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John Cassell's Educational Course.

OUTLINES OF BOTANY.

INCLUDING A DESCRIPTION OF

Mosses, Lichens, Fungi, Ferns, and Seaweeds.

BY

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CONTENTS.

PREFACE.

THESE FIRST OUTLINES OF BOTANY are not sent into the world for the purpose of disturbing the *prestige* which justly attaches to the writings of Lindley, Royle, Brown, and other celebrated botanists. The merits of these authors none will dispute, whether as writers of monographs or full treatises; but, in one respect, all these writings are so deficient that few students have been able to master even the rudiments of Botany, still less to become moderately acquainted with the characteristics of species, except on the condition of attending lectures and having the *entrée* to a botanical garden. This deficiency we have supplied by very copious, correct and highly-finished woodcut engravings. Under the ancient exclusive system of book publication the great expense attendant on the execution of so many pictorial arrangements would have rendered its adoption impossible. In this respect, then, our FIRST OUTLINES possess an undoubted advantage over every preceding treatise. The student will be rendered independent of botanical gardens, which, though highly desirable whenever they can be commanded, are not so indispensable that the whole science of Botany must be abandoned by students who have not that advantage.

It remains now to say a few words relative to the general treatment of the subject we have followed. Firstly, care has been taken to indicate the broad natural classifications of the vegetable kingdom, without going further into details than is absolutely necessary for purposes of illustration. Without minutely indicating the minor particulars in which authors of natural systems of Botany have differed amongst themselves, care has been taken to show that every natural classification of vegetables reposes on the same general basis, and accords harmoniously with chemistry and physiology; whilst the ingenious artificial system of Linnæus, however convenient for times when so many vegetable species remained undiscovered, is at best an ingenious *memoria technica*, a grouping of vegetables in most incongruous communities, totally at variance with every scientific analogy.

The reader will not fail to notice that the first half of our FIRST OUTLINES does not contain so many detailed characteristics of families as the second. This peculiarity has been adopted advisedly, under the impression that as soon as the student has mastered the outline of his subject, he will, without further difficulty than that already experienced, be enabled to enter upon its minuter details. Such, then, is an exposition of the author's views and intentions. It remains for the public to judge how far they have been carried out.

Most of the technical terms are explained in the early part of the work, but if any occur without explanation, or the reader cannot remember meanings which have already been given, he will be relieved of all difficulty by simply referring to the Glossary and Index at the end of the volume, where the explanatory portion is distinguished by the use of the dash, thus: "Acauliferous —without stalk."

[As some portion of the ensuing work has appeared in the "CHILD'S EDUCATOR," a word of explanation may be necessary. The very favourable reception given to the LESSONS IN BOTANY in that work suggested the issue of a more consecutive and comprehensive series, a series which should include the whole of the original engravings, and be further enriched with numerous additions. This suggestion having been followed by requests from respected correspondents, the result is, the appearance of the present work as one Volume of the "EDUCATIONAL COURSE."]

John Cassell's Educational Course.

FIRST OUTLINES OF BOTANY.

INTRODUCTION.

AT the outset we may as well state that by the term Botany we mean the science which teaches all about plants; such as their form, their aspect, the number and structure of their flowers, their seeds, and, in short, all that in any way relates to them. The word botany is derived from the Greek, in which language βοτάνη (*botané*), signifies a plant. Our friends the Germans call the study *pflanzenlehre*, plant-teaching; and, in our opinion, they are quite right to find a name for this and many other sciences out of their own language. We English might with great propriety do the same on many occasions, but it is not the custom.

Botany is a very interesting, no less than a very useful study, and it possesses over many others the advantage of being attended with no expense.

Inasmuch as Botany is the science which teaches all about plants, the learner will agree that it is necessary to set out with precise notions as to what a plant is. Nothing would appear to be more easy than this; and easy enough it is when we take extreme cases: thus, for instance, no one would ever take an oak tree for an animal, or a horse or an elephant for a vegetable; but there are certain beings whose characteristics are so little marked, that philosophers are to this day not agreed as to the division of nature to which they ought to be referred; in other cases again, beings have been taken out of one classification and inserted under another; this remark applies to the sponge, which, although it grows attached to rocks under the sea, is now universally considered to be an animal, or, more properly speaking, the skeleton of an animal, the soft portions of which have been dissolved away.

The great Swedish naturalist Linné, more frequently known by the Latin denomination Linnæus, adopted the following pithy designation of minerals, vegetables, and animals.

"Minerals," he said, "grow, plants grow and live, but animals grow, live, and feel." A very neatly turned expression this is, we must all allow, and the task would not be easy in few words to show wherein it is insufficient. Naturalists of the present day, however, do not consider it quite correct, and, what is more, naturalists own that their ingenuity has been unable to find a distinction which is quite correct: however, the following is perhaps more nearly correct than any other. Animals are those living beings which derive their nutriment from an internal cavity (the stomach), and vegetables are those living beings which absorb their nutriment from without.

§ 1. ON THE PRINCIPLES WHICH SERVE FOR THE CLASSIFICATION OF PLANTS.

Whatever may be the subject of our study it requires to be classified; classification being the very key-stone of order, without which our ideas become obscure and confused: therefore it is that even the least botanical amongst us, when speaking of vegetables, make a rough sort of classification for ourselves, usually dividing them into herbs, plants, bushes, or shrubs, and trees. And, for many common purposes this rough and ready distinction is sufficient, but it is not very correct, and therefore will not answer the purposes of a botanist.

To prove that the distinction is not correct, we will mention two cases in point, and we are sure the learner will accede to the justice of the remark; what would the reader term a myrtle as he sees it growing in our climate? A poor tiny thing scarcely bigger than a geranium, he would not term a tree, he would call it a shrub or a bush; nevertheless, this very same species of myrtle assumes under the more genial sun of southern Europe and northern Africa, the dimensions of a goodly tree. Again, what would the reader term the mignionette? A plant of course; yet in northern Africa, along the Barbary coast, its stem becomes woody, and it assumes the aspect of a bush or shrub at least.

When the true relations subsisting between vegetables are well considered, we shall find that the mere size of a vegetable has nothing to do with its real nature:—thus the sugar cane, which grows to the elevation of fifteen or sixteen feet, is still, to all intents and purposes a grass; as in like manner is the bamboo, which assumes the dimensions of a tree.

Then, again, the lily tribe,—does not the very sound of the word lily cause ideas to arise of some delicate herb-like growth, surmounted with drooping flowers? Of this kind are the lilies which grow in our climate; but all lilies are not thus. The great dragon tree, as it is called, is still a lily; and as though Nature desired to confound our prejudices by one bold master-stroke, these dragon trees are amongst the largest, and the oldest, if not the very largest and very oldest, of known trees. The great dragon tree of Orotava, in the island of Teneriffe, a drawing of which we give on the following page, is of such dimensions that ten full-grown men, joining hand to hand, are scarcely sufficient to encircle its base. It is now about four hundred years ago since the island of Teneriffe was first discovered. The great dragon tree of Orotava was then, as it is now, the twin wonder of that island, dividing its interest with that of the stupendous peak. Precise accounts have been handed down to us of its size; from a consideration of which it appears, that the monster has increased but very little in dimensions since that time; a probability which is still further confirmed by observations made on young dragon trees, the growth of which is remarkably slow. What grand, what stupendous thoughts, does a contemplation of this fact awaken! When did this monster first begin to grow? How many thousand years have rolled over its weather-beaten head? We are afraid to speculate on these points, but will content ourselves by saying, that according to the most reasonable evidence which can be adduced, this great dragon tree began to grow long, very long, before the creation of man. Yet this monster is a lily!

The student will admit, that supposing our previous remarks to be correct, our ordinary notions concerning the similarities or dissimilarities of vegetables, in other words their alliances, and as a consequence their classification, are very incorrect. Not less incorrect are some of our common ideas regarding the similarities and dissimilarities, or the alliances, of the parts of which vegetables are composed. For example, do we not commonly speak of onions and potatoes as roots? yet they are not roots, nor are they similar, far less identical, in character. The onion is a bulb, or underground bud, and the potato is a tuber or knotty excrescence developed underground, from which the roots and stems of the potato plant respectively spring. Why are they not roots? the learner may ask. The reason why will appear by and by; to explain these reasons is an object, and one of the main objects, of Botany. We merely cite the example now for the purpose of making known in a striking manner the incorrectness of many notions we are in the habit of entertaining.

Again, do we not in ordinary language term the strawberry and the fig, fruits? Yet neither is a fruit.

Not a fruit! the young botanist exclaims, do we not eat them? Well, surely, our young reader would not limit the term fruit to something

The Dragon Tree.

which grows on a vegetable, and which is good to eat. We think he will admit that the bunches of apples, as they are called, which grow on potato stems, are the fruits of the potato plant; yet potato apples are not good to eat. He will admit that the bunches which grow on ash trees are the fruits of those trees, yet they are not good to eat; finally, not to multiply examples unnecessarily, he will admit that acorns are the fruits of the oak tree :—and although our ancestors, the ancient Britons, are known to have eaten them, yet all we can say upon that point is, that one pities the bad taste or the hard fortune, as the case may be, of our forefathers.

If strawberries, then, and figs are not fruits, what are they? Why the fig is to all intents and purposes a compound flower, as much as the dandelion is a compound flower; and a strawberry is something like a fig turned inside out; but the learner shall judge for himself.

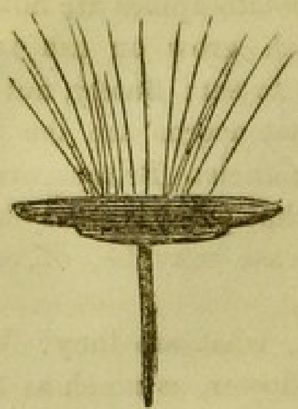
The strawberry plant bears, as we all know, a very evident, a very pretty flower; the petals or flower-leaves of which dropping off, we ultimately get something which is good to eat, and which we term the strawberry fruit.

Why, then, is it not a fruit? We will see. If it be a fruit, it should contain seeds; but on cutting it open we cannot find any. Here, then, the learner would be puzzled if Botany did not come to his aid. General principles have to be appealed to, and the appeal will not be made in vain.

Whilst conjecturing within ourselves the botanical nature of the strawberry, and trying to find out the freak which nature has been playing in order to lead us astray, we all at once bethink ourselves of the little hard protuberances on the outside of the strawberry; what are they?—of what do they consist?—what is their function?

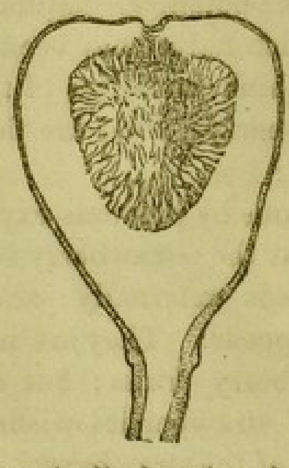
A learner, if he had not been rendered cautious by previous experience, might all at once arrive at the conclusion that the strawberry is a fruit turned inside out, having consequently its seeds externally; and amazingly like seeds do these little protuberances appear. They are not seeds nevertheless: they are fruits, the real strawberry fruits; but so little adapted for eating are they, that the lover of strawberries wishes them very far away. Then what is the edible portion of the strawberry? Botany answers this question satisfactorily and makes all clear. It is the juicy *torus* of the plant. The reader gains little knowledge from this remark beyond the knowledge of an, at present, unmeaning name: and as we do not intend that any names in this little book shall be unmeaning, we will proceed to explain what a torus is.

Torus, then, is the Latin word for *bed*, and signifies that portion of certain flowers upon which the flower itself reposes or grows. Take, for example, the marigold, and strip off all its floral parts; there will then remain underneath a flat fleshy expansion, called the torus. In the case of the marigold the torus is flat; but the reader may easily conceive that it might have been round or approaching to rotundity. In the marigold it is leathery and nauseous, but the reader will as easily conceive that it might have been fleshy and delicious, as indeed we find it to be in the strawberry. Analysed thus, we find a similarity between the strawberry and the marigold that the non-botanical reader would have little suspected. Nor is the similarity forced; it is quite natural, and loses nothing by the fullest investigation which the learner can devote to it. Thus, we dare say, the reader has watched the progress of a marigold to maturity; has noticed the flowers blown away, one by one, and nothing but the stem, the torus, and the little seed-like things imbedded upon the torus remain. These little things, like the hard excrescences on the strawberry, look so much like seeds, that they might be taken for such. However, we are never to assume because a thing is small that it is imperfect. If these so-called seeds be dissected and examined, they will be found to be real fruits, as much as the apple or the pear, and so contain seeds internally.



1. Torus of the Marigold.

And now for our other example, the fig. What is the fig? Not a fruit certainly, although the freak of nature here, if we may without disrespect use such a term, is different from those which have come under our notice hitherto. Let us cut open a fig; what then do we see? Why little things very similar in appearance to flowers, at the base of each of which there is a hard nut-like thing which cracks between the teeth. Flowers indeed they are, and the nut-like things are fruits, the edible portion of the fig being a torus; so that if we assume the strawberry to have had a flat torus instead of a knob-like one, and that the flat torus had been turned outside in, in such a manner as to form a bottle with a very narrow mouth, we should have had a result very much resembling a fig.



2. Longitudinal section of a Fig.

Even the delicious pine-apple can hardly be termed a fruit. Each pine-apple certainly contains many fruits, one corresponding with each lozenge-like marking; but the main bulk of the pine-apple, that which we find so delicious to eat, is only an assemblage of juicy fructs, as botanists call them, the exact counterpart of those little scales, which, when tightly compressed together, form the cup of the acorn.

We are sure, then, that sufficient has been stated to make apparent to a reader the necessity of abandoning many common notions he may have previously entertained in relation to the similarities and dissimilarities of vegetables, and the parts of which they are made up.

§ 2. ON THE SCIENTIFIC CLASSIFICATION OF VEGETABLES.

The observer who takes a survey of the various members of the vegetable world, becomes cognisant of at least one prominent distinction between them. He soon perceives that, whilst certain vegetables have flowers, others have not; or, perhaps, more correctly speaking, if the second division really possess flowers, they are imperceptible.

This distinction was first laid hold of as a basis of classification by the celebrated Linnæus, and to this extent the classification adopted by that great philosopher was strictly natural; beyond this, however, it was altogether artificial, as we shall find hereafter.

Now, taking advantage of this distinction, the great Swedish naturalist termed the evident flowering vegetables *phænogamous*, from the Greek work φαινόμαι (*phainomai*), *I appear;* or, *phanerogamous*, from the Greek word φανερός (*phaneros*), *evident;* and he designated the non-flowering, or more correctly speaking the non-evidently-flowering plants, by the word *cryptogamic*, from the Greek word κρυπτός (*kruptos*), *concealed.* The further classification of Linnæus was artificial, as we have already stated. The nature of this classification we cannot study with advantage just yet. Hereafter we shall proceed to explain the principles on which it was based, but this little book will not adopt the artificial system of Linnæus as a basis for teaching the science. In point of fact, the Linnean system may now be considered as obsolete. In making this division of plants into evident-flowering and non-evident flowering, or phænogamous and cryptogamic, the learner must take care not to fall into mistakes. He must greatly expand his common notions of a flower, and not restrict the appellation to those pretty floral ornaments which become objects of attraction, and of which bouquets are made. On the contrary, he must admit to the right of being regarded as a flower any floral part, however small, even though a lens should prove necessary for the discovery. Thus, in common language, we do not usually speak of the oak, and the ash, and the beech, elm, &c., as being flower-bearing trees; they are, nevertheless; and consequently belong to the first grand division of *evident-flower-bearing*, or phænogamous or phanerogamous plants. In point of fact, the learner may remember as a rule, to which there are no exceptions, that every member of the vegetable world which bears a fruit, and consequently seeds, belongs to the phanerogamous division. By following the indications of this rule, we restrict the *cryptogamic*, or non-evident-flowering plants, to the seemingly narrow limits of ferns, mushrooms, mosses, and a few others, all of which are devoid of seeds, properly so called, but are furnished with a substitute for seeds, termed *sporules* or *spores*. Sporules, then, the learner may remember, are, so to speak, the seeds of flowerless and therefore seedless plants. We admit the latter term to be a broad Hibernianism, a flat contradiction, but if it teach the reader to remember a fact, our end will be gained. Botany contains a great many hard, but useful terms; they will spring up in our path often enough, therefore let us shoot them flying when we have a chance, and fix them on some sort of memory-peg, even although the latter may be a joke.

