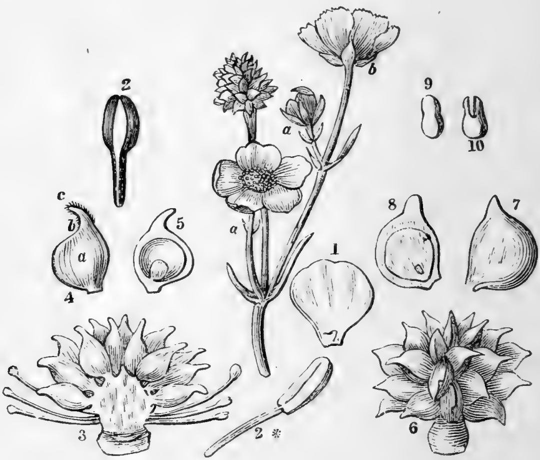


FIG. 26.—*Ranun'culus* (Buttercup). (For description, see text.)

nective forms the continuation of the filament between the anther-cells, which burst down the sides. (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 rough 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 called an *Etærio*, 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 carpel, now called the *Pericarp*. The white substance is *Endosperm*, sometimes called *Albumen*, and is the nourishment laid up for the minute embryo lying at its base. (9) is the embryo detached. (10) is a side view of it, showing the two cotyledons, the rounded end being the radicle.

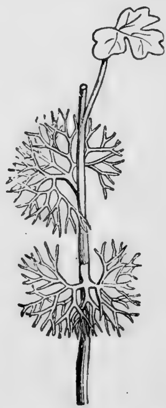


FIG. 27.—Leaves of the Water Crowfoot (*Ranun'culus aquat'ilis*): the floating leaves complete; the submerged leaves, finely divided.

There is a species of *Ranun'culus* which grows in ponds and rivers, probably introduced from Europe, called *R. aquat'ilis* (Fig. 27). It has white petals with a yellow base. If it grows in still water, it bears two kinds of leaves; some are floating and completely formed, while others are under water. These are always *dissected* or have fine thread-like *segments*.

This is a consequence of living submerged, as many other water-plants of quite different families have similarly dissected leaves. If the plant grow in rapid streams, the dissected, submerged leaf is the only kind usually formed.

An experiment was made by an American botanist with an aquatic plant of the United States called *Proserpin'aca,* which bears complete leaves in the air, but dissected ones under water. He added certain salts to the water; by this means the excess of water was withdrawn from the protoplasm, and the plant then bore complete leaves under water.

Anemo'ne. — *A. capen'sis* is a herb, common on Table Mountain. The flower-stem has two or three leafy bracts forming an *Involucre,* or "wrapper." Like *Ranun'culus,* it has all the parts of the flower quite free. It has no corolla, but many rosy-white coloured sepals. There are many stamens and carpels, which turn into achenes; but while the styles remain as little curved points in those of Buttercups (Fig. 26, 4), they grow out into long feathery tails by forming hairs along them, in the achenes of *Anemo'ne.* They probably assist in dispersing the fruit.

Clem'atis.—This genus has only four white or coloured sepals, no corolla, but ∞ stamens and ∞ carpels, all being *free,* and a fruit of ∞ achenes.

It differs from all others in being a woody stemmed and climbing plant. It climbs by means of its leaf-stalks, or petioles; for these are very sensitive to touch, and as soon as they come in contact with the shoots of other plants, they twist round them, and finally grasp them tightly. Then the petioles grow much thicker and stronger; nor do they ever fall off, as do those of leaves which do not happen to catch anything.

You must make a point of observing everything you read in this book, and make experiments, such as placing a petiole of this plant in contact with a twig, and seeing how it will have become bent after some hours, and finally coiled round it.

Knowlto'nia.—This genus is peculiar to South Africa. It has five sepals, ∞ petals, ∞ stamens, and ∞ carpels, and *all free.* It differs from all the other genera in its carpels, becoming succulent and juicy, instead of dry achenes.

Like all the members of this family, it has a more or less poisonous juice, which will raise a blister; hence the commonest of the five known species is called *K. vesicato'ria, i.e.* "blistering."

You will now see from the foregoing few facts why these four kinds are called by separate names, as *genera.* They all agree in the features italicized; but each differs from the others in certain important particulars.

Of course each of these *genera* has several *species.* Thus *Clem'atis* has four, *Knowlto'nia* five, and *Ranun'-culus* six, in South Africa.

Besides these three, there is one other genus, *Thalic'trum,* with two South African species; but it only occurs in Caffraria and Natal.

I will suppose that you have examined a plant of each of these genera, and written down all you have noticed about them under the headings Root, Stem, Leaves, Flowers, and Fruit, in addition to the very few points I have stated.

Then you will be able to see in what particulars they all agree, which will account for their all being members of the same family or order, *Ranun'culaceæ,* as follows :—

General Description of the Family or Order Ranunculaceæ.

Herbs (excepting *Clematis*)[1]—With a more or less poisonous juice.

Leaves—Much divided into segments, with the stalk sheathing the stem at the base.

Flowers—Sepals and petals, various in number and colours, but peculiar to each genus; stamens, many; carpels, many.

Fruit — Achenes (exception, fleshy in *Knowlto'nia* only) or *follicles* (as in the cultivated Columbine (*Aquile'gia*)).

All parts free.

It may be noticed how very hairy, almost woolly, many of these plants (as well as many others) are in South Africa. This is a common feature in a dry climate. On the other hand, all water-plants, and,

[1] In all families any description may have exceptions, but it refers to the great majority.

as a rule, all growing in wet places, are nearly or quite hairless, like the water *Ranun'culus;* the fact is that hairy plants can absorb water, such as rain and dew, when the supply from the soil is deficient in the dry seasons.

Nymphæaceæ.

The Water-lily Family.

The members of this family, some 35 species in all, of 8 genera in 3 tribes, are wholly aquatic, and mostly to be found in the Northern Hemisphere, such as the *Nelum'bium,* or "Lotus," of India. The largest flowering is the *Victo'ria re'gia,* discovered growing in the river Amazon, in Bolivia, about 1800. It first flowered in England in 1849. The leaves are six feet across, and strong enough to bear a child.

Nymphæ'a stella'ta.—The blue Water-lily is the only South African plant of this family, and appears to be the same as one growing in the Nile. The structure of the flower explains how petals are made out of stamens; for a perfect transition will be found between them, as shown by the illustration (Fig. 28, 1, 2, 3, 4). The petals begin with a broadening of the filament, while the anthers decrease in size till they disappear altogether—that is, in passing from the inside of the flower to the calyx, outwards.

The next point to notice is the outgrowth or disc from the floral receptacle which invests the ovary in the middle, at the same time carrying the stamens (*b*) and the petals (*a*) on the outside, as shown in (2). (5) is a cross-section of the ovary and disc, showing the numerous ovary-cells, each containing many ovules.

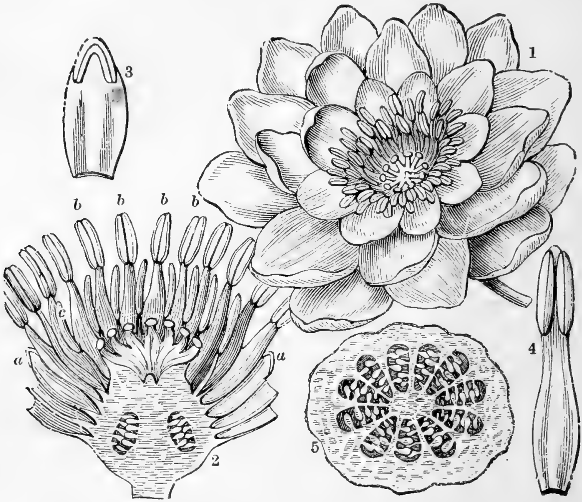


FIG. 28.—*Nymphæa* (Water-lily). (For description, see text.)

As the carpels are *coherent*, they make a *syncarpous*[1] pistil.

As we have not had this condition before, I will explain how it comes about. Take a pea-pod as a single carpel. Now, suppose half a dozen to be standing erect in a circle, in touch by their edges which

[1] *I.e.* carpels "together" (syn).

carry the peas. Then let them be compressed till their sides are in contact together. Now imagine them as grown together by their sides as in (5).

If the whole were now cut across, six chambers would be seen with two rows of peas on the "marginal placentas," forming the inner angles of the ovary-cells. They then thus would form a *syncarpous* pistil.

There may be any number of carpels, but two, three, four, and five are the commonest among flowers. In the Water-lily the ovules are in a somewhat exceptional position, being all over the sides of the divisions, and *not* exclusively in the angles.

The circular leaf, so characteristic of this family, is seen also in some other aquatic plants not belonging to this order, and it also occurs in some marsh plants which were probably once aquatic, as *Ranun'culus Mey'eri*[1] and *Hydrocot'yle verticilla'ta.*[2]

If the petiole of a leaf, or the flower-stalk of the Water-lily, be cut across, and then slightly wetted with indian ink, good impressions can be made on paper showing the long *Lacunæ,* or "air-chambers," always to be found in submerged plants. It is the air in these hollow tubes which enables the flower-stalks and petioles to stand erect in the water. It will be also noted how feeble is the wood in all submerged stems. The reason is that stems growing in the air have to

[1] Found at Kat-berg.

[2] An "Umbellifer" occurring in wet places near Cape Town.

support themselves; consequently, to prevent falling, they put on "supportive tissues," of which wood-fibres are the most important. But as the water helps to support a submerged stem, which is also filled with air, there is no necessity for much, if any, wood. As a result it is not developed. The general effect of a submerged life is a "degeneration" by the arrest of the formation of internal supportive tissues, and in other ways.

The Water-lily's leaves and flowers arise from a thick, horizontal stem called a *Rhizome.* If a section of this be made, the "woody bundles" do not form a ring, but are scattered about, like those in a stick of asparagus, or as described in speaking of the stem of Monocotyledons.[1]

General Description of the Water-lily Family.

Herbs—Aquatic, with thick rhizomes.

Leaves—Mostly floating, with *cordate*[2] or *peltate*[3] blades.

Flowers—Petals numerous, passing into stamens; carpels, numerous, syncarpous, within a fleshy disc.

[1] See p. 71.

[2] *I.e.* heart-shaped.

[3] *I.e.* shield-like, the petiole entering the middle of the blade.

Papaveraceæ.

THE POPPY FAMILY.

This order contains 160 species of 24 genera in 3 tribes.

The members of this family are characterized by having a milky white, yellow, or red juice; that of the poppy when hardened forms the opium of commerce, which yields useful drugs, especially for sleeping draughts.

Papa'ver aculea'tum.—This is the only South African plant of this order. It occurs in sandy ground near rivers in the north and east districts. One called *Papa'ver hor'ridum* in Australia appears to be nearly the same. It has orange-scarlet coloured flowers.

The illustration (Fig. 29) explains the structure of the flower of a Poppy as follows: All poppies have only two sepals (1), which fall off as the bud opens, and are therefore said to be fugaceous, *i.e.* "flying off." The petals are corrugated or crumpled up in the bud in consequence of their developing a little too fast within it. The stamens are very numerous (A). The pistil consists of a variable number of carpels coherent by their edges, each to each, so they make a single chamber (3), while outgrowths from the placentas, which are *parietal*, being on the wall,[1] project like erect plates,

[1] Latin *paries*, a "party-wall."

but do not meet in the middle (3 and 6). There is no style, but the stigmas lie over the top of the ovary (compare 2, 3, and 6), so that the pollen tubes can grow downwards inside the soft tissue of these plates till they reach the ovules upon them (3 and 6). The tissues of the styles in flowers, which are especially

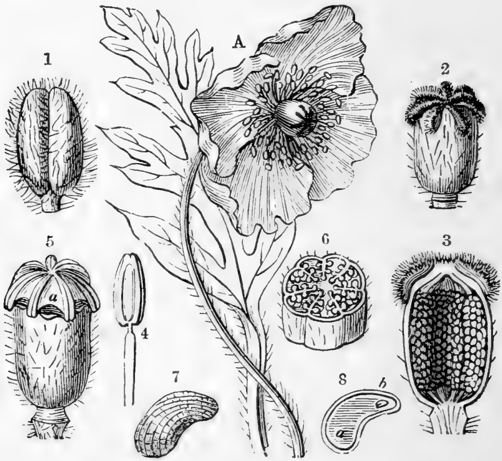


FIG. 29.—*Papa'ver* (Poppy). (For description, see text.)

adapted for conveying the pollen tubes, are called *conducting* tissues. The fruit is a dry *Capsule,* known as the "poppy-head." It opens by holes, or *pores,* at the top (5, *a*) to let the seeds (7) fall out. The seeds when cut through show a tiny embryo (8, *b*) buried in an oily endosperm (8, *a*). (4) is a stamen.

As the poppy-head stands on a tall stem, the advantage of having the pores at the top and not the bottom of the "head," is that the seeds do not fall out close to, and all about, the plant; but as the wind blows and sways it, the seeds are thrown to a distance.

The whole of the "sub-order," which contains the poppy and its allies, have a thick juice, white, yellow, or red, which is more or less poisonous. The opium poppy is commonly cultivated as a garden plant, the opium of commerce being the dried milky juice obtained by making cuts on the green poppy-heads. The seeds are oily, but do not contain opium.

A Mexican intruder, *Argemo'ne Mexica'na*, has become a great pest on the waste-heaps at Kimberley, and is spreading elsewhere.

General Description of the Poppy Family.

Herbs—With milky or coloured poisonous juice.

Flower—Sepals, 2, deciduous;[1] petals, 4, crumpled in bud (poppy); stamens, ∞; pistil with $2-\infty$ [2] carpels, with parietal placentas and dissepiments.

Cruciferæ.

The Stock and the Cabbage Family.

This order contains some 1200 species of 172 genera in 10 tribes. The greater number are in the Mediterranean regions and Asia Minor.

[1] *I.e.* falling off. [2] *I.e.* varying from *two* to *many*.

The name of the family means "Cross-bearers," because the four petals make a cross; but you must not suppose that *all* flowers with four petals belong to it. Of the seventeen genera in South Africa, eleven are also English. The two following will illustrate the family.

Helioph'ila.—This genus is only known in South Africa, and has sixty-one species. Observe how the expanded flowers surround the closed buds in the middle; and as fast as the latter burst into bloom, the stem continues to grow. Hence the old flowers are left behind, and soon form long pods, so that you will see fruit-pods below, flowers in the middle, and buds at the top. Each is carried on its own little *pedicel,* all springing from the main stalk, or *peduncle.* This particular kind of inflorescence is called a *Raceme;* but as long as it is flat-topped, it is known as a *Corymb.*

It is usual to find in most plants a tiny leaf-like *bract,* or reduced leaf, from the *axil* of which (that is, the corner between it and the stem) a flower arises, and it is said to be *bracteate;* but in Crucifers it is always wanting. The inflorescence of Crucifiers is, therefore, characterized by being *ebracteate* (the "e" meaning "without").

Now let us dissect a flower carefully, and you will find there are four sepals; the front and back ones (that is, as you look at a flower while still upon the peduncle) overlap the two side ones. Whenever the parts of any whorl overlap one another by their edges they are said to be *imbricate.*

The side or lateral sepals have little pouches at the bottom to contain a drop of honey (Fig. 30). Remove the sepals very carefully. The four petals will now be seen to be fixed by slender stalks called *claws.* In some flowers they are much longer, the broader part above being called the *limb* of the petal. Before we remove the petals look at them from the sides and you will observe a little hole at the bottom just over the pouch of the side sepals. It appears to be fringed. Now, if we remove the petals, we shall discover what that fringe is. It is composed of three parts; one is on the stamen, and one on each of the two adjacent petal-claws. The *honey-gland* is at the spot where that stamen arises. This is formed by a superficial swelling on the receptacle. The hole not only allows the honey to escape into the pouch of the sepal, but the proboscis of an insect can pass through the hole to get it.

FIG. 30.—Cruciform flower, with saccate, *i.e.* "pouched" sepals and clawed petals.

Next observe there are six stamens; the two side ones (Fig. 31, I., *a*) are usually shorter than the four others (*b*). The stamens are said to be *tetradynamous,* a word meaning "four in power," in reference to the four tall ones.

Now remains the pistil. The lower part is the ovary, the short contracted piece above it is the style, while the stigma is the somewhat rounded rough top. The pistil is composed of two carpels as the diagram (Fig. 31, II.) will show. This is supposed to represent a flower cut across. The four outer crescents stand for the sepals, the four inner the petals, the six black

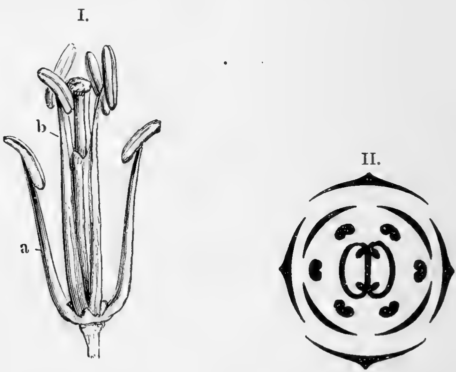


FIG. 31.—I. Tetradynamous stamens and pistil of a Crucifer: *a*, shorter, *b*, longer stamens. II. Floral diagram.

spots are the anthers, and the oval in the middle is the ovary of the pistil, the little projections being the ovules. It will be observed that these are not in the middle of the ovary, but on the wall, while the parietal placentas, or the thickened margins of the carpels, are connected by a plate, half of which has grown out from each side and united in the middle. In order to understand how this *cohesion* [1] between the

[1] The word *cohesion* is used when the parts of any whorl are

two carpels has taken place, the best way is to take two pea-pods, split them open, but down the edge only, namely, that which carries the peas; half the peas will be found clinging to one edge and half to the other edge. Cut a second pod in the same way, and now place them face to face. If the two pairs of edges which now meet be supposed to grow together, we should have an ovary such as that of *Crucifers,* though wanting the *extra growth* forming the plate, which occurs in all members of this family.

FIG. 32.—Wallflower. Siliqua dehiscing from below, upwards.

As this peculiar structure is much better seen when the pistil has ripened into a fruit, we will examine the long pod, now called a *Siliqua*[1] (Fig. 32), and you will see how two strips from the backs of the two carpels peel off from below upwards. These are called *Valves.* There then remains a sort of a long, narrow framework carrying the plate upon which are the seeds. This plate is called the *False Dissepiment,* or Division-plate, being the extra growth spoken of above. "True dissepiments," or *septa,* of an ovary are formed by the walls of the carpels themselves, as explained under *Nymphæa,* or the Water-lily.

united together. *Adhesion* applies to the parts of a whorl when united to a different whorl.

[1] Latin for a "bean-pod."

I will now compare the flower of *Helioph'ila* with that of a very common introduced weed called the Shepherd's-purse, in Latin *Capsel'la Bur'sa-Pasto'ris.* The accompanying figure (Fig. 33) supplies all the details as follows: (1) is a complete flower. In (2) the calyx and corolla are removed. The stigma (1, 2, 5) is rough

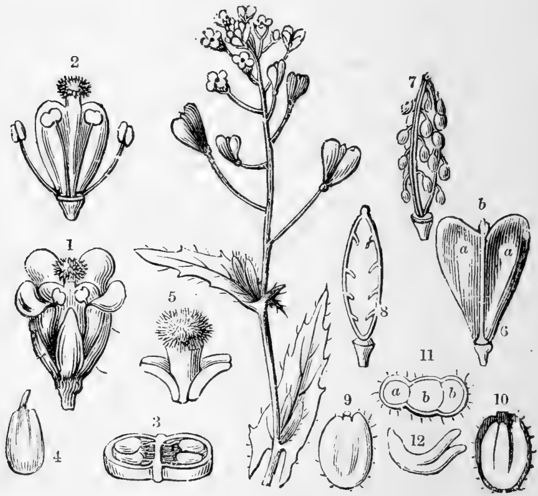


FIG. 33.—*Capsel'la* (Shepherd's-purse). (For description, see text.)

and globular, such being usually the case with regularly self-fertilizing flowers of this family. (3) is a transverse section of the ovary, showing a very narrow false dissepiment, and as the pod is so small it is called a *Silicula* ; (4) is an ovule; (6) is a ripe silicula, (*a*, *a*) being the valves—(*b*) is the remains of the style—which separate from the frame-like placentas (7 and 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 section, showing the embryo, the *radicle* being on the right and the *cotyledons* on the left; (11) is a seed cut across or transversely, (*a*) being the radicle and (*b*, *b*) the cotyledons.

The *radicle* is not a true root, but develops a root from its tip, and from it arises the first stem [1] above upwards. The two *cotyledons* are really the first pair of leaves, but only turn green when they come up into the light, as of mustard and cress when fit to eat. Between the two cotyledons is a minute bud, which will in time grow up into the new plant.

Such vegetables as all sorts of cabbages and kales, the radish, turnip, etc., of this family, show how plants change under cultivation, for they are all raised from seed of wild plants, the roots of which are small, tough, and wiry, but as soon as they grow in a rich soil, they begin to get larger and "fleshy." Then by taking the seed from those which have the best roots, *i.e.* "selecting" for about six years, fine garden vegetables are secured, the seed always reproducing the good root, or whatever it is that has been turned into a garden crop.

[1] The first stem is called the *Hypocotyl*, *i.e.* "below the cotyledons." If the plumule forms the stem, it is called the *Epicotyl*.

Similarly, wild potatoes in Peru are no bigger than hazel nuts; but we now get magnificent tubers half a pound in weight. It is all done by carefully selecting the best only for propagation.

General Description of the Crucifer Family.

Herbs—Non-poisonous.

Inflorescence—Corymbs passing into racemes of ebracteate flowers.

Flowers—Sepals, 4; petals, 4, clawed; stamens, 6, tetradynamous; pistil of 2 carpels, syncarpous.

Fruit—A siliqua or silicula, with a false dissepiment, dehiscing by two valves, and with four rows of seeds.

No plants of this family are poisonous, and many are useful for food. The cabbage is wild on the chalk cliffs of the South of England, and is the origin of all the many sorts of that vegetable. The turnip and rape, mustard and cress, horseradish and radish, etc., all belong to it.

Of garden flowers, the wallflower, stock, candytuft, natives of Europe, are grown in gardens.

Capparideæ.

The Caper Family.

This family has 300 species of 23 genera in 2 tribes in all, and 25 species in South Africa, of which the caper (*Cap'paris*) has 9, principally in the Eastern districts.

Cap'paris (Fig. 34).—Like Crucifers, this genus has four imbricate sepals, four petals, but many stamens, and two to eight carpels in different species, forming a *syncarpous* pistil. This is supported on a long stalk called a *Gynophore*, *i.e.* "pistil-bearer" (Fig. 34, I., II.), arising out of the middle of the flower. The ovary is one-celled with several false dissepiments, as in poppies (IV.). It forms a capsule (III.), and the seed (V.) has no endosperm. There is a long embryo (VI.).

The capers used in sauces are the unopened flower-buds of *C. spino'sa*, a species common on rocks and walls on the Mediterranean shores. The caper is mentioned in Scripture (Eccles. xii. 5), "The caper-berry shall fail," *i.e.* no longer act as a stimulant to the aged man. It is referred to by Pliny in the first century, who says, "The seed of the caper is a well-known article of food, and is mostly gathered with the stalk." Of course he means the buds.

One Cape species of Caper (*C. albitrun'ca*) has a white bark and wood useful for yokes, etc.

General Description of the Caper Family.

Trees, shrubs, or *herbs.*

Leaves—Simple or compound.

Flowers—Sepals, 4; petals, 4–8 or more, clawed;

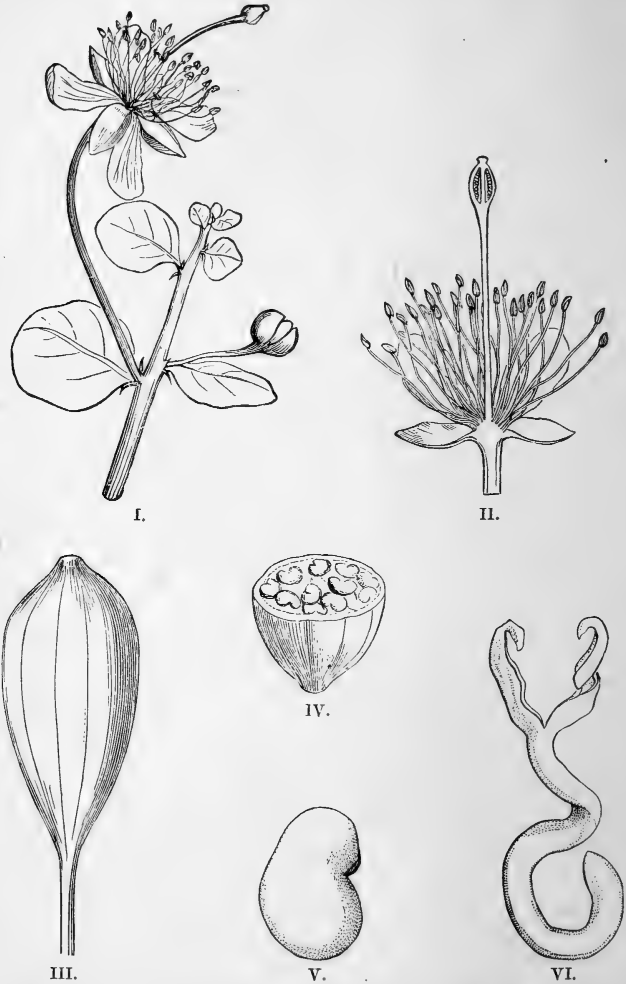


FIG. 34.—*Cap'paris.* I. Flowering branch. II. Vertical section of flower. III. Fruit. IV. Transverse section of fruit. V. Seed. VI. Embryo, coiled up in seed.

stamens, 4, 6, or ∞, *not tetradynamous*; pistil of 2–3 carpels, parietal placentas.

Fruit—A capsule or berry.

Droseraceæ.

The Sundew Family.

This order has 110 species of only 6 genera.

The members of this family, which abound in Australia, and are two in number in South Africa, are remarkable for not only catching insects by their sticky *glands*, but for absorbing nourishment out of their prey.

The accompanying illustration will give the details of an example of sundew.

Dros'era.—This genus, called Sundew in England, has eight species in South Africa. Some have elongated leaves, others, as the one figured (Fig. 35, 1), have round blades, but covered with red glandular hairs both on the surface and margins. (2) represents one of the round blades; the "tentacles" on the circumference will be seen to be much longer than those on the middle. (3) is one of the tentacles enlarged; it is composed of a *gland* at the top, while the stem is built up of brick-shaped cells containing a coloured fluid. (4) is a fringed sheath formed by the *Stipules*[1]

[1] Stipules are two appendages at the base of the petiole in many plants. If present, the leaf is said to be *stipulate*; if wanting, the leaf is *exstipulate*.

as the base of the petiole; (5) is a complete flower; (6) represents a vertical section of the pistil with three of the five sepals. The styles and stigmas are six in number (6, *a*), as two belong to each of the three carpels. (7) is a bursting capsule; (8, 9, 10) are seeds; (8) shows the loose seed-skin, or *testa*. This contains

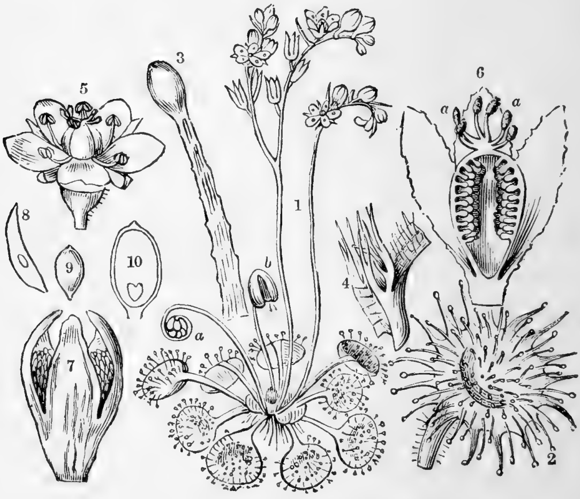


FIG. 35.—*Dros'era* (Sundew). (For description, see text.)

a sort of kernel (9) filled with a large quantity of endosperm, at the base of which is a small embryo (10).

It is an interesting experiment to transfer some plants with moss to a bowl, keeping them well moistened. Then, if minute fragments of hard-boiled egg or biscuit be placed upon the middle of the leaf, the tentacles, after some hours, bend over and bring their head-like glands down upon the object; a fluid is secreted by them which gradually dissolves the egg, etc., 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 becomes clotted into little droplets, leaving clear spaces in the cells. 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, etc., is left behind.

Rorid'ula.—This genus differs from *Dros'era* in having a three-celled ovary with a solitary seed in each cell, instead of many seeds. It is a much larger plant, quite a shrublet, with larger and divided leaves.

Dr. Marloth has made the interesting discovery that the flowers are fertilized by small insects, which also pierce the stems for sweet juices as food; but, at the same time, they can run over the plant regardless of its sticky glands, which have no power to arrest, much less consume them as food.

There are two species, natives of the Western district.

General Description of the Sundew Family.

Herbs—Frequenting marshes.

Leaves—Covered with sticky glandular hairs or tentacles for catching insect prey.

Flowers—Sepals, 5, persistent; petals, 5; stamens, 5; pistil of 1, 3, or 5 carpels; ovary, one-celled, with 1–5 parietal placentas; flowers sometimes *cleistogamous*, or self-fertilizing buds.

Fruit—Capsule.

Polygalaceæ.

The Milkwort Family.

This order contains 400 species of 15 genera, of which 4 occur in South Africa.

Polyg'ala.—The structure of the flower of the Milkwort, as it is called in England, is very peculiar. It would be best to examine one of the larger flowered species, as *P. myrtifo'lia*, as many of the forty native species have small blossoms.

Fig. 36 will supply all the details. There are five sepals, very unequal or *irregular* in size, as the two lateral ones are much larger than the other three, and usually violet in colour, at least inside (2, *b*, *c*). They all remain or are *persistent*, turning green when the fruit is forming. When sepals do this they assist the leaves in making nourishment, as starch, for the benefit of the fruit and seeds. The five petals very much resemble a pea-blossom, and the corolla has been called falsely *papilionaceous*, as this word is applied to members of the pea family, a word meaning "like a butterfly."

It is particularly noticeable in the flower of *P. myrtifo'lia.*

The five petals are all somewhat united together (2, *d*, *e*, and 3, *b*, *c*) by being adherent to the split tube of the coherent filaments of the stamens (3 ; 4, *d* ; 5, *a*). The largest petal has a fringe or a white crest at the

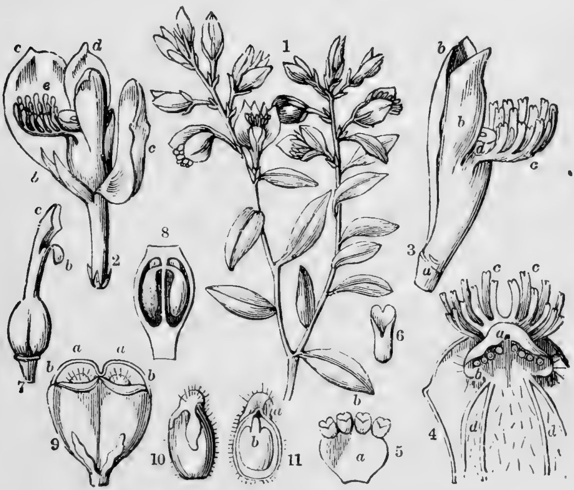


FIG. 36.—*Polyg'ala* (Milkwort). (For description, see text.)

summit (3, *c* ; 4, *c*). There are eight anthers, four (4 and 5, *b*) on each side of a spoon-shaped extremity of the style[1] (7, *c*). The single stigma is a knob (7, *b*) at the base of the spoon, which represents the other stigma. The two anther-cells of each of the eight

[1] This may be well seen in *P. bractea'ta*, a common species with linear leaves.

stamens become confluent, so that they resemble four short fingers of a glove with the tips cut off (4, *a*; 5, *b*). 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 for honey passes it over the sticky knob-like stigma; and on withdrawing it carries away the pollen which has dropped into the spoon-like apex of the style. Then it transfers it to the next flower visited in the same way.

After fertilization the two large violet or purple sepals, as stated, 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.

Mund'tia spino'sa.—In this genus the spoon-like process of *Polyg'ala* is reduced to a little point. The fruit differs in being fleshy. The flower of this common spiny plant is apparently self-fertilizing.

Mural'tia.—This endemic[1] genus has some fifty species, and is remarkable for its five sepals, being almost equal in size, and its capsule has four little horns upon the top. The front petal is purple and the upper ones white. There is a peculiar irritability in the stamens; for it will be found, on inserting a

[1] *I.e.* peculiar to the country.

pointed instrument, that the stamens spring up against the upper petals. A similar spring-like action occurs in some members of the pea family (*Leguminosæ*), as in the much-cultivated lucerne. The spoon-like extremity of the style of *Polyg'ala* is reduced to a point in *Mural'tia.* The anthers all cluster round the stigma, and are one-celled in consequence of a fusion of the original two. Like *Mund'tia,* this is probably self-fertilizing.

General Description of the Mikwort Family.

Herbs or *shrubs.*

Flowers—Irregular; sepals, 5 unequal, 2 lateral, petaloid;[1] petals, 5, adherent to the filaments, the lower (keel) enclosing the stamens and pistil; stamens, 8, filaments, monadelphous,[2] anthers, with pores.

Fruit—Capsule or drupe (*i.e.* with a stone).

Caryophylleæ.

The Pink Family.

This order contains 1200 species of 35 genera in 3 tribes. It consists entirely of herbs, many being little weeds. They all have opposite leaves arising from somewhat enlarged *nodes,* or the joints of the stem. It

[1] *I.e.* "like petals."