If the reader wishes to ascertain what these sporules are like, let him take the leaf of a fern—which, by the way, is no leaf at all, but a frond (we will explain the meaning of this term by and by)—let him turn the lower surface of the frond uppermost, and there will be seen many rows of dark stripes. These are termed *sporidia*, and they contain the sporules of the plant, which sporules therefore may be got by opening the sporidia. Sporules, when regarded by the naked eye, look almost like dust; when examined under a microscope, however, their outline can be easily recognised. The difference between a *sporidium* (singular of sporidia) and a real seed may be thus explained. A seed has only one part (the embryo or germ) from which the young plant can spring; whereas a sporule does not refuse to sprout from *any* side which may present itself to the necessary conditions of earth and moisture.

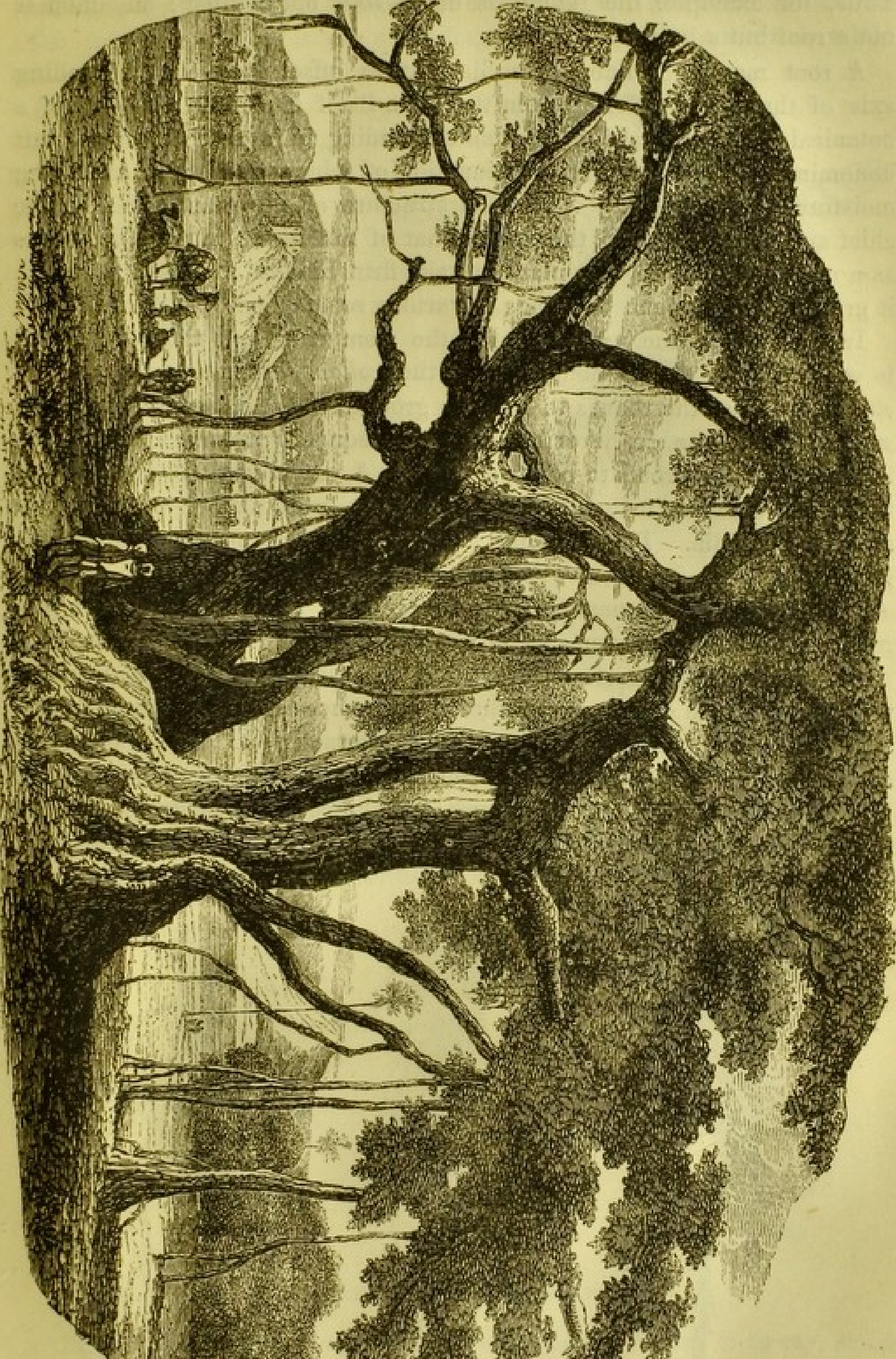
Although the sporules are thus easily discoverable in the fern tribe, yet the young botanical student must not expect to find them thus readily in other members of the cryptogamic tribe, in various members of which not only does their position vary, but their presence is totally undiscoverable.

Ferns are the very highest and best developed of all cryptogamic plants. In England, and other European countries, they are comparatively small, but in certain tropical countries they assume the dimensions of considerable trees.

§ 3. ON THE ORGANS OF VEGETABLES.

Vegetable organs admit of the very natural division into those intended for nutriment and growth, and those intended for propagation. Hence we may speak of them as nutritive and reproductive organs. Nutritive organs consist of leaves, stems, branches, roots, and various appendages to all of these, hereafter to be described; whilst the reproductive organs of vegetables are flowers and their appendages.

The Root.—We have already seen that it does not suffice to constitute

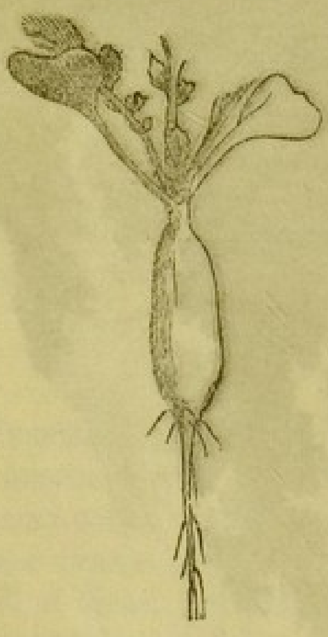


The Banyan Tree.

a root that the portion of the vegetable treated of be underground. Thus, for example, the potato is not a root but a tuber; an onion is not a root but a bulb (p. 3).

A root may be defined as a filamentous offset from the descending axis of the plant, differing from the stem itself in certain relations of a botanical structure, and each filament ending in a soft absorbent tuft denominated the spongiole, the function of which consists in absorbing moisture, and conveying it into the structure of the plant. Hence the chief and primary use of the root is that of nutrition; but it also serves as a means of enabling the plant to take firm hold of the earth in which it grows. We append drawings of various roots (figs. 3, 4, 5, and 6).

In most cases, the part at which the stem ends and the root begins is well defined. It is denominated the *collar*. Although the general characteristic of the root is to seek the ground, as the characteristic of the stem is to seek the air, nevertheless stems frequently assume a tendency to become roots, and roots to become stems. A very remarkable example of the former tendency is furnished by the banyan tree (p. 9), or *ficus religiosa*, a native of India. This tree has a natural tendency to shoot down prolongations from its stem, which, taking root, cover the ground with an arbour-like growth of most fantastic appearance. The opposite tendency is recognisable in certain varieties of the elm, which shoot up sprouts from the root over large tracts of ground in the vicinity of the native trunk, very much to the annoyance of the farmer, whose land is thus considerably damaged. Although the essential characteristic of a stem is to ascend into the air, yet certain forms of stem in some vegetables exist underground; of this kind are ginger, and the so-called orris root. Stems of this kind are known in Botany by the apellation of *rhizomes* (fig. 7).

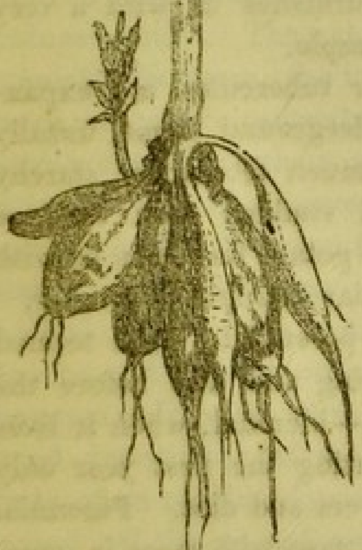


3. Radish. Spindle-shaped root.

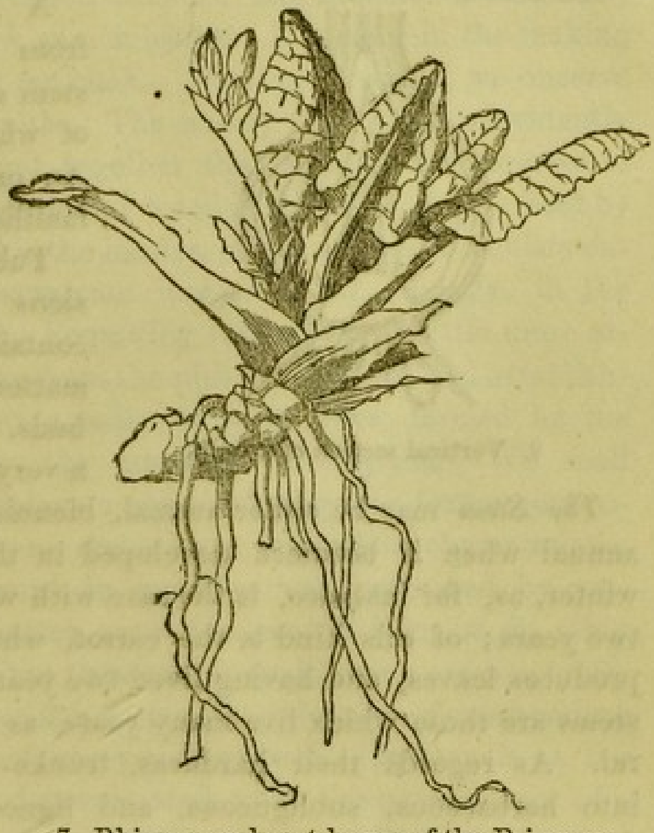
4. Pasture grass. Fibrous root.

5. Dropwort. Knotty root.

Usually the root is attached by the collar to an ascending stem, from which latter proceed the leaves; in certain plants, however, for instance, the primrose, there is no ascending stem, but an horizontal, under-

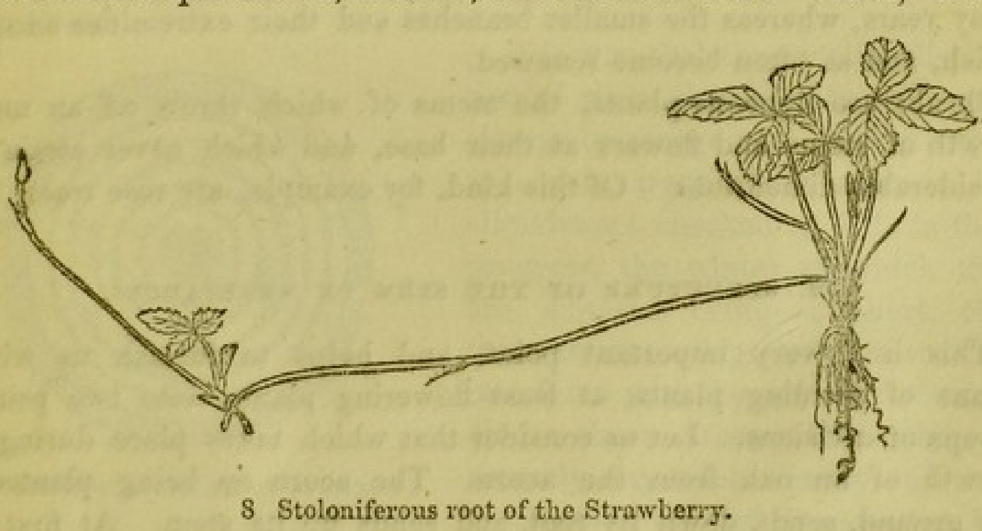


6. Dahlia. Tuberous root.



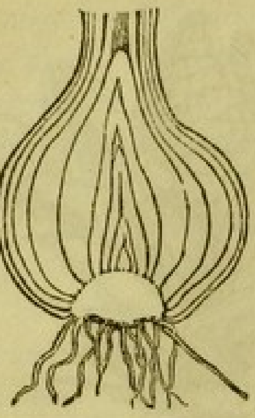
7. Rhizome and root-leaves of the Primrose.

ground one (the rhizome) takes its place, and from this the leaves immediately grow; such leaves are then termed "radical," that is to say, proceeding from the root, and the plant itself is said to be acauliferous; from the Greek privative α, without, and the Latin word "*caulis*," a stem.



8 Stoloniferous root of the Strawberry.

Sometimes the root is said to be "stoloniferous," that is to say, stole-bearing, which expression requires the previous explanation of the word *stole*. A *stole*, then, is a little stem which springs from the axilla (literally arm-pit) or point at which the leaves spring from the stem. The strawberry (fig. 8) affords a common and well marked illustration of this kind of root.



9. Vertical section of a bulb.

A bulb is an underground bud, from the upper part of which the stem arises, and from the lower part of which the root descends (fig. 9.) An onion furnishes us with a very familiar example.

Tubers or tubercules are expansions of underground stems, usually containing much fecular or starchy matter, and studded with eyes or buds. The potato furnishes us with a very familiar example of a tuber.

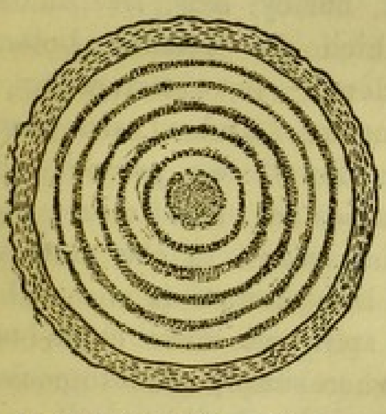
The Stem may be either annual, biennial, or perennial. It is termed annual when it becomes developed in the spring and dies before the winter, as, for instance, is the case with wheat;—biennial, when it lives two years; of this kind is the carrot, which during the first year only produces leaves, and having lived two years flowers and dies. Perennial stems are those which live many years, as is the case with trees in general. As regards their hardness, trunks or stems are usually divided into herbaceous, subligneous, and ligneous. Herbaceous stems are those in which woody fibre is almost altogether absent, and which are therefore soft and juicy; of this kind is the stem of parsley, hemlock, &c. Subligneous stems are those in which woody fibre although present does not exist in the smaller shoots; of this kind are sage and rue, the bases of the stems of which are hard and woody, and therefore continue for many years, whereas the smaller branches and their extremities annually perish, and as often become renewed.

Shrubs are ligneous plants, the stems of which throw off an undergrowth of stems and flowers at their base, and which never attain any considerable dimensions. Of this kind, for example, are rose trees.

§ 4. STRUCTURE OF THE STEM OF VEGETABLES.

This is a very important point, and helps to furnish us with a means of dividing plants, at least flowering plants, into two primary groups or divisions. Let us consider that which takes place during the growth of an oak from the acorn. The acorn on being planted in the ground, sends down its root, and sends up its stem. At first this stem is a little tiny thing of very inconsiderable diameter; year by year, however, it grows, until at length a gigantic tree results. If we now cut this tree across and examine the structure of its section, we shall recognise the following appearances. In the first place, commencing our examination from without, we shall find the bark, or *cortex*, separable into two distinct layers, the outer of which is termed *cuticle* or *epidermis*, and the inner one the *liber*, so called because the ancients occasionally employed this portion of the bark as a substitute for paper in the making of books—*liber* being the Latin for book. Passing onwards, we observe the woody fibre and its central pith. The woody fibre itself is evidently of two kinds, or at least is so put together that wood of two degrees of hardness results. The external portion of wood is the softer, and termed by botanists *alburnum*; the internal is the harder, and termed by botanists *duramen*, although carpenters denominate it *heart-wood*. Lastly, in the centre comes the pith or *medulla*. Regarding this section a little more attentively, we shall observe passing from the pith to the bark, and establishing a connexion between the two, a series of white rays, termed by the botanist *medullary rays*, and by the carpenter *silver-grain*. We shall also observe that the section displays a series of ring-like forms concentric one within the other. These are a very important characteristic. They not only prove that the trunk in question was generated by continued depositions of woody matter around a central line, or, in other words, of an outside deposition, but they enable us in many cases actually to read off the age of any particular tree—the thickness corresponding with one ring being indicative of one year's growth. Inasmuch as the formation of an oak tree is thus demonstrated to be the consequence of a deposition of successive layers of woody fibres externally or without—it is said to be like all others subjected to the same kind of growth, an *exogenous* plant—from two Greek words, ἔξω (*exo*), *without*, and γεννάω (*gennao*), *I generate*.

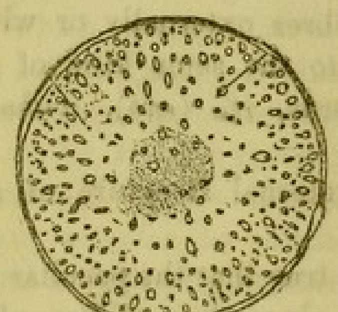
The appended diagram represents the internal structure of an exogenous stem.



10. Horizontal section of an exogen.

It is true that the peculiar disposition of rings thus spoken of cannot always be recognised. For example, as a rule, trees which grow in hot climates are checked so little in their progress, the winter to which they are exposed being so short, that their course of growth is scarcely interfered with by any impediment. Under these circumstances, there is scarcely any winter pause sufficient to create a line of demarcation between ring and ring; the progress of deposition goes continuously on. However, the manner of deposition is not the less external because we cannot see the rings.

Very different from this method of increase is that by which another grand division of plants augments in size. For an example we must no longer have recourse to a section of one of our temperate plants, but must appeal to the larger tropical productions of this kind. If we cut a piece of bamboo, or cane (with which most boys are familiar), horizontally, we shall find a very different kind of structure to that which we recognised in the oak. There will be no longer seen any real bark, nor any pith, and the concentric rays will be also absent, but the tissue of which the stem is made up may be compared to long strings of woody fibre tightly packed together. These concentric rings, in point of fact, could not have existed; inasmuch as a cane does not grow by deposition of woody matter externally, but internally, or, more properly speaking, upwards. A young cane is just as big round as an old cane, the only difference between them consisting in the matters of hardness and of length. Hence, bamboos, and all vegetables which grow by this kind of increment, are termed *endogenous*, from two Greek words ἔνδον (*endon*), *within*, and γεννάω (*gennao*), *I generate*. The largest specimen of endogenous growth is furnished by palm trees—those magnificent denizens of tropical forests to which we are so much indebted for dates, cocoa-nuts, palm-oil, vegetable wax, and numerous other products. Appended will be found a representation of the section of a palm tree, in which the peculiarities of endogenous structure are very well developed.



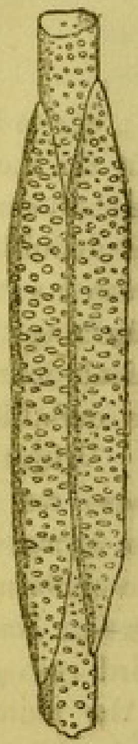
11. Horizontal section of an endogen.

All the endogenous productions of temperate climes are small, though very important. In proof of the latter assertion it may suffice to mention the grasses; not only those dwarf species which carpet our lawns and our fields with green, but wheat, barley, oats, rice, maize, all of which are grasses, botanically considered, notwithstanding their dimensions. Indeed, size has little to do with the definition of a grass; for if we proceed to tropical climes, we shall there find grasses of still more gigantic dimensions. Thus the sugar cane, which grows to the elevation of fifteen or sixteen feet, is a grass, as in like manner is the still taller cane, out of the stem of which, when split, we make chair-bottoms, baskets, window-blinds, &c., and which, when simply cut into convenient lengths, is also useful for other purposes; one of which will, perhaps, occur to the reader

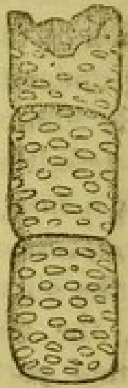
The reader will not fail to remember that we, a few pages back, divided vegetables into phænogamous and cryptogamic (we are sure we need not repeat the meaning of these terms). We may now carry our natural classification still further, and say that phœnogamous plants admit of division into exogenous and endogenous ones. This division is quite natural, even if we have regard merely to the structure of the stem; but the agreement is much wider than this, and recognisable by other analogies, as we shall presently see, when we come to consider the nature and peculiarities of leaves and seeds.

§ 5. CONCERNING LEAVES AND THEIR USES.

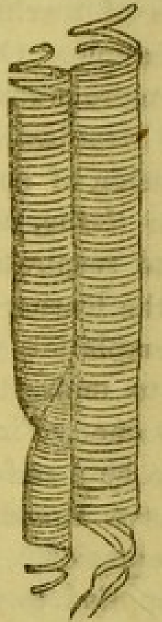
There are two methods of teaching the nature of a thing; one is by definition, the other by example. Of these the latter is usually the more easy, but the former is the more precise. Accordingly, then, we shall commence by stating that in botanical language a leaf admits of definition as "a thin flattened expansion of epidermis, containing between its two layers vascular and cellular tissue, nerves, and veins, and performing the functions of exhalation and respiration." Such is the botanical definition of a leaf. Probably the learner may not understand this definition just yet, but a little contemplation will enable him to do so. With the object of enabling him to understand the definition, suppose we go through its clauses one by one. Firstly, then, *a thin flattened expansion of epidermis*, we assume to be a self-evident expression. The epidermis (ἐπιδερμίς) means, as we have already stated, the outside bark—at least, this is its botanical acceptation. Literally, the Greek word ἐπιδερμίς means *skin*, and is also applied to indicate that portion of the animal skin which readily peels off, which rises under the action of a blister, and which, when thickened and hardened, constitutes those troublesome pests, *corns*. As regards the epidermis of vegetables, it may readily be seen in the birch tree, from which it peels off in long strips. Well, a leaf, then, consists of two layers of this epidermis, one above and the other below, *enclosing vascular and cellular tissue*, the meaning of which terms we have now to explain to the reader. By vascular tissue is meant those little pipes or tubes which run through vegetables, just like arteries and veins through animal bodies, and which serve the purpose of conveying juices from one part of a plant to another. In plants, these pipes or tubes are so exceedingly small that their tubular character is only recognisable by the aid of a microscope or powerful lens, but their presence may be recognised by the naked eye. Thus, for example, we have little doubt that most readers of this work have noticed that, on breaking across a portion of succulent vegetable stem, such, for instance, as a piece of *pie-rhubarb*, that the two portions do not always break clean off, but one part remains attached to the other by certain little fibrils. Now, these fibrils are vascular, that is to say, they are tubes, and tubes of various kinds, admitting of distinction amongst themselves. These distinctions we shall not enter upon here further than stating in general terms that, while some of the tubes are straight, others are twisted or spiral, like the perforator of a corkscrew; whence arises the term *spiral vessels*, which botanists have applied to them. Figs. 12, 13, 14, and 15, are magnified representations of the most remarkable kinds of vessels contained in vegetables; the spiral vessels of which we have been treating will easily be recognised by their peculiar appearance.



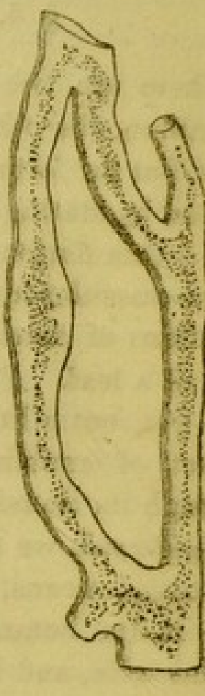
12. Dotted vessels of the Clematis.



13. Dotted vessels of the Melon.



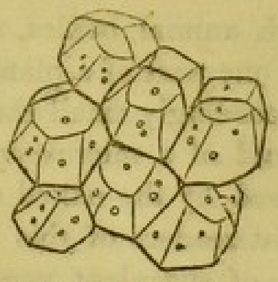
14. Spiral vessels of the Melon.



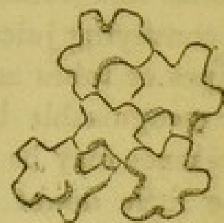
15. Laticiferous or juice-bearing vessels of the Celandine.

Cellular tissue is, as its name indicates, an assemblage of little cells, the natural form of which is spheroidal or oval (fig. 16), but more frequently this form is modified from various causes, usually the mutual pressure of cells against each other. Thus the pith of trees, a portion which is made up of cellular tissue, if examined under the microscope, will be found to be

16. Ovoid cell.



17. Angular cells.



18. Stelliform cells.

composed of cells having the form of honeycomb cells, that is to say, hexagonal (fig. 17).

This last drawing represents the appearance of a thin segment of elder pith when submitted to microscopic examination. Occasionally the cells of cellular tissue assume a star-like or stellate form, as, for example, is the case in a common bean, of which our diagram (fig. 18) represents a section as seen when examined under the field of a microscope. Usually these vegetable cells are so very small that a microscope, or, at least, a powerful lens, is necessary for observing them. In certain vegetables, however, they assume such dimensions as to admit of being readily seen by the naked eye. For an example the reader may refer to an orange, especially an orange somewhat late in the season. If the fruit be cut, or, still better, pulled asunder, the cells will be readily apparent. Still more readily do they admit of being observed in that large species of the orange tribe to which the name shaddock, or forbidden fruit, is ordinarily given.

We must now inform the reader that not only do the cells of this cellular tissue admit of being altered in form, but occasionally they give rise to parts in the vegetable organisation which would not be suspected to consist of cells. The cuticle of which we have spoken is nothing more than a layer of cells firmly adherent; and the medullary rays, or silver grain, of exogenous stems, the appearance of which has been already described, is nothing more nor less than closely compressed cellular tissue.

We commenced by describing a leaf, but observations have been so often directed to matters collateral to the subject that the description appears somewhat rambling. Nevertheless, it cannot be helped. In Botany, above all other sciences, there occur many curious names. They must be learnt, and the best way to teach them is to describe them as they occur.

A leaf, then, we repeat, is an extension of two flat surfaces of cuticle enclosing nerves and veins, vascular and cellular tissue. All these terms have been pretty well explained. We may add, however, that when cellular tissue exists confusedly thrown together, as it does in the substance of a leaf, or as it appears in the orange, then such cellular tissue is denominated *parenchyma*, from the Greek word παρένχυμα, *anything poured out*.

Before we quite finish with our remarks relative to the substances which enter into leaves, it is necessary to observe that the green colouring matter of leaves is termed by botanists and by chemists *chlorophyl*, from the two Greek words, χλωρός (*chloros*), yellowish green, and φύλλον (*phullon*), a leaf. This chlorophyl is subject to become sienna red in autumn, as we all know, but the cause of this alteration has not yet been explained.

§ 6. LEAVES CONSIDERED AS TO THEIR FUNCTIONS.

Although leaves have a great variety of uses, yet the principal is that of respiration or breathing. In this manner they become the representatives of lungs in animal beings. But though plants breathe, the vegetable function of respiration in them is not to be considered as similar to that function in animals. On the contrary, it is directly the reverse, the very gas which animals expel from their lungs as useless or injurious, plants receive through the medium of their leaves, take out of it that which is suitable to their wants, then exhale the portion which is refuse to them, but which is necessary to the existence of animals. What a train of reflections does the contemplation of this beautiful provision call forth! Not only are vegetables useful in supplying us with food and timber, not only do they beautify the landscape with their waving branches and picturesque forms, but they are absolutely necessary to the existence of animal life as a means of purifying the atmosphere!

The breathing function of leaves is far too important to admit of being lightly passed over with these few remarks, yet a difficulty occurs in pursuing it further, inasmuch as to understand the precise theory of vegetable respiration the reader must be acquainted with certain facts in chemistry. Some readers, doubtless, are acquainted with these chemical facts, others are not; consequently, the best plan will be to present a slight outline of these facts at once.

To begin, then: did the reader ever set fire to a bit of stick or a little charcoal? No doubt he has. What does the reader think becomes of this stick or charcoal? Is it lost, destroyed? Oh no, there is no such thing as destruction in all nature; substances, even when they appear to be destroyed, only change their form. What, then, becomes of a piece of stick or a piece of charcoal when we burn either in the fire? Now, whenever philosophers desire to study the conditions of an experiment, and the choice of more than one set of conditions stands before them, they very properly take the simplest. We have here two sets of conditions; the burning of a stick is one, the burning of a piece of charcoal is the other. The latter being the simpler of the two, we will take it, and use it for our purposes; moreover, we will assume the charcoal employed to be absolutely pure. We burn, then, an absolutely pure bit of charcoal in atmospheric air, and it totally disappears; nothing remains; not the smallest trace of ashes; all is gone. What, then, has become of the charcoal? This is not a chemical book, therefore we have not space to go into the matter in all its chemical relations. We must, therefore, content ourselves by saying that the charcoal, by burning, is converted into a gas termed the *carbonic acid gas*. This carbonic acid gas is quite invisible, therefore one might look for it in vain; but it has a smell and a taste, therefore we might be conscious of its existence, even though we had no means of catching it. But we have such means. If this gas comes in contact with lime, or potash, or soda, either of these substances lays hold of it, combines with it, or, if we may be pardoned the expression, *licks it up*. Therefore, by setting a little quicklime in places where carbonic acid gas exists, we may catch it just as readily as we can catch a mouse in a trap;—aye, more readily, because a mouse may at least choose whether he go into the trap or stay out of it; but the carbonic acid gas has no such choice; if it comes in contact with the trap of lime, in it must go without fail. Now, what we want to come at is this. Although a piece of charcoal when burnt goes away in an invisible form, it nevertheless only makes a new acquaintance and puts on a mask. We can catch it, can unmask it, and get the charcoal out of it once more.

Carbonic acid gas is a poison, as, we dare say, most of our readers know; hence the danger of sitting near a pan of burning charcoal.