[2] *I.e.* "one brotherhood," the filaments being coherent.

is a very large order in the Northern hemisphere; and 8 species out of the 33 genera in South Africa have been probably introduced.

Dian'thus.—There are nine South African species of this genus, which supplies all the pinks, carnations, and picotees of gardens.

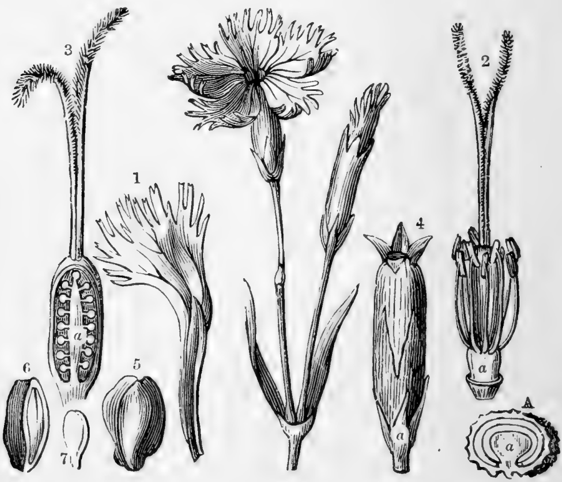


FIG. 37.—*Dian'thus* (Clove-pink). (For description, see text.)

In the illustration (Fig. 37) observe the two opposite leaves, the joint, or *node*, of the stem being swollen. At the base of the flower are two pairs of bracts (4, *a*). The calyx is a long tube with five points, as shown by the bud on the middle figure. (1) is a fringed petal. In some species there is no fringe, the blade being simply rounded. It has a long claw. (2) consists of the ten stamens and pistil standing on an *internode* (*a*)—or space between two joints or nodes—or gynophore, as in the Caper-plant; (3) is the pistil composed of two carpels, the ovary being cut open to show the ovules arising from a central support. This results from the two divisions, or *septa*, having ceased to grow at an early stage, so that the column made up of the *four* margins combined remains in the middle. This is called the "free, central placenta." (4) is a ripe *capsule*, as any dry, bursting fruit is called, dehiscing by four teeth at the top. It remains included within the calyx and the four bracts (*a*). (5) is a ripe seed; (6) is a seed cut through vertically, showing the straight embryo; (7) is the embryo extracted.

The embryo in other plants of this family is usually coiled round the endosperm or reserve food-stuff, as shown in (A, *a*), the seed of Chickweed.

Sile'ne.—This genus has thirteen species in South Africa. Like pinks, it has a united calyx and a gynophore. The petals have long claws, with a limb either entire, cleft, or fringed. It has, however, three styles, showing that the pistil is made of three carpels. A troublesome cornfield weed introduced from Europe is *S. gallica*, called the "Gunpowder weed" by the colonists, its black seeds resembling it.

Agrostem'ma.—This is another introduced plant. It is tall, with large purple-red flowers, and long, almost leafy, tips to the sepals. It is called "Corn-cockle" in England, and is common in cornfields.

Stella'ria me'dia (Chickweed).—This troublesome weed has been introduced from Europe, and occurs frequently in cultivated ground. It has the sepals distinct, no gynophore, and each petal is rather deeply cleft. The number of stamens varies from 10, 8, 5 to 3, generally 8 to 10 in Cape plants. In England they are usually 3. The corolla varies in size, as in South Europe it is sometimes very large, and the name *grandiflo'ra* has been given to it, but only as a variety. The petals are generally about as long as the sepals. In some plants the buds never open, especially in cold weather; but the pollen fertilizes the ovules just as well, as, though in sunny weather insects get a little honey secreted by a honey-gland at the bottom of the filaments, it usually is self-fertilizing, and is one of the most abundant of seed-makers.

A line of hairs runs from leaf to leaf, but on opposite sides of the stem on alternate *internodes*—that is, the portion of the stem between each pair of leaves.

Lepig'onum.—*L. margina'tum* is a plant with clusters of awl-shaped leaves, and almost transparent *scarious,* or colourless and dry, *stipules* at the nodes. The stem and leaves are covered with *glandular hairs.*[1] The

[1] These are hairs composed of a single cell, or rows of cells, terminated with a globular cell which contains some peculiar fluid.

flower has five pointed sepals, five pointed petals, ten stamens, and a pistil with three styles. One variety when growing in very wet places is much less hairy than those growing in dry spots. It is found everywhere in salt, damp ground near the seashore, throughout the Colony. The seeds are round, flat, and smooth, with a broad, white, marginal wing.

FIG. 38.—Dichotomous cyme of *Ceras'tium.*

The last two plants illustrate very well the prevailing type of Inflorescence in this family. It is *definite* in kind, in that the main peduncle "ends" in a flower. When an inflorescence does *not* do so, it is called *indefinite;* and the particular form in plants of the order *Caryophylleæ* is called a "cyme"[1] (Fig. 38). It is also said to be *dichotomous, i.e.* "twice-cut," or forking, as we say. It will be seen that the lowest flower, now in fruit, terminates the primary peduncle. Then from two opposite bracts, secondary peduncles arise, each terminated by a pedicel with its flower. Hence the order of blossoming may be represented thus: 4, 3, 4, 2, 4, 3, 4, 1, 4, 3, 4, 2, 4, 3, 4.

[1] From the Greek *kuma,* "a wave;" but the connection is not clear.

General Description of the Pink Family.

Herbs—With stems having thickened nodes.

Leaves—*Opposite*, and *entire*—that is, with a smooth edge.

Flowers—Regular; sepals, coherent or free; petals, clawed or not; stamens, often twice the number of petals; pistil, with coherent ovaries, but with styles free.

Fruit.—A capsule with a free, central placenta bearing many seeds.

Malvaceæ.

The Mallow, Hibiscus, and Cotton Family.

This order contains 700 species of 59 genera in 4 tribes; 10 genera are in South Africa. The only mallow (*Mal'va*) is an introduced plant (*M. parviflo'ra*). It is cultivated in Egypt and elsewhere as a pot-herb, but is a common weed by roadsides. No member of this family is poisonous.

Hibis'cus.—This genus has twenty species in South Africa, of which *H. Æthiop'icus* occurs on grassy hills throughout the Colony. It is a dwarf plant with five to seven stipulate, *dentate*, or toothed-edged leaves, covered with *stellate*—that is, star-shaped hairs. The flower has numerous little bracts round the base of the calyx.

This has been called an *epicalyx, i.e.* "upon the calyx," as shown in the diagram (Fig. 39, II.).

The five sepals meet by their edges, but do not overlap; when this is the case with sepals or petals, they are called *valvate.* If the calyx be turned back, a honey-secreting surface will be found at the base; an insect in searching for it passes its proboscis between the bases of the petals, and so reaches the calyx.

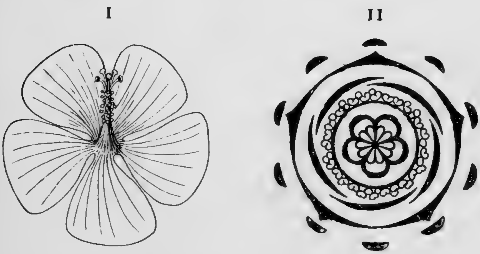


FIG. 39.—*Hibis'cus.* I. Corolla, with petals adherent to monadelphous stamens. II. Diagram.

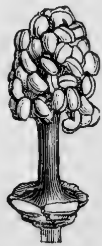


FIG. 40. — Monadelphous stamens of *Mal'va.*

The five petals are *imbricate,* overlapping one another in a spiral manner, or *contorted,* in the bud, as shown in the diagram (II.).

They will be found to be adherent to the cylinder formed of the ∞ filaments (Fig. 39, I.), the tops of which are free, each bearing a one-celled anther; seen also in Fig. 40 of the Mallow.[1]

The pistil will be found to be quite free inside the

[1] When all the filaments cohere, the stamens are called *monadelphous, i.e.* "one brotherhood."

staminal tube. This must be split open from top to bottom. The fruit is a capsule, and the seeds are downy. It is composed of five carpels, as shown in the diagram.

In the Mallow the fruit breaks up into separate one-seeded pieces (*i.e.* the carpels, which remain indehiscent, each tightly covering a seed).

One of the most ornamental, cultivated species is *H. Ro'sa-sinen'sis.* It forms large shrubs, with usually scarlet flowers. It is a native of China. The flowers are often double, by the numerous stamens being replaced by petals, and these are then multiplied. They have varied much under cultivation, being sometimes white or even yellow or purple. The flowers have a juice which turns black, and is used by the Chinese ladies for blackening the hair, and in Java for blacking shoes; hence it has been called the "Shoe-flower."

A much more useful member of this family is the cotton plant, of which every seed is covered with long, twisted hairs supplying the cotton of commerce. Some species of *Gossyp'ium* are natives of Peru, others occur in India as the tree cotton (*G. arbor'eum*). Cotton is mentioned once in the Bible, Esther i. 6, where "green" is a mistranslation for "cotton."

Two genera have no involucre, *Si'da* and *Abu'tilon.* In the former the ovules are solitary, but in the latter there are three or more in each carpel. Some of the many species of *Si'da,* which are found in both tropical and sub-tropical regions of both worlds, have excellent fibres. Thus the Chinese use that of *S. tiliæfo'lia,* it being as good as hemp.

Several specimens of *Abu'tilon* are cultivated as handsome shrubs; and several hybrids have been raised. There are two or more species in the eastern parts of Natal.

General Description of the Mallow Family.

Herbs, shrubs, or *trees*—None poisonous.

Leaves—Stipulate, simple, often with stellate hairs.

Flowers—Calyx, 5 cleft, valvate in bud, mostly with an epicalyx or involucre, the base secreting honey; petals, 5, twisted in bud, and adherent to the stamens; stamens, ∞, united into a tube by the filaments; 3 to ∞ carpels, syncarpous, within the stamens; seeds with a curved embryo and plaited cotyledons.

DIVISION II.—DISCIFLORÆ.

Geraniaceæ.

The Geranium Family.

This order contains 750 species of 16 genera in 7 tribes.

The flowers are sometimes quite regular, *i.e.* every part of each whorl is exactly alike; in some, as *Pelargo'nium,* they vary in shape, colour, size, and number, so that whenever the parts of a whorl are not all alike, it is said to be *irregular.*

There are seven genera in South Africa, of which *Ox'alis* has more than 100 species and *Pelargo'nium* about 160. The others have very few, as from one to eight species only.

Of the four South African genera with regular flowers, *Monso'nia* and *Sarcocau'lon* have fifteen stamens. *Gera'nium* has ten, and *Ero'dium* five.

Monso'nia has the fifteen stamens grouped in five parcels, each containing three stamens. There are eight Cape species.

Sarcocau'lon is remarkable for secreting a great quantity of wax, so that the stem burns like a candle, emitting a pleasant odour at the same time. The stem is succulent and spiny, a common result of living in very dry regions, as that of the north-western districts, etc., where it grows.[1]

Gera'nium ("Crane's Bill").—There is a common species, called *G. inca'num,* from the "hoary" or white appearance in consequence of the dense, silky hairs upon the stems and lower sides of the leaves. It occurs in the Cape flats on the Peninsula and elsewhere in the western district. The blades of the leaves are *palmately* divided from the base, consisting

[1] See p. 39 for a description of it.

of five somewhat narrow segments, like fingers from the palm of the hand. The flower is quite regular, having five minutely pointed, or *mucronate*, sepals, five white or rosy-tinted petals, ten stamens in two whorls. There are five honey-glands on the receptacle, one in front of each sepal.

When a flower is regular it can always be visited by insects from any point, so that the glands are regularly situated; but when flowers are irregular, as we shall see in *Pelargo'nium*, then the honey is located at one spot, wherever it is most easily accessible.

The pistil is composed of five carpels, the long styles of which form a "beak" in the ripened stage, the ovaries being very small, each containing a single ovule (Fig. 41, I.).

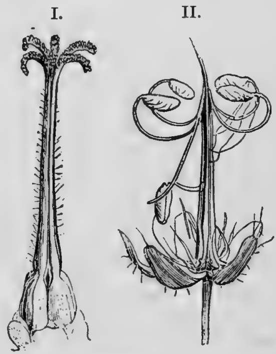


FIG. 41.—*Gera'nium*. I. Pistil with honey-glands below the ovary. II. Carpels splitting from the central column of coherent margins.

When ripe the five carpels split off from the coherent margins of the carpels from below upwards (II.); and as the ovary bursts at the same time, the elastically curling style throws the seed to a distance.

Ero'dium ("Stork's Bill").—This genus differs from *Gera'nium* in having pinnately divided leaves (from *pinna*, a "feather"), as in *Ranun'culus pinna'tus*. It has also only five stamens bearing anthers; on the other five filaments there are none, hence these are called *staminodes*.[1] There are five Cape species, of which two are endemic and three introduced from Europe.

The species of these two genera, especially that described of *Gera'nium*, are examples of many South African plants provided with a clothing of hair, as an "adaptation" to drought. It not only checks the loss of water by transpiration, but can absorb dew in the rainless time.

Pelargo'nium ("Heron's Bill").—This genus is almost entirely South African, having a great variety of habit of growth, some being small bulbous plants, others large shrubs, etc. There are some 170 species in all. They have five sepals; just within the back, or posterior, sepal is a honey-tube, or nectary,[2] running down the pedicel. The number of petals vary from two to five, the posterior pair being the larger ones, the single anterior petal is suppressed when there are four only (Fig. 42).

There are ten stamens, but as a rule seven only bear anthers (III.). They are often bent downwards in front, together with the style, and are then called *declinate* (I.). The object is to provide a landing-place for the insect, which then passes its proboscis down the

[1] The fruit being like that of the Heron's Bill (*Pelargo'nium*), the same description will apply.

[2] This is the name given to altered sepals, petals, etc., which secrete honey. The honey-gland, or disc, is on the receptacle.

honey-tube at the back. The bee thus gets dusted on the under side and conveys the pollen to another flower. But it will be noticed in the photo (I.), that the style is *below* the stamens, and ends abruptly. The reason of this is that the anthers in this flower mature *before* the five stigmas are ready to receive the pollen. A flower

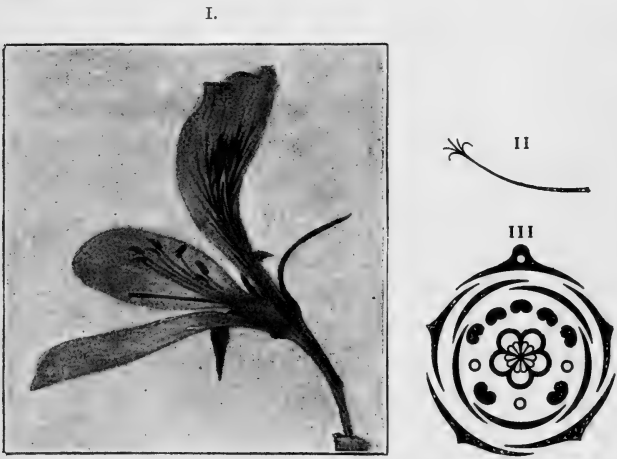


FIG. 42.—*Pelargo'nium.* I. Vertical section of flower in first, or male stage. II. Style and stigma in second, or female stage. III. Diagram. [See p. 22, *ff.*]

in this condition—and it is the usual one with conspicuous flowers—is called *protandrous, i.e.* "male first." In the second stage of the flower, the filaments with their shrivelled and pollenless anthers, become depressed, to get out of the way, so to say, when the style rises up into their position (II.). The stamens are represented as protandrous in the photo. Then the five curling stigmas spread themselves out, ready for the pollen to be brought to them.

In some flowers, usually small ones and not attractive, the stigmas mature before the anthers. Such are called *protogynous, i.e.* "female first."

When the fruit is ripe, it has a long beak as in the other genera, but each style has sometimes a row of silky hairs upon it where the carpels separate. This possibly enables it to fly to a distance, but it has another use. It will be noticed how each carpel has its style curled up like a corkscrew. The same feature is seen in *Ero'dium.* The seed does not fall out of the ovary, as this does not open, but it is provided with a sharp point below, and is covered with short hairs pointing upwards.

Now, when a carpel falls and finds moisture, the screw absorbs the moisture and uncoils, while the long hairs on the style with the short ones on the ovary catch among grass, etc., and so enable the fruit to gain a support, or "purchase," while the screw by uncoiling buries the fruit in the soil. The "awn" of the oat behaves much in the same way.

There is another plant of the same family as *Ox'alis, Gera'nium,* and *Pelargo'nium,* known as the Balsam. There are one or two kinds in the Eastern district and Natal, but several sorts are cultivated. The pod looks just like that of *Ox'alis,* but when ripe the slightest touch causes it to explode; for the "valves" curl up rapidly, on the instant, into little corkscrew-like pieces, and fling the seeds to a great distance in doing so.

Ox'alis.—This genus has been dealt with so fully that I need only refer the reader to "The Plant and its Parts" for a full description. Its name is derived from a Greek word meaning "sharp," because the juice is acid, which renders it unfit for food; even goats refuse it in Malta.

General Description of the Geranium Family.

Herbs—Often hairy.

Leaves—Stipulate.

Flowers—Mostly regular, with whorls of fives; sepals persistent; stamens, 5 or 10, sometimes coherent; pistil of 5 coherent carpels.

Fruit—With long "beaks."

N.B.—*Pelargo'nium* is irregular.

Rutaceæ.

THE CAPE CHESTNUT AND ORANGE FAMILY.

This order contains 650 species of 83 genera in 7 tribes, of which only 3 are represented by 14 genera in South Africa. They are trees and shrubs, but rarely herbs, having the leaves dotted with oil-glands, which give them a strong scent. The glands are well seen in the rind of an orange.

Caloden'dron.—*C. Capen'se,* the Cape chestnut, is a fine tree, a native of the Eastern side. It has evergreen, dotted leaves and clusters of white and purple flowers. The calyx has five sepals; there are five petals, five perfect stamens, and five without anthers, being staminodes. The syncarpous pistil has five carpels. There is a disc for secreting honey between the stamens and the pistil. The disc is only a superficial outgrowth from the receptacle, just as are the five glands of *Gera'nium.* The fruit is a capsule.

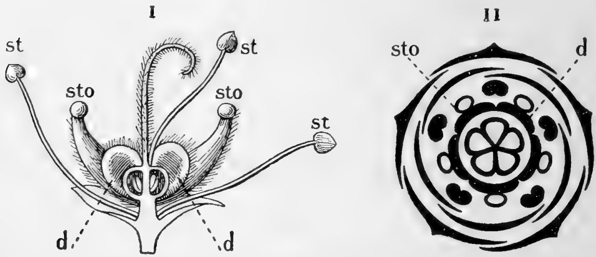


FIG. 43.—I. Section through flower of *Baros'ma crenula'ta* after the removal of the petals (magnified): *st*, fertile stamens; *sto*, barren stamens (staminodes); *d*, lobes of disc. II. Diagram of flower: *sto*, staminodes; *d*, disc.

Baros'ma.—This is so called from its "heavy scent." There are fifteen species of small shrubs, some, such as *B. crenula'ta*, are called "Buchu," the leaves being used in medicine.

The diagram (Fig. 43, II.) shows the five sepals and five petals, both being imbricate. The petals are really much larger than the sepals; then follow five perfect stamens and five staminodes, *i.e.* filaments with no anthers; then there is the circular, *crenate*, or scalloped disc with five rounded lobes. Lastly, is the syncarpous pistil of five carpels, forming a five-celled capsule, when in fruit.

Agathos'ma.—Of this genus there are some 100 species bearing flowers clustered at the ends of branches. Like the water-lily, this shows the connection between petals and stamens, as the staminodes have anthers replaced by an oval limb. The whole closely resembles the long clawed petals.

Dios'ma.—Eleven species are known ; the illustration (Fig. 44) is that of *D. longifo'lia* (I.), with small heath-like leaves, as so many South African plants have them. The petals in this genus are not clawed, nor are there any staminodes as in *Agathos'ma ;* but the anthers have the apical glands (II.), and there is the usual cup-shaped disc with its *crenate* or wavy margin (II.). The fruit breaks up into its separate carpels called *cocci* (III.). (IV.) is a seed showing a peculiar crest at the top.

As the orange and lemon trees belong to this family, I will here add one or two peculiar features of these familiar fruits. The orange has a sweet juicy flesh within the rind ; but this is not really the inner part of the *pericarp,* as the ripened fruit is called ; for while in flower the ovary-cells of the orange are hollow, but long and short *hairs* with swollen ends grow into and fill up the hole, and the juice is contained in the swollen ends. These fit together one with another, so that they quite fill up the ovary-cells, and cover the pips or seeds in the middle, where all the margins of the carpels meet together.

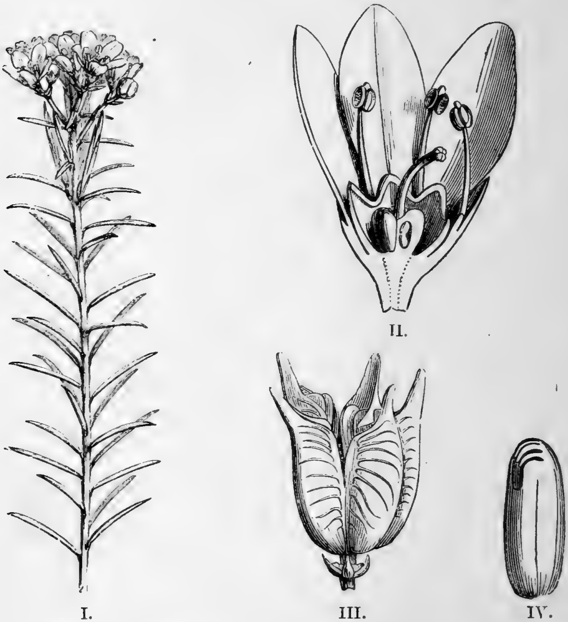


FIG. 44.—*Dios'ma.* I. Flowering shoot. II. Vertical section of flower. III. Fruit. IV. Seed with terminal crest.

General Description of the Cape Chestnut and Orange Family.

Trees or *shrubs.*

Leaves—Dotted with oil-glands and strongly scented.

Flowers—Sepals and petals, 4 or 5; stamens around a thick honey-disc, equal to or twice as many as the petals, free or monadelphous; carpels, 2 to 5.

Fruit—Capsule or berry.

Anacardiaceæ.

The "Wild Plum" Family.

This order contains 450 species of 40 genera. They consist of trees and shrubs, sometimes with a milky juice. The flowers are small, in clusters and usually *unisexual, i.e.* having the stamens and pistil in separate flowers. Several have edible fruits, as the Mango. There are 7 genera in South Africa.

Rhus.—This genus has upwards of fifty species in South Africa; some are common, as on the slopes of Table Mountain. It bears minute flowers (Fig. 45, I.) and orange-coloured berries the size of a peppercorn.

Fig. 45, II. is a section of a male flower, showing the thick disc within the stamens and the rudiment of the pistil. (III.) is the diagram, in which the disc is not represented.

The female flower has no stamens, but a perfect pistil of three carpels, with three stigmas; but the ovary is only one-celled.

The presence of the remains or rudiment of the pistil in the male flower shows that this unisexual condition has resulted from the separation of the sexes in different trees.

Several species of *Rhus* are useful. Thus *R. vimina'lis,* growing by rivers, is used by the Kaffirs

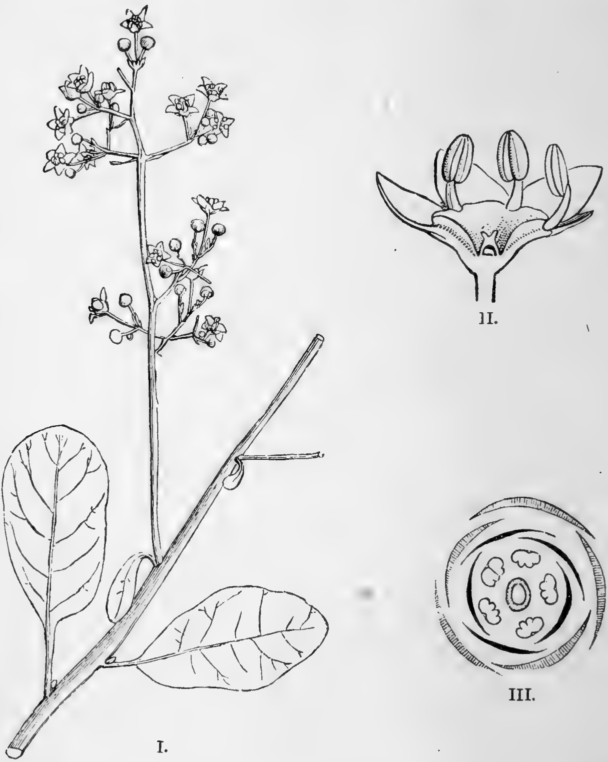


FIG. 45.—*Rhus.* I. Flowering shoot. II. Vertical section of male flower with abortive pistil. Diagram of male flower.

for making the frame of their beehive huts. *R. lu'cida* supplies a good bark for tanning. *R. Thunber'gia* has a good hard wood suitable for furniture. It grows at Stellenbosch.

A species in Japan, *R. vernicif'era,* supplies the celebrated varnish for Japanese lacquer-work, while the oil of the seeds is used for lamps. Some species in North America are very poisonous, and are known by such names as poison-wood vine and oak.

Harpephyl'lum Caff'rum.—The only species is a smooth tree of the Eastern district and Kaffraria. The wood is useful for household furniture, and the edible fruit is called the "Wild Plum."

General Description of the "Wild Plum" Family.

Trees or *shrubs*—With a balsamic or gummy juice.

Flowers—Complete, polygamous [1] or unisexual; sepals coherent; petals free, enlarged after flowering; honey-disc forming a ring; stamens, twice as many as petals; ovary, one-celled.

DIVISION III.—CALYCIFLORÆ.

Leguminosæ.

The Pea Family.

This order is one of the largest in the world, containing between 6000 and 7000 species of 400 genera in 23 tribes.

[1] A plant is called "polygamous," *i.e.* "many unions," when it bears male, female, and bisexual flowers.

Some members are to be found in nearly all parts of the world, excepting the very cold antarctic islands.

I.

Fig. 46.—*Lath'yrus* (Sweet-pea). I. Leaf and flower.

It includes some of the smallest herbs as well as gigantic trees. In the great majority the leaves are compound, and have a pair of stipules at the base of the stalk. These take the form of thorns in Acacias, etc.

The order is first divided into three "Sub-orders" as follows, each of which has its "Tribes":—

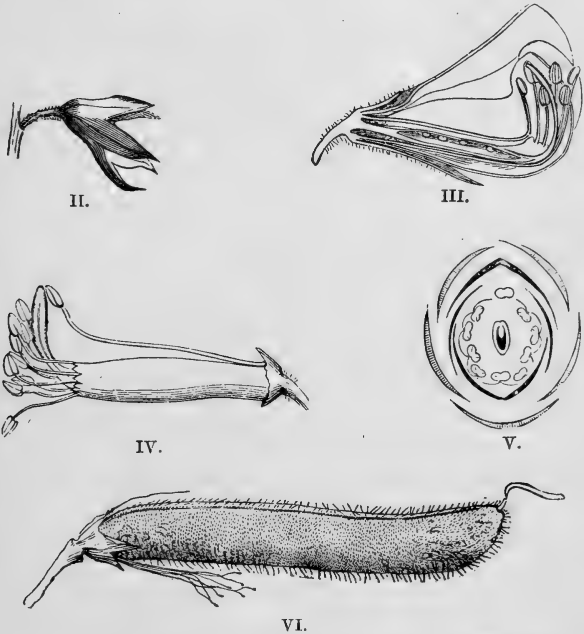


FIG. 46.—II. Calyx. III. Vertical section of flower. IV. Stamens and pistil. V. Diagram. VI. Legume.

I. **Papilionaceæ.**—This tribe is so called from the fancied resemblance to a butterfly (Latin *papilio*) in the irregular corolla.

II. **Cæsalpineæ.**—Though the flowers are irregular, they are different in form from those of the first.

III. **Mimoseæ.**—The flowers are regular, very minute, and clustered in small tufts.

All three agree in having the fruit a pod or *legume,* from the Latin word for bean, *legumen* (Fig. 46, VI.). It bursts down both edges into two pieces, or *valves* (Fig. 47).

The legume is a most characteristic feature of

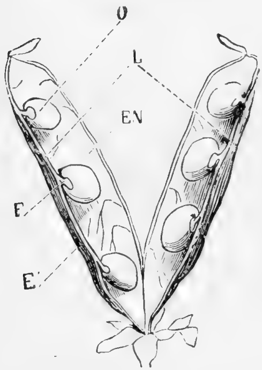


FIG. 47.—Legume of Pea split lengthwise: E outer, EN inner, layer of the pericarp; L, placenta; F, funiculus; O, seed.

FIG. 48.—Spirally twisted legume of Lucerne (*Medica'go sati'va*).

FIG. 49.—Lomentum of *Hedys'arum.*

this family, but it may take special forms. That of the pea is the usual or typical character; but in the lucerne it coils up as shown in Fig. 48, or it may cling tightly to the seeds so that it breaks up without separating from them; each piece has one seed (Fig. 49).

The seeds have large embryos without any endosperm, their reserve food being stored up in the cells of the two cotyledons, as in peas, beans, lentils, etc.

As this is a very important family, it is desirable to examine some flower of considerable size to understand all its parts, so I will take the garden sweet-pea as a good example. The kitchen-pea would do equally well.

Fig. 46, I., shows a leaf, a blossom, and a young pod just beginning to form. There are a small pair of stipules at the base of the leafstalk. These are very large, like two leaf-blades, in the kitchen-pea. The leaf has only two perfect leaflets, the rest being changed into sensitive tendrils. These are continually "bowing around," or *circumnutating*, so as to catch hold of twigs; for as soon as they feel the pressure, they coil round them, and so firmly support the plant.

Now let us examine a flower. There is an irregularly shaped calyx of five coherent sepals (II.), an irregular corolla of five petals named as follows, already referred to in speaking of Lucerne; but I will repeat them here. The large petal at the back is the *Standard;* the two at the sides are the *Wings;* the two in front, united along the lower edge, form the boat-like *Keel*. These latter include the ten stamens and the pistil as shown in (III.), which is a vertical section through the flower.

The ten stamens have nine united with one free above (IV.). This enables the bee to get to the honey secreted within the tube of cohering filaments. (V.) is a diagram showing the relative position of all the parts of the flower. (VI. and Fig. 47) is the pod or fruit, a *legume*, characteristic of the family.

Podaly'ria.—A genus of silky leaved shrubby plants with simple leaves and small deciduous stipules. The peduncles are few-flowered. The flowers are purplish. There are nearly twenty species in the west and south-west.

The calyx is bell-shaped with a five-pointed limb, showing the five sepals.

The stamens are ten in number, and all quite *free* in this flower; but in by far the greater number of this group they are united, and in three different ways. The commonest is to have nine coherent by their filaments, or *diadelphous*, meaning "two brotherhoods," the uppermost filament only being separate (Fig. 46, IV.), as in the garden-pea. Another method is to have all the stamens coherent, but the tube split down, above. The third method is for the tube not to be split at all.

Crotala'ria.—This is a large South African genus having some twenty-four species. The calyx is somewhat two-lipped, the upper having two points and the lower three, making the five sepals. The corolla is large, having yellow petals as a rule, the keel being sharply beaked. The pod is turgid with very convex valves

It differs from the preceding genus in having *all* the stamens united together into a tube, which is, however, cleft above.

Many others have the tube cleft to the base; but, unlike genera of England, none appear to have the tube entirely united from bottom to top and not cleft.

Aspal'athus.—This large genus with about 150 species frequents dry, stony, and sandy places; and in consequence of a deficiency of water are often of a heath-like form and spiny.

Erythri'na.—This plant has handsome scarlet flowers, the standard (Fig. 50, I. and II., *s*) being very large in comparison with the size of the wings (*w*) and keel (*k*). This has resulted from the dwarfing of the latter since the stamens are not included, but form the landing-place for the insect. They are declinate, just as described in *Pelargo'nium.* The stamens are united as in the pea.

From the photo, it will be seen how an insect alighting on the projecting stamens will get dusted below, when crawling into the flower. Subsequently, on entering another flower in the same way, the stigma (*st*) will hit it just where the pollen has been retained from the previous flower visited.

Medica'go (Lucerne).—This plant is not indigenous, but is so largely grown that it is worth while repeating a peculiarity which can easily be observed. It bears numerous little purple flowers. If a pencil-point be thrust down in imitation of an insect, the flower explodes. This is caused by the stamens, which lay concealed horizontally within the keel, suddenly rising upwards and assuming a curved position, at the same time, it may be supposed, dusting the bee with pollen. A similar explosion takes place in some of the *Polyg'ala* family.

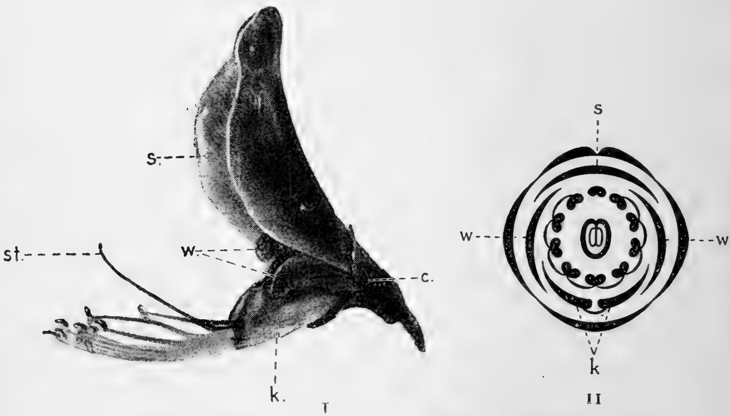


FIG. 50.—*Erythri'na caff'ra.* I. Flower. II. Diagram: *s*, standard; *w*, wings; *k*, keel; *c*, calyx; *st*, style.

Cas'sia.—This is a good type of the second sub-order. Fig. 51, II., is a section through the flower of *C. arachoi'des*, and (I.) is a diagram of the same. If this be compared with that of *Erythri'na*, it will be seen that the posterior petal or standard in *Erythri'na* overlaps the wings, while the keel petals are united below; but the posterior petal is included *within* the others, and there is no true "keel." The stamens are irregular, being unequal (s.a. and s.b.), some being reduced to staminodes (s.c.). The fruit is a pod or legume, as in the first sub-order.

Aca′cia.—This is a good type of the third sub-order. The flowers are minute, forming dense yellow clusters; they are quite regular. The calyx forms a little tube (Fig. 52, I.); the five petals do not overlap, but just meet by their edges, being valvate (I.). The stamens are numerous, and the pistil forms the characteristic legume common to the whole family (Fig. 52, III.).

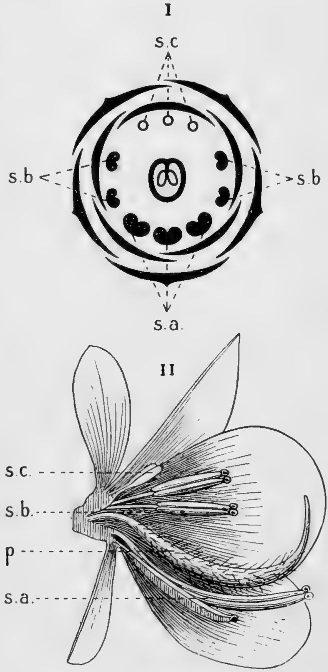


FIG. 51.—*Cas′sia arachoi′des.* I. Diagram of flower. II. Vertical section of flower; *sa*, large stamens; *sb*, small stamens; *sc*, staminodes.

The species consist of trees and shrubs; the majority have no leaf-blades, but only petioles, which, however, are flattened in a vertical position, and called *phyllodes.* The use of this, as stated with regard to the sleep of plants (p. 4), is to avoid loss of heat by radiation, or as a protection against too great heat.

Many species have spines instead of stipules. These have suggested the name "Wait-a-bit" thorn to the common species, *A. hor'rida*, the Karroo thorn. Some species have compound blades, but the Austra-

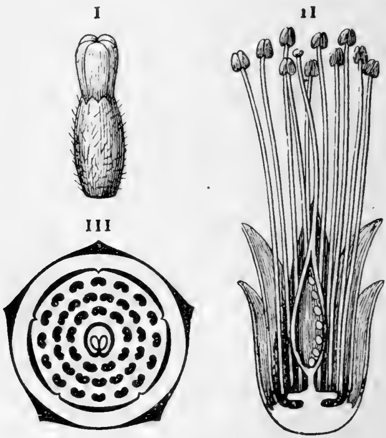


FIG. 52.—*Aca'cia hor'rida.* I. Flower-bud (× 3). II. Section through flower (× 5). III. Diagram of flower.

lian Wattle cultivated at the Cape has no blade; the petiole is flattened into a "phyllode," and stands with its edges turned towards the sky and earth.

The tough wood of the Wait-a-bit thorn renders it useful for building purposes, as well as for wheels, poles, yokes, and turnery.

Any plant of this family will be found to bear *nodules* on the roots. It has been discovered that they always contain minute *fungi*, generally called *microbes* (a word meaning "small living beings"). These are enabled in some unknown manner to absorb the *nitrogen* gas from the air (which consists of about four-fifths of nitrogen and one-fifth of oxygen, with about $\frac{1}{25}$ per cent. of carbonic acid gas). No flowering plant is capable *by itself* of taking up this beneficial element from the air, but only from mineral ingredients in the soil called "nitrates," as compounds of ammonia (smelling salts). The consequence is that leguminous plants are found to contain more nitrogen than any others, so that while, *e.g.*, a potato has only 2 per cent. of "nitrogenous" matters, peas, beans, and especially lentils, have about 24 per cent. Nitrogen *must* be present in our food for building up the brain, muscles, nerves, bones, and blood, so that no other vegetables are so important in this respect as those derived from the order *Leguminosæ.*

General Description of the Pea Family.

Herbs, shrubs, or *trees.*

Leaves—Compound, rarely simple, stipulate, sometimes as tendrils.

Flowers—Calyx coherent; petals irregular (except sub-order *Mimoseæ*); stamens, free, monadelphous or diadelphous; pistil of one carpel.

Fruit—A legume.

Rosaceæ.

The Rose Family.

This family contains 1500 species of 71 genera in 10 tribes; but there are only 11 genera in South Africa, and these have mostly one, two, or very few species.

Cliffor'tia, confined to South Africa, has 40. Three genera are introduced from Europe.

The ten tribes are not all represented in the Colony, but are best known by their different kinds of fruits, as also by the different forms of the *receptacular tube*. This arises as an expansion of the floral receptacle, so that the sepals, petals, and stamens are carried out to a little distance from the pistil; hence the last two whorls are said to be *perigynous*, or "around the pistil" (see Fig. 53, II.).

Tribe, **Pruneæ.**—The type genus is *Pru'nus*, which supplies us with the so-called "Stone-fruits," as peach, apricot, nectarine, almond, plums, cherries, etc. In the flowers of these the receptacular tube takes the form of a cup, lined with an orange-coloured honey-disc, at the bottom of which is a single carpel (Fig. 53, II.). Although the calyx is now elevated upon the tube, it is still called "inferior," because this term has no reference to *height*, but only to *freedom* from the ovary. We shall see that it becomes *adherent* to it

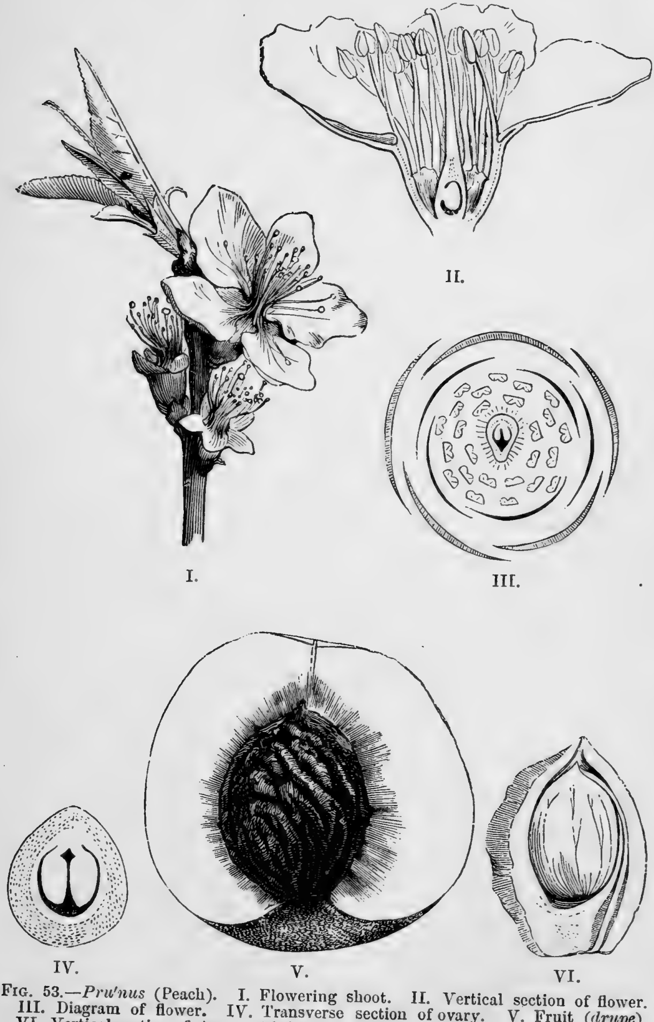
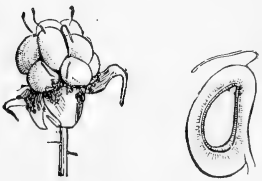


FIG. 53.—*Pru'nus* (Peach). I. Flowering shoot. II. Vertical section of flower. III. Diagram of flower. IV. Transverse section of ovary. V. Fruit (*drupe*). VI. Vertical section of stone, with kernel.

in the tribe *Pomeæ*, where the calyx becomes *superior*, and the resulting fruit *inferior.*

The single carpel of the peach contains two ovules (Fig. 53, III., IV.), but as a rule one only becomes a kernel or seed (VI.). The carpel becomes the fruit (V.), consisting of three distinct layers, the skin, or *epicarp*, the edible flesh, or *mesocarp*, and the stone, or *endocarp*, the three together making the *pericarp*. There is no wild species of the genus *Pru'nus* in South Africa, but one tree *Py'geum*, is in Kaffraria.



I. II.

FIG. 54.—Fruit of Bramble (*Ru'bus*). I. Natural size. II. Section of a single drupel.

Tribe, **Rubeæ**.—This contains one genus only, *Ru'bus*—the blackberry and raspberry. There are five species in the Colony. The receptacular tube takes the form of a little trough. The fruit is a dense head of miniature drupes called *drupels* (Fig. 54, I.). II. is a vertical section of a drupel, showing the embryo.

Tribe, **Potentilleæ**.—One European species, *Poten-til'la supi'na*, has been introduced. The fruit consists of a cluster of achenes, as seen in the strawberry. But as the edible part of this is *not* the fruit at all, the whole is called a *pseudocarp*, or "false fruit"; the achenes upon it are the real fruits. The following is the description of the details of Fig. 55 :—

The trifoliate leaf will be seen to have a pair of *adnate* stipules (1, *a*); (2) represents a vertical section of the flower, the petals being removed; (*a*, *a*) are the sepals; behind and alternate with the sepals are five bracts, as shown on the back of the flower figured by the fruit on (1). These constitute the epicalyx (described under *Hibis'cus* of the Mallow Family).

FIG. 55.—*Frag'area* (Strawberry). (For description, see text.)

The honey-secreting receptacular "tube," but really only a lateral expansion of the stalk, is seen above (*c*, *c*) in (2). The petals and stamens arise from its outer rim (*b*, *b*). (3) and (4) are front and back views of a stamen. (5) is a carpel, showing the ovary (*a*), the style (*b*) arising from near the base of the ovary, with its stigma (*c*); and (6) is a ripe fruit, or *pseudocarp*, consisting of the enlarged top of the floral receptacle, and bearing numerous free achenes (*a*). (7) is a ripe achene, the style being removed; and (8) is an achene opened to show the single seed within it. (9) is the seed extracted, and (10) the embryo removed from the skin.

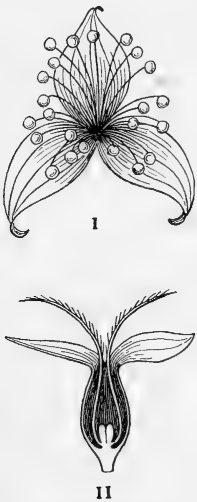


Fig. 56.—*Cliffor'tia.* I. Male flower. II. Vertical section of female flower.

Tribe, **Poterieæ.**—The Agrimony has been introduced from Europe, but *Cliffor'tia* with forty species is peculiar to South Africa. The flowers of members of this tribe have little receptacular tubes, at the bottom of which are situated two free carpels (Fig. 56, II.); but while the Agrimony has a yellow corolla with scented flowers, the *Cliffor'tia* has no corolla and no scent. It is also diœcious.

Fig. 56, I., is a male flower, consisting of three sepals and ∞ stamens; II. is a female flower (in section), showing two sepals on the receptacular tube and two carpels with long styles.

Tribe, **Roseæ.**—There is no wild rose native of South Africa, but the Dog-rose of England has been introduced, and occurs wild in the Peninsula. The rose has very many species, many of which, as well as numerous hybrids, are cultivated. It has a thick receptacular tube forming the "hep." This includes many free carpels, and carries the sepals (free), the petals, and many stamens on the rim above (Fig. 57). The rim is orange-coloured, and looks like a honey-disc; but it seems to have lost the power of secreting honey.

Tribe, **Neuradeæ.**—One genus represents this tribe in South Africa, *Grie'lum.* It has only ten stamens

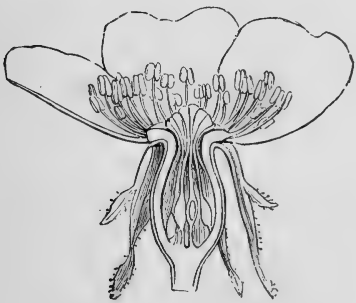


FIG. 57.—Vertical section of flower of Rose.

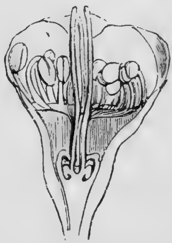


FIG. 58.—Vertical section through the flower of the Pear, showing the ovaries really free, embedded in the receptacular tube.

and a short tube adherent to the ovary. Hence the latter is now *inferior.* The petals are large and yellow. The carpels vary from five to ten. The species grow in sandy places and in salt ground.

Tribe, **Pomeæ.**—This tribe is wanting in South Africa; but the fruit is familiar in apples, pears (Fig. 58), loquats, and is called a "pome."

As in *Grie'lum,* the receptacular tube invests the ovary, but becomes fleshy; so the above fruits might be called pseudocarps, as the edible part is really the flower-stalk.

General Description of the Rose Family.

Herbs, shrubs, or *trees.*

Leaves—Simple or compound, stipulate.

Flowers—Regular, sepals coherent; petals, 5; stamens ∞, both being on a receptacular tube; carpels, free, 1–∞, within the free or adherent tube.

Fruits—Achenes, drupes, or drupels, pomes, etc.

Crassulaceæ.

The Crassula Family.

This order contains 400 species of 14 genera. It is a very characteristic family of South Africa; since the country, especially the western half, is always marked by great dryness, many plants possess the means of storing up water for months, till the rains come again. The commonest way is to make the stems or leaves thick, fleshy, and massive. This is done by the cells of the interior being very thin-walled, and filled with gummy water or a milky fluid. This is protected by a tough rind or skin, so that the loss of water by transpiration is greatly retarded.

There are two tribes, one in which the stamens are as many as the petals, as in *Cras'sula* and *Roch'ea*—in South Africa there are five genera in this tribe; the other, in which the stamens are twice as many as the petals, as in *Cotyle'don*, *Kalancho'œ* and *Bryophyl'lum*, the only three in South Africa.

Cras'sula.—The calyx has five sepals very slightly coherent below. The petals are five, free or coherent; stamens five; there will be found some scales, probably honey-secreting, and lastly, five carpels, as a rule nearly free, so they become follicles with many seeds (Fig. 59).[1]

I II

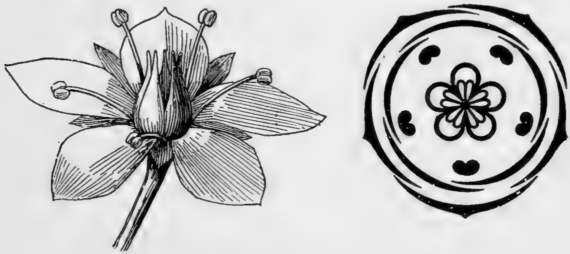


FIG. 59.—*Cras'sula.* I. Flower (× 2). II. Diagram.

Cotyle'don.—In this the corolla has all its petals coherent, which carries ten stamens adherent to it.

Bryophyl'lum.—This genus has one species growing near Delagoa Bay; but another has spread over the warmer regions of the North, *B. calyci'num*, which is remarkable for propagating itself by its leaves. These are oval and crenate, or scalloped on the margin, *i.e.* indented and rounded between the indentations. The leaves are fleshy, and fall before being decayed. Roots

[1] The *follicle* resembles the *legume*, as of a pea; but bursts down *one* edge only, not both, as in the legume.

soon appear at the notches, and buds follow, each of which then becomes an independent plant.

General Description of the Crassula Family.

Herbs.

Leaves—Succulent.

Flowers—Regular, sepals nearly free; petals, free or coherent; stamens, equal to or twice as many as petals; carpels nearly free.

Fruit—Follicles.

Bruniaceæ.

The Brunia Family.

This family of 40 species of 9 genera is exclusively South African. It consists of heath-like shrubs. The leaves are small or needle-like, and crowded together, with a hard tip. The flowers are minute, white or red in clusters (Fig. 60, I.), rarely solitary. The plants, like true heaths, are eminently characteristic of a dry climate, Many other South African plants of several different families put on a similar appearance. It is the want of sufficient moisture which prevents leaves of little herbs growing large, so that a great number remain heath-like, or the short needle-like leaf may be still further reduced, till it becomes very minute and closely pressed against the stem, as in *Bru'nia nodiflo'ra*

(Fig. 60, I.). A similar result occurs in the dry regions of Australia.

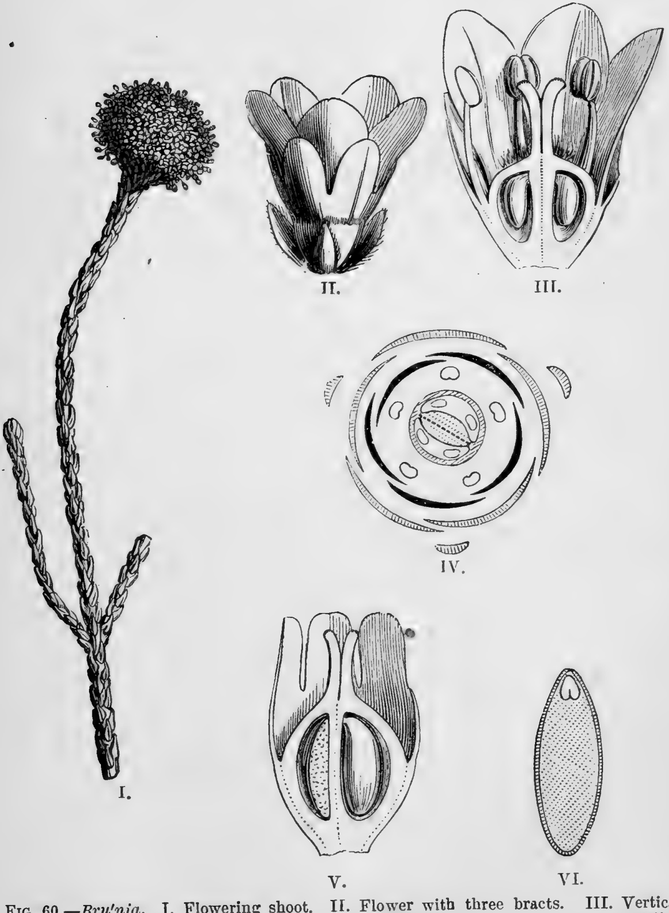


FIG. 60.—*Bru'nia.* I. Flowering shoot. II. Flower with three bracts. III. Vertical section of flower. IV. Diagram. V Vertical section of fruit. VI. Vertical section of seed.

Bru'nia.—This genus has ten species. Outside the flower there are three little bracts (Fig. 60, II.). The calyx has five sepals, the corolla five petals (II.) with five stamens (III., IV.), all standing on the rim of a receptacular tube, which is only half adherent to the ovary (III.). This is, therefore, said to be "half-inferior," and the calyx "half-superior." The petals and stamens are accordingly "half-epigynous." (V.) is a vertical section of calyx and pistil. (VI.) is the seed cut vertically to show the embryo at one end of a mass of endosperm. Though there may be four ovules, *Bru'nia* has only one seed.

Staa'via.—This genus has six species; the fruit is dehiscent, and not indehiscent, as in *Bru'nia.* Some species have a scarious or dry involucre at the base of the flowers, so that the "head" might be readily mistaken for a composite.

General Description of the Brunia Family.

Shrubs—Small.

Leaves—Heath-like, sessile.

Flowers—Calyx, half or quite superior, of 5 sepals; petals and stamens, 5, upon the receptacular tube; ovary, 1 to 3-celled.

Cucurbitaceæ.

The Cucumber Family.

This is a very large order comprising some 470 species of 68 genera grouped into 8 tribes. South Africa has 13 genera, of which I will select two. All the species are herbs, either prostrate or climbing by tendrils. The flowers are always unisexual, sometimes monœcious, as of melons and cucumbers, and sometimes diœcious, as some species of the berry-fruited *Zehne'ria.*

Cu'cumis (Melon) (Fig. 61).—The *male* flower has five coherent, superior sepals; a corolla of five coherent petals; five stamens (III.), the filaments being more or less united, and the anthers in two coherent pairs, the fifth being free and alone (IV.). The anthers are usually curved like an S, and are called *sinuate* (III.).

In the *female* flower there are, of course, no stamens, but the ovary of the pistil is peculiar. The structure can be best seen in a thin slice of cucumber held up to the light. What one observes is the seeds facing inwards, and suspended on an anchor-shaped support (VII.). To account for this, we must first consider the three carpels as having their margins united edge to edge, making a single chamber; then, suppose the united pairs of edges to grow inwards, till they touch, but without cohering, in the middle. Now let them turn outwards again, till they reach the wall of the ovary. Once more let the edges separate and turn

FIG. 61.—Melon. I. Flowering branch, with male and female flowers.

round again, facing the middle, and then stop. This

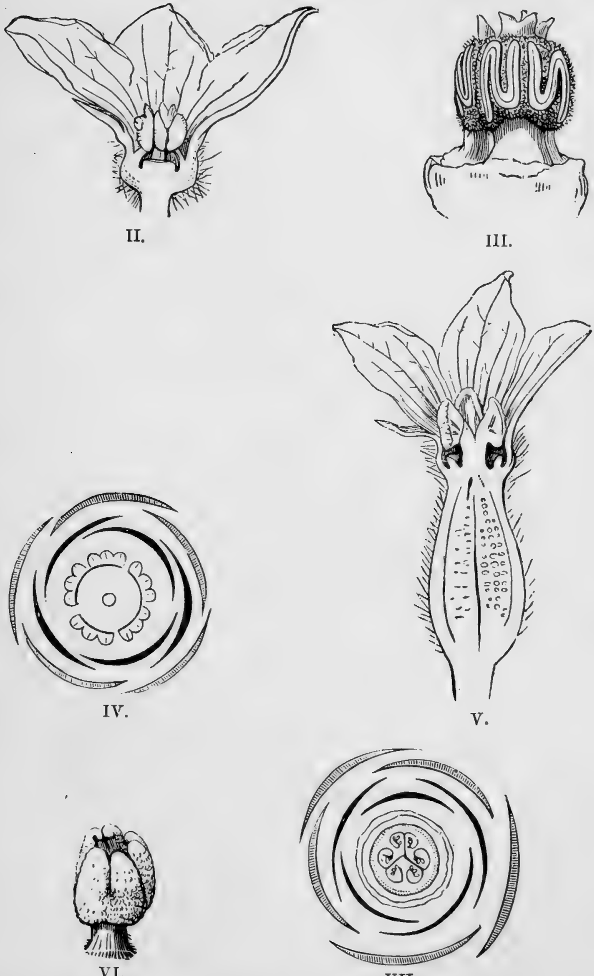


FIG. 61.—II. Vertical section of male flower. III. Stamens. IV. Diagram of male flower. V. Vertical section of female flower. VI. Style and stigmas of female flower. VII. Diagram of female flower.

will account for the anchor-like appearance (VII.)[1] and the seeds pointing inwards. The next thing is for the inner tissues of the carpels to become thick and succulent, and so completely embed the seeds; and we get the solid cucumber. In melons and gourds a cavity is often left in the middle. As the calyx, etc., are situate on the top of the ovary, this is, of course, really invested by the receptacular tube, which goes to form a certain amount of the fruit.

Zehne'ria.—This is a perennial climber with simple thread-like tendrils. The flowers are small and white, the calyx is bell-shaped with five minute teeth, the corolla having five divisions. There are only three stamens, the anthers having a large, round, and hairy *connective*; the anther-cells are nearly straight, and not sinuate. The fruit of the female forms a small globular berry.

As the calyx, etc., fall off, the fruit *looks* as if it were superior, but it is really inferior, as will be at once seen from the flower of the Melon.

Now let us examine a tendril. It resembles in form that of a Passion-flower. If either be carefully watched, they will be found to move round and around, taking several hours to complete a circle. This is called *circumnutation*, a word meaning "bowing around."

[1] In the diagram the *first* ingrowth from the circumference to the centre is omitted. The three radiating lines represent the coherent edges on the return journey to the circumference.

This movement enables the tendril to search for a support. If the little hooked end catches a twig, the tendril at once begins to coil round it, and at the same time grows thicker, and coils up into a spiral. But it will be noticed that it coils in opposite directions two or three times, with straight pieces between the opposite groups of coils. This prevents the tendril from breaking under tension. It can be imitated by fixing one end of a piece of string, pulling it tight, then, by twisting the other end for some time and subsequently relaxing it, the string will suddenly twist upon itself the opposite way, till it comes to rest. You have put force into it which, to be in equilibrium, must be balanced by twisting in the contrary direction. The tendril does a precisely similar thing.

Of other genera, the reader will be familiar with the Water-melon (*Citrul'lus vulga'ris*) and the *Luf'fa*, which produces a dry and fibrous fruit, often used in baths and for various other purposes. The Bottle-gourd (*Lagena'ria vulga'ris*) has a globular top with a contracted base. This is due to the fact that the ovules in the lower (stalk end) part were not fertilized; as the result of fertilization is not only the development of the embryos in the seeds, but the formation of the fruit which contains them.

Gourds and pumpkins belong to another genus (*Cucur'bita*).

General Description of the Cucumber Family.

Herbs—Climbing by tendrils.

Leaves—Simple.

Flowers—Unisexual; sepals, 5, coherent; petals, 5, coherent; male, stamens monadelphous or in groups (2 + 2 + 1), anthers sinuate, or **S**-like; female, pistil of 3 carpels, ovary inferior.

Fruit—An inferior berry, *pepo* or gourd.

Mesembriaceæ.

THE MESEMBRIANTHEMUM FAMILY.

This large family is specially characteristic of South Africa. It contains some 450 species of 22 genera. There are 8 genera in South Africa, of which *Mesembrian'themum* has some 300 species alone. The thick, fleshy leaves of the greater number, like those of *Cras'sula*, are due to the effects of the dry climate, enabling the plants to store up much water against the hot and rainless season. The leaves assume various forms, some being three-cornered, often of a round, rod-like shape, but always fleshy (Fig. 62).

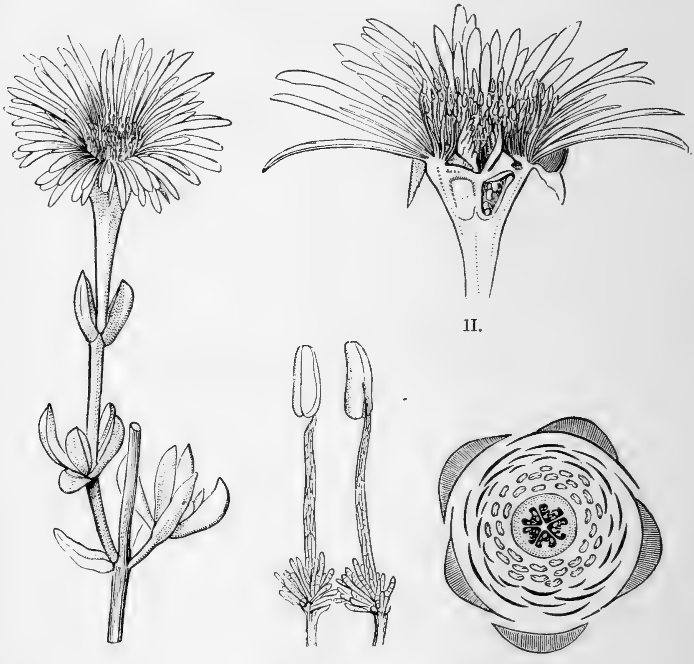
Mesembrian'themum.—This genus is so named from the fact that the flowers require the full midday sun for opening, many closing as soon as the direct sunlight is off them; hence they are called "midday flowers," for that is the meaning of this compound

Greek name. The illustrations will explain the structure of the flower as follows :—

The ovary is obviously inferior and the calyx superior, consisting of five thick sepals (diagram IV.). The petals and stamens are numerous, or *indefinite*, *i.e.* more than twelve at least, being epigynous on the top of the receptacular tube (II.). This secretes honey within the stamens. These often have fringes at the base (III.). The pistil has from four to twenty carpels, according to the species (V.–VII.), and as many cells to the ovary.

The fruit is a capsule (V.–VII.) bursting along the stigmatic ridges on the top. The outer skin separates from the inner tissue (or mesocarp), but the triangular valves only rise up (VI., VII.) when the whole has absorbed moisture, and by spreading themselves out, they open little slits leading into the chambers wherein are the black seeds (VII., VIII.).

The great majority of capsules, *i.e.* of plants in general, only burst in *dry weather;* but certain plants, like those we are considering, and the so-called Rose of Jericho, a little crucifer of the desert near Port Saïd, do so when they are moist—an appropriate arrangement, as it is only at such time that the seeds will germinate. The pods retain the power of opening and closing for ever, so that the reader should procure some dry capsules and place them in water. If he watch them he will perceive how they open in about three to five minutes, till they radiate in a star-like manner. The narrow opening to the seeds lies *between* each of the rays. (VIII.) is a seed with a tuberculated



I. III. IV. II.

FIG. 62.—*Mesembrian'themum.* I. Flowering shoot. II. Vertical section of flower. III. Stamens. IV. Diagram.

testa, and (IX.) the same cut through to show the embryo curved round the endosperm.

The fruits of some species, as *M. edu'le*, are edible, called the Hottentot fig. The ice-plant, *M. crystalli'num*, has been introduced into South Europe and grown as

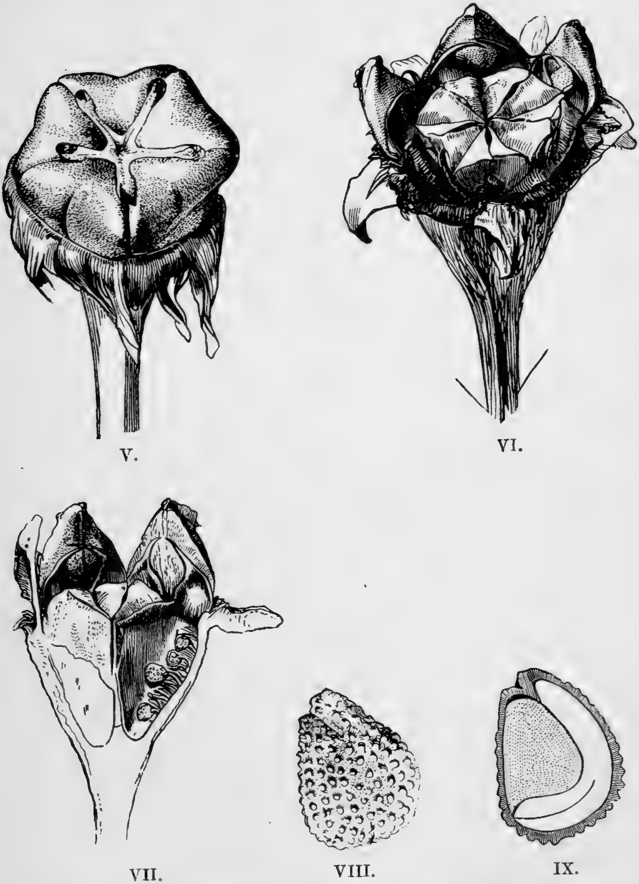


FIG. 62.—V. Nearly ripe fruit. VI. Ripe fruit dehiscing. VII. Vertical section of same. VIII. Seed. IX. Vertical section of seed.

a decorative plant; for it is covered with globular hairs, filled with water, which give it a frosty appearance. This is another method of storing water not uncommon in desert plants.

General Description of the Mesembrianthemum Family.

Herbs, or small *shrubs*.

Leaves—Fleshy and thick.

Flowers—Sepals, 4 to 8, coherent; petals, 0 or ∞; stamens, few or ∞ free; ovary, inferior, 2- to ∞-celled.

Fruit—Capsule, opening when wet.

Umbelliferæ.

THE CARROT AND PARSNIP FAMILY.

This is a large order of some 1300 species of 152 genera in 9 tribes. In South Africa there are 35 genera. The structure of the flower and fruit is so uniform that when one example is thoroughly mastered, any member of the family will be recognized at once.

The species, as a rule, excepting, for example, the money-wort, as it is called in England (*Hydrocot'yle*), have divided or compound leaves, their petioles more or less sheathing the stem. The inflorescence of by far the greater number is easily known, as being a *compound umbel*, *i.e.* the flowers on their pedicels form a *simple umbel*, but many of these radiate again from the end of the main peduncle, so making a compound umbel.

Bu'bon.—This has compound leaves with lobed segments, the petioles being channelled above, in that the two side ridges give strength to the stalk, on the same principle as in "Fox's patent stays" of an umbrella. They are, in fact, "flanges" of a "girder." Engineers and others often imitate Nature by adopting her methods of strengthening stems, etc., so that they can support the heavy weight of foliage and branches. This is partly effected by the petiole more or less sheathing the stem, thus securing a large base. In palms the sheath goes completely round the stem, and is made of interlacing fibres, thereby supplying great strength to support the enormous weight of gigantic palm-leaves.

The flower (Fig. 63, I.) will at once be seen to have an inferior ovary, upon which the five petals and five stamens stand. As a rule, the calyx is either represented by five minute points or is wanting altogether—a common occurrence when small flowers are massed together. On the top of the ovary will be seen two cushion-like masses or honey-discs, between which arise the two short styles. The petals may often have "inflected points" (I.), along which, as in a little groove, the proboscis of an insect can glide so as to reach the honey.