Proceeding with our chemical remarks, we must now go on to say that combustion is far from being the only source of carbonic acid gas; thus it is given off during fermentation, is given off from effervescent wines, such as champagne and sparkling moselle, is given off from ginger beer and soda water, and, what is far more to our purpose, is given off from the lungs of animals by the act of respiration. Indeed, the functions of animal digestion and respiration taken together may be considered as a sort of combustion, and are actually termed combustion by some authors. The similarity is indeed striking, as a little contemplation will serve to demonstrate. Thus, if we throw a lump of coal into a fireplace, heat is given out, and gaseous matter (chiefly carbonic acid) escapes. If we swallow a morsel of food, it is digested, heat is given out, and carbonic acid escapes. In the former case carbonic acid escapes by the chimney, in the latter case by the lungs. One chemical point yet remains to be explained before the student will be in a position to understand the functions of a vegetable leaf. The carbonic acid, of which we have been speaking, is a gaseous compound of charcoal, termed by chemists carbon and something; that something is oxygen, the vital principle of the air. Now, the bulk of vegetable bodies is made up of carbon, otherwise how could we get charcoal in the ordinary way? And this bulk, this carbon, is got out of the air. Yes, the largest tree, whatever its size, is for the most part formed of carbon, and all this carbon once existed in the gaseous form. Philosophers have made calculations, from which it appears that the total amount of carbonic acid thus floating about in the atmosphere amounts to the enormous quantity of many tons, and that tons of carbonic acid hover over each acre of ground, ready to give up its carbon to vegetables which require this substance. Before quitting this subject, we must not forget to direct the reader's attention to the beautiful provision by means of which the amount of carbon necessary to be got rid of from the animal economy is evolved in the particular form of gas. Even supposing no positive injury to result, yet just think how dirty and begrimed we should be if we were always puffing out charcoal dust with every expiration! We do not expire a small quantity either, no less than thirteen ounces of charcoal being evolved during twenty-four hours from each human individual. Had not some provision been adopted for enabling carbon to be thus evolved in a gaseous form, we should all have been blacker than chimney-sweeps. What a miserable state of things would this have been!

Respiration, then, is the chief function of leaves, but it is not the only function; they also serve as evaporative organs, by means of which the plant gets rid of excessive moisture; and in this respect, again, they present a striking analogy to animal lungs. Who amongst us is not aware that our breath contains moisture?

§ 7. ON THE FORM AND MODIFICATIONS OF LEAVES.

Having described the general functions of leaves, we must now proceed to examine their forms, and to learn the terms by which those forms are designated, otherwise we should not be able to describe a plant in such a manner that a person would understand our description. As in many other parts of Botany, the student will here encounter some long names; they are very useful names, nevertheless, and require to be understood.

In the first place, taking a general review of the aspect of leaves, it will be evident to the reader that their form is exceedingly varied, as is also their manner of attachment to the stem, to say nothing of such characteristics as softness, hardness, thickness, thinness, and so forth. As regards their attachment to the vegetable, some leaves grow directly out of the stem, or, in figurative language, may be said to *sit upon* the stem. Such leaves are termed by botanists *sessile*. Others are attached to the parent stem by a little stem of their own. Now, this leaf-stem botanists denominate a *petiole*, and leaves thus supplied with a petiole are said to be *petiolate*. Again, some leaves are attached to the parent stem exactly opposite each other, consequently they are said from this circumstance to be *opposite* or *opposed*. Others are alternately attached, from which circumstance the denomination *alternate* is given to them. All these characteristics are very important, not only in enabling a botanist to describe the configuration of plants in the fewest possible words, but in enabling him at the same time to separate plants into natural groups and alliances.

Again, some leaves are single in themselves, as is the case with those of the apple tree; whilst others are made up of several little leaflets, as we see for example in the ash. Hence arises the very natural distinction of leaves into *simple* and *compound*.

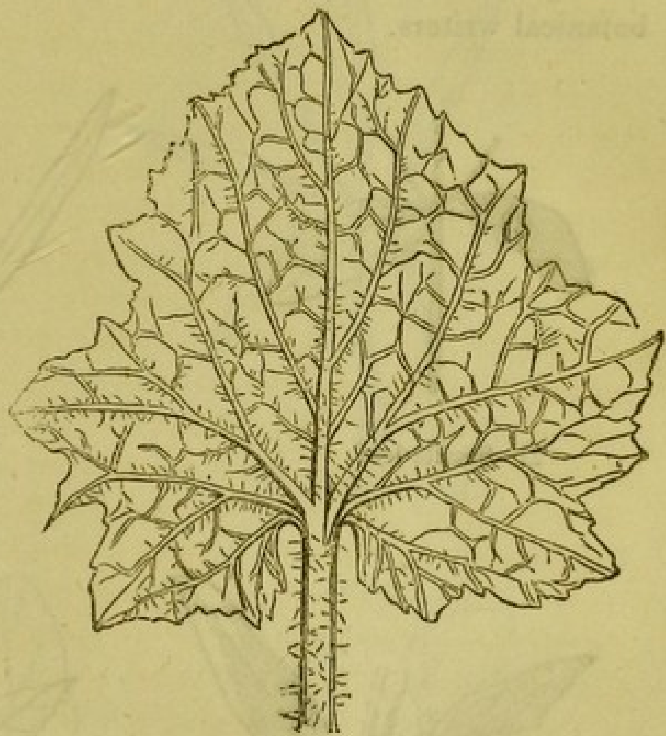
The forms which leaves assume are so very numerous, that botanists are accustomed to indicate them by the similarities which they manifest to natural objects. Some are like shields, for which reason they are termed *peltiform*; others are like hearts, whence they are termed *cordiform* or *cordate*. Some resemble feathers, others are jagged like a saw, whence arise the denominations *penniform*, *serrate* or *serratiform*, and so forth; but we shall presently give drawings of the chief varieties of leaves, from an inspection of which the various names respectively applied to them will be rendered more evident.

§ 8. ON THE NERVATION OR VENATION OF LEAVES.

Animal anatomists understand by veins and nerves two widely different portions of the human frame; not so botanists, in whose language veins and nerves mean the same thing, being applied to those cord-like ribs which ramify upon, or rather under, the surface of leaves. The manner in which these nerves or veins are distributed requires careful study, as it serves to distinguish divisions of vegetables from each other. Plants examined with reference to the manner in which their leaves are veined, admit of being separated into two great divisions: the parallel veined, and the meshed or reticulated.

For example underneath are two drawings, one of the leaves of an

19. Iris leaves.

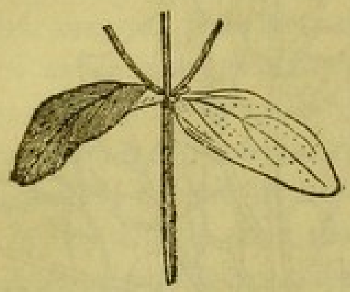


20. Melon leaf.

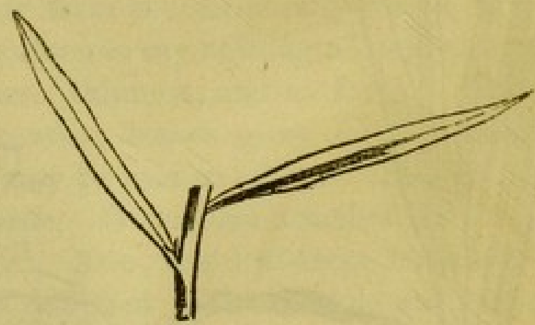
iris plant, the other of a leaf of a melon. How great is the difference between the general aspect of these leaves we need not say. In the former the veins or nerves are almost parallel to each other, or converge at either extremitiy of the leaf by a very imperceptible gradation, and never in any part of the leaf combine or interlace together. In the second example, the melon leaf, this parallelism is totally wanting, and in place of it we find the intermingling of nerves to be so frequent that a complete net-work (in Latin, *rete*) results, hence this leaf and all like it are said to be *reticulated*.

Does not the reader remember that we have already established the existence of two grand natural divisions amongst flowering plants, as determined by the sectional aspect of their stems? Does he not remember that, from a consideration of this difference of appearance, we have already agreed to divide flowering plants into the exogenous and endogenous? (p. 13). Does he not also remember our promise to tell him other means of distinguishing an endogenous from an exogenous plant by another sign than the sectional aspect of the stem? One means is this. The leaves of all endogenous plants are straight-veined, while the leaves of all exogenous are reticulated. Hence, referring to the iris, we know at once that it is an endogenous, or *within-growing* plant, and we know by the same kind of examination that the melon is an *exogenous* or *without-growing* plant. What can be more simple than this mode of discrimination?

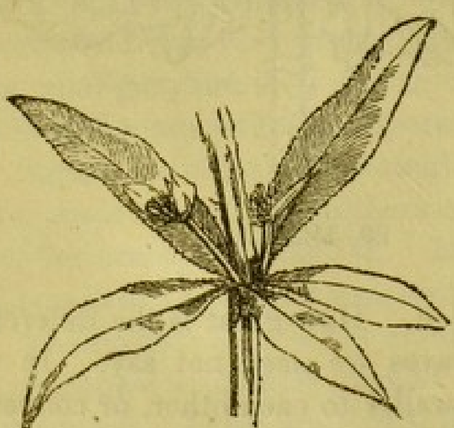
We shall now give some representations of various shaped leaves, mentioning underneath the names which are respectively applied to them by botanical writers.



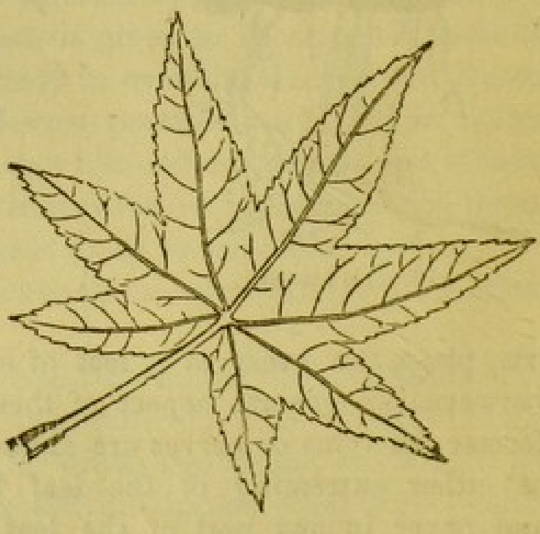
21. Sessile leaf.



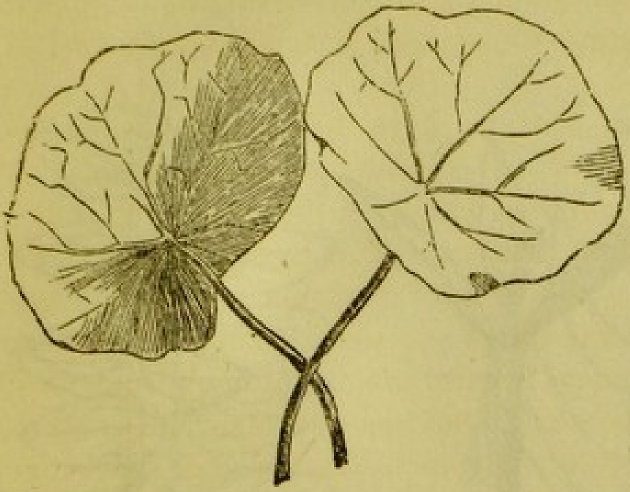
22. Alternate leaves.



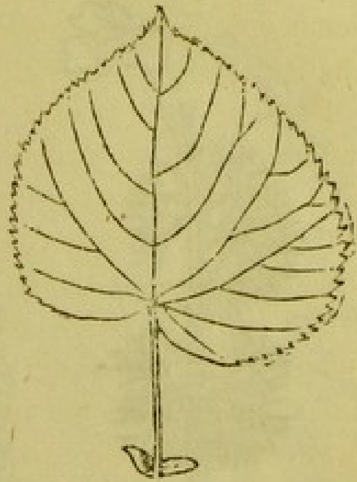
23. Verticillate leaves.



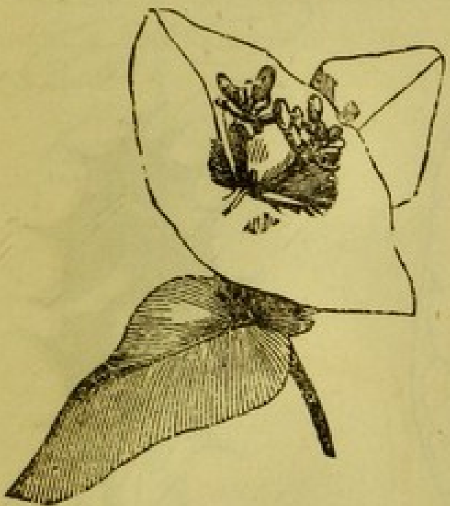
24. Palmifid leaf



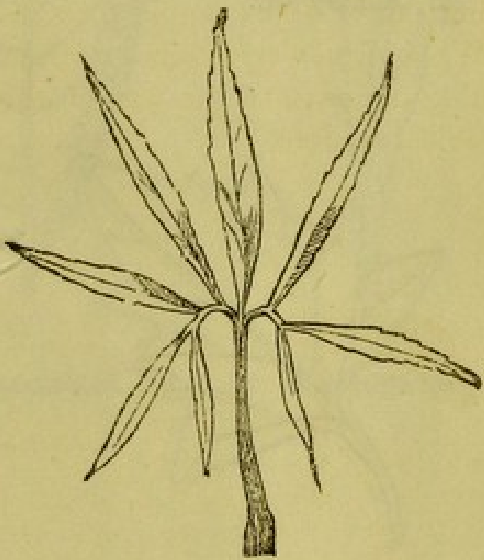
25. Peltate leaf.



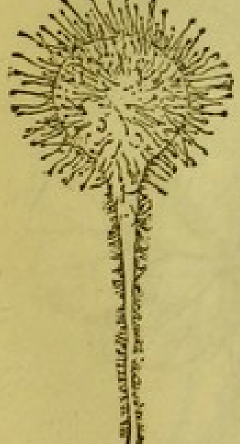
26. Cordate leaf.



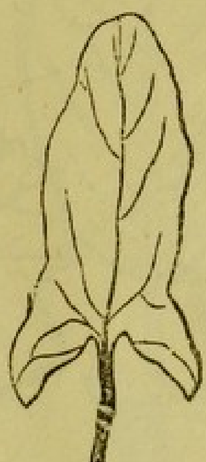
27. Confluent leaves.



28. Pedalate leaf.

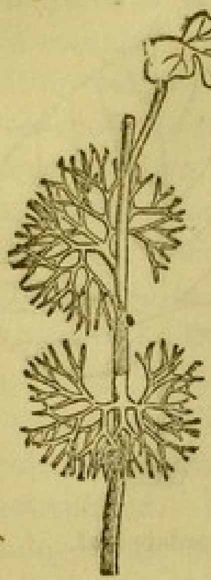


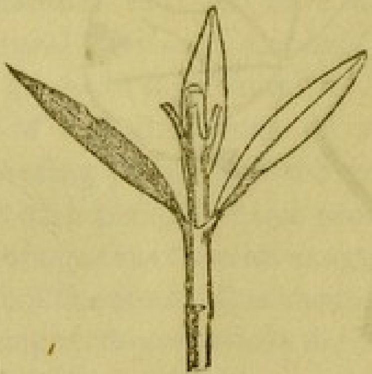
29. Ciliate leaf.