The diagram (II.) shows the arrangement of the whorls with a syncarpous pistil of two carpels, having one (pendulous) ovule to each ovary-cell.

When the fruit ripens, it is called a *cremocarp*, or "hanging fruit," because the two carpels (the single seed of each being invested by the pericarp) separate along the line of junction called the *commissure*, and

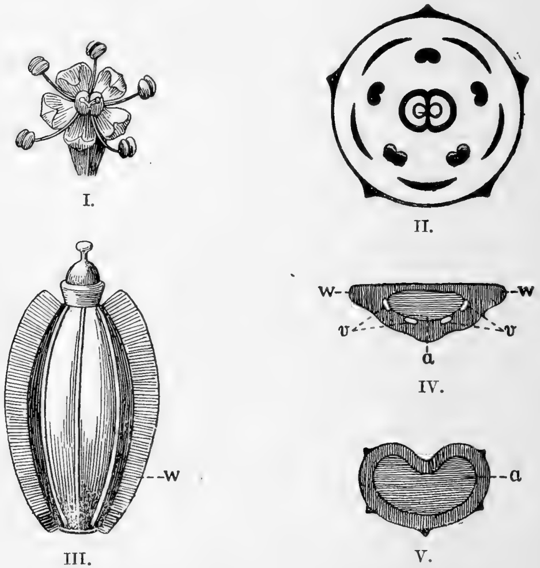


FIG. 63.—*Bu'bon Galba'nu.* (For description, see text.)

at first hang on the two branches of a **Y**-like support, as shown in that of the Fennel (Fig. 64).

The **Y**-like *carpophore*, or "fruit-bearer," is formed out of the four margins of the two carpels which have met and united in the middle. Each half of the fruit is now called a *mericarp*, *i.e.* "divided fruit" (Fig. 63, IV.). A usual feature is the presence of five *primary* ridges on each mericarp, shown as slight elevations in *Bu'bon* (Fig. 63, IV.) and as points in the Hemlock (V.), but are much stronger in the Fennel (Fig. 64).

On some fruits there are four *secondary ridges* between the primary. They are prominent in the fruit of the carrot, in which they take the form of a row of spines like a comb (Fig. 65).

Some fruits have no ribs at all, being quite smooth all over.

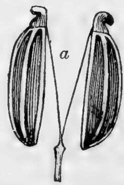


FIG. 64. — Fruit of the Fennel: *a*, carpophore.

The next point to notice is the presence of oil-sacs called *vittæ*. The usual number is six in each mericarp, four on the outer surface (Fig. 63, IV., *v*) and two on the inner or commissural surface (wanting in *Bu'bon*).

The seed fills up the ovary-cell, and consists of a mass of endosperm (IV., V., *a*). The embryo is embedded in it, but is not seen in the sections (IV., V.), as, unless this be made high up, the embryo is missed in cutting it across.

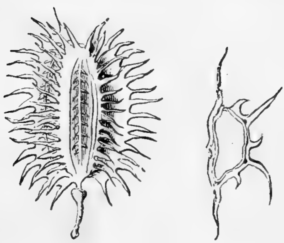
Hydrocot'yle.—This genus has seventeen species. Some have long, *linear, i.e.* narrow and grass-like, leaves; in others they are quite round or heart-shaped, or again *peltate*, the petiole supporting the blade in the middle like a round "shield." It differs from most members of the order in having its flowers in *sessile*—that is, stalkless, or "seated"—clusters, or as simple umbels. The fruits have no *vittæ*.

Sanic'ula.—*S. Europæ'a* has been introduced. It is a common weed in woods in Europe, and has its flowers in globular, simple umbels.

A'pium.—*A. grave'olens,* the wild celery, is another introduction from Europe.

Petroseli'num.—*P. sati'vum,* or parsley, is naturalized from Europe.

Fœnic'ulum.—*F. officina'le* (Fennel), well known by its finely divided leaves and strong scent, is naturalized in various places in the Colony.



I. II.

FIG. 65.—I. Fruit of Carrot. II. Transverse section of a mericarp.

Pastna'ca.—*P. sati'va* is the parsnip.

Dau'cus.—*D. Caro'ta* is the wild carrot (Fig. 65).

These last two mentioned are common wild flowers in England, with slender, spindly roots. The large garden roots were obtained by sowing the wild seed in a rich soil, and then by selecting the seed, year after year, from those plants which showed the largest roots. In about five years a permanent "race" was established. Thus the best parsnip in the English trade is known as the "Student." It was raised by the Professor of Botany at the Royal Agricultural College at Cirencester, between 1847 and 1851. It was issued to the trade, and has ever since been the best parsnip in England.

The carrot was "ennobled" in the same way, and was changed from an "annual" into a "biennial" by sowing the seed late in the season. This prevented it from flowering the same year. The leaves had therefore a season and a half to do work in, and so made more food (starch, sugar, etc.) than was wanted. The root had to enlarge in order to store it up. Then, by selecting seed, year after year, from the plants which flowered latest in the season, the permanent race was established, which, though sown in the spring, refuses to flower in the autumn of the same year, but makes large, fleshy roots instead.

Another interesting fact was discovered, and it applies to rape or turnip and radishes as well. If the seed be sown in a loose, sandy, or light soil, long, tapering roots are formed; but if in a stiff, cloggy soil, then there will be more of the stunted, globular roots produced.

Finally, by selecting seed from those of any particular shape, various races of long, round, truncated "horn" carrots have been established, and now "come true" by seed as garden races.

It should be borne in mind that though many members of the "umbellifers" are harmless, such as these kitchen vegetables, and others like dill and aniseed, several are very poisonous. Indeed, wild green celery is far from wholesome, and should be blanched by earthing it up, as the deleterious principle is not then developed.

Coni'um.—The hemlock, a common plant in England, of which there is one species in South Africa (*chærophylloi'des*), growing in the Eastern district, is very poisonous (Fig. 63, V.). The Greek philosopher, Socrates, was compelled to drink the juice of the hemlock.

Her'mas.—This has five South African species, of which *H. gigantea* has woolly leaves, and, known as "Tondel blaren," is used for tinder.

General Description of the Umbellifer Family.

Herbs.

Leaves—With sheathing petioles, simple or compound leaf-blades.

Inflorescence—Usually simple or compound umbels.

Flower—Sepals, as 5 minute teeth, or wanting; petals, 5, often with an inflected tip; stamens, 5, incurved in bud; pistil with 2 carpels; ovary, inferior, having 2 honey-discs above.

Fruit—A cremocarp of two mericarps, supported on a carpophore.

Corneæ.

The Hassagaywood Tree Family.

This is a small family of 12 genera and 75 species, represented in South Africa by one plant only.

Curtis'ia.—*C. fagin'ea,* the only species, occurs in forests throughout the Colony. It grows to forty feet in height, with a dark-coloured smooth bark. The leaves are *ovate, i.e.* broad towards the base, or "egg-shaped," and *dentate, i.e.* toothed along the margins. The flowers are small in terminal clusters.

The wood is described as solid,[1] very tough, heavy, and close-grained and durable, resembling mahogany, being very useful for waggons, etc.

The flower will be at once seen to have an *inferior* ovary and a *superior* calyx of four small triangular sepals. There are four petals, hairy outside and valvate in the bud, and four stamens.

The exposed part of the ovary at the top forms a honey-disc, from the middle of which rises the style with four stigmas.

The fruit is a *drupe*[2] with four cells, having one seed in each cell, the lining of which is stony.

DIVISION IV.—GAMOPETALÆ.

Rubiaceæ.

THE GARDENIA AND COFFEE FAMILY.

This order contains 4100 species of 337 genera in 25 tribes; but South Africa has only 25 genera. It

[1] This applies to many South African woods. It is due to the dryness of the climate.

[2] *I.e.* a "stone fruit" having a soft, fleshy exterior part and a hard, stony interior, as a peach or plum.

is a family mainly characteristic of tropical countries of both hemispheres; but one section of herbs, called *Stellatæ*, because the opposite leaves with intermediate leaf-like stipules make a whorl or "star-like" arrangement, is extra-tropical, and is represented in South Africa by two genera.

It is the first order to be considered which has the petals coherent into one piece. Hence the corolla is called *Gamopetalous*, giving the name to the *Division*.

Garde'nia.—Of the trees and shrubs which abound in this order this plant is a great favourite under cultivation, when it is often "double." The flower will be at once seen to have an inferior ovary. The corolla is trumpet- or funnel-shaped, with five or more petal-lobes. Stamens, as many as the petals, epipetalous, the rule with gamopetalous corollas, Heath, *Campanulaceæ* and *Plumba'go* affording exceptions.

The pistil is composed of two carpels, but the ovary is one-celled, as the two placentas do not meet in the middle, but remain parietal.

The fruit is a somewhat fleshy, inferior drupe, as it has a hard internal shell.

Of shrubs and trees of importance of this family are species of coffee, natives of Abyssinia and Liberia; the medicinal cinchonas of South America, supplying the invaluable drug "Quinine;" and the native "Peach" of Africa, which is the fruit of *Sarcoceph'alus esculen'tus.*

Hedyo'tis.—This genus consists of small herbaceous plants with a long-tubed corolla and a two-celled capsule. The parts of the flowers are usually in fours; and the two opposite leaves have small stipules between them. It supplies a sort of passage to the tribe *Stellatæ*, of which *Ru'bia*, which used to supply the red colour known as Madder, and *Ga'lium* belong; the first has its flowers usually in fives and the second in fours. *Ru'bia peregri'na*, the only English species, has been introduced into the Colony.

Ga'lium.—*G. Apari'ne*, which is now growing throughout the Colony, is an introduction from Europe. It is excessively common in England, clambering over hedges by means of its little hooks, and dispersing its fruit by their clinging to dogs, sheep, etc. The full details of the plant are given in the accompanying illustration.

The so-called leaves make a whorl of six to eight in number (Fig. 66), but only two are true leaves, of which one has the branch arising from its axil, and the other is exactly opposite to it. All the rest of the whorl are stipules. The reasons for saying so are, first, that all other members of the order, other than those of the tribe *Stellatæ*, have small and unmistakable stipules between the opposite leaves. Secondly, stipules never issue out of a stem in the same way as do leaves; and as this can be readily seen in *Ga'lium*, it may be explained here. If a stem be cut across just *above* a node, but as close as possible to the whorl, and again just *below* it, so as to cut out a thin slice carrying the whorl, and if it then be held up to the light, a circle of woody cords will be noticed surrounding the central pith.

A cord passes out of this circle into each of the two opposite leaves, but *not* so to the stipules. A

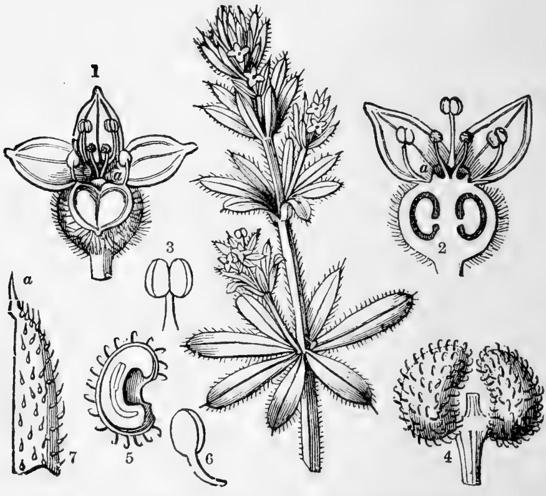


FIG. 66.—*Ga'lium* (Cleavers). (For description, see text.)

zone will be seen connecting the two leaves, *outside* the circle of woody cords. Then, the cords which enter the stipules, forming their middle lines, or mid-ribs, arise from this so-called "stipular arc," or zone. In all cases of stipulate, alternate leaves the fibro-vascular cords entering stipules arise from the outermost cords which enter the petiole of a leaf.

We will now examine the structure of the flower. (1) represents a complete flower; (1, 2, *a*) is the disc on the summit of the inferior ovary, which has two cells with one ovule in each. Unlike *Garde'nia*, the placentas are fused together and become *axile*. (3) is one of the four epipetalous stamens; (4) is a ripe fruit, consisting of two more or less globular halves (the two carpels) covered with hooked bristles; (5) is a vertical section of one of the carpels, showing the albuminous seed and curved embryo embedded in the endosperm; (6) is the embryo; (7) is half a leaf, showing the point at the apex. The calyx is wanting, or *obsolete*.

General Description of the Gardenia and Coffee Family.

Herbs, shrubs, or *trees.*

Leaves—Opposite, entire, stipulate; stipules leaf-like in the tribe *Stellatæ*.

Flowers—Regular; stamens, on the corolla tube; ovary, 2-celled, inferior.

Fruit—Various.

Compositæ.

The Composite Family.

This and the Grasses are probably the largest families of flowering plants in the world. It is supposed to contain some 12,000 species of nearly

770 genera in 13 tribes, scattered all over the world. In South Africa there are 153 genera.

The distinguishing features are in the flowers, called *florets*, from their minute size, being clustered into *heads*; but this alone is a not uncommon feature in other plants, as in *Bru'nia* (Fig. 60). But the five stamens, which are adherent to the tube of the corolla, always have their anthers coherent into a little cylinder, supported by the five free filaments. The style passes freely up the middle of it. This condition of the anthers is called *syngenesious*, a word meaning "grown together."

The heads of florets always have numerous imbricated bracts below them, collectively called an *involucre* (meaning a "wrapper"). In most of the composites there are two kinds of florets in a head, those forming the central *disk*, which have corollas with a small five-toothed limb, and the florets on the circumference, constituting the *ray*, with broad, strap-shaped, or *ligulate*, corollas. Sometimes the entire head is composed of one or other of these two kinds of florets.

Ger'bera.—Fig. 67, I. represents a head cut down through the middle, showing bracts of the involucre on the outside, the large ray florets at the back and the disk florets in front. (II.) is a separate disk floret. First notice the hairy inferior ovary. Upon it is the *pappus*, or ring of hairs surrounding the corolla. This is really in the place of the superior calyx; for in some plants the five sepals are well developed, as in

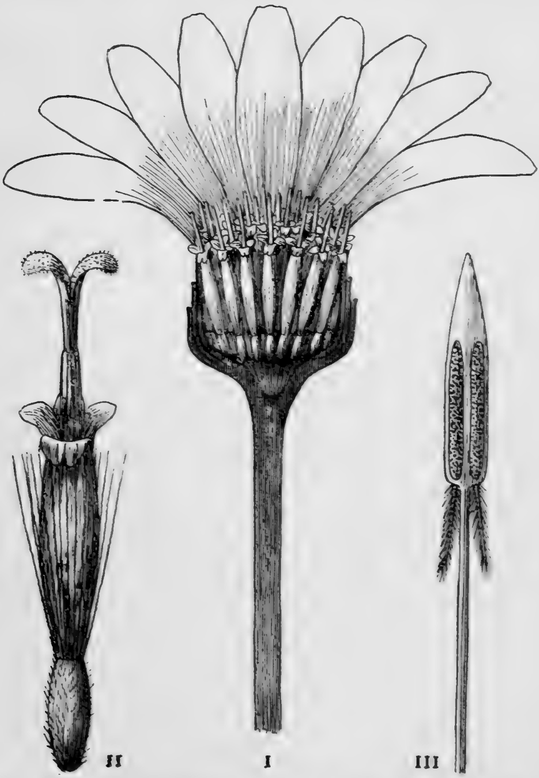


FIG. 67.—*Ger'bera asplenifo'lia.* I. Section through head. II. Disk floret. III. Stamen.

Spheno'gyne (Fig. 68), in which they form five large, obovate, milk-white scales.

The corolla is epigynous, gamopetalous, and has the five stamens adherent to it. The united anthers can be seen in Fig. 67, II., just above the corolla-lobes. The style, with its two spreading stigmas, protrudes above.

Each anther is provided with two tails (III.). Similar appendages to the anthers will be found in many Heaths. If we extract a ray floret, we shall find that a pistil is present but no stamens. The corolla has really only three petals, but is much larger than the five-pointed little corolla of a disk floret.

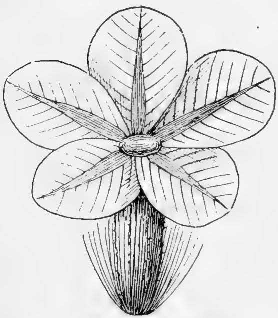


FIG. 68.—*Spheno'gyne anthemoi'des.* Achene with scaly pappus.

It seems that in changing from the latter into a ray floret, the stamens had to be sacrificed to allow for the enlargement of the corolla. Indeed, in some kinds the pistil goes too, so that the floret is said to be *neuter*.

In many garden flowers of this family the flowers have become "double," but this is not the same as the doubling of any ordinary flower, which consists, first, of the substitution of petals instead of stamens and carpels; and then, secondly, in greatly multiplying the number.

In all composites, the so-called doubling consists of the conversion of tubular florets of the disk into ligulate ones, like those of the ray.

In those composites, which have no ray at all, as

Athana'sia, of which genus there are forty species in South Africa (*A. parviflo'ra*, with clusters of flat-topped, yellow heads, is very common), all the florets have tubular corollas.

Sene'cio.—This is an enormous genus of about 900 species, some 180 being Cape plants. They vary in size from small herbs to trees. The flowers are yellow or purple. The involucre of the heads is one-seriate, often having the tips of the scales dark, with or without small *bractlets* at the base. The general receptacle is naked. The style-arms of the disk-florets are truncated. The pappus is of several series of *pilose*,[1] slender and roughish hairs. The name is from the Latin *senex*, "an old man," in reference to the white "down," or pappus, on the achenes. A genus, called *Klei'nia*, closely agrees in its flowers with *Sene'cio*, but has fleshy stems for storing water. There are eighteen Cape species.

One tribe, called *Cichoreæ*, after the genus *Cichor'ium*, which supplies us with Chicory, has all the florets ligulate, but they retain the five petals, as shown in Fig. 69, of the common Sow-thistle (*Son'chus olera'ceus*), introduced from Europe.

When the fruit is mature, it forms a one-seeded, inferior achene, with or without a pappus. This may be *sessile*, *i.e.* "seated," as in *Ger'bera* and *Son'chus*

[1] *I.e.* of simple hairs. If the hairs branch like a feather, the pappus is said to be *plumose* (Fig. 71).

(Figs. 67, II., 69), or it may be *stipitate*, or "stalked" (Figs. 70, 71). This means that the receptacular tube which clothes the ovary below, grows beyond and above it as the fruit ripens, and so elevates the pappus. It then spreads out horizontally, and aids, like a parachute, in conveying the fruit to a distance.

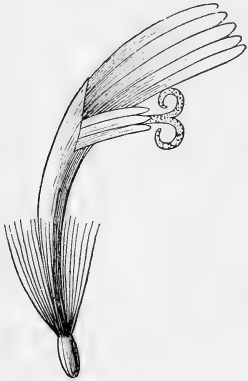


FIG. 69.—Floret of Sow-thistle.

FIG. 70.—Pilose stalked pappus of Dandelion.

FIG. 71. — Plumose sessile pappus of *Tragopo'gon.*

The method of securing pollination in the Composites is peculiar.

Of course the pollen is shed from the anther-cells into the tube formed by them. Fig. 67, III. shows the open anther-cells as seen from within. The "style-arms" are pressed together when inside the anther-tube, and by the growth of the style they push up the pollen, and by so doing bring it out at the top of the anther-tube. Then the style-arms separate, and insects, crawling over the head, get dusted with pollen, which finds its way on to the "stigmatic surface," on the upper surface of the style-arms; or else on those of other heads to which the pollen-carrying insect may fly.

Many florets manage to fertilize themselves. One way is to keep the stigmas within the tube, but slightly separating them there, so the pollen is applied directly to them. This can easily be seen in the Groundsel. Another way is for the style-arms to curl backwards, so that the tips are plunged into the pollen brought from below (Fig. 69).

As a rule, there are many florets in one head; but in the genus *Corym'bium,* of which there are seven species, the cylindrical involucre of very few bracts contains a single floret. They also have a curious silky root-stock with linear, grass-like leaves.

General Description of the Composite Family.

Herbs, shrubs, or *trees.*

Leaves—Various.

Flowers—In heads within an involucre of bracts.

Florets—With a superior pappus (calyx) or none; petals coherent, tubular, or ligulate, epigynous; stamens, 5, upon the corolla, filaments free, but anthers coherent (syngenesious).

Fruit—Inferior achene, with or without a pappus.

Campanulaceæ.

THE ROELLA AND LOBELIA FAMILY.

This order contains 1000 species of 53 genera in 3 tribes. In South Africa there are 20 genera. *Wahlenber'gia* has 46 species, and *Roel'la* 11, while *Lobe'lia* has nearly 30.

The genus *Campan'ula,* which gives the name to the order, is absent from South Africa, being widely dispersed in the northern hemisphere; but *Wahlenber'-gia* has only one species in England. Blue and white flowered Canterbury Bells (a species of *Campan'ula*) are cultivated in South African gardens.

Wahlenber'gia.—It will be readily seen in this or any other member of the family that the ovary is inferior, the sepals arising from the summit. Within them is the *gamopetalous* corolla, forming a tube generally bell-shaped, but sometimes spreading. The stamens arise from within it, but are *not adherent* to the corolla, a most unusual condition when the petals are coherent. The same occurs in the Heaths, but is very exceptional.

The bases of the stamens are broad, and all five together form a dome over the honey-secreting top of the ovary.

The capsules open by slits, holes, or pores in different genera. Thus, while in Campanulas they are at the base, in *Wahlenber'gia* they are at the top of the ovary, and by valves. *Roel'la* has no valves.

Lightfoot'ia.—The capsule of this has five valves, but the corolla is almost *polypetalous*, *i.e.* with the petals nearly free. There are twenty-five species.

Prismatocar'pus.—This has fourteen species, and its capsule splits from top to bottom.

Lobe'lia.—This is a large genus scattered over the world, twenty-six species being in South Africa. It differs from the preceding in having an irregular corolla (Fig. 72).

The method of pollination agrees with that described for Composites.

The calyx has five sepals, and is superior, the ovary being inferior. The corolla of five petals is *epigynous*, being "upon the ovary." The stamens are five in number (V.), coherent by their anthers, or syngenesious (III.). Some of the filaments usually cohere slightly to the corolla (II.). The style has a ring of hairs just below the two stigmas, which are pressed together at first (IV.). By the style elongating the hairs sweep the pollen upwards, and bring it out beyond the anthers, just as in Composites.

When the stigmas separate, they are ready to receive any pollen brought by insects from some other flower, as the pollen, being *behind* the stigmas, will not readily reach them, if at all. Hence, *Lobe'lia* is a regularly insect-fertilized flower.

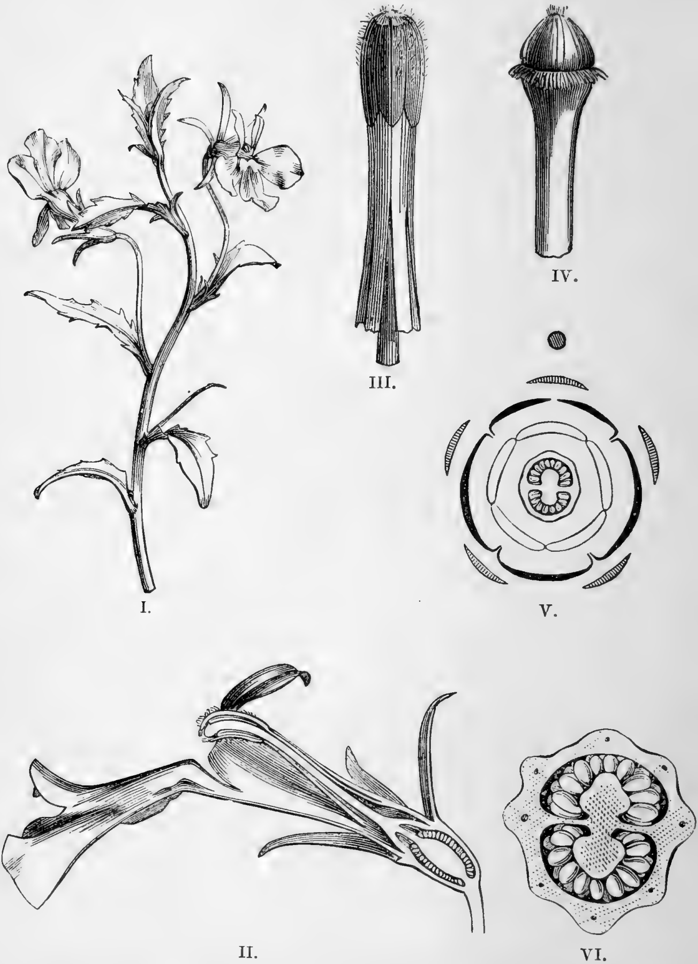


Fig. 72.—*Lobe'lia.* I. Flowering shoot. II. Vertical section of flower. III. Stamens with syngenesious anthers closed over stigmas in bud. IV. Style and adpressed stigmas from III. V. Diagram of flower. VI. Transverse section of fruit.

In (II.) and (III.) the anthers are in an early stage, and closed at the top by continuations of the connectives. (IV.) represents the early stage of the stigmas, which are adpressed together, and the fringe of hair below them, which sweeps out the pollen.

In (II.) the style and closed stigmas are seen within the anther-tube.

When the stigmas have escaped, they separate as in Composites, like a pair of ram's horns.

(V.) is a diagram. The spot represents the stem to show the posterior and anterior sides. The corolla is split on the posterior side. The pistil is composed of two carpels, with a large axile placenta bearing many ovules (VI.).

There are some twenty-five species in South Africa. *L. Erin'us*, with blue flowers and slender stems, as well as *L. lu'tea*, with yellow flowers, are common about the peninsula. The former is much "improved" by cultivation, and is grown as a "bedding-out" plant in England; both were introduced there about 1775. A tall one, growing about three feet, bright with scarlet flowers (*L. cardina'lis*), was introduced from Virginia in 1629. *L. infla'ta*, called "Indian tobacco," is used in medicine, but is a violent poison; indeed, all the Lobelias are probably more or less injurious.

General Description of the Roella and Lobelia Family.

Herbs—Often with a milky juice.

Leaves—Various.

Flowers—Sepals, 5, superior; petals, 5, coherent, regular, or irregular; stamens, 5, free or partly adherent to corolla, filaments with a broad base; anthers, free or coherent; ovary, 2 to 10-celled, inferior, with a honey-disc above.

Fruit—Capsule or berry.

Ericaceæ.

The Heath Family.

This order contains some 1000 species, divided into 5 tribes; but only one tribe is represented in South Africa, containing 10 genera, of which the Heaths are some 500 in number, and very characteristic of the dry climate of south-west districts. Indeed, the foliage is imitated by many other plants which do not belong to the family at all.

The tribe *Ericeæ* is divided into two sub-tribes—*Eucriceæ,* in which the ovary is four to eight-celled, there being two or more ovules in each cell, of which the true Heaths are the best example; the other sub-tribe is *Salaxideæ,* named after the genus *Salax'is,* in which the ovary is one- to four-celled and the cells one-ovuled.

Eri'ca.—Fig. 73 (1) is a flowering spray of the plant. (2) is a flower showing the four sepals (*a*) and the globular corolla with four small teeth or lobes. (3) shows the eight stamens, which are free and hypogynous, *not* being adherent to the corolla, as is the rule when this is gamopetalous. *Plumbago* affords another exception.

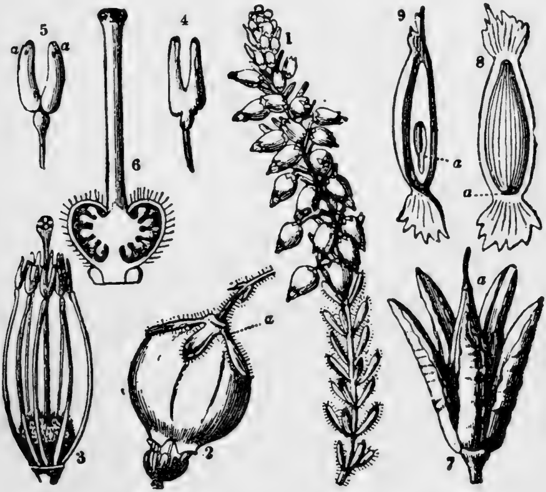


FIG. 73.—*Eri'ca* (Heath). (For description, see text.)

Each filament carries a purple anther, with two distinct lobes, shaped like the two prongs of a fork, and opening by a hole, or *pore* (5, *a*), at the summit (4 and 5 are back and front views). (6) is the pistil with the ovary cut through vertically, showing the central placenta, where the eight edges of the four carpels meet, carrying many ovules. (7) is a bursting, ripe capsule; the four valves break away from the central placenta (*a*). The countless seeds are very small, and often terminated by little crests or wings (8, 9). (9, *a*) is the embryo buried in endosperm. The two features particularly to be remembered are the *hypogynous stamens,* and *the anthers* dehiscing *by pores.* The anthers in many Heaths are provided with two little tails, as in *Ger'bera* (Fig. 67, III.); but they are wanting in the species here figured. The use of these appendages is regarded as connected with pollination, for at first the eight anthers are arranged close to the style (3), the pores pressing against it; but when an insect thrusts its proboscis down to the bottom (where the honey-disc or glands form a ring round the base of the ovary), it pushes its way between the "tails," and so dislocates the whole; the pollen then falls out of the pores upon its head. On entering another flower, the sticky, knob-like stigma strikes the head where the pollen was deposited. There is, however, much variety in the lengths of the filaments and position of anthers among the numerous South African species, since they have become specially adapted to several different species of insects.

Young botanists should make a point of observing what sort of insects visit flowers, and how they go to work to get the honey; and then notice how the flower is adapted to receive them.

General Description of the Heath Family.

Shrubs—Small.

Leaves—Exstipulate, evergreen, very often small.

Flowers—Sepals and petals, 4, coherent; stamens, 4, 8, *not* adherent to corolla, anthers with pores; ovary, free, and 1-, 2-, 4-, or 8-celled.

Fruit—Capsule.

Oleaceæ.

THE OLIVE FAMILY.

This order has 18 genera in 4 tribes, with 280 species altogether. The most important genera of the 4 in South Africa are the Olive and Jasmine. All the members of the order have opposite leaves.

O'lea.—This has about eight species in South Africa. The calyx is gamosepalous, with four *valvate* lobes to the limb, *i.e.* the edges meet but do not overlap. The stamens are two only, epipetalous; and the pistil has two carpels. The fruit is a drupe, with one seed. The olive is the species, *O. europæ'a*, which has purple drupes when ripe, the flesh being very oily, from which the oil is expressed.

Three species of South African *O'lea* supply wood suitable for cabinet-makers, waggons, etc.

Jas'minum (Jasmine, Fig. 74).—There are about six species in South Africa. The calyx and corolla have five- to eight-lobed limbs; the stamens, two (2); and the ovary two-celled (3). The fruit is a berry (4, 5).

The genus has about 100 species in number, spread over Asia, Africa, and Australia, with one in South Europe.

FIG. 74.—*Jas'minum* (Jasmine). (For description, see text.)

General Description of the Olive and Jasmine Family.

Trees or *shrubs*.

Leaves—Opposite, entire, simple, or compound.

Flowers—Sepals, 4, coherent; petals, 4, coherent; stamens, 2, adherent to corolla; pistil carpels, 2; ovary, 2-celled.

Fruit—Berry, drupe, capsule, or samara (a winged indehiscent fruit, as of the *Acridocar'pus* of Natal).

Primulaceæ.

The Primrose Family.

This order has 250 species of 21 genera in 5 tribes; but there is no representative of the genus *Prim'ula*, the Primrose, in South Africa, where there are only 3 genera.

Anagal'lis.—Pimpernel, or the poor man's weather-glass, so called because it only opens its flowers in bright sunshine.

It is an annual with opposite leaves and scarlet or blue-purple flowers. It has been introduced from Europe, but there are two or three native species as well in the Eastern district.

The calyx is almost polysepalous; the corolla is gamopetalous, with the five stamens adherent to it, but situated *in front* of the five lobes, instead of being alternate with them.

This is explained by the suppression of an outer whorl of five stamens. In *Sam'olus*, of which one species with small white flowers is common on muddy seashores, there are five staminodes *between* the lobes of the corolla, being rudiments indicating a lost whorl of stamens.

The fruit of *Anagal'lis* is a capsule which bursts by a *circumscissile* dehiscence, *i.e.* by splitting horizontally, the top falling off like a lid. The seeds all stand on a free, central placenta. There are really five carpels; and the way this central column appears to have been made, is by the carpels having their basal parts only growing up to form the column, no ovules being borne by the parietal margins, which are coherent to form the single chamber, as in the violet and poppy.

General Description of the Primrose Family.

Herbs.

Leaves—Opposite or alternate.

Flowers—Calyx and corolla, 4- to 5-lobed; stamens, 4 to 5 adherent *in front* of the petals; staminodes sometimes present; ovary, free, 1-celled, with free, central placenta.

Fruit—Capsule.

Asclepiadeæ.

The Stapelia Family.

This order contains some 1300 species of 146 genera in 7 tribes, scattered over the warmer regions of both hemispheres; but especially abundant in South Africa, where it has 48 genera, of which *Stapelia* has about 90 species.

Many of the genera are stem-climbing plants. This is done by all stem-climbers in much the same way. The shoot continues to circumnutate, and as it lengthens the tip describes a wide circle, and so comes in contact with some plant. By continuing "to bow around," it twists itself spirally round the support.

Several genera of this family, as well as of another to be described hereafter (*Euphorbiaceæ*), are specially adapted to live in the dry climate of South and West Africa, by having acquired a thick, fleshy stem, in which much gummy or milky fluid is stored up. The surface forms a tough, rind-like covering which prevents the loss of water by transpiration.