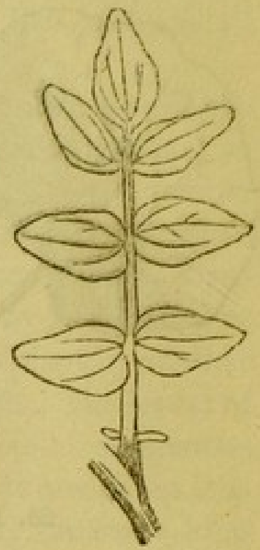


30. Sagittate leaf.

31. Pennate leaf with tendrils.

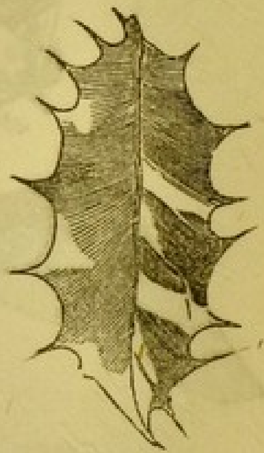

32. Capilary leaf.

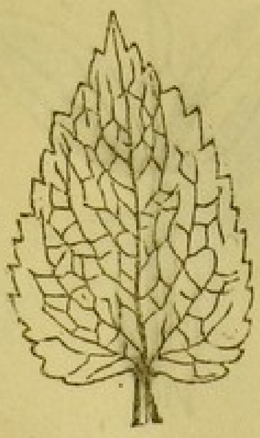

33. Acute leaf.

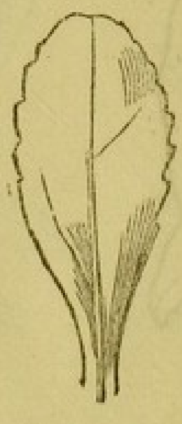

34. Pennisecate leaf.

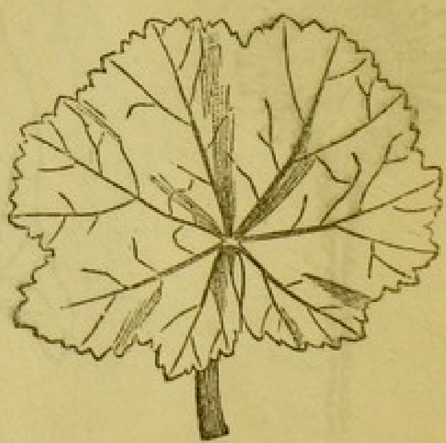

35. Deltoid leaf.

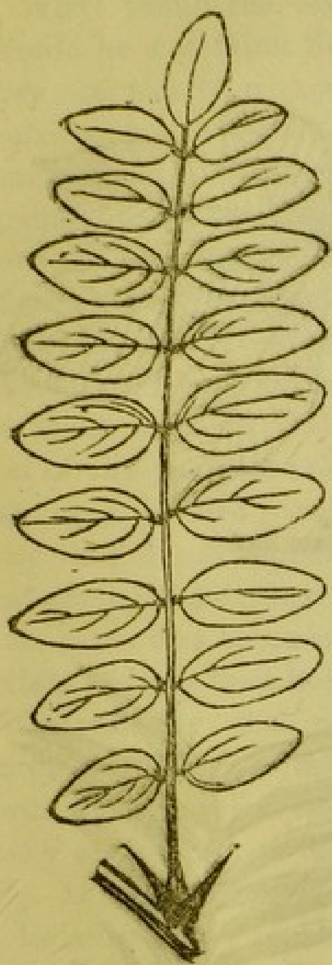

36. Lanceolate leaf.


37. Spiny leaf.

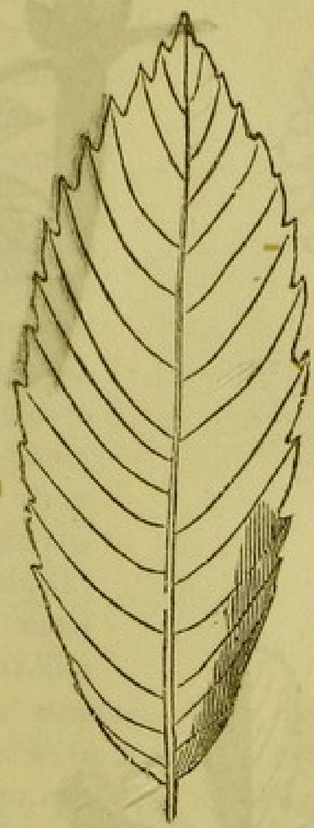

38. Serrate leaf.


39. Spatulate leaf.

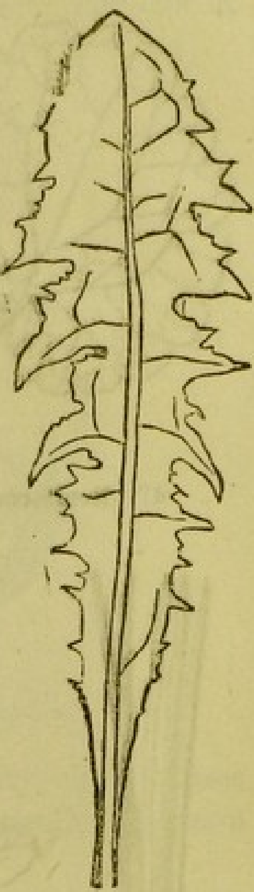

40. Orbicular leaf.



41. Pennate leaf.

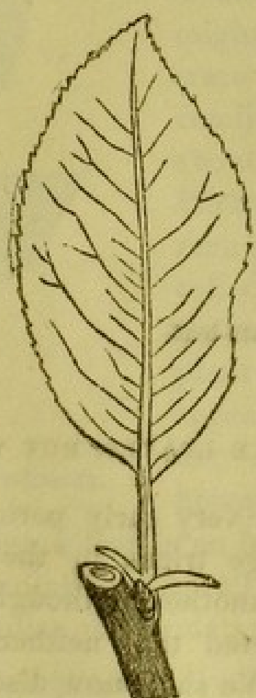


42. Dentate leaf.

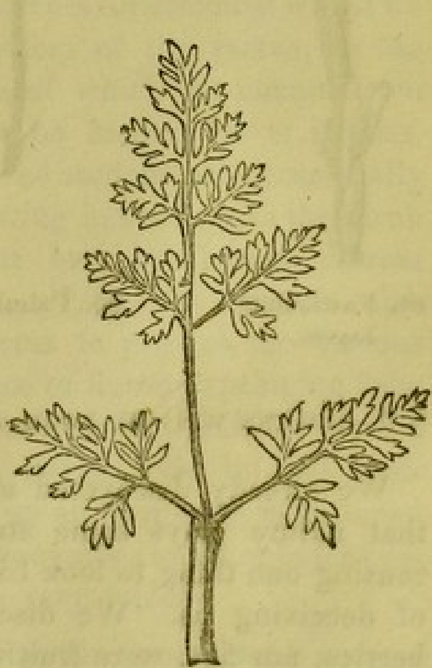


43. Pennatifid leaf.

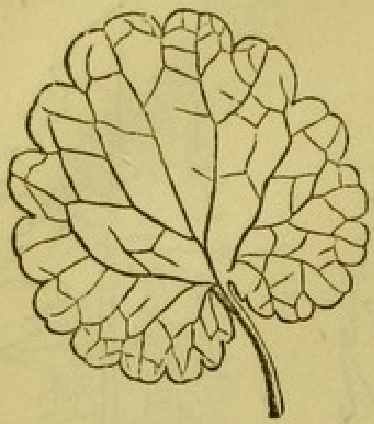
44. Bipennate leaf.



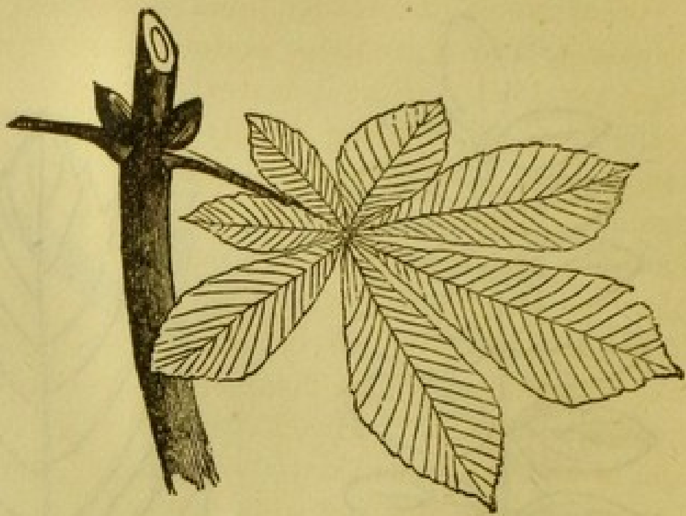
45. Oval leaf.



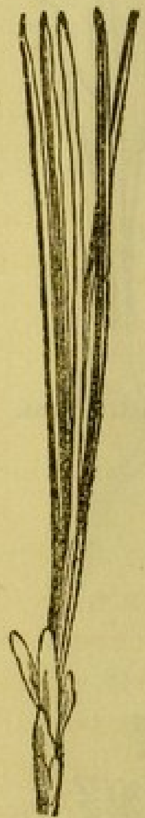
46. Decomposite leaf.



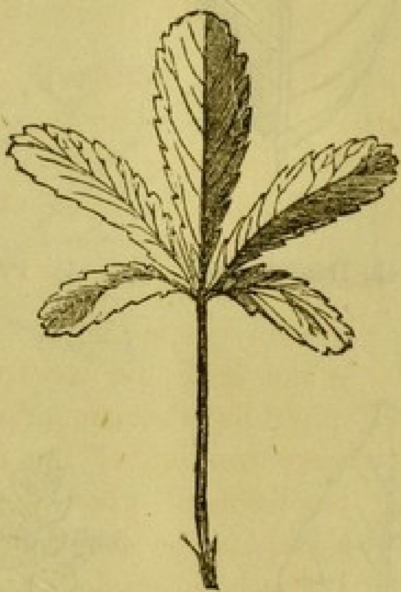
47. Reniform leaf.



48. Digitate leaf.



49. Fasciculate leaves.



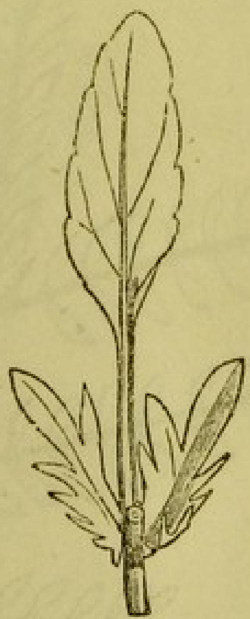
50. Palmisecate leaf.

51. Distic leaves.

§ 9. ORGANS WHICH LOOK LIKE LEAVES, BUT WHICH ARE NOT LEAVES.

We already discovered at a very early period in our investigations that nature plays some strange tricks in the construction of plants, causing one thing to look like another, as though for the express purpose of deceiving us. We discovered that neither pine-apples, nor strawberries, nor figs, were fruit. We shall now discover that certain things which appear like leaves are not leaves.

What would the reader think as regards many of the cactus tribe? Would he not think these curious plants were all leaves? The fact is, they are totally without leaves, the leaf-like portions being merely flattened stems. What would he think, again, of those two little leaf-like expansions recognisable in the pansy, of which we give a drawing (fig. 52). These are not leaves, but certain leaf-like appendages which botanists denominate stipules. Hence the real leaf of the pansy is said to be *stipulate* or *stipulated;* and the reason why we did not represent the pansy leaf amongst the other leaves a short time back, was because the term stipulate had not then been explained.



52. Stipulate leaf.

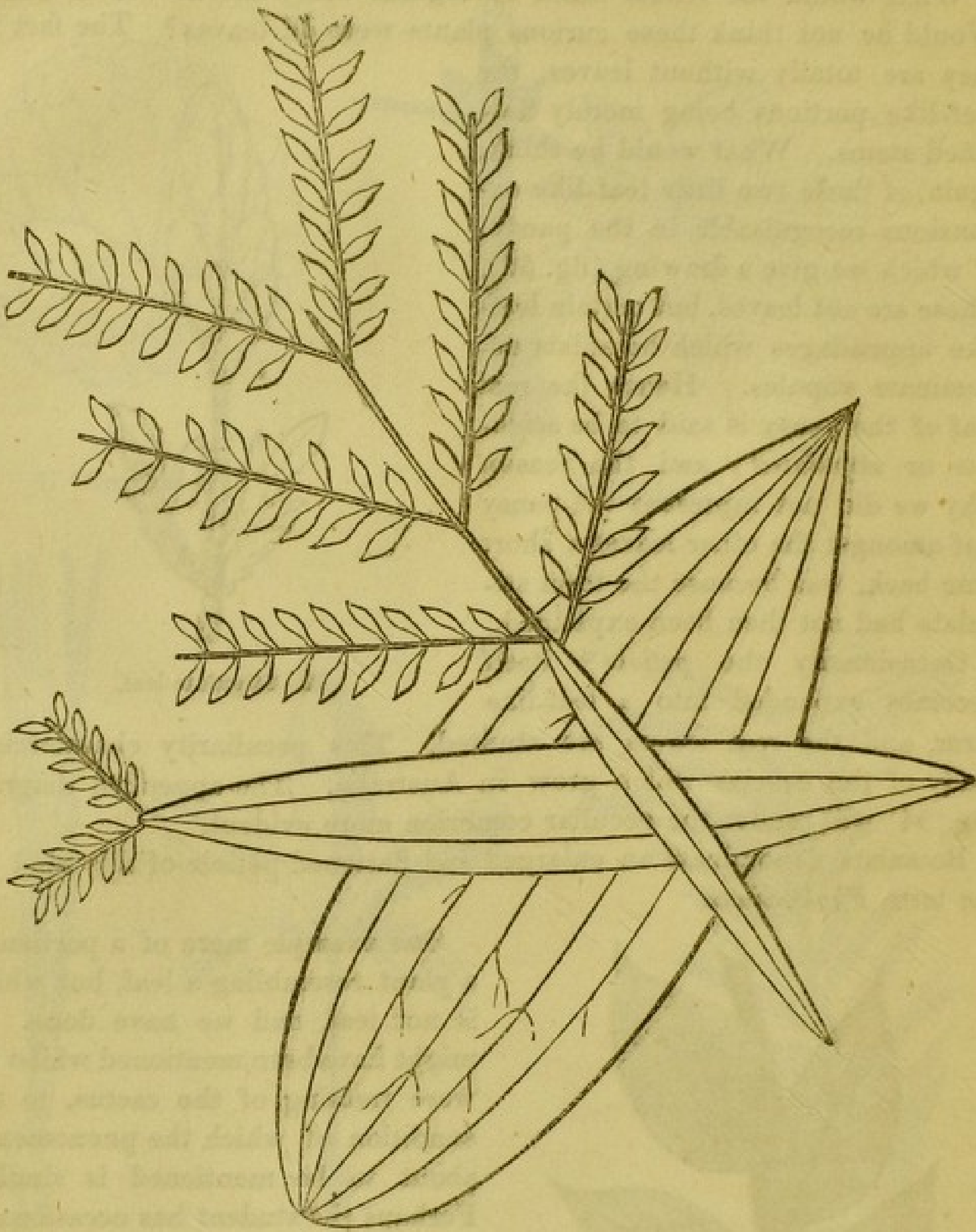
Occasionally the *petiole** itself becomes expanded into a leaf-like form, and the real leaves are stunted. This peculiarity characterises many of the acacias which grow in Australia. The appended diagram (fig. 54) will render the peculiar condition more evident.

Botanists denominate an enlarged and flattened petiole of this kind by the term *Phyllodium.*

53. Leaves of the Butcher's-broom.

One example more of a portion of a plant resembling a leaf, but which is not leaf, and we have done. It might have been mentioned whilst we were treating of the cactus, to the condition of which the phenomenon about to be mentioned is similar. Perhaps the student has occasionally seen growing in the hedges the shrub called the butcher's-broom, *Ruscus aculeatus.* Like the cactus, this plant seems to present the curious appearance of flowers springing from the surface of a leaf. Flowers, however, never grow in that position. The part resembling a leaf is no leaf at all, but only a flattened stem. The accompanying diagram (fig. 53) represents a sprig of butcher's-broom, in which this peculiar conformation is very evident.

* The term has already been explained, and one explanation for one thing is supposed to be enough. See p. 20.