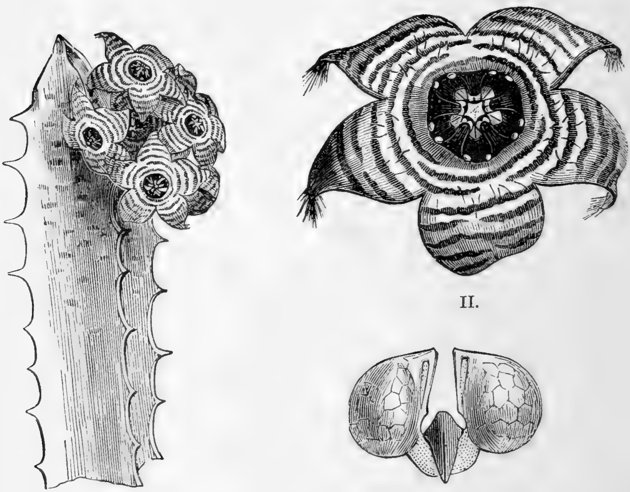
As the climate of Mexico is of a similar nature, plants of a quite different family, *Cactaceæ*, put on a similar external appearance. Thus, stems of some members of this family are just like those of *Stapelia* (Fig. 75, I.), as also of *Euphorbia*, being thick, many-angled, fleshy, and leafless, the leaves being replaced by spines.

The fact is that this peculiar form of stem of both *Cac'tus* and *Stape'lia* and others, is the actual result of living under similarly arid conditions of the localities where they grow. The plants *respond* to the external influences; and in the course of several generations form the remarkable structures which become a permanently fixed feature.

Stape'lia (Fig. 75).—The flowers of all members of this order are somewhat difficult to understand; but the beginner must look for the following details carefully :—

The calyx has five sepals, gamosepalous ; the corolla is gamopetalous (II.), with honey-glands at the base of the lobes.

There is a sort of double *corona*,[1] as the petals carry five deeply lobed appendages, together with five



I. II. III.

Fig. 75.—*Stape'lia.* I. Stem and flowers. II. Flower. III. Pollen mass.

interior scales, adherent to the base of the anthers, and prolonged into horn-like structures.

It has often a very disagreeable odour, which is deceptive to flies, who lay their eggs upon it, apparently

[1] This term is used for a fringe or separate appendages round the mouth of the tube of a corolla, etc.

under the impression that it is carrion; but the eggs never hatch.

The stamens are five in number, fixed to the base of the corolla, the filaments being in contact, if not actually united. The anthers lie upon or are partly immersed in the large pentangular stigmas, upon which are five usually dark-coloured bodies over the space *between* the anthers.

The pollen grains, instead of being a loose powder, as in most flowers, form a wax-like, solid mass, by being all united together in each anther-cell. Then the *pollen masses* of two adjacent cells, *i.e.* belonging to *different* stamens, become united by a secretion which hardens into an arch-like structure (III.), fixed to *corpuscles*, or "little bodies," on the stigmas, and having the above-mentioned structure, it thus enables an insect to lift the two masses out together. Then, on entering another flower, the masses are pushed up against the stigma lying in the depression between the anthers. There are five of these "stigmatic surfaces," though the pistil, having only two carpels, should have but two stigmas, if they were not so peculiarly modified to form a great five-angled summit. This ultimately falls off, and the two carpels become free follicles, not having cohered at all below.

The seeds have a silky tuft of hairs, which spread out as the carpels burst; so that they push one another out, and then can be wafted away by the wind.

General Description of the Stapelia Family.

Herbs—Some climbing, many with milky juice; many leafless with succulent stems.

Leaves—Opposite, entire, in some represented by short spines.

Flowers—Calyx, 5-parted; corolla, 5-lobed, with a corona of various forms; stamens, 5, adherent to corolla, filaments coherent; anthers with pollen masses, fixed to corpuscles on the stigmas.

Fruit—Two follicles.

Gentianeæ.

The Chironia Family.

This order contains 520 species of 49 genera in 4 tribes. In South Africa there are 9 genera only. The genus *Gentia'na* embraces a very great number of species with yellow, red, and blue flowers on the Alps of Switzerland; one of which (*G. lu'tea*) supplies the bitter root used in medicine. There are several species in England, but Gentians are not known in the southern hemisphere.

Chiro'nia.—This is a genus, confined to South Africa, having red or purplish flowers. The leaves are opposite. The gamosepalous calyx has five lobes. The corolla is gamosepalous, and also has five lobes contorted or twisted up in bud; and as it remains on when withered, it is said to be *marcescent.* The stamens are epipetalous, alternate with the lobes of the corolla, the pistil having usually two carpels. The fruit is a capsule. They are all perennial herbs or half-shrubs, forming profusely flowering tufts with rose-red, handsome blossoms.

One tribe contains aquatic plants of two genera, with alternate leaves, viz. *Villar'sia* and *Limnan'themum.* The first has ovate leaves on long petioles, and bears groups of yellow flowers. The only species is *V. ova'ta,* common throughout the Colony. *Limnan'themum* has two species; they have *cordate, i.e.* heart-shaped or else peltate, leaves, resembling a miniature leaf of the water-lily. The flowers are yellow. Both species are in the Eastern districts. This round form of leaf occurs in some aquatic plants in both Dicotyledons and Monocotyledons. From mathematical calculations, it has been found to be the best form for resisting the strains caused by running water, so as not to rupture the leaves. The commoner method is to subdivide the blades into fine threads, which then can lie in the direction of the running water, as described under *Ranun'culus.*

General Description of the Chironia and Gentian Family.

Herbs—With a bitter juice.

Leaves—Opposite or alternate.

Flowers—Sepals, 5, persistent; corolla, regular, petals coherent, and withering on; stamens adherent to corolla; ovary, 1-celled with opposite placentas.

Fruit—Capsule.

Convolvulaceæ.

The Convolvulus Family.

This family is largely made up of climbing herbs. There are about 800 species of 32 genera in 5 tribes. In South Africa there are 11 genera.

Some have a milky juice, and one yields a drug known as "Jalap," as it comes from the town Xalapa in Mexico. Another from South Europe is also medicinal under the name of "Scammony."

The sweet potato is the underground stem of a species of Batatas, a name which became corrupted into "potato" in the sixteenth century. The Natal cotton-plant is another species of this genus, the seeds being covered with long hairs, as the seeds of the true cotton-plant (*Gossyp'ium*) are. Most of the members of this family climb by their stems, but some species living out in hot desert-land are little woody, shrub-like plants, without any climbing powers at all, while closely allied ones may be found climbing in forests, etc. This has suggested a probable origin of this habit. Where plants grow under shade they get "drawn," as gardeners say;

and bowing around as they grow, they have become climbers by twisting about other plants, till the habit became a fixed feature.

It can be held in abeyance, for French beans, like scarlet-runner beans, climb by their stems. Yet dwarf

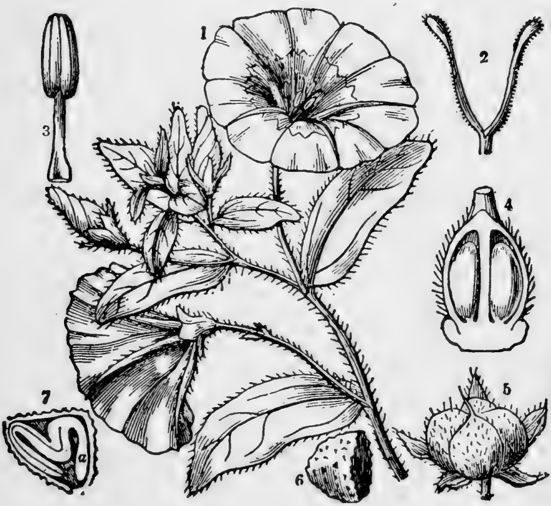


FIG. 76.—*Ipomæ'a.*

non-climbing beans have been established. They will, however, occasionally *revert* to the habit of climbing.

Ipomæ'a.—Fig. 76 gives the details of a species of *Ipomæ'a,* of which there are several dispersed through the Colony.

The calyx of five sepals is gamosepalous but deeply divided (1 and 5). The corolla is spirally twisted up in bud (1). There are five stamens (3), as usual, epipetalous. The pistil is composed of two carpels (2, 4, 5), the ovary being two- or four-celled (4) with two ovules in each, as seen in the ripe fruit (5). The style ends with two long stigmas (2); or in some species the stigma is globular. (6) is a seed. (7) is a seed cut through to show the embryo with large leaf-like, folded cotyledons within the endosperm; (*a*) is the radicle.

Cus'cuta.—This genus, known as "Dodder" in England, has several species at the Cape, and is entirely *parasitic*—that is, after having attached itself by suckers on to a "host-plant," it derives all its nourishment from, and not infrequently kills it. It forms entangled masses of yellow and red thread-like stems over herbs and bushes. It has no leaves, but dense clusters of minute flowers, white or pinkish. The little globose corolla is provided with toothed scales within it. It has a capsular fruit, the seeds being very minute, with a coiled-up, rod-like embryo, without cotyledons. This germinates in the soil, and as soon as the little stem can catch hold of anything, it coils round it, and makes suckers at various points in contact with the host. Through the middle of a sucker a root penetrates, and so fixes the parasite on to the host-plant. It soon loses all connection with the soil.

We shall see under the order *Thymeleæ* how another plant can closely imitate the *Cus'cuta* as far as its parasitic, thread-like stem is concerned; but the flowers are quite different, showing how the vegetative parts of plants acquire similar forms under like conditions, as explained of *Stape'lia* (Fig. 90, p. 227).

General Description of the Convolvulus Family.

Herbs—Mostly climbing by the stem, parasitic in *Cus'cuta.*

Leaves—Various, wanting in *Cus'cuta.*

Flowers—Mostly large, handsome, parts in fives; corolla funnel or bell-shaped, petals twisted in bud; stamens adherent to corolla; ovary, 2- or 4-celled, with honey-disc below.

Fruit—Capsule.

Solanaceæ.

The Potato Family.

This order contains some 1250 species of 65 genera in 5 tribes. In South Africa there are 8 genera.

Many of this family are poisonous, as the thorn-apple, *Datu'ra Stramo'nium*, easily known by its long, tubular white flowers and prickly capsules, which is a naturalized weed at the Cape.

The Tobacco plant, Henbane, and Deadly Nightshade are useful plants for medicine, but are all dangerous herbs. The Mandrake, which was supposed to shriek when torn out of the ground, but of which the root was a charm against evil spirits, is a species allied to the Deadly Nightshade. But of all plants the Potato is the most useful. Even this is not harmless in the *green* state; and tubers should never be allowed to be exposed to the sun when growing, for that reason. It is a native of South America, and in the wild state produces tubers about one inch in diameter. The chief use of this vegetable is on account of the large amount of starch which it contains, some 15 per cent. Water amounts to about 75 per cent., and the most nutritious (nitrogenous) ingredient only 2 per cent.; whereas this, which supplies muscle, bone, and brain-forming matter, amounts to over 20 per cent. in beans, peas, and lentils of the *leguminous* family. Hence potatoes are an excellent accompaniment to meat, but taken *alone*, would furnish a very poor diet indeed.

Sola'num. — There are thirty-three Cape species. The illustration (Fig. 77) is that of *S. ni'grum*, a common weed in English cultivated gardens, which is found not only widely dispersed by man, but wild in the most out-of-the-way places, as the Galapagos Islands, two hundred miles off the west coast of South America.

The inflorescence has the peculiarity of rising midway between the leaves on the stem. (1) is the corolla laid open to show the adherent stamens; the anthers, (*a*), open by pores, as in Heaths. (2+) represents the calyx and pistil only; (2++) is a transverse section of an ovary with the much-enlarged axile placentas carrying numerous ovules; (3) is a cluster of berries; (4) and (5) are seeds, (5) a seed cut vertically, showing the coiled cotyledons of the embryo included within the endosperm.

The edible potato was introduced by Sir Walter Raleigh into Europe in the sixteenth century. It is

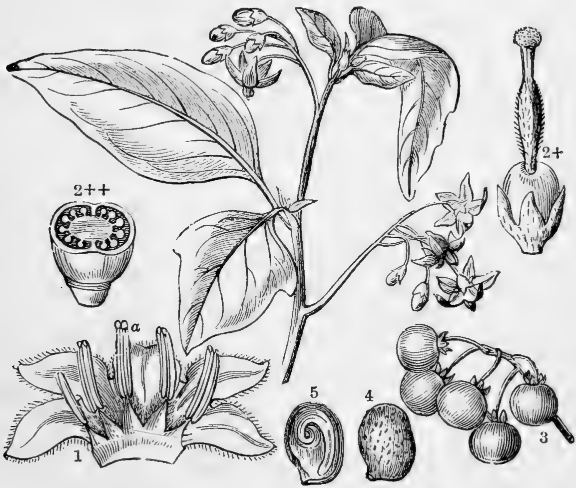


FIG. 77.—*Sola'num.* (For description, see text.)

known as *S. tubero'sum*, or perhaps *S. Mag'lia* is the original species. It is unfortunately liable to be attacked by a parasitic fungus, which sometimes will ruin whole crops. A great deal of the starch, however, can be saved, for the starch is easily extracted by grating the tuber and washing the pulp in cold water through a sieve. It is often made into an imitation of sago.

S. Sodomæ'um is a common wayside species about Cape Town, recognizable by its thorny leaves, purple flowers, and yellow "apples." It is an introduction from the north.

Physa'lis.—This is best known by the species *P. Peruvia'na*, the "Cape Gooseberry," which is naturalized throughout the Colony.

Lyc'ium.—The species of this genus are small trees, which are often spiny. They have rather small flowers, the corolla being funnel-shaped, the anthers open by longitudinal slits in the usual way. The fruit is a berry. They are grown as hedge-plants, etc.

General Description of the Potato Family.

Herbs, shrubs, or *trees*—Often with a poisonous juice.

Leaves—Various, alternate.

Flowers—Regular, bell-shaped, or rotate, *i.e.* "wheel-like;" whorls in fives; pistil of 2 carpels.

Fruit—Capsule or berry.

Scrophularineæ.

The Nemesia and Harveya Family.

This large order contains 1900 species of nearly 160 genera in 12 tribes. In South Africa there are 42 genera in 10 tribes.

The order consists of herbs, shrubs, and trees.

Several species are cultivated in gardens, as the Snapdragon (*Antirrhi'num*), a native of South Europe, and the Foxglove (*Digita'lis*), wild in England. On the other hand, species of South African *Neme'sia* are grown in England.

The corolla is always irregular, very often *ringent*, or gaping widely, as of *Harveya*; as well as *personate*, with a closed mouth, as of the Snapdragon and *Lina'ria*. It is sometimes *rotate*, *i.e.* flat and "wheel-like," as of *Veron'ica*.

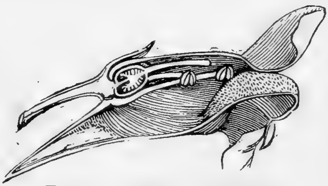


Fig. 78.—*Lina'ria* (Toad-flax).

The number of stamens is usually four, of which one pair has longer filaments than the other pair. The fifth stamen is almost always suppressed, but would lie between the posterior pair.

The stamens are said to be *didynamous* (*i.e.* "two in power"), because two are longer than the other two.

The pistil is, in this order, always composed of two carpels, one behind the other, the ovary having a large central, or *axile*, placenta bearing many ovules.

Fig. 78 represents a flower of the Toad-flax (*Lina'ria*), showing the "lip" pressed against the posterior petals, thus closing the "mouth," and making the flower to be *personate*, *i.e.* "mask-like."

The longer stamens will be seen to arise from the anterior side of the corolla, an almost invariable rule with irregular flowers, such as this is.

The section cuts the two cells of the ovary from back to front, showing the invariable position of the cells, one being posterior and the other anterior.

The front petal is prolonged into a spur into which the honey passes, being secreted by a disc at the base of the ovary. This is one of the flowers from which bees often extract the honey by "burglary," for instead of entering it in the legitimate way by the mouth, they bore a hole through the corolla at the base, and so get it with less trouble; but of course no pollination is effected by them. Smaller bees, etc., which are not strong enough to cut a hole, take advantage of the stronger sorts, and so get the honey through the hole which their predecessors have made.

The corolla of the Snapdragon only differs from that of *Lina'ria* in having a "pouch" instead of a "spur;" but the way the capsules burst is different. In the former the posterior cell has *one* pore and the *anterior two;* but there is one to each in the *Lina'ria.*

Neme'sia.—This has a five-parted calyx, a personate corolla, which may be yellow, white, violet, or parti-coloured, the upper lip being four-cleft, and the throat prolonged into a pouch or spur. The two longer stamens curve round at the base and clasp the upper ones. The anthers are one-celled, somewhat cohering in pairs. When the capsule bursts, the two carpels separate from each other. There are nearly twenty species in South Africa, and the genus does not appear to be known elsewhere.

Halle'ria.—This genus has three species in South Africa. They are smooth-leaved shrubs with red flowers.

Fig. 79 (I. to IV.) shows the flower to have a nearly regular corolla (I.), but the stamens are still

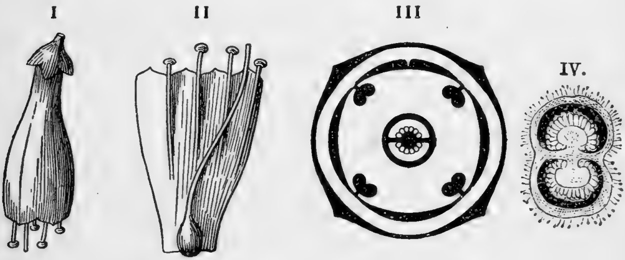


FIG. 79.—*Halle'ria.*

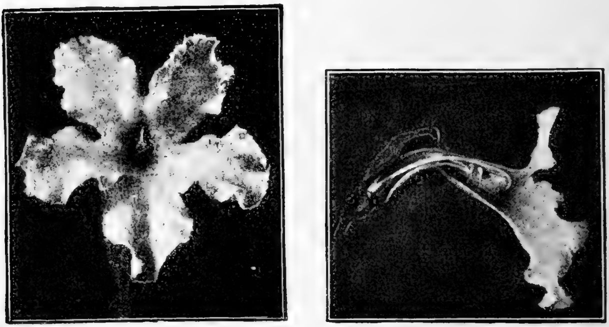
in two pairs of different lengths (II.). The diagram (III.) gives the relative positions of the parts of the four floral whorls. The "lip" (or usually enlarged front petal) is the one in front, while the "hood" (wanting in *Halle'ria*) will be seen to be made of two. (IV.) illustrates very well the two ovary cells and large placentas covered with ovules.

One species (*H. lu'cida*), called the "White Olive," has a fine-grained wood.

Harvey'a.—This is a very handsome flowering parasite, with a large white or rosy, ringent corolla, as seen in Fig. 80.

There are twelve South African species. The genus is named after Dr. Harvey, the great South African botanist, who commenced the *Flora Capensis,* now being completed at Kew.

When the root comes in contact with that of the



I. II.

FIG. 80.—*Harvey'a.*

host-plant, it swells by the growth of tissue beneath the epidermis, or skin, while this last also begins to grow at the spot, forming a sort of sucker. It then sends out a kind of root, which penetrates down into the root of the host, and becomes thoroughly engrafted upon it.

It is thus able to extract nourishment, and may in time kill its host. The process of parasitism has a degenerating effect upon the parasite, for, not requiring to make its own food out of carbonic acid gas (as described in the Introduction), it gradually loses the power to do so, these green-leaved parasites being in this condition. After many generations, it loses it altogether, and at the same time the *chlorophyll*, or green matter, ceases to be made, when all power to decompose carbonic acid is gone, and the parasite becomes white or tinted with yellow, red, etc., but *not* green.

General Description of the Nemesia Family.

Herbs, shrubs, or *trees.*

Leaves—Simple, opposite or alternate.

Flowers—Sepals, 4 or 5, free or coherent; petals, 4 or 5; corolla, irregular, forms, various; stamens, 4, didynamous or 2; ovary, 2-celled, with a terminal style.

Fruit—Capsule, with many seeds in each cell.

Lentibularineæ.

THE BLADDERWORT FAMILY.

This order only contains 4 genera, widely dispersed over the warmer and temperate regions of both worlds. Many are remarkable for catching living animals and deriving nourishment from them, but by a different method from that described under the Sundew (*Droseraceæ*).

In South Africa two genera only occur, *Utricula'ria*, the Bladderwort, and *Genlis'ea*. The Butterworts (*Pinguic'ula*) abound in the northern hemisphere. They have got the English name of "Butterwort" for a peculiar property of curdling milk. It is said the Laplanders use the leaves for that purpose in preparing the milk of reindeer. Their oval, spoon-like leaves are covered with glands, which secrete fluids much in the same way as described in *Dros'era*, but are immovable.

Utricula'ria.—The species are either aquatic and submerged plants, with finely divided leaves (as described under *Ranun'culus aquat'ilis*), provided with "traps," or else they are marsh plants, with entire narrow leaves without the bladder-like traps. The late Mr. Darwin has given us an elaborate account of the structure of the traps in both these genera, as well as of *Dros'era*.[1]

In *Utricula'ria* the bladder-like traps, which suggested both the Latin and English names, are little oval or pear-shaped hollow bodies on short stalks. They can be opened at one end only, but are usually closed by a flap. A minute water creature lifts up the flap, in its investigations in search of food, and so enters the bag-like trap. The flap instantly falls down on its rest, and the creature cannot escape. It soon dies, and when it decays, club-shaped cells projecting inward from the inner surface of the wall of the trap,

[1] "Insectivorous Plants."

generally grouped in fours, have the power to absorb the animal juices, and carry the nourishment to the interior of the plant. Various details are here passed over, as the student, it is hoped, will be able some day to read Darwin's account in full.

With regard to the flower, the calyx is two-lobed; the corolla is personate and spurred. There are only two stamens, and the syncarpous pistil is composed of two carpels.

Genlis'ea.—*G. Africa'na*, the only South African species, has a very different leaf from that of the other genera. The lower part has a long tube enlarged at one place into an oval bladder. At the upper end of the tube, where it opens above by a slit, are two spiral arms. The tube is lined with many rows of stiff hairs pointing downwards, which Darwin compared to a paper of rows of pins rolled into a tube. Among these are both four- and two-celled absorbing processes, as in the Bladderworts. Insects crawl down the tube, and the hairs completely prevent them escaping backwards. After their death, all nourishment capable of being absorbed is taken into the plant by means of the glands.

With regard to the flower, this has a five-parted calyx; the corolla is personate, the lower lip being three-lobed with a spur at the base. The flowers are yellow or violet. There are only two epipetalous stamens.

The structure of the flower thus shows its agreement with *Utricula'ria*, but the foliage is very different, having become modified in a different way, though both genera have doubtless descended from some common ancestor.

General Description of the Bladderwort Family.

Herbs—Marsh or aquatic plants.

Leaves—Crowded on the ground or submerged and dissected, often with traps or glands for securing insect prey, etc.

Flowers—Sepals, 2- or 5-parted; corolla, 2-lipped, spurred or pouched; stamens, 2, adherent to the corolla; anthers, 1-celled; ovary, 1-celled.

Fruit—Capsule.

Acanthaceæ.

The Acanthus Family.

This is a large order, mainly in the hot regions of the world, becoming scarcer in the cooler, temperate regions of both north and south hemispheres. There are in all about 1350 species of 120 genera in 5 tribes. South Africa has 23 genera.

Justic'ia.—Taking this as a type, the species are herbs and shrubs, often with handsome flowers, many being cultivated. The calyx is five-parted. The corolla-tube is short, and two-lipped. There are only two stamens, projecting forwards. There are about twenty species, chiefly Eastern.

Duvernoi'a.—*D. Adhatodoi'des* is a Natal shrub often cultivated, and illustrates how the corolla has become perfectly adapted to bear the weight of the large bee which visits it, as will be seen by the accompanying illustration.[1]

I. II.

FIG. 80A.—*Duvernoi'a.* I. Flower. II. Ditto with bee.

Looking at (I.) above (supposing we know nothing of insect visitors), one might ask—For what use is this great irregularity of the corolla? Why and how has it come into existence? And no answer is forthcoming. Now, turning to (II.), we at once see a use. The weight of the bee must be very great; and the curious shape of the lip with its side ridges is evidently

[1] From a paper by Mrs. Barber, *Journ. Lin. Soc.*, vol. xi. p. 467.

not only an excellent landing-place, but is so constructed as to bear that weight. Moreover, the two walls slope off, and are gripped by the legs of the bee, so that it can evidently secure an excellent purchase, and can then rifle the flower of its treasures at its ease; as has been more fully described on page 25.

Hypoes'tes.—This has only two species in the Eastern districts and Natal; but there are some forty in all scattered round the Indian Ocean, from South Africa, Madagascar, East Indies, China, Malay Archipelago, and Australia, showing, as several other plants do, a former land connection, across which plants came from India, etc., to South Africa.

The genus *Acan'thus*, which gives the name to the family, has one species in South Europe. Its leaves are large and "incised," or cut down with pointed segments. It suggested the form of the capital in the Corinthian style of pillars.

General Description of the Acanthus Family.

Herbs or *shrubs* (chiefly tropical).

Leaves—Opposite.

Flowers—Calyx, 4- to 5-parted, persistent; corolla, irregular, 2-labiate; stamens, 4, didynamous or 2, with staminodes; ovary, 2-celled, with a honey-disc.

Fruit—Capsule, with 2 or few seeds in each cell.

Verbenaceæ.

The Verbena Family.

There are three families, according to some botanists, agreeing very closely in many respects, which others group together as sub-orders, or tribes, of the above-named. As this is so in Dr. Harvey's "Genera of South African Plants," I will follow his arrangement.

The first sub-order is *Verbeneæ,* containing the long-cultivated *Verbe'na,* from South America, as well as *Cleroden'dron, Lanta'na, Vi'tex,* etc., of which there are species in South Africa.

The second sub-order is *Stilbeæ,* from the genus *Stil'be,* in South Africa, with one other genus.

The third sub-order is *Selagineæ,* containing eight genera, of which five are entirely in South Africa.[1]

Verbe'na is chiefly South American, but *V. Bonarien'sis,* with dense clusters of small purple flowers, and *V. officina'lis,* a tall, wiry, branching herb, of European origin, are naturalized at the Cape.

The calyx is five-parted, the corolla being tubular with an irregular border; the stamens are four, didynamous. The pistil is composed of two carpels, the ovary being four-celled (by the two carpels being

[1] Bentham and Hooker, in their "Genera Plantarum," regard *Verbeneæ* and *Stilbeæ* as 2 out of 8 tribes of *Verbenaceæ, Selagineæ* being a separate order. *Verbenaceæ* has 700 species of 59 genera; *Selagineæ* has 140 species of 8 genera.

deeply lobed), forming four *nutlets* in fruit. The style arises from the *top* of the ovary, not from the *base*, as in the *Labiates*, which have a very similar pistil and fruit.

Stil'be.—This genus consists of heath-like shrubs (Fig. 81). The calyx is five-parted, with equal lobes, hairy without and valvate in bud. The corolla has five scarcely unequal lobes (II.). The stamens are four, with a rudiment of the posterior one—not represented in the diagram (II., III., IV.)—and are equal, or very nearly so, in length.

The pistil has two carpels, the posterior one being abortive, as shown in the diagram (IV.) and (VI.).

The fruit is a one-seeded capsule, one ovary-cell being empty (VII.).

The regularity of the outer whorls shows that this flower is indicative of a more ancestral type than those genera with irregular corollas.

Sela'go (Fig. 82).—This is a large South African genus, having some seventy species, one being called *Aarbschje*. They consist of herbs or under-shrubs with small leaves, due to drought. The flowers are in heads, or *spikes*, *i.e.* sessile along the peduncle, as in the figure (I.). The calyx is cleft more or less deeply. The corolla (II.) is irregular (III. laid open). The four stamens are didynamous (II.). The two anther-cells are fused into one at an early stage (IV.). The pistil has two carpels, the ovary-cells (V.) having one ovule

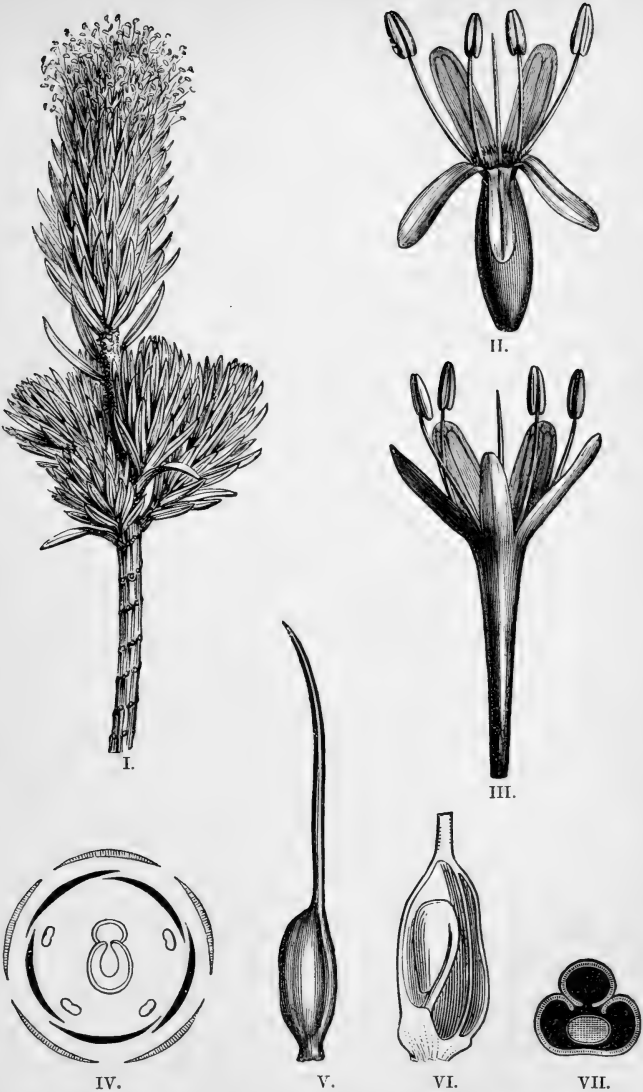


FIG. 81.—*Stil'be.* I. Flowering shoot. II. Flower. III. Ditto, calyx removed. IV. Diagram. V. Pistil. VI. Vertical section of ovary, showing abortive cell and single ovule. VII. Transverse section of ovary.

in each cell (omitted in diagram V.). When ripe, the carpels are easily separated.

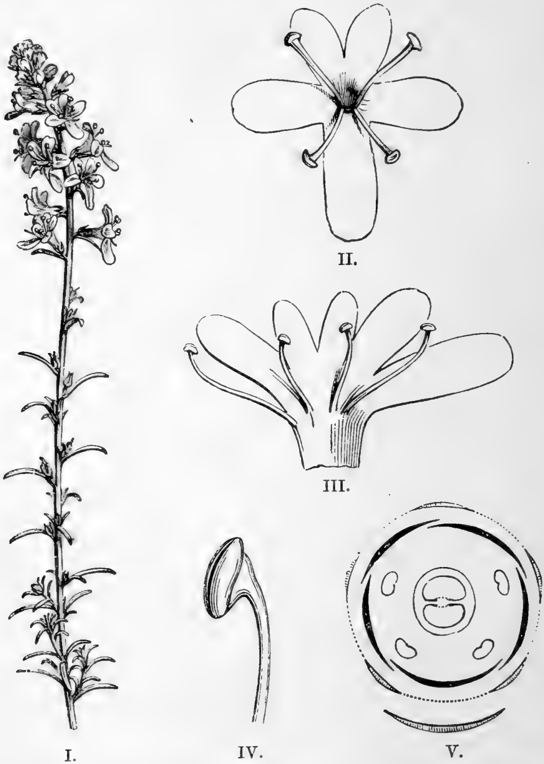


FIG. 82.—*Sela'go.* I. Flowering shoot. II. Flower. III. Corolla and stamens laid open. IV. Stamen. V. Diagram.

General Description of the Verbena Family.

Herbs, shrubs, and *trees.*

Leaves—Opposite or alternate.

Flowers—Calyx, 5-parted; corolla, more or less labiate; stamens, 4, didynamous; ovary, free, 2- to 4-celled.

Fruit—Separating into 4 nutlets, 2-parted (*Scla'go*), or juicy.

Plumbagineæ.

The Plumbago Family.

This order contains 200 species of only 8 genera in 2 tribes, represented in South Africa by 2 genera in one, and 1 genus in the other tribe.

Plumba'go.—*P. Capen'sis* is familiar to all for its blue flowers, and by being so often grown as hedges, etc.

The calyx is tubular, having glandular hairs (Fig. 83, II.), the corolla-tube being much elongated. The stamens, as in Heaths, are hypogynous, and *not* adherent to the corolla-tube (II., III.). The ovary is one-celled (IV.), but the five free stigmas indicate the presence of five carpels (III.). There are five honey-glands on the receptacle (III.). (IV.) is the diagram of the flower. The single ovule is suspended on a long cord (II.), called the *funicle,* or "little cord," as the word means. The *micropyle,* or orifice, to the ovule is at the top, and a sort of plug comes down from the style, bringing the pollen-tube with it directly into the micropyle.