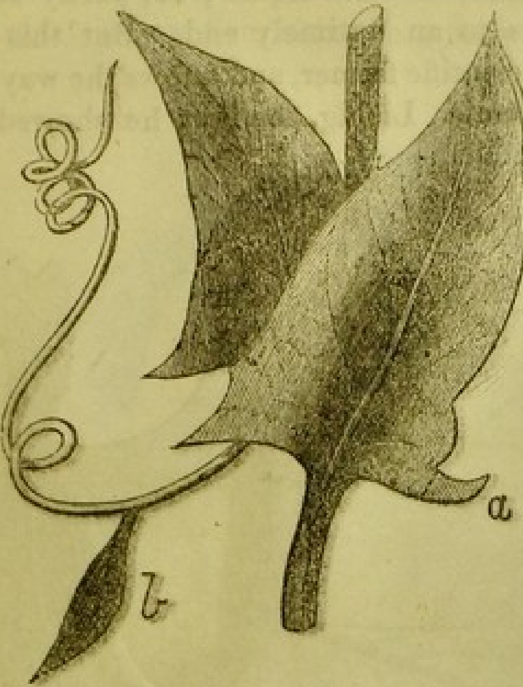
54. Leaves of the Australian Acacia.

§ 10. METAMORPHOSES OR CHANGES TO WHICH LEAVES ARE SUBJECT.

Just as certain parts of vegetables not leaves may assume the general appearance of leaves, so, on the other hand, leaves occasionally lose their own specific appearance, and look like things they are not.

For example, who at a first glance would think that the prickles on common furze were leaves? Nevertheless, they are; the ordinary flat leaf-like appearance being lost.

Again, many of those tendrils which shoot from slender plants, enabling them to lay hold of neighbouring objects and derive support, are nothing more than modified leaves. This is the case with the plant *Lathyrus Aphaca*, a representation of which we give below.



55. Lathyrus Aphaca.

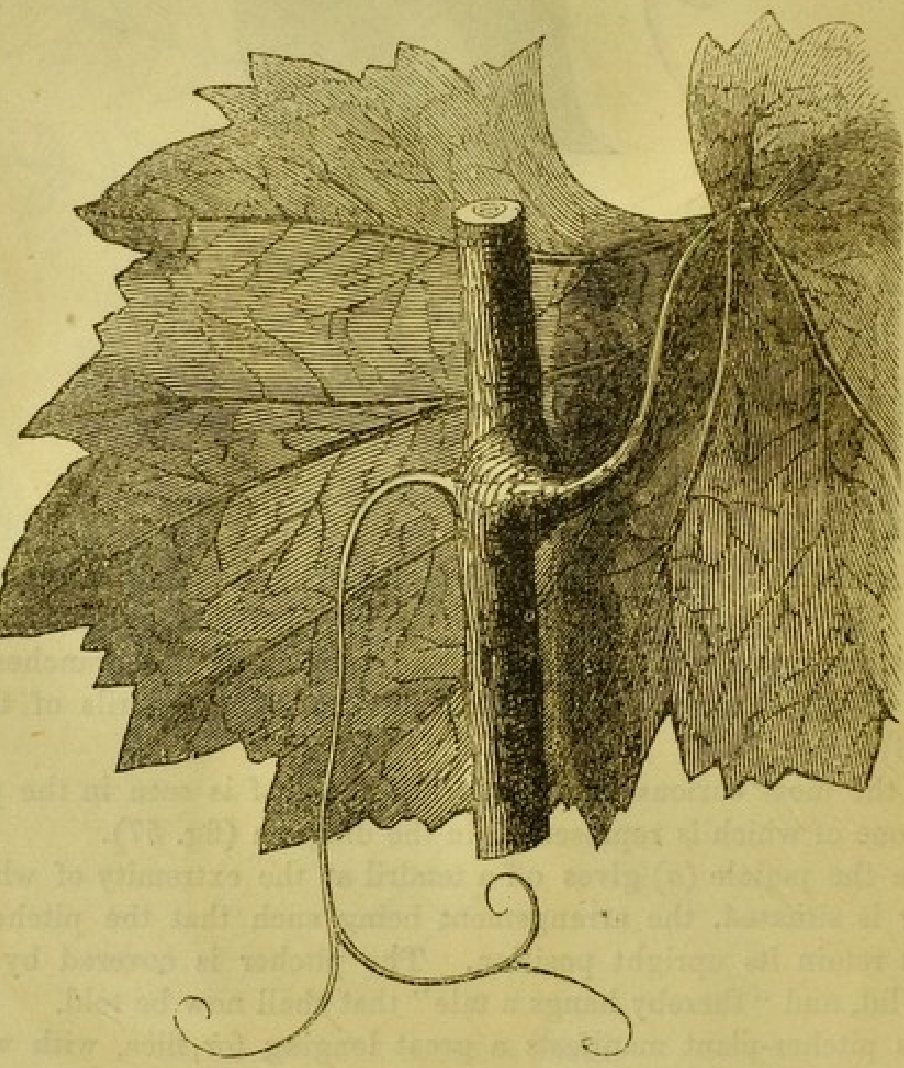
The student is not, however, to imagine that all tendrils are modified leaves. In certain plants, for example the cucumber, stipules undergo this metamorphosis, in others it is the petioles or the branches themselves which change; such, for example, are the tendrils of the vine (fig. 56).

But the most curious modification of the leaf is seen in the pitcher-plant, one of which is represented in the diagram (fig. 57).

Here the petiole (*a*) gives off a tendril at the extremity of which the pitcher is situated, the arrangement being such that the pitcher shall always retain its upright position. The pitcher is covered by a well-fitting lid, and "thereby hangs a tale" that shall now be told.

This pitcher-plant manifests a great longing for flies, with which it warms or nourishes itself. But how to catch the flies; that is the question. Had this problem been propounded to one of us, we suppose we should have smeared the plant with some glutinous body, a kind of bird-lime, or fly-lime, as we might call it. Nature manages things in a better way, as we shall see.

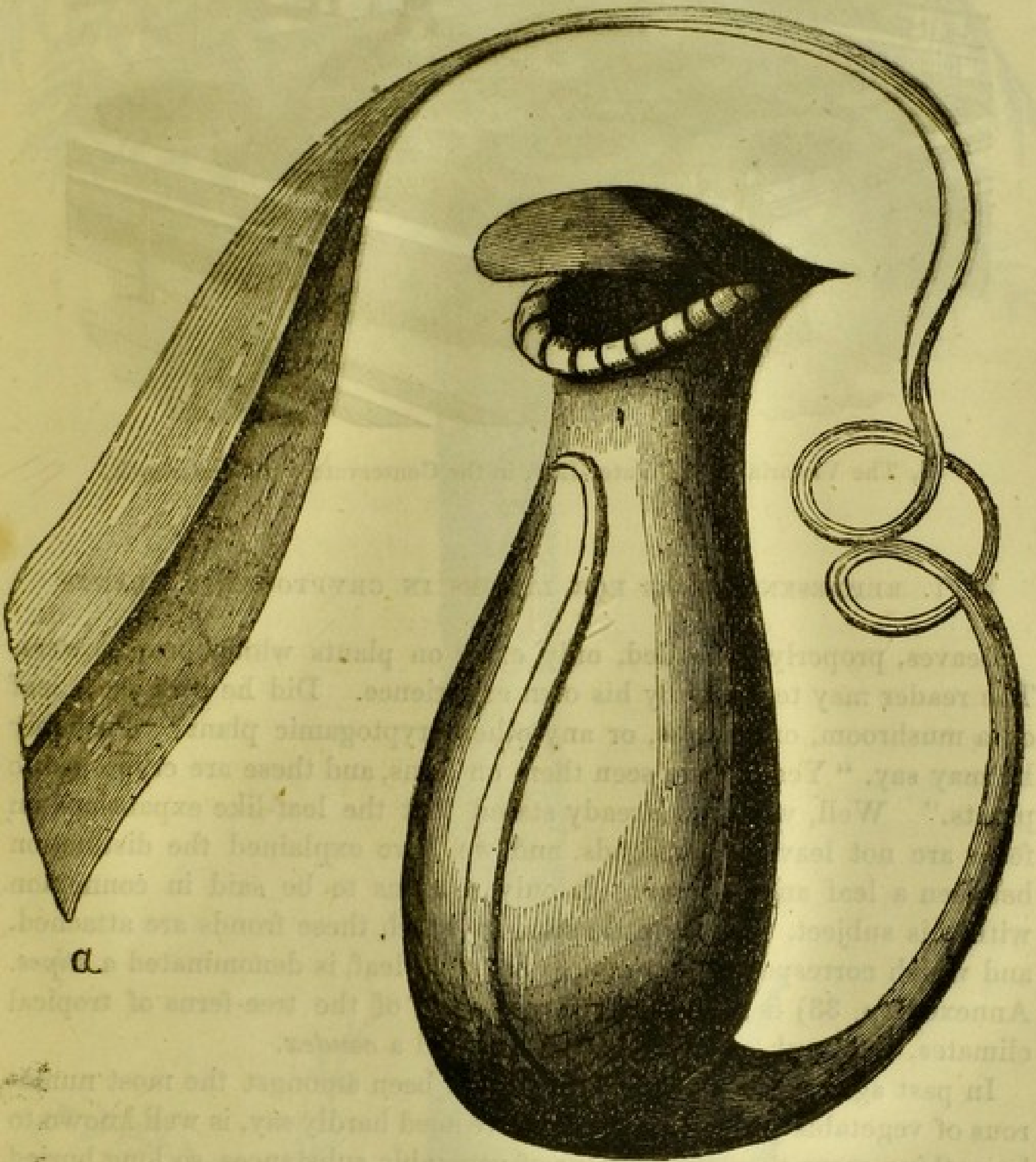
Flies, as we all know, have a prying habit of crawling into little holes and corners for the purpose of seeing what they can steal. In this way we see them get into daffodils, buttercups, and many other flowers, into some of which, if they cannot go bodily, they thrust their noses. What wonder, then, if a hungry fly should crawl into the pitcher of the *Nepenthes* (for such is the classical name of the plant), which lies so invitingly open, and tempts by its beautiful form? In the fly crawls, and down the cover pops, and the fly is caught. His sufferings are not long. The pitcher is not empty, but contains an acid liquid; so, partly suffocated, partly drowned, the fly comes to an untimely end. But this is not all; the pitcher-plant is a good scientific farmer, and knows the way to make a good manure. The great chemist, Liebig, thought he showed the farmers a



56. Vine Tendril.

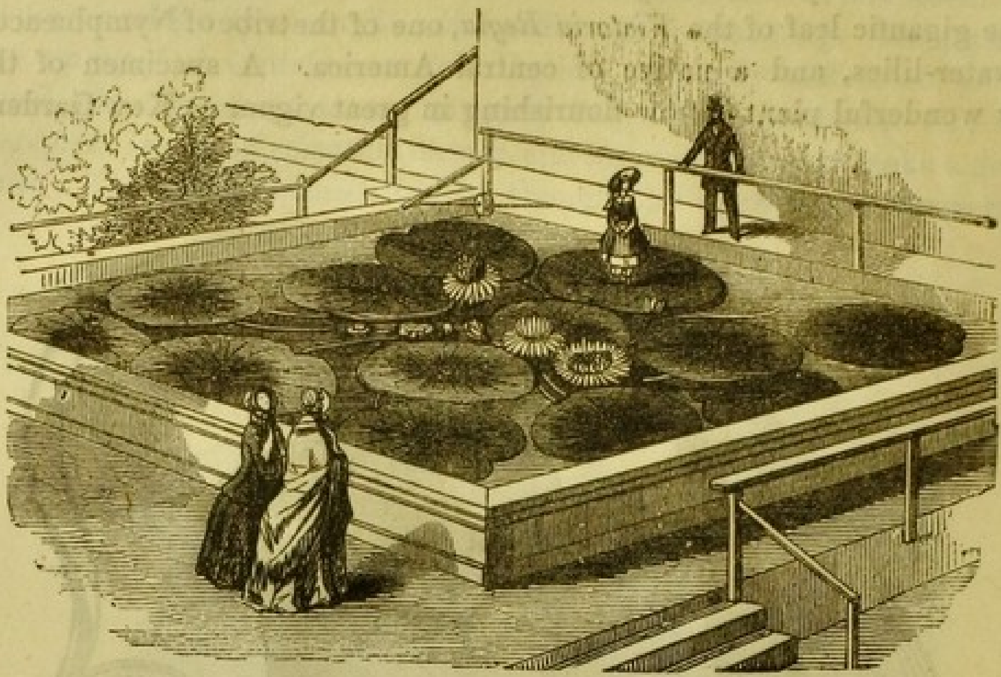
thing worth knowing when he taught them to soak bones in acid to make them into manure. Farmers might have got the same knowledge from our friend the pitcher-plant centuries, aye thousands, of years ago. This liquid which the pitcher-plant contains is acid; thus it rapidly dissolves the fly—skin, bones, and all. His fate is like that of Mekanna the reviled prophet, who, when conquered, jumped into a tub of aquafortis, and was dissolved.

We must not quit the subject of leaves without devoting a passing word to the gigantic leaf of the *Victoria Regia*, one of the tribe of Nymphæaceæ, or water-lilies, and a native of central America. A specimen of this truly wonderful plant is now flourishing in great vigour at Kew Gardens.



57. The Pitcher-plant.

Its leaves are from fifteen to eighteen feet in diameter, and its flowers and capsule, or seed-case, proportionately large. Annexed (fig. 58) is a representation of this wonderful plant. A child is represented standing on one of its floating leaves, which, on account of its size, acts the part of a boat, and supports the child on the surface of the water.



58. The Victoria Regia Water-Lily, in the Conservatory at Chatsworth.

§ 11. REPRESENTATIVES FOR LEAVES IN CRYPTOGAMIC PLANTS.

Leaves, properly so called, only exist on plants which bear flowers. The reader may test this by his own experience. Did he ever see a leaf on a mushroom, or a moss, or any other cryptogamic plant? Probably he may say, "Yes, I have seen them on ferns, and these are cryptogamic plants." Well, we have already stated that the leaf-like expansions on ferns are not leaves, but fronds, and we have explained the distinction between a leaf and a frond. It only remains to be said in connexion with this subject, that the little stem to which these fronds are attached, and which corresponds to a petiole in a real leaf, is denominated a *stipes*. Annexed (p. 33) is a representation of one of the tree-ferns of tropical climates, the trunk of which is denominated a *caudex*.

In past ages these tree-ferns must have been amongst the most numerous of vegetable productions. Coal, we need hardly say, is well known to be nothing more than the remains of vegetable substances, so long buried under great pressure in the earth that they have changed to the condition in which we at present find them. Notwithstanding the change of quality, yet in many cases the original shape of the vegetable has not undergone alteration. So that a person sufficiently acquainted with Botany can readily tell the kind of plant from which any specimen of coal under consideration has been formed.

Although fronds are the substitutes for leaves in ferns and several other cryptogamic plants, nevertheless these organs are not the universal

The Fern Tree.

substitutes; but the general complexity of cryptogamic plants, the microscopic nature of these organs, and the comparatively limited acquaintance with this division of the vegetable world, renders it undesirable to state much concerning them in a little book like this, in which so many tribes of flowering plants claim our notice.

§ 12. ON THE REPRODUCTIVE ORGANS OF PLANTS: THE FLOWER AND ITS APPENDAGES.

Having written what is necessary concerning the nutritive parts of plants, we shall now describe their reproductive members, the flower and its appendages. It would be folly indeed to describe formally what is meant by a flower, but the purposes to which a flower is designed in the economy of vegetable nature will require our attentive consideration. Without flowers there could be no fruit; without fruit there can be no seed; and without the latter the greater number of vegetables could not be multiplied. The reason, then, for denominating flowers the reproductive organs of plants will be manifest. To state this fact, that flowers are the reproductive portions of a plant, is very easy. To demonstrate, however, the elaborate means by which the functions of reproduction are discharged is very difficult. Indeed, the laws affecting the multiplication of animals and vegetables are so similar in many respects, that many of the terms employed in this department of Botany are borrowed from the sister studies of animal anatomy and physiology; and without some preliminary knowledge of these sciences it would be next to impossible to make the reader comprehend the intricacies of vegetable reproductions.

We therefore shall not attempt to deal with these intricacies, but shall content ourselves by saying that all plants most probably, certainly all evidently-flowering or phænogamous plants, possess sexes, and these sexes are usually in the same plant, in the same flower of the plant. Occasionally, however, the two sexes are on different flowers, and sometimes on different plants. We may, therefore, popularly say, that the greater number of flowers contain both gentlemen and ladies, but occasionally, on some plants, the gentlemen and ladies have flowers, each sex to itself; and occasionally, again, the gentlemen monopolise all the flowers on one plant, and the ladies all the flowers on the other. When the two sexes reside in two sets of flowers on one plant, then such a plant is said to be *monœcious*, from two Greek words signifying "one house." The plant, we suppose, being regarded as a house, and the flowers as chambers in the same. When, however, the males all reside in the flowers of one plant, and the females in all the flowers of another, then such plants are said to be *diœcious*, or "two housed," the reason of which will be obvious.

§ 13. ANATOMICAL EXAMINATION OF A FLOWER.

Pleasing objects of contemplation as flowers are, beautiful to look at and agreeable to smell, the botanist is obliged frequently to destroy them before he can make himself acquainted with the peculiarities of their structure; that is to say, is obliged to cut or pull their various organs from their attachments;—this operation is termed dissection. Presently, then, we shall have to dissect a flower and learn its various parts. As a preliminary to this examination, however, it will be necessary that the learner should make himself acquainted with some general terms employed in this department of Botany.

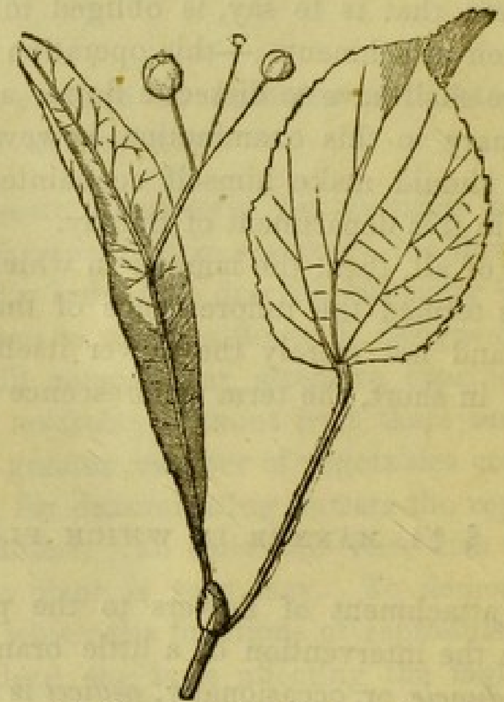
First of all, then, the manner in which flowers are arranged upon any plant is termed the inflorescence of that plant. By this term botanists understand not merely the flower itself, but various appendages to the flower; in short, the term inflorescence has a very wide signification.

§ 14. MANNER IN WHICH FLOWERS ARE ATTACHED.

The attachment of flowers to the parent stem usually takes place through the intervention of a little branch-like appendage, to which the term *peduncle*, or, occasionally, *pedicel* is applied. The reader will, therefore, remember that a peduncle or pedicel stands to a flower in the same relation as a petiole to a leaf. It is also called the *primary axis* of inflorescence, and the flower-stalks which spring from it are called the *secondary*, *tertiary*, *&c.*, *axes*. These pedicels or flower-stalks are arranged on various plants in different ways, and thus give rise to various terms indicative of the nature of inflorescence.

The inflorescence is said to be *definite* or *terminal* when the primary axis is terminated by a flower. When the original stem goes on growing in a straight line, giving off as it proceeds little flower-shoots or secondary axes of various degrees on either side, but does not terminate in a flower, then the term *indefinite inflorescence* is applied; the propriety of which term will be obvious. The term, *axillary*, is sometimes given to this condition of inflorescence. If the reader glance for an instant at the accompanying drawing (fig. 59), he will be at no loss to comprehend what is meant by *indefinite* or *axillary* inflorescence. The reader will here please to observe the little leaf-like things from the *axillæ* (or junctions with the primary axis) of which the flower-peduncles spring in this example. Such leaf-like appendages are often to be seen attached to the peduncles of many flowers. They are called *bracts*, and although their usual appearance is green like a leaf, yet they sometimes undergo very strange modifications. Thus, the pine-apple, which we discovered long ago to be no fruit, is in reality nothing more than an assemblage of fleshy bracts, and the scale of the fir-cone is nothing more than hard leathery bracts. In proportion as bracts are developed nearer to a flower, so does their natural green colour give place to the colour of the flower itself. Occasionally the flower actually springs from the upper surface of a bract, as is the case in the linden (fig. 60).

59. Axillary Inflorescence.



60. Flower of the Linden Tree.—Bract consolidated with the Peduncle.

Sometimes bracts unite at the base of each group of flowers, and on the same plane, as, for example, we find in the carrot. This association of bracts gives rise to what botanists term the *involucrum*. Under the classification *indefinite inflorescence* are comprehended the *raceme*, the *panicle*, the *corymb*, the *umbel*, the *spike*, the *capitulum*, and the *cyme*, all of which we shall now proceed to describe.

The raceme is that kind of inflorescence in which the pedicels or secondary axes are almost equal in length, and arise immediately from the primary axis or stem. Of this kind of inflorescence the black, white, and red currant trees offer familiar examples (fig. 61).

The panicle or *compound raceme* is a form of inflorescence in which the secondary axes or pedicels, springing from the primary axis or stem, do not at once bear each a terminal flower, but ramify a third, and sometimes even a fourth time. Of this description is the inflorescence of the horse-chesnut (fig. 62).

The corymb is that kind of inflorescence in which the lower pedicels, much longer than the upper ones, terminate, in consequence of this difference of length, at the same level, or nearly so, as the latter. An example of this is afforded by the Mahaleb cherry, of whose inflorescence a diagram is appended (fig. 63).

61. Raceme of the Currant.

62. Compound Raceme of the Horse-chesnut.

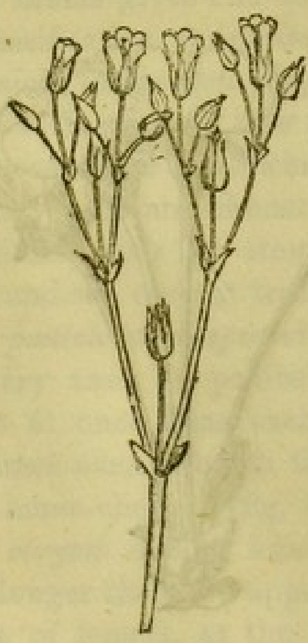
63. Corymb of the Mahaleb Cherry.

64. Simple Umbel of the Common Cherry.

The umbel is an inflorescence in which the pedicels or secondary axes, being equal in length amongst themselves, spring from the same level, rise to the same height, and diverge like the ribs of an umbrella or parasol. An umbel is *simple* when each pedicel terminates at once in a flower, as, for example, in the common cherry (fig. 64), *compound* when the pedicels, instead of terminating at once each in its own flower, severally give off other pedicels on which the flowers are arranged. An example of this is seen in the common Fennel (fig. 65).

65. Compound Umbel of the common Fennel.

The spike may be either simple or compound. The compound spike is that form of inflorescence in which the pedicels are completely or almost completely wanting, and the flowers accordingly are *sessile*, as may be seen in the Vervain (fig. 69). The compound spike is that form in which the secondary axes, instead of terminating in a flower, emit each a little flower-bearing pedicel. Of this description is the inflorescence of wheat (fig. 68).



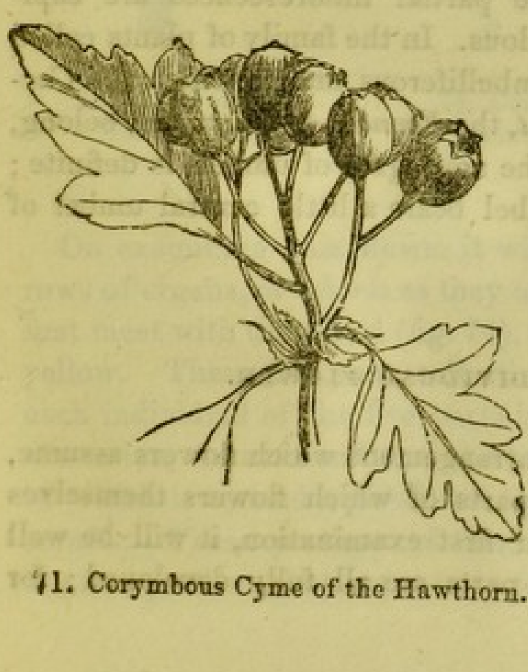
66. Dichotomous Cyme.

67. Corymbous Capitula of Groundsel.

68. Compound Spike of Wheat.

69. Simple Spike of the Vervain.

70. Capitulum of the Scabious.

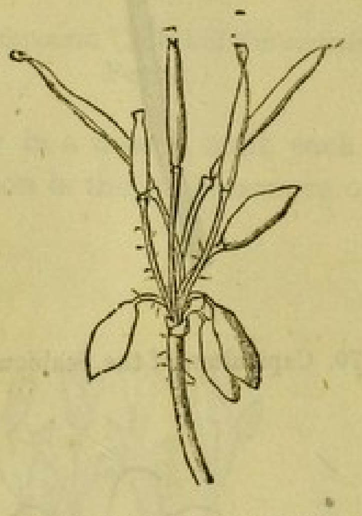


71. Corymbous Cyme of the Hawthorn.

72. Fascicule of the Mallow.

The capitulum is the form of inflorescence in which sessile flowers are collected upon the thickened head, called *torus*, of a peduncle. This torus may be flat, as we see it in the Marigold and the Scabious, or concave as in the Fig. It appears, then, that the *capitulum* is that form of inflorescence to which the Fig belongs.

The cyme is a definite inflorescence which imitates by turns several of the indefinite kinds of inflorescence, from all of which it essentially differs in the circumstance that the primary axis is itself terminated by a flower which appears before the others; each of the subsidiary axes also terminates in a flower, but the secondary axes flourish before the tertiary ones, tertiary axes before quaternary ones, and so on in like manner for the rest. The chief varieties of the cyme are the *racemous cyme*, as in the Campanula or Blue-Bell, the *dichotomous cyme* (fig. 66), the *corymbous cyme* (fig. 71), the *umbellar cyme* (fig. 73), the *scorpioidal cyme*, as in the Myosotis or Forget-me-not, and the *contracted cyme*, in which the flowers are crowded together through the extreme shortness of the axes. The *fascicule* is an inflorescence in which the axes preserve a certain length and an irregular distribution, as in the Sweet William.



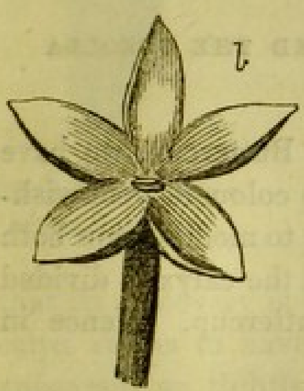
73. Umbellar Cyme of the Celandine.

Mixed inflorescence is that which partakes of the characters of both definite and indefinite inflorescence. In the Dead-Nettle the general inflorescence is indefinite, whilst the partial inflorescence consists of true cymes or fascicules. In the Mallow there is a similar arrangement (fig. 72). In the Groundsel (fig. 67) and the Chrysanthemum the general inflorescence is a definite corymb, but the partial inflorescences are capitulous. In the family of plants called umbelliferous, and to which the *Carrot*, the *Fennel*, *Angelica*, &c., belong, each umbel in itself is indefinite, but the aggregate of umbels is definite; frequently, indeed, the axis of an umbel bears a little central umbel of its own.

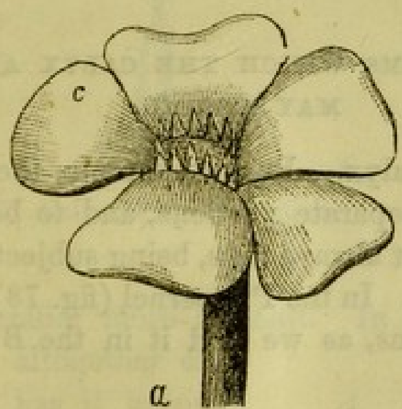
§ 16. PARTS OF AN INDIVIDUAL FLOWER.

Having already described the chief arrangement which flowers assume, we may now proceed to examine the parts of which flowers themselves are made up. For the purpose of our first examination, it will be well to select a flower in which the various parts are all fully developed; for this co-existence of all the parts necessary to constitute a perfect flower is not invariable ; in certain species one or more of these parts are wanting, and conversely in certain species the parts are redundant. Thus botanical productions are very apt to assume monstrous appearances, sometimes by the suppression of organs, at other times by their change, or their presence in increased numbers. In point of fact, the greater number of garden flowers are, botanically speaking, monsters, care and cultivation having succeeded in effecting remarkable changes. They are beautiful for a mere lover of flowers to look at, and often the objects of much solicitude, but quite unfit for the purpose of being the subjects of a young botanist's first investigations. Thus, how striking is the difference between the wild and cultivated roses. The flower-leaves of the former are thin and meagre, the flower-leaves, of the latter thick and tightly packed. Yet the additional flower-leaves, called *petals* of the garden-rose, are only modifications of the *stamens*, or little thread-like growths, of the wild flower. In saying, therefore, that we will commence our study of the parts of a flower by examining a perfect specimen, we mean the perfection of nature, not the perfection of the gardener.

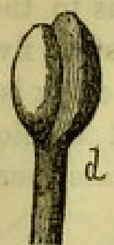
The reader cannot do better than select a Ranunculus or Buttercup as the subject of his first floral dissection.



74. Calyx of the Ranunculus.



75. Corolla of the Ranunculus.



76. Stamen of the Ranunculus.

77. Carpels of the Ranunculus.

On examining this flower it will be seen to consist of several circular rows of organs, or *whorls* as they are termed. Commencing externally, we first meet with the whorl (fig. 74), made up of five parts coloured greenish-yellow. These five parts collectively form what is termed the *calyx*, and each individual of the five parts is termed a *sepal*. Proceeding with our dissection, we next arrive at the bright yellow flower-leaves (fig. 75), each of which is termed a *petal*, and the whole five collectively are termed the *corolla*. These portions of this, or any other flower, are not its reproductive portions, but are merely to be regarded as the materials of little painted houses in which the gentlemen and ladies dwell. The term *perianth* is frequently given to the calyx and the corolla of a flower taken collectively. Proceeding still with our examination, we next arrive at many whorls or circular rows of *stamens*, or male parts of the flower. Our diagram (fig. 76) represents one of them cut off. Lastly, we arrive at several whorls of *carpels* or *pistils* (fig. 77), each springing from the *ovary* below, and terminating in what is called the *stigma* above, the intermediate portion being called the *style*. Let the reader, then, not fail to remember that stamens are male parts of plants, and carpels or pistils are the female parts. The carpels or pistils we have already stated to be each composed of ovary below, style in the middle, and stigma above. Each stamen is also divided into a *filament* or thread-like portion, and *anther* or head. This anther or head is covered with a dust called *pollen*, which, by falling upon the stigma, causes the ovary to expand, the fruit to ripen, and the seed to grow. This pollen the reader, we doubt not, has seen a thousand times over. It is very easily recognisable in most large flowers, especially tulips, into which, if we thrust our fingers or our noses, one or the other, as the case may be, comes back covered with a yellow powder. This yellow powder is pollen, without which the tulip plant would be totally incapable of fructifying.