Stat'ice—This genus represents the other tribe in

South Africa. The English species is called Sea-

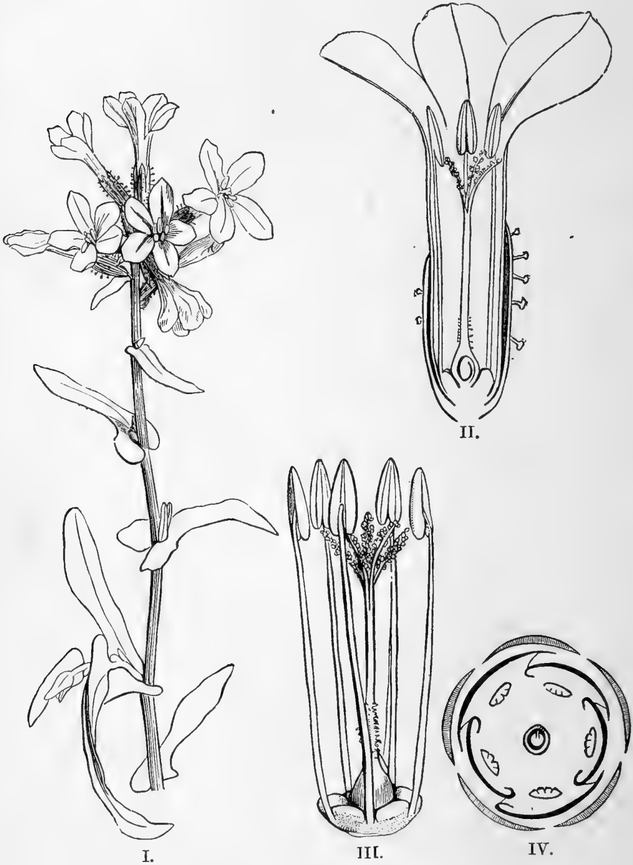


FIG. 83.—*Plumba'go.* I. Flowering shoot. II. Vertical section of flower. III. Stamens, pistil, and honey-glands. IV. Diagram.

lavender, as it grows in salt marshes. The calyx is peculiar in being scarious and petaloid, *i.e.* coloured like a corolla. The petals, unlike those of *Plumba'go*, are generally quite free or polypetalous, when the stamens are epipetalous in being adherent to the claws of the petals.

Many species are cultivated on account of their brightly coloured calyx, and though the flowers are small, they are massed together in clusters.

General Description of the Plumbago Family.

Herbs or *half shrubs*—Some maritime.

Leaves—Various, sometimes tufted (*Stat'ice*).

Flowers—Calyx, persistent; corolla, regular and tubular, or of 5 free petals; stamens, 5, *in front of* the petals, *free* from corolla when tubular, but *adherent* to the free petals (*Stat'ice*).

Fruit—A capsule; indehiscent (*Stat'ice*).

Boragineæ.

The Heliotrope Family.

This order contains 1200 species of about 70 genera in 4 tribes, widely dispersed over the globe. In South Africa there are 14 genera, of which two are cultivated, the Heliotrope (*Heliotro'pium*) and Forget-me-not (*Myoso'tis*). The flowers are nearly always regular, the whorls (excepting the pistil of 2 carpels) being in fives.

E'chium, called Viper's Bugloss in England, is irregular, with declinate stamens. The foliage is often very rough, with stiff hairs arising from a thick base.

Anchu'sa.—This genus has two or three South African species. The one figured, called *Alkanet*, is used for a purple dye.

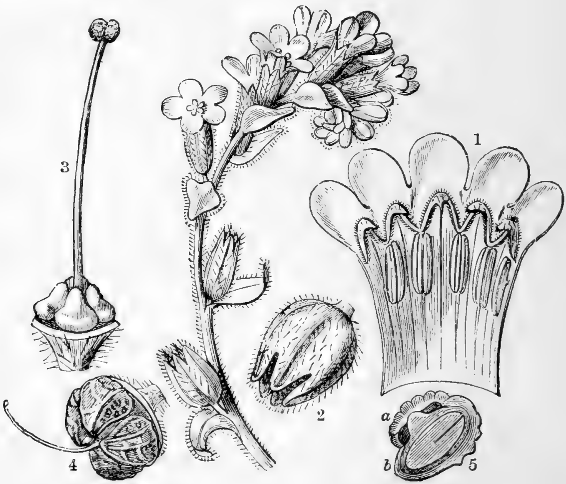


FIG. 84.—*Anchu'sa* (Alkanet). (For description, see text.)

The inflorescence (Fig. 84) is characteristic of the family. It is a *scorpioid* or coiled peduncle on which are two rows of flower-buds; as these open, they become separated, and the stalk continues to elongate and straighten itself. As a rule, the flowers of this family have no bracts (as was the case with Crucifers, described above); but sometimes they are present, as in *Anchu'sa*

(1) shows a corolla laid open, revealing the scales, or *corona*, in front of the petals, and the stamens alternating with the petal-lobes. (2) is the gamosepalous five-toothed calyx. The pistil (3) is peculiar in having the two-celled ovary deeply four-lobed, the style arising from the bottom between the lobes. These when ripe break up into four nutlets (4), each of the four seeds being invested with one quarter of the pericarp. (5) is one of the nutlets cut vertically to show the embryo, (*a*) being a thickened ring round the point of attachment. The large embryo is seen within, the radicle being towards (*b*).

Loboste'mon.—This is a genus of forty species dispersed through the Colony, and entirely South African. They consist of herbs or shrubs, with scattered, sessile, entire, and pointed leaves. The corolla is pink, blue, or purple in colour, funnel-shaped, with a slight tendency to be irregular. The stamens mostly project beyond the corolla, or are *exerted*, as it is called.

Each filament has at the base a hairy-bordered scale. The style is slightly inclined, or *sub-declinate.* The nutlets are wrinkled.

The flowers show the commencement of irregularity, which is more pronounced in *E'chium*, in which the stamens are decidedly declinate, this position being the best for insects to alight upon when searching for honey, which is secreted by a gland, or disc, on the receptacle just below the ovary. A peculiarity resides in the colour of several plants of this order, in that they are red when first opening; but the colour changes to blue or purple afterwards.

This individual alteration is supposed to correspond with the development of colours in the floral world. The primeval colour was probably yellow; next followed reds, then purples, and finally blue. When a red chrysanthemum or other plant throws out a yellow blossom, called a "sport," it is said to *revert* to the ancestral, or original, colour.

Lithosper'mum.—This genus is so called from the polished, stone-like fruits. This is due to the secretion of lime in the ovary-walls which tightly invest the seeds. There are seven or eight South African species consisting of herbs or under-shrubs. The flowers are mostly small, of various colours.

General Description of the Heliotrope Family.

Herbs, shrubs, or *trees.*

Leaves—Alternate, with rough or bristly hairs.

Flowers—On *scorpioid* racemes; calyx, 4- to 5-parted, persistent; corolla regular, often rotate, or irregular (*E'chium*); stamens, as many as petals and adherent to corolla; ovary, of 2 carpels, but 4-lobed.

Fruit—Separating into 4 nutlets or drupe-like.

Labiatæ.

The Labiate Family.

This order contains 2600 species of 136 genera in 8 tribes. There are 19 genera in South Africa. It is one of which the members, as a rule, can be readily recognized. First, the square stem and opposite leaves are universal. These features, coupled with the flowers being clustered in the axils of the leaves or bracts, *looking* as if they formed a whorl all round the stem, must be noted. The flowers thus make a "false" whorl, or *Verticillaster*, each of the two clusters being a *glomerule*, or *sessile cyme*, and therefore "definite," for the order in which they expand may be thus expressed: 3, 2, 3, 1, 3, 2, 3 (Fig. 85, I.). It is the same as in the dichotomous cyme of Chickweed, described under the family *Caryophylleæ.*

The flowers are always irregular and lipped, much resembling many flowers of the orders *Verbenaceæ, Scrophularineæ, Acanthaceæ,* and others; but each order is, of course, known by a *collection* of characters, and not by the shape of the corolla alone.

Leono'tis.—The calyx has five sepals, and has strong "ribs" down it. The significance of these will be explained under *Sal'via.* It is slightly irregular or divided into two halves, the posterior portion having three sepals, the anterior two. The corolla has a prominent "lip" in front and a hood-like structure behind, composed of two petals (II.); but the lip, which has three lobes in other flowers, is really the single middle petal (III.–IV.). In (III.) the lip is cut in two. The stamens are didynamous, the front pair having, as is the rule, the longer filaments (III.), taking a bend over to the back, and, as in most of the genera, stand erect by the side of the shorter, or posterior pair. The pistil has two carpels (IV.), the ovary of which is deeply four-lobed, as in *Borragineæ*, and the style arises from the *base* and not the summit of the four lobes of the ovary, and is therefore called *gynobasic*.

When the ovary becomes the fruit this is then deeply four-lobed, and breaks up into four nutlets (V.), as in *Boragineæ*, etc., and does not form a many-seeded capsule, as in the *Scrophularineæ*. This plant is called "Wild Dagga," the corolla of which is of a bright scarlet colour and a velvety texture. The leaves are smoked by the natives; but, unlike Indian hemp and tobacco, no member of the "Labiates" is poisonous. Hence, many are grown as kitchen-herbs, especially on account of the strong perfumes they possess, due to glandular hairs, which secrete scented *ethereal* oils, such as lavender, thyme, mint, sage, etc.

Men'tha.—There are four species of "Mint" in South Africa, occurring along watercourses. The flowers are very small, and are not so irregular as those of most of the genera (Fig. 86).

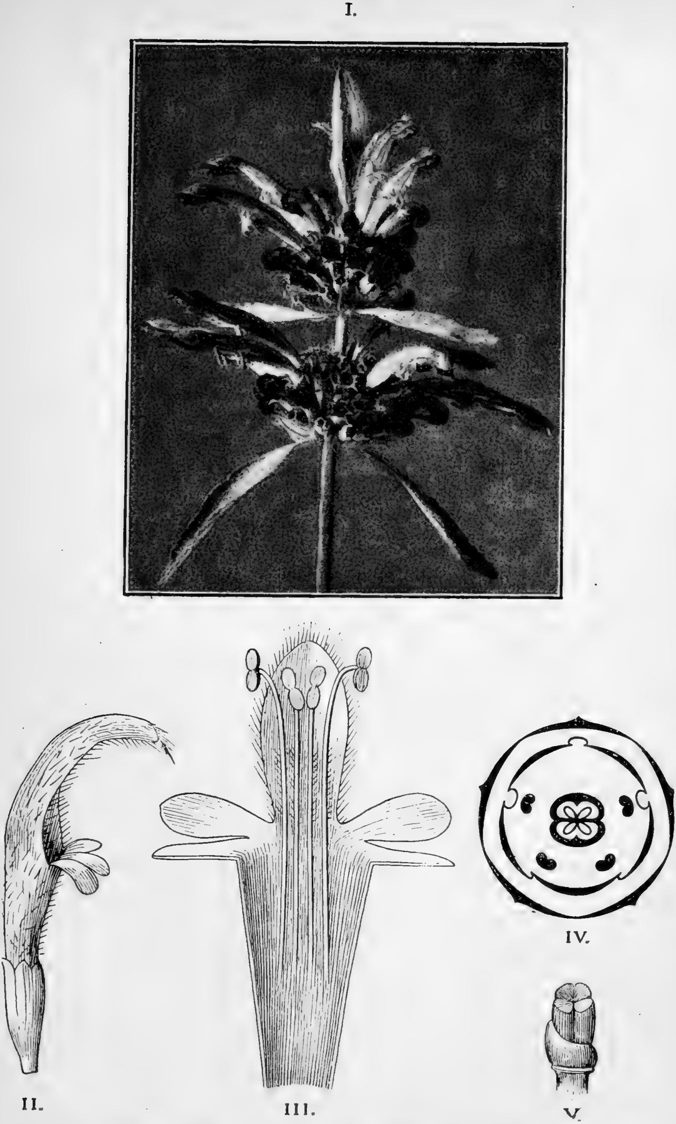


FIG. 85.—*Leono'tis Leonu'rus.* I. Flowering branch. II. Flower. III. Corolla opened. IV. Diagram of flower. V. Fruit, with honey-disc.

It will be observed that the sepals and petals are nearly regular. The stamens, though *one* pair is longer than the other, the fifth being suppressed, stand out in a spreading manner. Comparing this flower with that of *Leono'tis,* it will be seen that in the latter the insect enters one flower at a time, the anthers are above and strike the bee on the back, covering it with pollen. On entering another flower, the forked stigma protruding from the top of the hood strikes the bee where the pollen was deposited. In the Mints, however, as the flowers are very small and densely clustered together, the bee walks over them and gets dusted anywhere; the stigmas (just visible in Fig. 86) thus easily get dusted.

Fig. 86. — Nearly regular flower of Peppermint.

The garden mint is a cultivated variety of a South European species. Peppermint is another, and the drug "Menthol" is obtained from a Chinese species (*M. piperascens*).

Sal'via.—This genus, of which *S. officina'lis* is the garden sage, has many Cape species, both herbs and shrubs, dispersed through the Colony. I have already described the curious instance of a mechanical adaptation to bees for pollination, as the accompanying illustrations will show.[1]

[1] See p. 27.

I will here call attention to a few additional facts. First observe the number of "ribs" of the calyx, say, of the very common species, *S. panicula'ta.* We may represent this as follows: Being composed of five sepals, and each sepal stands for a leaf, let *d* be their mid-ribs, then where the margins are united there would be none, as leaves have none there. But since the weight of the bee is all on the lip in front, and the slender tube of the corolla has to be supported, Nature has run up, so to say, additional columns to strengthen it; and we shall find they are distributed as follows:—

```
            d
      m          m
  d                  d
  m                  m
      d          d
          m  m
```

where *d* stands for *dorsal, i.e.* the *back* or mid-rib of the sepals, while *m* stands for *marginal.*

Now, it will be noticed that the calyx is two-lipped. The meaning of this is that there has been a tendency to tear the calyx across. To prevent this the insertion of marginal cords was made; but in front, where the strain is greatest, *two* cords (*m m*) have been added. In another species (*S. pa'tens*), with blue flowers, there are *two* marginal cords at the sides, and a *third* is inserted between the two in front. Moreover, the cords are branched at their upper ends where the calyx expands.

The number of cords varies in different plants, according to their requirements.

Plectran'thus.—There are several species, herbs and shrubs, of this genus, and the method of pollination differs from the preceding, in that the stamens and style lie along the *horizontal* lip, instead of standing *erect*, under the hood; so that an insect gets dusted with pollen *below*, instead of *above*, its body. It thus resembles the flowers of *Leguminosæ* and some kinds of *Pelargo'nium.*

General Description of the Labiate Family.

Herbs or *shrubs*—With 4-angled stems; none poisonous.

Leaves—Opposite.

Flowers—In short, whorl-like, axillary glomerules, or in terminal clusters; calyx, 2-lipped, persistent; corolla, irregular, labiate; stamens, 4, didynamous; ovary, 4-lobed; style arising from their base; stigmas, 2.

Fruit—Separating into 4 nutlets.

DIVISION V.—INCOMPLETÆ.

Polygonaceæ.

THE DOCK FAMILY.

This order contains 600 species of 30 genera in 6 tribes. In South Africa there are only 4 genera.

Buckwheat (*Fagopy'rum*) and Rhubarb (*Rhe'um*) are members of this family.

They are herbs with peculiar stipules. Each leaf has two, such being usually the case with stipulate leaves. They are not, however, separate, but have their edges united both in front of the leaf—*i.e.* between the blade and the stem—and on the opposite side as well, making a complete sheath round the stem, often with a fringed upper edge. It has been called an *Ochrea* (*i.e.* a boot) (Fig. 87, 2, *a*).

Ru'mex.—The common English name for the species of this genus is "Dock," of which there are several in South Africa. Most of the species have a calyx of two whorls of three sepals to each; there is no corolla and six stamens. The ovary has three stigmas. The fruit is a one-seeded nutlet surrounded by the calyx, of which the three outer sepals become much enlarged, carrying one or more tubercles on the back of them. Two species are diœcious; one of them is introduced as a weed (*R. Acetosel'la*), known as Sheep's Sorrel. The leaves are acid to the taste, like those of *Ox'alis*, which is called "sorrel" in South Africa.

Polyg'onum.—One of the commonest species in England, and introduced into South Africa as a roadside prostrate weed, is the Knot-grass (*P. Avicula're*) (Fig. 87).

The flowers (3) are very small. The five sepals are green with a pink edge and gamosepalous. There are seven or eight stamens adherent at the base (4). (5) is the pistil, the ovary being cut open vertically to show the ovule arising from the base, and three styles and stigmas above. (6) is a ripe, three-cornered fruit invested by the persistent calyx. (7) is the seed seen in section, showing the embryo on the surface of the

FIG. 87.—*Polyg'onum* (Knot-grass). (For description, see text.)

endosperm. It is the presence of a large quantity of this "farinaceous"—that is, "starchy"—endosperm that makes buckwheat so valuable for poultry, etc.

There is a native species very much resembling it, with slender flowering shoots, called *P. serrula'tum.*

Rhubarb is a genus found in the northern hemisphere, the species occurring in Russia, Siberia, and north of Thibet. One has long been a familiar medicine, and another a useful plant for its leaf-stalk, which, cut into short portions, makes a so-called "fruit-tart."

General Description of the Dock Family.

Herbs or *shrubs*—With swollen nodes ; often with an acid juice.

Leaves—With ochreate or sheathing stipules.

Flowers—Bisexual or polygamous; calyx, 3- to 6-parted, persistent, often enlarging in fruit; stamens, adherent to calyx ; ovary, 1-celled, free.

Fruit—Achene or nutlet, rarely fleshy.

Chenopodiaceæ.

The Goosefoot Family.

This order contains some 520 species of 80 genera in 12 tribes. In South Africa there are 9 genera. Many species of the two above-named plants are weeds of cultivation, and have been probably introduced from Europe.

Several frequent salt-marshes, and have acquired peculiar forms, as salt induces a fleshiness of the stem and leaves, *e.g. Salicor'nea herba'cea,* the Marsh Samphire of England, which is a fleshy-stemmed herb without leaves, and occurs in the Cape Flats. The

Canna-bosch (*Caroxylon*) is a prickly but fleshy-leaved herb, occurring on the shores of the Peninsula, etc.

Chenopo'dium.—The leaves and sepals of species of this genus are often more or less covered, specially when young, with a white, mealy appearance. This

FIG. 88.—*Chenopo'dium* (Goosefoot). (For description, see text.)

is due to the presence of minute cells filled with water (Fig. 88, 1, 2). The flowers are minute and densely clustered.

The calyx (3) has five sepals. The corolla is wanting, but the five stamens standing *in front* of them show that the flower has been derived from one in which a corolla was present, and would have alternated with them, probably from the order *Caryophylleæ.* The pistil (4) has two styles, but a single ovary-cell, in which is one ovule (5) attached to the bottom by a 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 endosperm, a condition also seen in most of the *Caryophylleæ,* as Chickweed (Fig. 37, A, p. 102), but it is straight in *Dianthus,* this being an exception (Fig. 37, 6). *C. al'bum* is a troublesome annual on cultivated land.

Several plants of this family have been used as spinach, but the true species is *Spina'cia olera'cea.* It is diœcious. The native country is unknown; as it has been long cultivated, it has become different from any known wild plant.

General Description of the Goosefoot Family.

Herbs—Many maritime.

Leaves—Various or wanting.

Flowers—Calyx, 5-parted, often changing in fruit; stamens, equal in number to and opposite the sepals, adherent to calyx.

Fruit—*Utricle* or membranous capsule, within the persistent calyx.

Thymelaceæ.

THE STRUTHIOLA FAMILY.

This order has 360 species of about 36 genera in 3 tribes. In South Africa there are 10 genera.

Those most characteristic of Cape Colony are unknown in other countries, but are "represented" by some different species in Australia of a very similar appearance.

The South African species are often heath-like from the small pointed leaves, but the flowers are, of course, very different.

Struth'iola.—This genus has nineteen species, being heath-like shrubs or under-shrubs, mostly with long, slender branches, and opposite, linear, or narrow leaves.

The flowers are often sweetly scented. *S. virga'ta* is a very common species, having a white calyx, and blossoming in the early months of the year.

Fig. 89 will explain the structure. Thus the calyx has four pointed sepal-lobes, with a long tube below them (III.). At the mouth of the tube are eight "glands," two in front of each sepal,[1] with four stamens alternating in position with the sepals. This indicates the loss of four outer ones which ought

[1] Not correctly placed in the diagram (II.); but in (III.) the two in the middle (*g*) *are* in front of the opposite sepal, and the side ones belong to the lateral sepals (*p*, *p*).

to be in front of the sepals (III., *st*). In other genera, as *Gnid'ia*, the complete number, eight, is present.

The question arises—What do the so-called glands represent? They are not always present. They are wanting in *Arthroso'len* and *Passeri'na*. Again, in

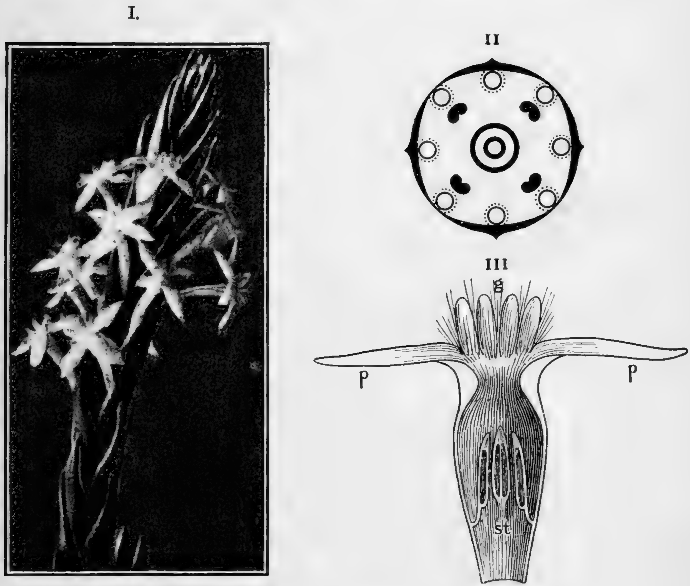


FIG. 89.—*Struth'iola.*

Gnid'ia, the glands look like solid anthers or else like little petals; so that one is tempted to think that that is just what they once were, but that they have "degenerated" into their present form. A common feature of the calyx in these genera is to "split around," in a *circumscissile* manner, just above the ovary; when this ripens, the lower portion closes over the nut-like fruit. The stigma is capitate, *i.e.* forming a globular head.

Passeri'na filiform'is.—This has a tufted stigma, a very usual condition with "wind-pollinated" flowers, as the long projecting cells, called *papillæ,* readily catch the pollen.

Chymococ'ca.—The fruit of this is called "Dronk-besjes," and differs from the others in being succulent.

General Description of the Struthiola Family.

Herbs, shrubs, or *trees*—With a very tough, stringy bark.

Leaves—Entire, sometimes heath-like.

Flowers—Inflorescence capitate, umbelled or racemose; calyx, petaloid, tubular, 4- to 5-lobed, with glands or scales, 4 to 8, free or united into a cup; stamens, 4 or 8 upon the calyx; ovary, free, 1-celled.

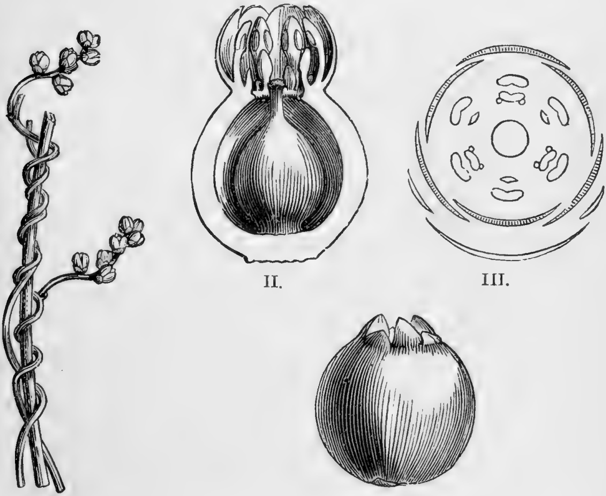
Fruit—Nut or drupe.

Laurineæ.

The Cinnamon and Camphor Family.

This family contains some 900 species of 34 genera in 4 tribes, scattered over all tropical countries, a few being extra-tropical, as the Laurel or Bay-tree of South

Europe (*Lau'rus no'bilis*), which gives the name to the order. In South Africa there are only 3 genera, but one (*Cas'sytha*) is peculiar in being a leafless parasitic climber, closely resembling the Dodder (*Cus'cuta*) of the Convolvulus family (see p. 188).



I. II. III. IV.

Fig. 90.—*Cas'sytha.* I. Twining and parasitic flowering shoot. II. Vertical section of flower. III. Diagram. IV. Fruit.

Cas'sytha. — Fig. 90 illustrates a flower which is very small (I.) and very peculiar. The receptacular tube carries a calyx of six sepals in two whorls (II., III.). Then there is a whorl of six stamens (III.). The three standing in front of the three *outer* sepals have three others in front of them; but the anthers of the outer six burst inwards, or are *introrse;* the three inner burst outwards, or are *extrorse.*

The anthers open by little flaps which rise upwards, and not by slits, as is usually the case (see Fig. 90A of the Bay-tree).

Each of the three innermost stamens has two glands at the base, apparently consisting of abortive stamens.

FIG. 90A.—Stamen of Bay (*Lau'rus no'bilis*), with two glands at the base of the filament, the anther opening by recurved valves.

Each of the stamens in front of the inner whorl of stamens has also a gland at the base (III.), so that we may write down the whorls of the flower in order thus—

Bract, two bracteoles (see diagram III.); sepals in two whorls; three stamens (introrse); three stamens (extrorse) with one gland; three stamens (extrorse) with two glands; pistil of one carpel.

The flowers are self-fertilizing and almost cleistogamous.

The fruit (IV.) is a pseudocarp, as the fleshy receptacle is not adherent to the ovary (II.).

Oreodaph'ne.—This genus is chiefly American. One only is a Cape species, *O. bulla'ta*, known as "Stinkwood," as it smells disagreeably when cut, but is a durable wood for cabinet-makers. The white variety has been used for shipbuilding.

General Description of the Cinnamon and Camphor Family.

Herbs, shrubs, or *trees*—Chiefly Asiatic and American tropics.

Leaves—Entire or wanting (*Cas'sytha*).

Flowers—Bisexual or unisexual, small; calyx, free, 6-parted; stamens adherent to calyx, 3 to 4 rows, or partly staminodes and anthers opening by pores with lids; ovary, free from the receptacular tube, 1-celled.

Fruit—Dry or fleshy.

Proteaceæ.

The Silver-tree Family.

This order contains 950 species, and mainly occurs in South Africa and Australia. There are 49 genera in 7 tribes. In South Africa there are 11 genera. Though the flowers are very simple, yet there is an immense diversity in the foliage. It was this which suggested the name from Proteus, a god of the sea, who continually changed his form. He was the keeper of Neptune's sea-calves.

The leaves are in some, needle-like (*Spatal'la*), or divided into fine segments (*Serru'ria*). They may be linear or lanceolate, as in the Silver-tree, or even very broad, as of some species of *Leucosper'mum.*

It will be noticed how often the foliage is of a leathery, or *coriaceous,* texture. In some the surface is covered with hair, as the Silver-tree, and others secrete wax, etc.; but in all cases both the surface and the interior structure are adapted to great drought. This is a common feature both in South Africa and South-West Australia, where members of this family abound; but there is no single species common to both countries.

Leucosper'mum.—The illustrations (Fig. 91, A, I.–III.) will show the structure of the flower, which is very simple and much the same throughout the family.

It consists of a calyx of four sepals only (III.), joined into a tube below, and having the four free portions above. Upon each of these sepals lies a stamen, the filament being adherent to it (II.).

The pistil is in the middle and quite free (II.); its ovary is, therefore, superior.

Pro'tea.—The flowers of this genus are like those of the preceding, and arranged in heads. The involucre consists of persistent coriaceous bracts, sometimes coloured. The fruit retains the long style as an appendage; the ovary, being covered with stiff hairs, forms an achene.

The Sugar-bush (*P. mellif'era*) and Waageboom (*P. grandiflo'ra*) are common species.

Pro'tea grandiflo'ra.—This is known as the "Wagon-tree," the wood being useful for various purposes. The leaves contain a good deal of tannic acid, so that they are useful for tanning, and make good ink with salts of iron.

Leucaden'dron.—Fig. 92 is the inflorescence and

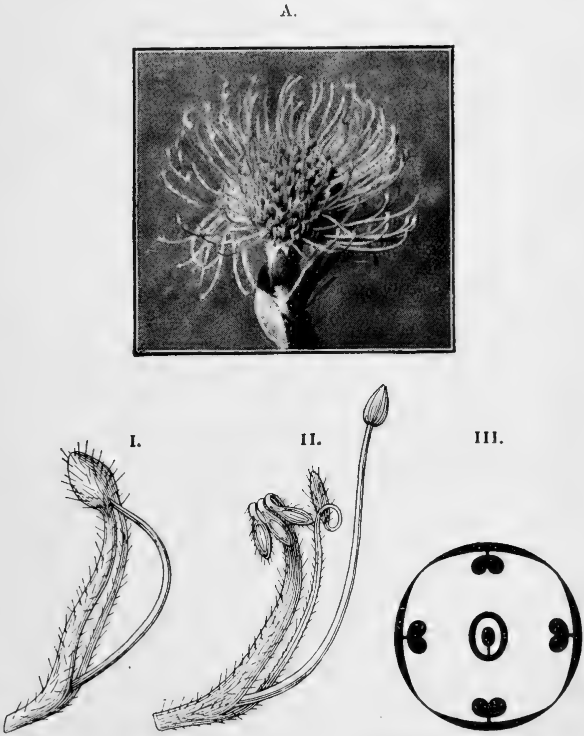


Fig. 91.—*Leucosper'mum*. (For description, see text.)

foliage of the Silver-tree. It differs from the preceding in being diœcious. The small flowers (II.) have a gamosepalous calyx, with four stamens adherent to the sepals; but the pistil is abortive, with a sterile style and stigma. The female has four sepals, but no stamens. The fruit is a globose nut in *L. argen'teum*,

I.

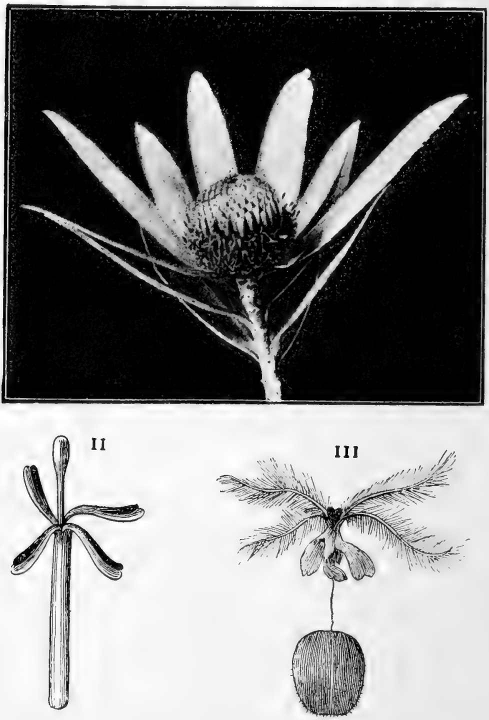


FIG. 92.—Silver-tree. I. Male inflorescence ($\frac{1}{3}$). II. Single flower with barren style (× 2). III. Nut with persistent style and calyx, the latter split at its base and prevented from slipping off by the knobby stigma.

the Silver-tree. The style remains, and when the calyx is detached at the base, it is prevented from slipping off by the knobby stigma, as shown in (III.). The female inflorescence develops into a cone formed of the hardened and persistent bracts.

The wood is of inferior quality, and is more commonly used for fuel.

General Description of the Silver-tree Family.

Shrubs or *trees.*

Leaves—Very various, coriaceous.

Flowers—Capitate, spiked, or axillary; calyx, 4-parted, lobes valvate in bud; stamens, 4, adherent to sepal lobes; ovary, free, 1-celled.

Fruit—Nut or drupe.

Euphorbiaceæ.

The Euphorbia and Castor-oil Family.

This order certainly contains some 3000 species of nearly 200 genera in 6 tribes, which are again divided into sub-tribes. In South Africa there are 23 genera. The greater proportion of members of the order are found within the tropics of both worlds. They are altogether wanting in Arctic and Antarctic regions, as also in the higher regions of the European Alps.

The temperate forms of the type genus *Euphor'bia* are very different from those of the hotter and drier regions of South Africa.

The former are herbs with a milky juice known as "Spurges," and several have been introduced as weeds of cultivation. The typical Euphorbias of the hotter parts of Africa are leafless, with thick, angular, massive, and fleshy stems. In this respect they resemble Stapelias (see Fig. 75, p. 182) and the Cactuses of Mexico, but the flowers invariably show the genus and order.

These three plants—but others might be mentioned —go to prove how plants can acquire outward forms together with internal structures, in adaptation to the conditions of soil and climate in which they live; for the fleshy stems and leaves (as of *Crassulaceæ*) are really storehouses of water against the dry season when no rain falls.

Euphor'bia.—The illustration (Fig. 93) will explain the structure of one of the small herbaceous species which have been introduced, and are now common about Cape Town. (1) is the terminal part of a plant bearing inflorescences (and not *one* flower only). In the fork of the branches (1, *a*) is an inflorescence. (2) is the same enlarged, consisting of a coherent, cup-like involucre (3, *b*, laid open), with crescent-like glands (3, *a*) on the rim. In the common, fleshy-stemmed, finger-like *E. Ca'put-Medu'sæ*, the glands are of a dull purple colour, with a green-and-white appendage between them.

The involucre contains *many* male flowers (3, *c*) and *one* female flower (2, *b*); only the pedicel is left in (3).

These flowers require further explanation. It will be noticed that the stamens in (3) are of different lengths (*c*), indicating different stages of growth. Each stamen (4) has a joint (at *a*). The interpretation of this is, that the lower part (*b*) is the pedicel, while the upper part (*c*) is the filament. Hence each stamen is

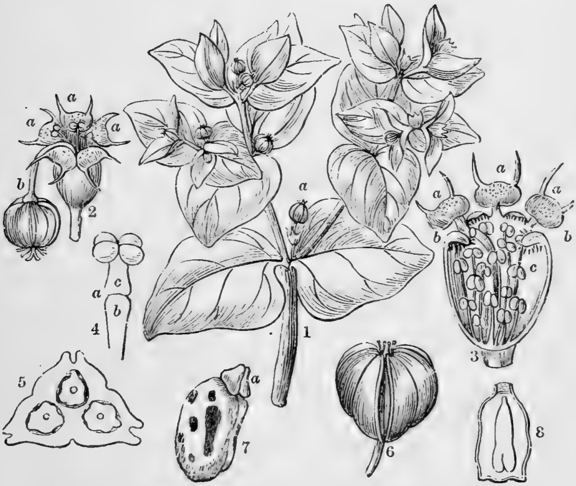


FIG. 93.—*Euphor'bia* (Spurge). (For description, see text.)

all that exists to represent a male flower. In some species there is a little bract at the base of each stamen, which would also tend to prove that *each stamen* is a *flower*.

(5) is a section through the three-celled ripening ovary, showing one seed in each cell.

(6), the ripe capsule, bursts elastically with three valves, liberating the seeds and throwing them to a distance. The seeds (7) are slightly downy and spotted. There is a white protuberance at one end called a caruncle (7, *a*); a very similar structure occurs in *Polyg'ala* (Fig. 36). (8) is a section of the seed, showing the embryo in the middle of endosperm. This often contains oil instead of starch, as Castor-oil and Croton-oil.

There are two or three species of *Cro'ton* in the Eastern district and Natal.

Ric'inus commu'nis, the Castor-oil plant, is commonly grown, and is partly naturalized, throughout the Colony.

All the Euphorbias are poisonous in varying degrees. Children have been poisoned by eating the fruits of some species of spurges.

General Description of the Euphorbia Family.

Herbs, shrubs, or *trees*—Often with an acrid, milky juice.

Leaves—Alternate, sometimes replaced by spines.

Flowers—Unisexual; calyx, 4- to 6-parted, or wanting (*Euphor'bia*): male flower, stamens, definite or free, or united; female flower, ovary, 2–∞ celled, styles free.

Fruit—Capsule, or carpels separating into what are sometimes called *cocci*.

Urticaceæ.

The Stinging Nettle and Fig Family.

This is a large order, with about 1500 species of 108 genera in 8 tribes. In South Africa there are 10 genera in 3 tribes. The flowers are mostly unisexual, either monœcious or diœcious; but while members may be very different in appearance, as a nettle is from a mulberry and fig tree, yet the structure of the flowers are so closely in agreement that they must be united, though arranged in different tribes. Many species are provided with stinging hairs. These, on close examination, will be seen to be pointed cells, with a bulbous base, within which is the irritating fluid. When the point enters a pore of the skin, it breaks off, and fluid is injected by the pressure. As it is too minute in quantity to be analyzed, it is impossible to say what its exact nature is.

Urti'ca.—If we take the common perennial nettle, *U. dioi'ca*, naturalized from Europe, it will be seen that the male flowers (all on one plant) have a calyx of four sepals with four stamens. These have their filaments curled inwards in bud, so that as soon as the sepals separate, they spring up and curl outwards, flinging the pollen into the air, by the filaments being under a great state of tension while they were kept down by the sepals.

The female flowers on separate plants have also a calyx of four sepals, with a pistil of one carpel in the middle, with a tuft-like stigma.

This stigma consists of a tuft of *papillæ*, or short hairs, which are thus enabled to catch the pollen wafted to them by the wind, the nettles being "wind-pollinated" plants.

Fi'cus.—The fig is a *pseudocarp*, in that the edible part is only an expanded flower-stalk.

If a young fig in the flowering stage be cut down from top to bottom, it will be found to have a little opening at the top, but closed by many minute bracts. In nearly all cultivated varieties of fig the whole of the interior chamber is covered with female flowers, consisting of a calyx of three or more sepals, and a pistil having a forked stigma. The ovary is only one-celled with one ovule. This, however, never becomes a seed, and therefore never develops an embryo. In fact, these female flowers are more or less abortive. Moreover, there are no stamens.

In some figs, as the so-called "Wild Fig," or *Caprificus*, of the Mediterranean regions, stamens form a cluster just inside the orifice, hanging downwards.

Now, although, as stated, hundreds of different sorts of figs become edible fruits without any pollination, certain kinds (such as the Smyrna figs) *do* require it, or they will fall off prematurely.

The "caprification" is effected by minute wasp-like insects which breed in the wild fig, their grubs living in the ovaries of the pistils. They then escape and fly to the others, enter the hole, and convey the pollen to the female flowers below. These then enable the figs to mature without prematurely falling.

There are several species of fig, natives of the Eastern districts and Natal. The fibre of the bark is used for ropes of certain species, but the fruit and wood are of no use.

General Description of the Nettle Family.

Herbs, shrubs, or *trees.*

Leaves—Opposite or alternate, often with stinging hairs, stipulate.

Flowers—Mostly unisexual; calyx, cleft; stamens as many as sepals inflexed in bud, sometimes with spring-like filaments; ovary, free, 1-celled.

Fruit—Nut or achene, free, or in a fleshy receptacle (Fig), or fleshy calyx (Mulberry).

Amentaceæ.

The Catkin-bearers.

This is not strictly an order or family, but is a group of plants, having the male, and sometimes the female, flowers clustered on long stalks forming *catkins.* The chief native genus, which has 9 species at the Cape, is called the Wax-berry, *Myri'ca,* giving the name to a family, *Myricaceæ,* containing only this single genus.

The introduced trees are the following:—

The Poplar (*Po'pulus*); species of the Willow (*Sa'lix*), of which there is one native species, *S. capen'sis,* with a silky-leaved variety (*hirsu'ta*).

These two genera make up the order *Salicaceæ.*

The Walnut (*Jug'lans re'gia*) represents another order, *Juglandaceæ,* with five genera.

The Oak and edible Chestnut represent the order *Cupuliferæ,* or "cup-bearers," in allusion to the cup of the acorn and prickly covering to the chestnuts. This order has ten genera in three tribes. It contains 400 species, scattered over the north temperate regions of the whole world. Four only are British, the Oak, the Beech, the Hazel, and the Hornbeam.

Sa'lix.—The willows are diœcious. The male tree has its flowers in a dense elongated catkin. Each flower consists of two or more stamens only in the axil of a bract. The female tree has its flowers also in catkins, each flower consisting of a pistil of two carpels. The seeds have a tuft of silky hairs at one end.

Quer'cus.—The Oak, familiar to all in the Peninsula, has been long introduced (Fig. 94). A is a young branch with three slender "interrupted" male catkins, *i.e.* there are marked intervals on the peduncle between the flowers. Each consists of a gamosepalous calyx of a variable member of lobes (I.). Stamens usually about ten (but only six are given in I.). The female flowers are on the same tree, the oak being monœcious. First to be noticed is the little cup composed of overlapping or imbricated scales (II.). Within this is the

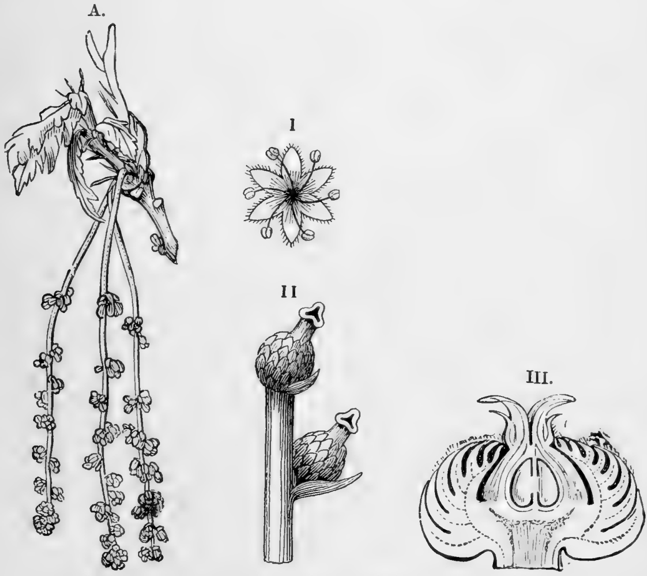


Fig. 94.—A. Catkin of the Oak. I. Male flower of Oak. II. Female flowers. (Both × 3.) III. Female flower, cut vertically.

female flower. It consists of a pistil of three carpels, as shown by the three-lobed stigma, the ovary being invested by a receptacular tube, and is, therefore, inferior.

The calyx limb is almost imperceptible, being a little jagged rim only, not represented in (II.), but visible below the stigmas in (III.).

The three cells of the ovary contain two ovules each, but when it becomes an acorn only one ovule is developed into a seed; this enlarges so much that the other two ovary-cells are pushed to one side. The large embyro with its two massive cotyledons quite fills the interior. The cup grows at the same time, so that it is always large enough to hold the acorn as it continues to increase in size (III.).

Myri'ca (Fig. 95).—The species consist of shrubs often with a balsamic odour. They are monœcious or diœcious, in catkins. There is a bract, sometimes with two bracteoles, or minute bracts, to the male flower. The bracteoles are wanting in (II., III.). This consists of two to eight stamens, some being often abortive. The anthers are extrorse (III.). The female flower has from two to three scales. There is no calyx, only a pistil with a one-celled ovary, having a solitary erect ovule. There are two stigmas, possibly indicating two carpels (IV.). The fruit is somewhat "drupaceous" and one-seeded (V., VI.). The fruit is covered with little round *papillæ*, or hemispherical protuberances, which are often covered with wax (IV.). When a fruit, as the grape, is covered with a very thin layer of wax, this is called the "bloom" of the fruit.

The reader may wonder why it is that some orders have an immense number of genera and species, such as the *Compositæ*, *Leguminosæ*, etc., or some one or more

FIG. 95.—*Myri'ca.* I. Flowering shoot. II. Monœcious inflorescence; female flowers above; male, below. III. Bract and stamens of male flower. IV. Pistil of the English *M. Ga'le*, Sweet Gale. V. Transverse section of fruit. VI. Embryo.

genera of a family may abound in species, as the Heath;

while other orders, such as those included in the Catkin-bearing group, have very few genera, even two or one, as the *Myri'ca.* The interpretation accepted by botanists is that an order with one, two, or very few members is a very ancient one, and the few that remain are the last relics of a long-lost family, whereas when there are many in an order, such a family is of a much more modern origin. Indeed, it seems probable that *Myri'ca* and *Casuari'na,* the "beef-woods" of Australia, may represent some of the very earliest plants *which possessed pistils,* for the next families to be considered, the "Gymnosperms," *have no pistil* at all.

GYMNOSPERMÆ.

This peculiar group of plants contains only 3 orders: *Gnetaceæ,* with 3 genera, one of which is the extraordinary plant *Welwit'schia,* so called after its discoverer, Dr. Welwitsch, only found in Damaraland, near Waalvisch Bay, and northwards to Cape Negro; *Cycadaceæ,* with 9 genera, of which two, *Encephalar'tos,* the "Kaffir-bread," and *Stange'ria,* occur in the south-east sub-tropical part of South Africa. The third order is *Coniferæ,* a very large one having some 300 species of 32 genera in 6 tribes. Two genera only occur in South Africa, viz. *Podocar'pus,* the "Yellow-wood," and *Cal'litris* (also called *Widdringto'nia*), known as the "Cedars" of the Cedarberg Mountains.

Coniferæ.

THE PINE AND YELLOW-WOOD FAMILY.

Pi'nus.—This genus has 70 species dispersed over the cooler regions of the northern hemisphere. Two are now abundant on the north side of Table Mountain, etc., making woods of some extent. These are *P. pin'ea*, the "Stone Pine," a native of the Mediterranean regions of South Europe, and *P. pinas'ter*, the "Cluster Pine," a native of the south-west of Europe. The only species native in Great Britain is *P. sylves'tris*, the "Scotch Fir."

The fruit of all these are cones (Fig. 96, VI.), hence the name "conifers," or cone-bearers. They are borne in abundance by the trees in Cape Colony.

The illustrations (Fig. 96, I., II.) represent the male and female inflorescences from the same tree, as pines are monœcious. The former consist of a dense cluster of little oval catkins, arranged all round a shoot, which continues to grow at the top. Each of the catkins consists of stamens (III.) spirally arranged around it. The pollen grain is of a peculiar shape (IV.), as it has two pouches, one on either side; their use is not known. The little female catkins (II.), which develop into cones, consist of a number of female flowers also arranged spirally. Each flower consists of a roundish bract or scale with another, the ovuliferous scale, in front of it (*i.e.* on the side next the middle or axis). This scale is so called because it has two ovules at the base (V.); but it is never closed over the ovules as a pea-pod is, but always flat, so that the ovules are exposed. They hang downwards, but have very large openings, called the *micropyle*, a word meaning "little gate," so that pollen grains fall down between the scales and alight upon these orifices, where they are retained by a gummy juice exuded by the ovules. These thus become fertilized without the aid of stigma and style as in all angiosperms. (V.) represents one of the scales with the two ovules at the base.

When the catkin becomes a cone, the rule is for the bract to disappear; while the ovuliferous scale grows very long and its tip swells into a four-sided knob as shown in (VI.). The two ovules at the same time (now concealed by the hardened scales being pressed together during growth) increase in size, usually developing their wings, which some think are outgrowths from the surface of the ovules; but others say that they are formed from the inner surface of the scale.

When the seeds are quite ripe, the elongated, rigid, and now woody scales separate again, and by so doing somewhat abruptly, on a hot day, jerk the seeds out; their wings now are of use, for a breeze will send them off whirling away to a distance. When they fall, the wing becomes detached from the seed, which then

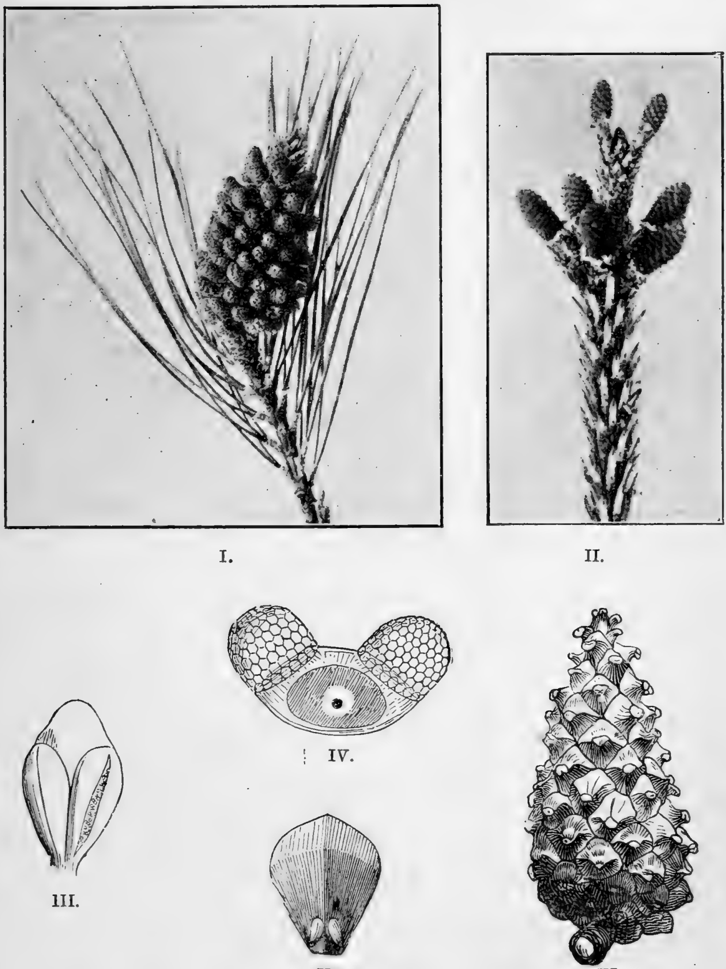


FIG. 96.—*Pi'nus.* I. Male inflorescence. II. Female inflorescence. III. Stamen of ***Pi'nus sylves'tris***, with longitudinal dehiscence. IV. Pollen grain. V. Ovuliferous scale bearing two ovules. VI. Cone of the Scotch Fir.

germinates. Thousands of seedling pines may be seen in the woods below Table Mountain.

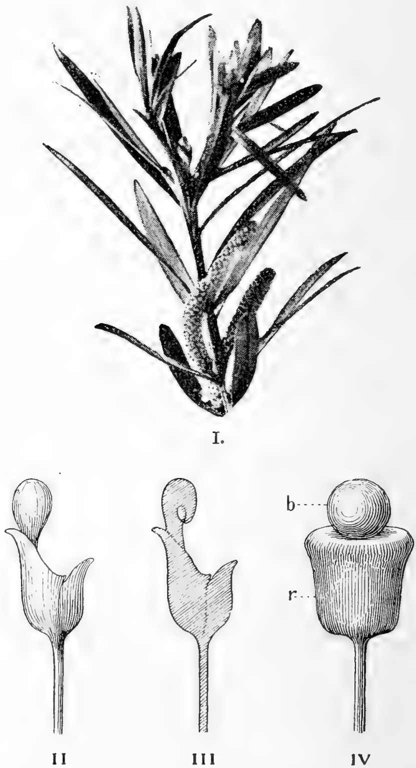


Fig. 97.—Yellow-wood. I. Branch (½) with 3 male catkins. II. Female inflorescence (× 3). III. Section through the latter, showing one ovule. IV. Ripe pseudocarp: *r*, fleshy receptacle; *b*, seed enclosed in green resinous scale.

Podocar'pus.—This genus represents the pines in South Africa (Fig. 97). The flowers are both monœcious and diœcious in different species, of which there are forty at least, only found in the southern hemisphere, but of both worlds. The male flowers are in catkins forming a cylindrical column (I.) ; the anthers are sessile, *i.e.* without filaments, arranged spirally. The connective is prolonged into a small appendage above the anthers.

The female flower consists of a solitary ovule, its peduncle being adherent to the ovuliferous scale. Another faces it, and sometimes carries an ovule as well. These with the axis form a fleshy support to the seed (II.–IV.). This is globular or ovoid and "drupaceous," having a fleshy exterior and "crustaceous" or hard and brittle interior lining.

The tree Yellow-wood is *P. Thunber'gii,* with a dark-blue receptacle. *P. elonga'ta* is the Outeniqua Yellow-wood, with narrower leaves than the former. The receptacle is bright crimson. It is common in the Knysna and Eastern forests. (II.–IV.) represent the ovule protruding above the sub-coherent ovuliferous scales, with two linear bracts below. (III.) is a vertical section showing the inverted ovule, its single coat and large orifice looking downward. (IV.) is the ripe condition of the pseudocarp, and shows the fleshy receptacle formed of the axis.

Cal'litris or **Widdringto'nia** (the "Cedar" of Cedarberg Mountains).—This has closely set leaves. In the young plant they are needle-like, but more scale-like in the adults.

The male catkins have many stamens; the filament is short, extending into a sub-peltate, scale-like connective bearing two anther cells. The female has four ovuliferous scales; there are from five to ten ovules at the base of each scale.

The fruit is a globose cone, or *galbulus*, four-valved, the valves being woody. The seeds are winged. The wood of both the "Cedar" and Yellow-wood is useful, forming timber for shipbuilding and houses, etc.

The name "Cedar" is, of course, incorrect. The true cedars belong to the genus *Cedrus*, of which there are three species—the cedar of Lebanon, one on the Atlas Mountains of North Africa, and one called the "Deodar" on the Himalayas.

Cycadaceæ.

The Kaffir-bread Family.

This order has 75 species of 9 genera in 2 tribes, in Asia, Africa, Australia, and America.

Two genera occur in South Africa. They have short trunks, unbranched, and carrying a crown of foliage at the top, not unlike a tree-fern.

The flowers are unisexual. The male consists of a cone-like structure composed of spirally arranged antheriferous scales, thick and leathery in consistence.

The female cone is terminal, and also composed of scales, called ovuliferous, as they bear ovules, but naked on the margins below the apex, which is more expanded. The seeds are more or less globose.

There are twelve species of Kaffir-bread and one of *Stange'ria* in Natal.

CLASS II.—MONOCOTYLEDONS.

DIVISION I.—PETALOIDEÆ.

Orchideæ.

THE ORCHID FAMILY.

This order contains, perhaps, the most curiously constructed flowers of all. It has some 5000 species in 334 genera, divided into 5 tribes. Each tribe, except one, has several sub-tribes. In South Africa there are 38 genera.

Di'sa.—This has many species in tropical and South Africa, of which *D. grandiflo'ra* is called the "Glory of Table Mountain."

Fig. 98 will explain the structure. The first thing to notice is the inferior ovary and superior perianth. The ovary in many orchids is often so twisted that the flower is really upside down. In others it is very slightly or even not at all twisted, but the flower may be still inverted, as it bends over to the opposite side of the stem.

To understand the true position of the parts of the flower, a line should be traced from the bract up the ovary, following its curvature, if any, and then the leaf of the perianth, which is strictly *anterior*, *i.e.* immediately over the bract, will be discovered.

Next, notice the three outer leaves (sepals) of the perianth. These may be all of the same simple form, or one of them may be "hooded," "bag-like," "spurred," etc.

Then follow the three petals of the inner whorl of the perianth.

In many "Orchids," as any plants of this family are called in popular language, it is the posterior petal which takes on some one of the above forms, instead of a sepal. It is then called the *labellum*. In (I.) it appears as a very minute body, and situated *below* in front (*l.*); but by comparing this with the diagram (II.), the labellum (5) stands on the posterior side of the flower next to the stem (*x.*). Consequently, the bract will be behind the sepal (*o.s.*) on the anterior side; but as the flower bends over to the opposite side of the stem, it is really inverted in (I.).

Within the perianth, of which the other two petals are shown in (III.), there is a solid body called the *column*. This is really composed of the filament of the single stamen adherent to the style; so that while the anther (*f.a.*) is on one side only, the two stigmas are below it (*s.t.*). These should, of course, be three;

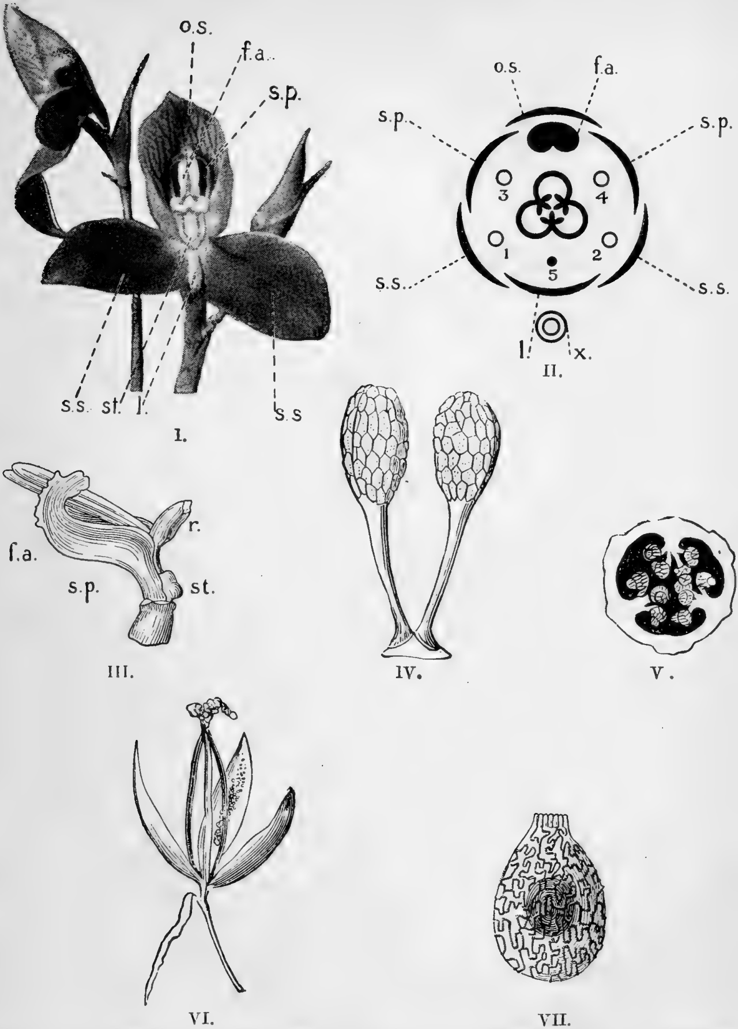


FIG. 98.—*Di'sa uniflo'ra.* I. Two flowers and one bud. II. Diagram of flower. In specimens with more than one flower the lip (l) is turned away from the stem (x) through a twist in the ovary. 1, 2, 3, 4, undeveloped or greatly modified stamens; x, stem of plant; *s.s.*, side sepals; *o.s.*, odd sepal; *s.p.*, side petals; l, odd petal (labellum); *f.a.*, fertile anther. III. Column (side view) with anther and two lateral petals: *st*, stigma; *r*, rostellum. IV. Pollen masses of an Orchid. V. Transverse section of an ovary. VI. Capsule dehiscing by three valves. VII. Seed ($\times 20$).

but the third is modified to form a projection (*r.*), called the *rostellum.* As this stands between the anther and the stigmas, by far the greater number of orchids are prevented from self-pollination.

In a few the rostellum is scarcely developed when the "pollen masses"—for the pollen grains are all coherent into a so-called *pollinium* (IV.) of a different orchid—can fall over it on to the stigma, and some few orchids are cleistogamous; all such do not require insects to move the pollen masses. (III., *s p.*) is one of the side petals.

When an insect alights in search for honey in orchids, the pollen masses become withdrawn from the anther cells by a sticky secretion which fixes them upon the head of the insect. On entering another flower, the pollen mass then hits the stigma, the glutinous surface of which retains it, when the insect retires. Numerous differences exist in the methods of pollination in orchids, many of which are described by Darwin, in his book "The Fertilization of Orchids."

(II.) is a diagram suitable for by far the greater number of orchids, showing the position of the three sepals and three petals (*i.e.* six "leaves" of the superior "perianth"); the labellum is the petal (5) next to the stem or axis (*x.*), and therefore posterior. There should be six stamens, but only one bears pollen; the others are only detected as ridges on the perianth leaves. Their positions are indicated by rings and a dot.

Although the structure is the same in all orchids but one genus (not in South Africa), there is an infinity of shapes and corresponding adaptations to insects. In many the ovary or its pedicel is so greatly twisted that the flower is completely reversed in position, so that the labellum, which we have seen is really the *posterior* petal (since it is on the side of the flower opposite to the position of the bract), actually becomes the front petal, and then grows out into a large one to receive the insect as its resting-place. In *Pterygo'dium*, of which there are some ten species in South Africa, the lip is in front, and forms a slipper-like structure.

The structure of the ovary should now be observed. By cutting it down, it will be found to be one-celled, but with three large parietal placentas projecting inwards, and carrying an immense number of ovules (V.). When some of these are fertilized, the fruit forms a capsule, which, when ripe, bursts by three valves, leaving a framework behind (VI.). The seeds are very minute and imperfect, consisting of a loose skin with an undeveloped embryo within it (VII.).

It not infrequently happens that, when plants are habitually propagated by underground tubers, bulbs, etc., they seem to lose the power of setting seed by their flowers. Such is the case with the garden Horse-radish, the species of *Cro'cus* cultivated for saffron, which consists of the dried style and stigmas, and with a very common species of *Ranun'culus* in England, called the Lesser Celandine, which is multiplied enormously by underground buds with tuber-like roots, similar to those of many terrestrial orchids; but it rarely sets any seed. Such is the case with *Di'sa grandiflo'ra.*

The swollen roots of many of these orchids used to be collected, and a drink made from them called "Salep," and sold in the streets of London, until the beginning of the last century; but salep has been replaced by coffee. It is still made in the East in Persia.

Satyr'ium.—This genus has many Cape species, several being cultivated. The lower lip of the perianth is formed by the regular sepals and petals. The upper lip is made of the labellum, which has two spurs or pouches. The anther is bent back, or *resupinate,* the glands being separate and naked. The stigma is two-lobed, the upper lobe being the larger. Many have handsome flowers of an orange, pink, crimson, or greenish colour.

The great majority of orchids of the south-west regions are terrestrial and propagating by means of underground buds. These buds arise from the base of the stem, and carry a globular or other shaped swollen root in which is stored a quantity of nourishment for its growth. Sometimes the bud is at the end of a short branch, so that the new plant which arises from it is at some little distance from the parent plant. Such is the case with *Di'sa grandiflo'ra.* It is a remarkable fact that all the various kinds of elaborate structures in adaptation to insects' visits, and all the attractive features of colour, honey, and scent, result in a quite disproportionate amount of seed. It has been observed that a species of *Dendro'bium*, growing in its native home in Australia, bore thousands of blossoms; but was found afterwards

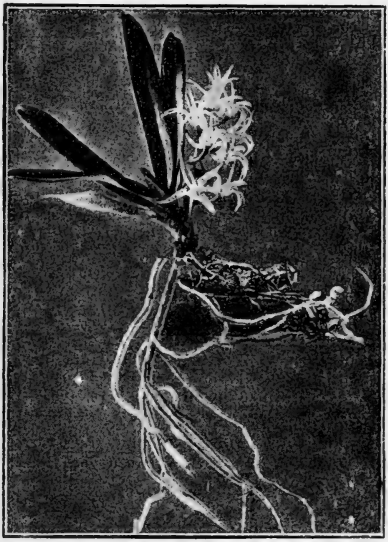


FIG. 99.—Epiphyte in the Eastern forests.

to bear only one pod. The same observer, however, discovered certain orchids to be cleistogamous, never opening their flower-buds at all; and these were all fully fertile.

In tropical forests the orchids are usually *epiphytal*—

that is, they grow "upon plants," mostly trees—but they are not parasites, for they derive no nourishment from their supports. They are provided with long, aërial roots, by means of which they fasten themselves to the branch of the tree, and also absorb water, etc., from the surface. Fig. 99 illustrates one species of an epiphytic orchid of South Africa, from the Eastern forests, known as *Mystacid'ium grac'ile.*

Angræ'cum.—This is another epiphytal genus. Species are found both on the east and west sides of South Africa, as well as Madagascar, where *A. sesquipeda'le* occurs, having a long slender spear, sometimes reaching about fourteen inches in length. The sepals and petals are nearly equal, spreading and free; the flowers are mostly white.

General Description of the Orchid Family.

Herbs—Terrestrial or epiphytal.

Leaves—Simple, entire, sheathing, forming *pseudobulbs,* or thickened internodes, if epiphytal.

Flowers—Perianth irregular, superior; stamens, 1 or 2 (*Cypripe'dium*); pollen, coherent in masses, with viscid disk or 0; stigmas, 2, effective, 3rd, a rostellum; ovary, inferior, 1-celled, with 3 parietal placentas.

Fruit—Capsule, bursting by valves, rarely succulent (*Vanil'la*).

Irideæ.

The Moræa and Gladiolus Family.

This order has 700 species of nearly 60 genera in 3 tribes. In South Africa there are 20 genera. They all agree in having only three stamens, whereas, excepting orchids, other orders of the Petaloideæ have almost always six.

The ovary is inferior, and the perianth superior, in all members.

Moræ'a.—There are many species of this genus in South Africa. The flowers are quite regular (Fig. 100, I.). In the figure the outer leaf of the perianth facing the observer has been removed, showing one of the three epigynous stamens behind it (*sta.*). Behind the stamen rises one of the style arms; but just above the anther (where the horizontal shading terminates) is a little ledge constituting the stigma. The honey-tubes are at the base of the filaments. An insect alights in the expanded sepal (*o.s.*), depresses it, and while searching below for honey, gets dusted on the head, as the anther bursts outwards (extrorse). Then, on entering over another sepal, the ledge scrapes off the pollen. (II.) shows the positions of the leaves of the perianth, the three stamens in front of the outer ones (sepals), and the pistil of three carpels, which cohere in the middle.

(III.) is a bursting capsule, dehiscing loculicidally—that is, through the back of the cell.

Glad'iolus (Fig. 101).—This has a somewhat irregular flower; while the three stamens stand erect at the back. Three of the perianth leaves are spread out

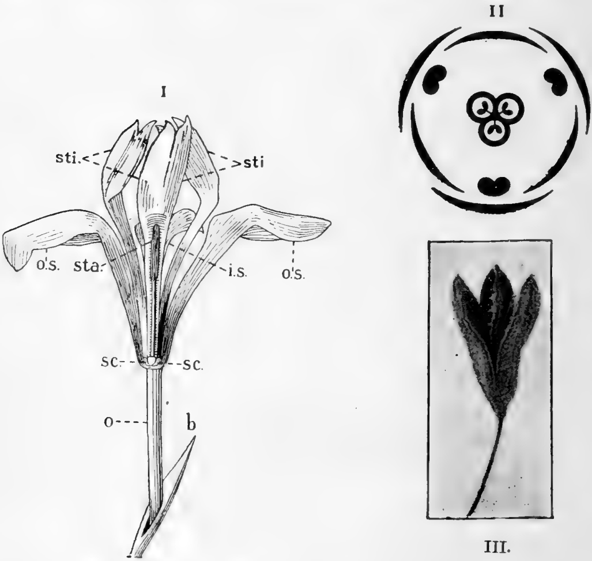


FIG. 100.—*Moræ'a edu'lis.* I. Flower after removal of one outer and two inner segments of perianth: *os.*, outer segments; *i.s.*, inner segments; *sta.*, stamen; *sti.*, petaloid stigmas; *sc.*, scars of removed segments; *o*, ovary; *b*, bract. II. Diagram of flower. III. Loculicidal capsule of *Moræ'a edu'lis.*

in front, forming a sort of false lip, as a landing-place. The style with the three sub-petaloid stigmas stand over the three anthers; so that the insect, having got dusted on the back or its *thorax*, thrusts it against the projecting stigmas on entering another flower.

If the reader will compare the flower of *Glad'iolus* with that of *Leono'tis* (Fig. 85), it will be seen that the modification for pollination is precisely the same, as well as in *Duvernoi'a* (Fig. 13), and indeed in many other flowers of quite different families.

The cultivated kinds of *Glad'iolus* are in many cases hybrids between wild South African species, and bear much larger and handsomer flowers in consequence.

Fig. 101.—*Glad'iolus.*

General Description of the Moræa and Gladiolus Family.

Herbs—With bulbs, corms, or rhizomes.

Leaves—Narrow, ensiform, or "sword-like."

Flowers—Perianth, superior, tubular, limb regular or irregular; stamens, 3, free or united, and adherent to the perianth; anthers, extrorse; ovary, inferior, issuing from a sheathing bract.

Fruit—Capsule, 3-celled.

Amaryllidaceæ.

THE BELLADONNA FAMILY.

This contains some 650 species of 64 genera in 5 tribes. South Africa has 21 genera in 2 tribes. It differs from *Irideæ* in having six stamens, but with a similar inferior ovary. This last feature is the only one which separates it from the Lily family (*Liliaceæ*), in which it is superior.

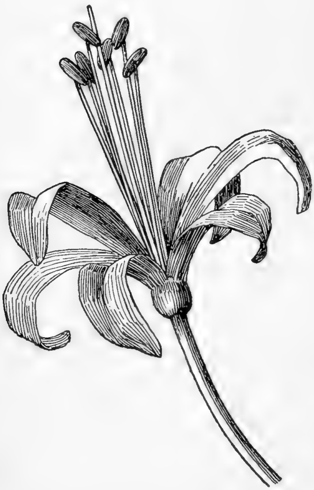


FIG. 102.—*Neri'ne Sarnien'sis* (Guernsey Lily).

Neri'ne. — There are several species, of which *N. Sarnien'sis,* the "Guernsey Lily," is common about Table Mountain. It obtained this name in consequence of a ship having been wrecked on the shore of Guernsey in 1680; quantities of the bulbs which formed part of the cargo were thrown ashore, so it became cultivated there and known as the Guernsey Lily (Fig. 102).

The flower of this, as of all the members of the order, is very simple. The inferior ovary and superior perianth must be first observed, to distinguish any members from the Lily family. The perianth may be in six separate leaves or coherent into a tube. The six stamens will be adherent to the tube, with introrse anthers, never extrorse as in *Irideæ.* In some genera with a polyphyllous perianth (*i.e.* with free perianth leaves), the stamens are free from the perianth tube, and are epigynous.

The fruit is usually a capsule, or sometimes a berry.

Hæman'thus.—This genus has its very small flowers massed into a large head surrounded by brightly coloured bracts, thereby imitating a single flower; but an examination of one of the tiny flowers reveals the structure as identical in main features with all other members of the family, which differ in the lengths of the tube and border, how they are expanded, etc.

Some genera have the stamens connected by a petaloid band, called a *corona.* This is seen in *Pancra'tium.* It is very characteristic of the English Daffodil, in which it forms a long trumpet; but in the Poet's Narcissus, it is reduced to a little purple rim.

Amaryl'lis Belladon'na.—This plant gave the name to the order and one tribe. It is the only species of the genus; it has just a slightly curved perianth, with not much difference in the size of the leaves; but it well illustrates another adaptation to insects in having the stamens and style *declinate,* or lying down in front.

As the separate perianth leaves do not afford a safe landing-place, the stamens have undertaken to provide one. This is a common feature in many flowers of Dicotyledonous plants, as in certain species of *Pelar-go'nium*, in *Plectran'thus* (*Libiatæ*), described above (p. 213), etc.

The interpretation is that the flower had originally erect, spreading stamens; but as insects always came from one side and depressed them in visiting the flower for honey, they finally and permanently assumed this dependent or declinate position.

The second tribe is called *Hypoxideæ*, and has three genera in South Africa, of which two have only one species each, but *Hypox'is* has many. The flowers are not in umbels as are those of *Amaryllideæ*. The seeds have a hard black coat.

Hypox'is.—Fig. 103, I. illustrates the characteristic appearance of the flower. (II.) is a vertical section of a flower-bud, showing the elongated inferior ovary and the hairy perianth. The diagram (III.) shows the flower to be perfectly regular and *three-merous*, *i.e.* whorls in threes.

General Description of the Belladonna Family.

Herbs—Bulbous, or fibrous rooted.

Leaves—Ensiform.

Flowers—Perianth superior, regular or irregular,

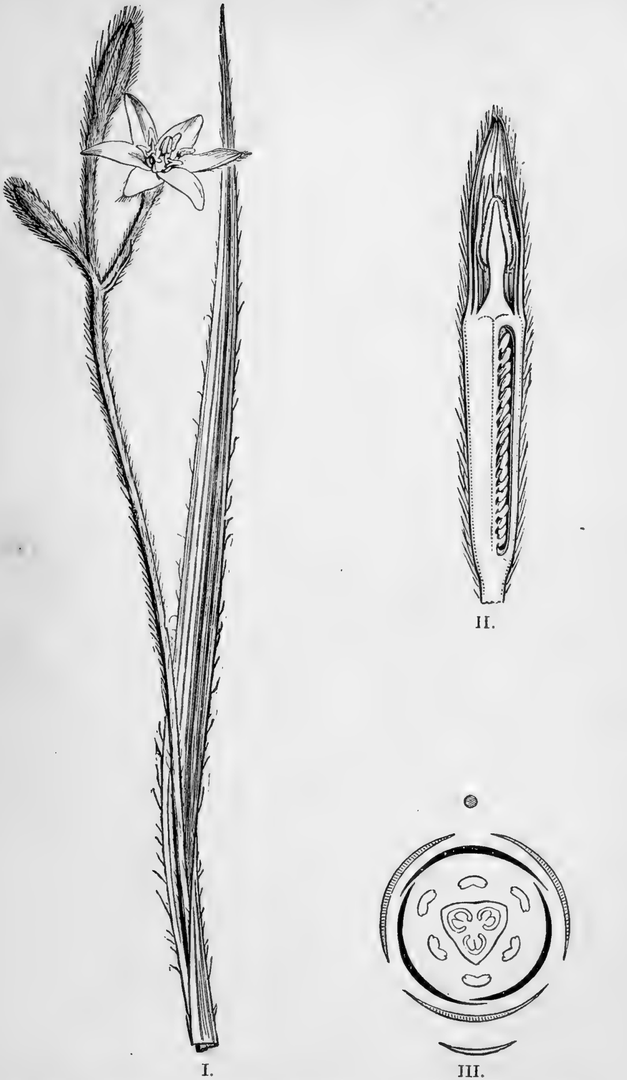


FIG. 103.—*Hypox'is.* I. Inflorescence and leaf. II. Vertical section of flower-bud. III. Diagram.

free or coherent; stamens, 6, adherent to perianth or free; ovary, inferior, 3-celled.

Fruit—Capsule or berry.

Liliaceæ.

The Lily Family.

This is an order containing some 2100 species of 187 genera in 20 tribes. South Africa has 31 genera. It takes its name from the genera *Lil'ium,* which has about 45 species, all natives of the northern hemisphere. The order only differs from *Amaryllideæ* by having the perianth inferior and the ovary superior; for, as in that order, the six leaves may be free or coherent, and the stamens may be free or adherent to the perianth. All have six stamens with introrse anthers and a fruit, either a capsule or a berry.

Ornithog'alum.—This genus has many South African as well as foreign species; one, called the "Star of Bethlehem" (*O. umbella'tum*), is not uncommon in England. The perianth is six-parted, and spreading in flower (Fig. 104, II.). The stamens are at the base of the perianth leaves. It has a membranous capsule.

The flowers are white, orange, or scarlet, rarely yellow.

Aloë.—This is a very large genus recognized by its massive and fleshy leaves. It is sometimes almost tree-like, with a simple or branched stem. The flowers

I.

II

Fig. 104.—*Ornithog'alum thyrsoi'des.* I. Raceme ($\frac{1}{3}$). II. Flower. The filaments of three stamens are winged at their base.

are in racemes, often brightly coloured. There are upwards of 80 species, natives of dry places.

The aloes of Africa are imitated by the so-called "American aloe," which is really *Aga've,* a native of Mexico, and belongs to the order *Amaryllideæ,* but in consequence of growing under similar arid conditions, during the course of many generations, the leaves have acquired precisely the same form and structure as of the true aloes. The use of the thick leaf is to store up water; the whole interior is made of large cells full of water saturated with a gummy or other substance. From special vessels is extracted, from certain species, the so-called "Bitter Aloes" of the chemists. Fig. 105 (I.) shows a branch of one species. (III.) is a section of a flower. In this genus the stamens happen to be free from the perianth. (II.) is a diagram showing the relative positions of the parts.

Aspar'agus (Fig. 106).—This genus is remarkable for producing tufts of, apparently, leaves at the nodes; but they are thought to be branches in the cultivated plant, and are called *cladodes*, from the Greek word for a branch. In some species they are, however, developed into true leaves, but may still be of the nature of flattened branches, called *phylloclades, i.e.* "leaf-branch."

The young edible shoot is called in botanical language a *turio*. Some species indigenous to South Africa are eaten. One with oval, pointed phylloclades is much used for table decoration. It used to be called

Myrsiphyl'lum, but is regarded now as a species of *Aspar'agus*. That it bears no true leaves may be seen

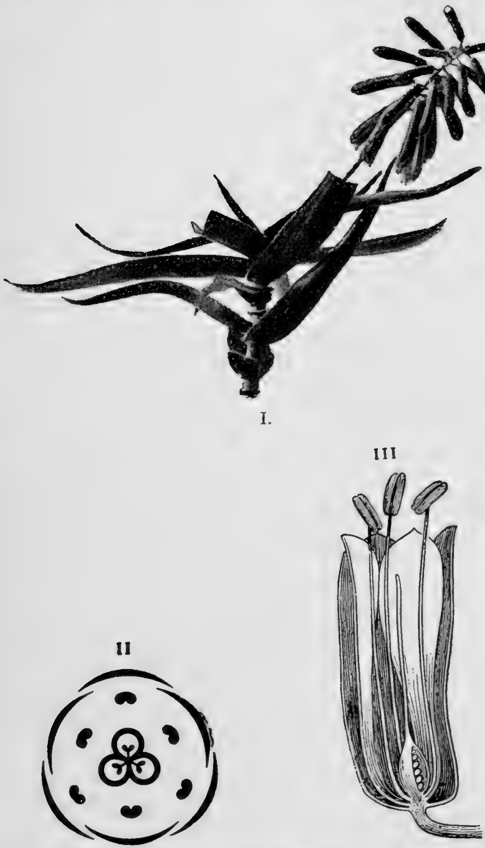


FIG. 105.—*Aloë cilia'ris.* I. Flowering-branch. II. Diagram of flower. III. Vertical section of flower.

from the fact that each phylloclade issues from the axil of a minute scale. This *is*, in fact, the leaf, but reduced to a mere rudiment.

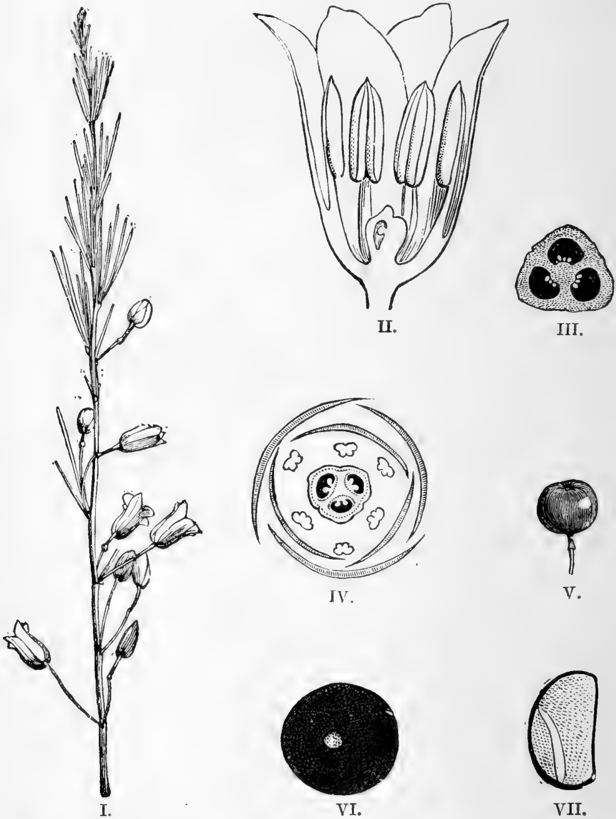


FIG. 106.—*Aspar'agus*. I. Flowering-shoot. II. Vertical section of flower. III. Transverse section of ovary. IV. Diagram. V. Fruit. VI. Seed. VII. Vertical section of seed.

The following are the details of a flower of *Aspar'agus*:—

The flower has six perianth leaves (II., IV.), slightly coherent at the base with the six stamens adherent to them; the ovary is, as usual, three-celled (III.), while the fruit is a berry (V.); and the seed (VI.) with much endosperm around the embryo (VII.). If the diagram (IV.) be compared with that of *Hypox'is,* it will be seen to be almost identical. In fact, the only distinctive feature between the orders *Amaryllideæ* and *Liliaceæ,* is the inferior ovary of the former and the superior one of the latter.

General Description of the Lily Family.

Herbs, shrubs, or *trees*—Bulbous, or fibrous rooted rhizomes, etc.

Leaves—Mostly linear or with broad blades.

Flowers—Mostly regular, perianth inferior; perianth-leaves free or coherent; stamens, free from or adherent to perianth.

Fruit—Capsule or berry.

Naiadaceæ.

The Water-uintjes Family.

This family of water or marsh plants contains about 120 species of 16 genera in 8 tribes. In South Africa there are only 6 genera.

Aponoge'ton.—The Water Uintjes has a tuber, which is esculent, bearing oval leaves. From among these rises the peduncle branching above, and carrying two rows of white bracts. In the axils of these are two coloured sepals, six to eighteen stamens, and from three to five carpels, which become follicles in fruit (Fig. 107, I.). (II.) is a seed with the embryo just beginning to germinate.

This is the only genus of the tribe to which it belongs. One species, formerly regarded as a separate genus (*Ouviran'dra*), growing in Madagascar, is remarkable for having the leaf full of holes, in consequence of the green tissue not being formed within the little squares made by the "ribs" and "veins" of the leaf, which go to make the so-called "skeleton." Other species are found in tropical Asia and temperate Australia.

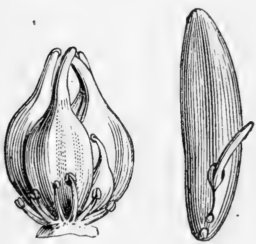


FIG. 107.—*Aponoge'ton.* I. Flower. II. Embryo commencing to germinate.

The top of the peduncles, boiled, are eaten. *A. distach'yon* is the commonest of the three South African species. All the other genera are probably introductions from Europe.

The flowers of *Aponoge'ton* illustrate a feature common in the family, namely, of *degradation.* Several have either a dwarfed perianth or none at all. This is, presumably, the result of an aquatic life.

Aroideæ.

THE "TRUMPET-LILY" FAMILY.

This order contains 900 species of 98 genera in 11 tribes. In South Africa there are only 3 genera, two being in Natal, and the third the common "Trumpet Lily," or "Lily of the Hill." The flowers are mostly unisexual, and arranged on a peduncle called a *spadix*. This is surrounded by a large white bract called a *spathe*. They are often water or marsh plants.

Richar'dia.—*R. Africa'na,* also called *Cal'la Æthiop'ica,* is a common ditch-plant throughout the Colony; and its large, fine, white spathe is a familiar object. The lower part of the spadix carries pistils intermixed with club-shaped, abortive stamens or staminodes.

The upper part is entirely covered with stamens. Each stamen has two anther cells, attached to a somewhat *cuneate,* or wedge-shaped connective, expanded above; on the top of the cells are pores by which the pollen escapes. There is no perianth; a pistil, usually composed of three carpels, together with three staminodes, make a female flower; and three stamens constitute a male flower.

The leaves and flowering stems arise from a thick fleshy rhizome.

There are three forms of leaves which are common in this family—a long, narrow, or linear form terminating in a point; a similar flat one with a blade at the top, of the shape of an arrow-head, as in *Richar'dia;* thirdly, the same with the space between the lower points filled in, so making a peltate, or shield-like leaf.

In a common English plant, called the "Arrow-head," from the shape of the leaf-blades, we discover that the first kind (without any blade) occurs when submerged in deep water, the long, narrow form being caused by its growing, or being "drawn" up, towards the light above.

When it can reach the surface, the blade begins to be formed, and is oval in shape; soon, however, it develops projections below, looking like a "spear"-head, and is said to be *hastate.* These points grow downwards, making a *sagittate,* or arrow-shaped blade.

The further condition of a peltate blade does not occur in this plant, but does in other genera, as *Cala'dium.*

Another point is important; namely, that the flat linear leaf is really the leaf-stalk, or phyllode, and as the veins run parallel to one another in leaf-stalks, this accounts for the general description applied to Monocotyledons of having "parallel or straight-veined" leaves. The importance of this is seen in the fact that, besides several plants of the *Aroideæ* showing these differences, much the same occur in the Water-lily family (*Nymphæaceæ*) of Dicotyledons.

There are, in fact, many more points of resemblance between Monocotyledons and aquatic Dicotyledons. I have already called attention to the structure of the rhizome of the water-lily, which closely resembles a stem of any monocotyledon. Again, when the seeds germinate, the first, primary, or axial root is soon arrested, as it always is in Monocotyledons.

Many points in the microscopical structure within the roots and stems also agree; so that the number of features in common is so great, that it is thought that the whole class Monocotyledons has been derived from some aquatic forms of Dicotyledons many thousands of years ago.

Many Monocotyledons are, of course, *now* terrestrial plants, but they still retain features which are really characteristic of water-plants.

Another fact may be mentioned, that the percentage of aquatic Monocotyledonous orders is about eighteen; whereas that of Dicotyledons is only four. Again, so long ago as 1835, a German botanist, who studied South African plants, came to the conclusion that the distribution of Monocotyledons over the world was regulated more by *moisture* than by *temperature*, as Dicotyledons are.

Again, a large number of the beautiful flowers, for which South Africa is famous, possess large bulbs. Now, we know that these are special storehouses, not only of reserve food materials, but also of water; and it seems probable that when they ceased to be true aquatic plants, they assumed this form to meet the difficulty of having to live out of water.

General Description of the Richardia Family.

Herbs—Sometimes climbing by aërial roots; with acrid juice.

Leaves—Linear or with ovate, sagittate, or peltate blades.

Flowers—Usually unisexual, on a spadix with or without a spathe; perianth, 3- to 6-parted or 0; stamens, definite or ∞; anthers extrorse, or with pores; ovary, free, 1-celled.

Fruit—Berry.

Juncaceæ.

The Palmiet Family.

This order, named from the genus *Juncus,* the Rush, which has nearly 200 species alone, contains about 80 additional ones; many of the southern hemisphere having only one or two apiece.

Prio'num.—*P. Palmi'ta,* called the Palmiet, is remarkable for its thick, trunk-like stem, four to six feet in height, with a crown of broad serrated leaves, from the middle of which rises a branched *panicle,* or loose cluster of flowers. Like the true rushes, it is a marsh-plant. The perianth is six-parted, more or less glume-like; there are six hypogynous, free stamens, a pistil of three coherent carpels, *i.e. syncarpous.* The fruit is a capsule, dehiscing loculicidally, or through the back of each carpel into the *loculus,* or cell.

General Description of the Rush or Palmiet Family.

Herbs, or *half-tree* like (*Palmiet*).

Leaves—Flat, channelled, or *fistular* (hollow).

Flowers—Perianth, glume-like, persistent; stamens, 6, on the base of the segments of the perianth; ovary, 1- to 3-celled.

Fruit—Capsule, 3-valved, loculicidal.

Restiaceæ.

The Restio Family.

This order contains 230 species, which are mainly inhabitants of South-West Africa and Australia. There are 20 genera, 11 of which are South African. They are perennial herbs bearing annual flowering stems. The leaves have sheaths, which in most of the genera remain on the stem after the linear blade has fallen; they are split on one side—that is to say, the edges of the sheath have not united as in Sedges, but resemble Grasses in this respect.

The flowers have bracts which contain the *spikelets,* *i.e.* little *spikes,* of sessile flowers.

Res'tio.—This genus gives the name to the order, and contains about 100 species. The perianth consists of six unequal *glumes*, or chaff-like scales, instead of petaloid perianth leaves (Fig. 108, III.).

There are three stamens in the male flower (III.), and a pistil of two to three carpels in the female (V.). The fruit is a capsule.

Do'vea.—This differs from *Res'tio* in having deciduous sheaths instead of *persistent* ones to the leaves—that is, they fall off instead of remaining on, forming the conspicuous dark-coloured tubes round the stems.

D. tector'um, of the Cape flats, is used for thatching, as the name implies.

General Description of the Restio Family.

Herbs—With scaly rhizomes.

Leaves—Linear, with persistent tubular sheaths.

Flowers—Diœcious, perianth glumaceous, persistent, of 6 glumes in 2 whorls; *male*, stamens, 3; filaments adherent to base of inner glumes; anthers, 1-celled; *female*, ovary, 1- to 3-celled.

Fruit—Capsule, 1- to 3-celled, dehiscent, or nut-like, and indehiscent.

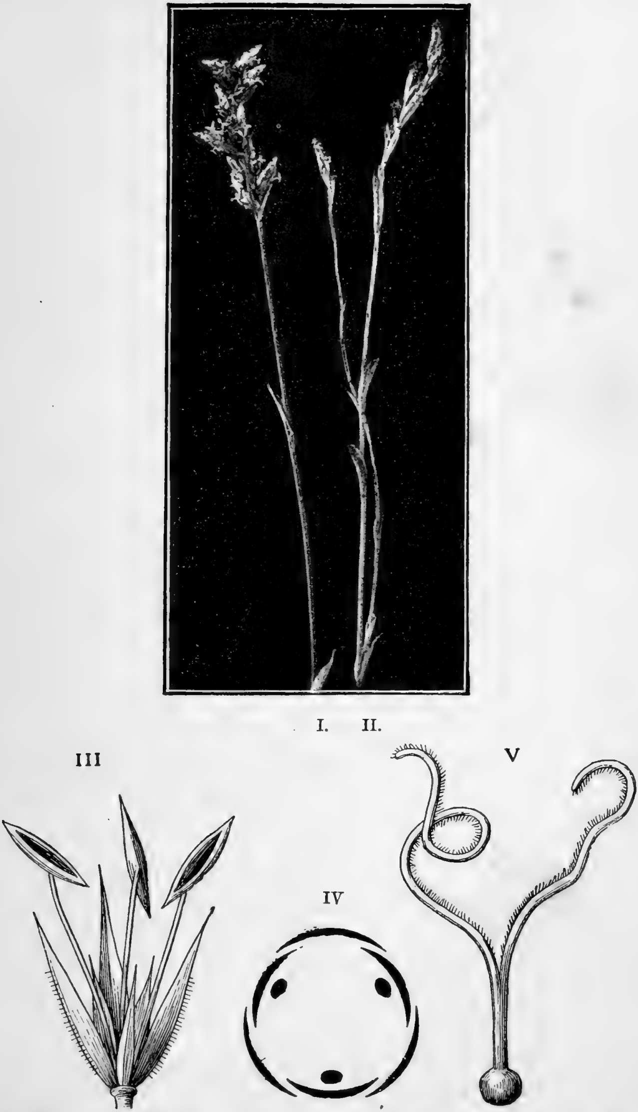


Fig. 108.—*Res'tio cuspida'tus.* I. Male plant (½). II. Female plant (½). III. Male flower (× 4). IV. Diagram of male flower without bracts. V. Pistil from female flower (× 4).

DIVISION II.—GLUMACEÆ.

Cyperaceæ.

The Matjesgoed and Nut-grass Family.

This is a very large order containing 2200 species of 61 genera in 6 tribes. South Africa has 30 genera. These are the true "Sedges," many being characteristic of wet places as well as growing in water. They have leaves with an entire sheath, not "split," as in *Res'tio* and Grasses.

Fig. 109.—*Cype'rus.*

The flowers are in spikelets, composed of scale-like, dry, or scarious bracts, called glumes, from the Latin *gluma*, meaning "chaff," as they are commonly known in wheat. Each glume has a solitary flower in its axil. As a rule, there is no perianth, but it may be represented by bristles or hairs, or it may be entirely wanting. Within the glume are usually three stamens, and the pistil is composed of three carpels indicated by the three stigmas; but there is only one ovary-cell, which forms a single-seeded achene.

Cype'rus.—The spikelets have their glumes arranged in two ranks. Each flower consists solely of three stamens and a pistil (Fig. 109).

There are many Cape species; the leaves are grass-like and mostly flat. The spikelets are usually tufted in dense clusters. *C. tex'tilis* is used for thatching.

Ca'rex.—This is a diœcious, or more usually monœcious, genus. The glumes are imbricated all round the axis, and not in two ranks like *Cype'rus.*

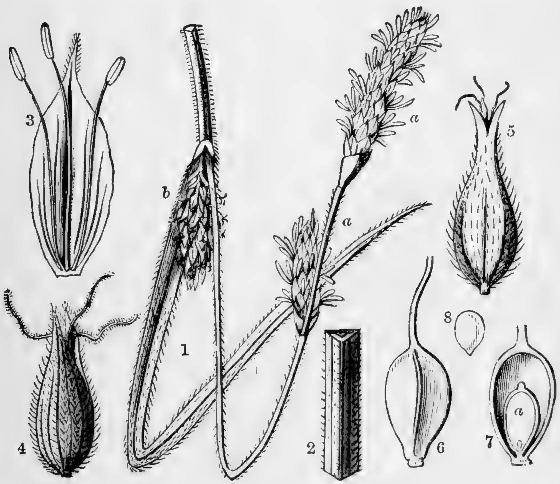


FIG. 110.—*Ca'rex.* (For description, see text.)

The flowers are very simple; the male consists of three stamens in the axil of a glume (Fig. 110, 3).

This genus has several species in the Colony. They are herbs with grass-like leaves. When monœcious, the female spikelets are *below* the male. The same arrangement occurs when both male and female flowers are in the same spikelet.

In the species figured (110, 1), the leaves are flat and hairy; the bract also taking the form of a leaf (1, *b*). The female spikelet (1, *b*) is sessile or seated in the axil of the long bract by itself; but the male (1, *a*, *a*) are usually two or three in number. (2) is a portion of the three-angled stem. (3) is a male flower, consisting of a bract or glume, with three stamens. (4) is a female flower, consisting of a pistil of three carpels, as indicated 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 vertical section of the ovary showing the single seed, the embryo at the base being surrounded by endosperm. (8) is the embryo.

General Description of the Matjesgoed Family.

Herbs—Tufted; with a creeping rhizome, and three-angled solid culms.

Leaves—With entire sheaths.

Flowers—In spikelets, with scale-like glumes, each having a flower in the axil. Perianth, of bristles, hairs or 0; stamens, 3; ovary, 1-celled.

Fruit—Achene, sometimes within a bag-like envelope (*Ca'rex*).

Gramineæ.

The Grass Family.

This is perhaps the largest order in the world, and contains some 3150 species of nearly 300 genera in 13 tribes, with sub-tribes. South Africa has about 90 genera. They are all herbs with the exception of Bamboos, which grow to hundreds of feet in height. The leaves have a "split" sheath.

The stem is called a *culm,* as in Sedges. It is usually hollow except at the joints, so as to impart strength; but the sugar-cane has a solid stem, the pith of which contains the sugar.

The flowers are very similar throughout the whole order; so that when one has been thoroughly mastered, it is easy to learn how other genera depart from the typical example.

Bro′mus.—This is a large genus; several species are European, and there are six at the Cape.

In the illustration (Fig. 111), we have all the important details shown. (1) is a part of a *panicle,* or loose cluster of spikelets, *i.e.* "little spikes," of sessile florets on alternate sides of the axis, called a *rachis* (1, *a*, *a*). (2) is a section of the *culm,* or stem, showing the solid *node* (*a*) and the hollow *internode.* The leaf arises from the node having a sheath "split" down one side, embracing the culm. At the top of the sheath whence the blade arises, is a little flap called a *ligule*. (3) is a complete spikelet composed of ten florets. There are two empty glumes at the base (*a*); (*b*, *b*, *b*) are individual florets or flowers, each consisting of the following elements: First, is the *Flowering glume*, wrapping up all the inner parts. It has a certain

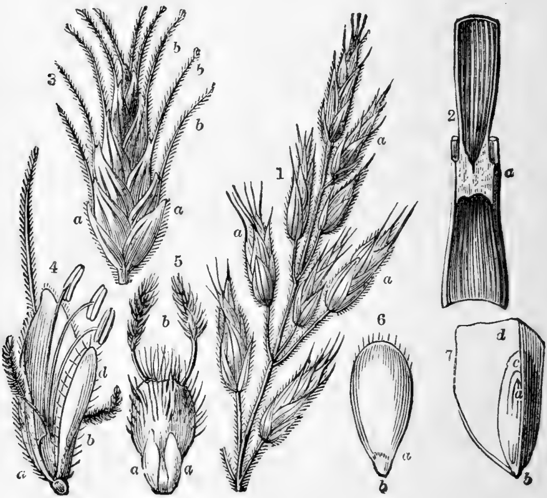


FIG. 111.—*Bro'mus.* (For description, see text.)

number of ribs. The middle one is prolonged into an *awn* (3, *b*). Opposite to it, and overlapped by the flowering glume, is a smaller glume, called the *pale* (4, *d*). It usually has two distinct ribs and overlapping margins (not represented in the figure, 4, *b*). These suggest the idea that the pale has been formed of two coherent glumes. Next are seen two very small bodies just inside the flowering glume. They are sometimes fringed at the top. They are called *lodicules* (5, *a*). A few grasses, as Bamboos, have three, suggesting the idea that grasses once had a perianth of six leaves, of which the inner whorl of three is now reduced to two lodicules. Then follow three stamens with *versatile* anthers, as they turn and swing readily, being attached to the filament at one point. Lastly, is the pistil (5, *b*), with its feathery stigmas (4, 5, *b*), indicating probably two carpels, but there is only one ovule.

The ripe fruit, or "grain," is of the nature of an achene, as the pericarp tightly invests the seed which contains much endosperm (7, *d*). This in wheat, when ground, makes flour. The embryo is found at the base of the grain just under the skin (6, *a*, *b*), in which (*a*) is the plumule and (*b*) the radicle end below.

The plumule consists of overlapping rudimentary leaves (7, *a*), which lie in a depression of the single cotyledon (*c*), sometimes called the *scutellum* in grasses, as it takes the form of a little "shield." The chief use of it is to secrete a ferment, by means of which it dissolves the endosperm (7, *d*), and absorbs the nutritive matters for the benefit of the plumule and roots. At (*b*) may be seen the adventitious roots, just beneath the surface, for the radicle produces no definite or permanent tap-root, as in Dicotyledons. These details can be best studied in the commencement of germination, as suggested in the Introduction to this book.

The student should examine some wheat and oats when in blossom, and he will find the essential features just the same as in *Bro'mus* (Fig. 112, I.–III.).

In most spikelets the topmost florets are barren,

I. II. III.

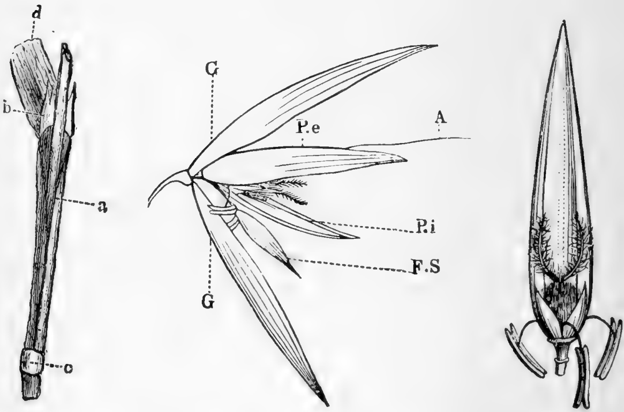


FIG. 112.—I. *a*, Split leaf-sheath of a Grass; *b*, ligule; *d*, part of the blade of the leaf; *c*, node of the culm. II. Expanded spikelet of the Oat, with a fertile and a barren flower, FS; G, glumes; Pe, flowering glume, with awn, A; Pi, the pale; within are visible the feathery stigmas. III. Fertile flower with the flowering glume removed.

consisting only of two glumes. In wheat, the lowermost florets, usually three, bear grains, but the upper ones, as of oat and *Bro'mus*, are abortive.

This most useful of orders has so many valuable species supplying grain for human beings, corn and food for animals, that it would be impossible to describe them; but although the family is so large, there is a great uniformity in the structure, so that when one, say wheat, is thoroughly understood, it will form a key to all other kinds.

General Description of the Grass Family.

Herbs—Rarely arborescent (Bamboos), sometimes with rhizomes bearing annual hollow culms, solid at the nodes.

Leaves—Long and linear, with a "split" sheath, bearing a ligule, or fringe at the top.

Flowers—Uni- or bi-sexual in spikelets, composed of glumes on opposite sides of the axis, lower glumes often empty; floret, usually consisting of flowering glume and pale, 3 lodicules, 3 stamens and pistil, with 2 feathery stigmas.

Fruit—A "grain."

INDEX TO TERMS, ETC.

INDEX TO GENERA, ETC.

D

THE END.

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