§ 17. DIFFERENT FORMS WHICH THE CALYX AND THE COROLLA MAY ASSUME.

First of all, as to the calyx. In our example, the Buttercup, we have seen it to consist of five separate portions, and to be coloured yellowish-green; but the calyx is not always thus, being subject to modification both as to shape and to colour. In the Pimpernel (fig. 78) the calyx is divided into five separate portions, as we find it in the Buttercup. Hence in

78. Quinquepartite Calyx of the Pimpernel.

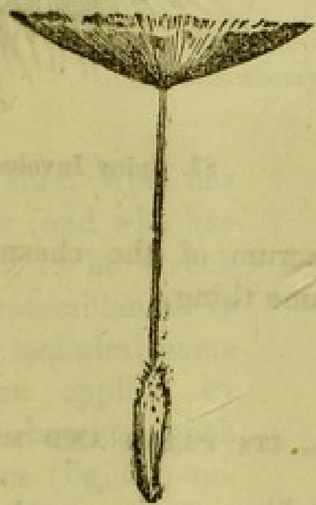
79. Quinquefid Calyx of the Gentian.

80. Irregular Calyx of the Dead-Nettle.

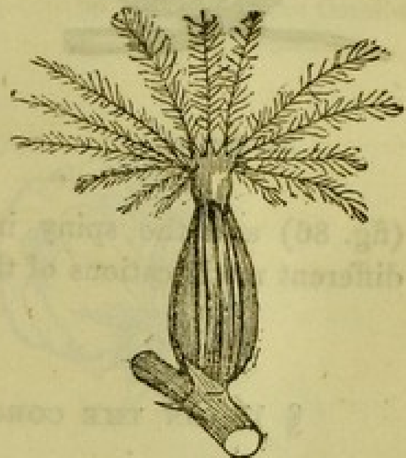
81. Calyx of the Madder.

these cases it is said to be *quinquepartite*. In the Gentian tribe it is no longer divided into five distinct sepals, but the calyx displays five clefts or fissures. Hence in this example it is said in botanical language to be a *fissured* or *fissile calyx*, and the number of fissures happening to be five, the term *quinquefid* or *quinquefissile* is applied to the calyx (fig. 79.) In the Lychnis tribe there is a calyx in which the rudiments only of these fissures are apparent, giving rise to the appearance of five teeth; hence such a calyx is said to be *quinquedentate*. The calyx is termed *regular* when the sepals of which it composed, whether equal or unequal, form a symmetrical whorl, as in the Pimpernel (fig. 78); but *irregular* when the sepals do not form a symmetrical whorl, as in the Dead-Nettle (fig. 80). The calyx is said to be *free* when it is not attached to the pistil, *adherent* when it is partly or wholly consolidated with the pistil. Although in our example, the Buttercup, and in most other examples, the calyx is easily recognisable, yet in certain other flowers it grows so tightly to the ovary,

82. Adherent calyx of the Sunflower.



83. Calyx of the Dandelion.

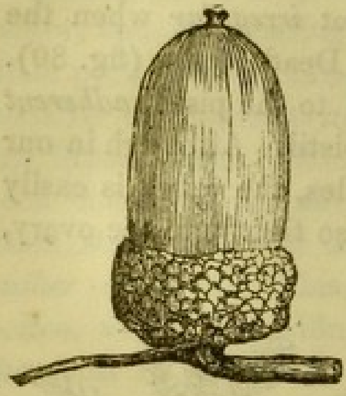


84 Calyx of the Centranth.

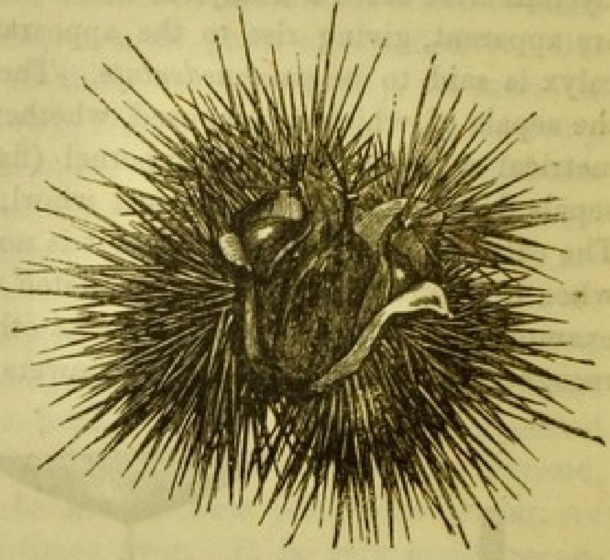
that its discovery is rather more difficult. In the Madder (fig. 81), the calyx seems to have altogether disappeared, so tightly has it become attached; in the Sunflower (fig. 82) the calyx adheres to the ovary, which it quite surrounds, but eventually becoming free, separates in thread-like prolongations. In each of the little florets of the Dandelion (fig. 83) the calyx is at first attached, but separated eventually in the form of an aigrette or plume. In the Centranth (fig. 84) the calyx, first adherent, separates in various feathery branches.

85. Calycule of the Strawberry.

The real calyx is made up of an association of sepals; but a sort of imitation calyx, termed the *involucrum*, is made up of bracts, those little modified leaves which we have already spoken of as being often found on the peduncles or flower-stalks. The extra calyx or *calycule* on the strawberry flower (fig. 85) is made up of these. The acorn-cup



86. Acorn.

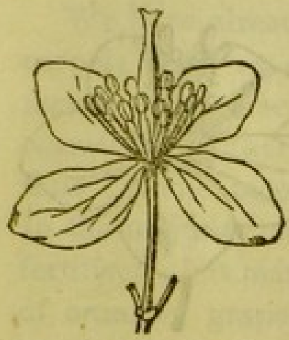


87. Spiny Involucrum of the Chesnut.

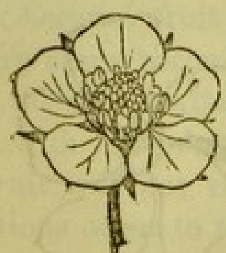
(fig. 86) and the spiny involucrum of the chesnut (fig. 87) are also different modifications of the same thing.

§ 18. ON THE COROLLA, ITS PARTS AND MODIFICATIONS.

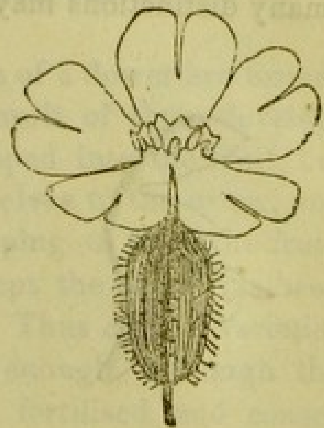
As the calyx may be made up of one sepal, in which case it is termed monosepalous, or of many sepals, in which case it is termed polysepalous, so the corolla may be made up of one of many parts called petals. In the former case a monopetalous, in the latter a polypetalous, flower results. Even the most casual observer of flowers must have noticed some of the various modifications of form and arrangement to which petals are subject. Hence have arisen numerous botanical designations, some of which we shall now proceed to explain. In the disposition and arrangement of petals, those which assume the cross form are very conspicuous. Vegetables of the Cabbage tribe, indeed, including turnips, watercresses, and many others, have had the botanical designation *cruciform*, or *cruciferous*, given to them from this very circumstance (fig. 88). The *rosaceous* disposition of petals is also very well marked, not only being observable in the Rose tribe, but being shared by numerous other vegetables. The Strawberry flower, for example, is rosaceous in the disposition of its petals (fig. 89). The cleft appearance which certain petals have is also highly characteristic, and gives rise to corollæ which are said to be *caryophyllate*. Of this the Lychnis (fig. 90) furnishes us with an example. The papilionaceous corolla constitutes an exceedingly well-marked natural division, the name being acquired from the circumstance that they resemble a butterfly in general appearance.



88. Cruciform Corolla of the Celandine.



89. Rosaceous Corolla of the Strawberry.



90. Caryophyllate Corolla of the Lychnis.

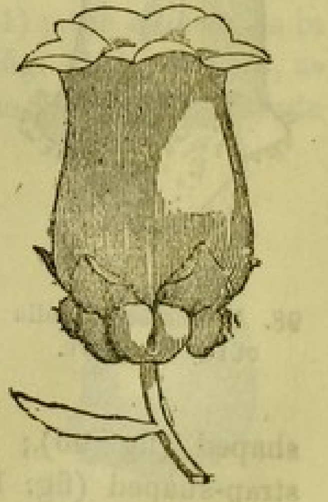
No person, we are sure, who has ever seen a Pea flower (and who has not?) can have failed to be struck with the marked resemblance in question. Hence the technical name *papilionaceæ* has been applied by botanists to plants bearing such flowers. Our diagram (fig. 91) represents the flower of a common Pea.

91. Papilionaceous Corolla of the Pea.

Such are amongst the chief of the modes in which the petals of polypetalous flowers are arranged. Monopetalous corollæ evidently do not admit

92. Tubular Corolla of the Corn-Centaury.

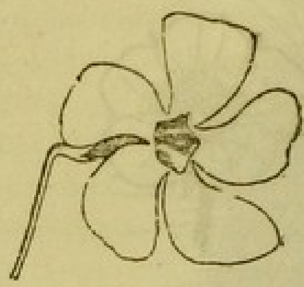
93. Infundibuliform Corolla of the Bind-Weed.



94. Campanulate Corolla of the Campanula.

of these variations, since they only consist of one organ; nevertheless, so numerous are the forms which these one-petalled corollæ assume, that many distinctions may be drawn between them. Thus, for example, we

95. Labiate Corolla of the Dead-Nettle.

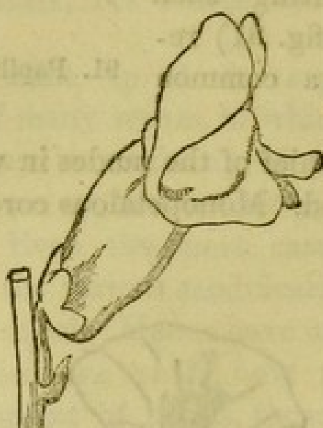


96. Hypocrateriform Corolla of the Periwinkle.

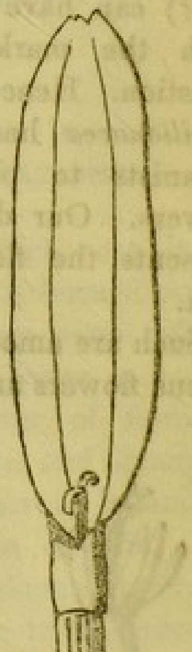
97. Rotate Corolla of the Pimpernel.

have *tubular* (fig. 92); *infundibuliform*, or funnel-shaped (fig. 93); *hypocrateriform*, or saucer-shaped (fig. 96); *campanulate*, or bell-shaped (fig. 94); *rotate*, or wheel-shaped (fig. 97); *labiate*, or lip-

98. Anomaleus Corolla of the Foxglove.



99. Personate Corolla of the Snapdragon.



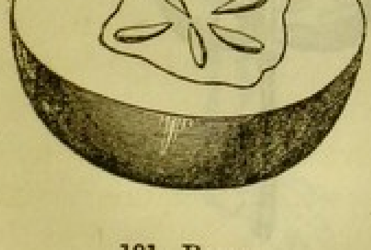
100. Ligulate Corolla of the Chrysanthemum.

shaped (fig. 95); *personate*, or mask-like (fig. 99); and *ligulate*, or strap-shaped (fig. 100) flowers. When the corolla is neither labiate, nor personate, nor ligulate, it is called *anomalous*, as in the Foxglove (fig. 98).

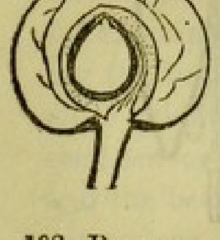
§ 19. ON FRUITS AND THEIR VARIETIES.

We have already remarked that the female parts of a flower are termed carpels, from καρπός, *fruit*, because fruit is the result of their development. Sometimes the ovary alone becomes developed into the fruit, but occasionally other parts of the flower attach themselves to the ovary, and thus become incorporated with its substance, helping to form the fruit. In the majority of cases fruit will not ripen except the ovary has been fertilised; but many exceptions occur to this rule. Thus certain varieties of oranges, grapes, and pine-apples ripen freely enough, although the ovaries from which they spring have never been fertilised, and consequently they bear no seed. Now, even in ordinary language, we employ various terms to denominate various kinds of fruit; it follows, therefore, that since botanists recognise many growths as fruits which we in ordinary language fail to dignify by that pleasing term, many botanical designations become necessary. There are two methods of communicating to the reader these distinctions. The first is by telling in what the distinctinctions consist; the second by *showing* in what they consist. Perhaps the latter method will, of the two, be the more simple. We shall, therefore, give drawings of the chief varieties of fruits, which are as follow:—

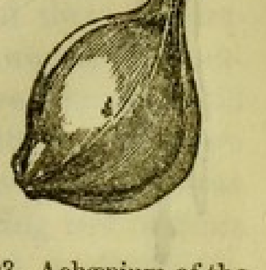
Pomes, or fruits resembling apples (fig. 101); *drupes*, or fruits resembling cherries, peaches, plums, &c. (fig. 102); the *achænium*, an example of which is seen in the Ranunculus (fig. 103); the *caryopsis*, as in Buckwheat (fig. 104); the *follicle*, as in the Columbine (fig. 105); the *legume*, or pod, as in the Lotus (fig. 108); the *capsule*, as in the Gentian (fig. 106), the Colchicum (fig. 109), the Iris (fig. 110), the Lychnis (fig. 116), and the Corn Poppy (fig. 107); the *pyxis*, as in the Pimpernel (fig. 117); the *siliqua*, as in the Celandine (fig. 111); the *silicule*, as in Mustard (fig. 112); the *samara*, as in the Maple (fig. 113); the *nut*, as in the Chesnut (fig. 114); and the *berry*, as in the Deadly Nightshade (fig. 115).



101. Pome.



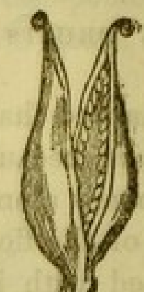
102. Drupe.



103. Achænium of the Ranunculus.

104. Cayopsis of Buckwheat.

105. Follicle of the Columbine.

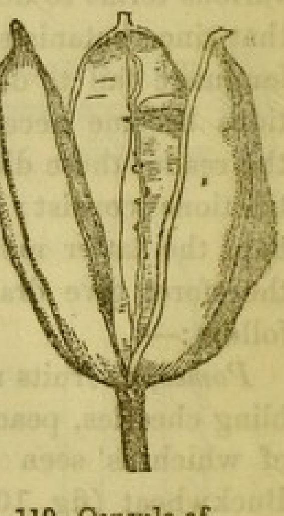


106. Capsule of the Gentian.

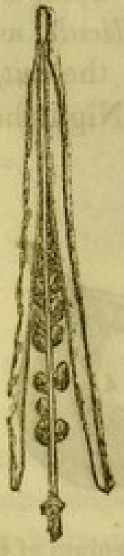
107. Capsule of the Corn Poppy.

108. Legume of the Lotus.

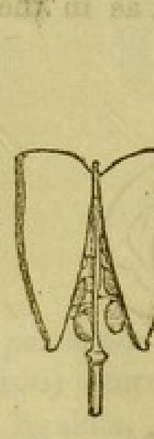
109. Capsule of the Colchicum.



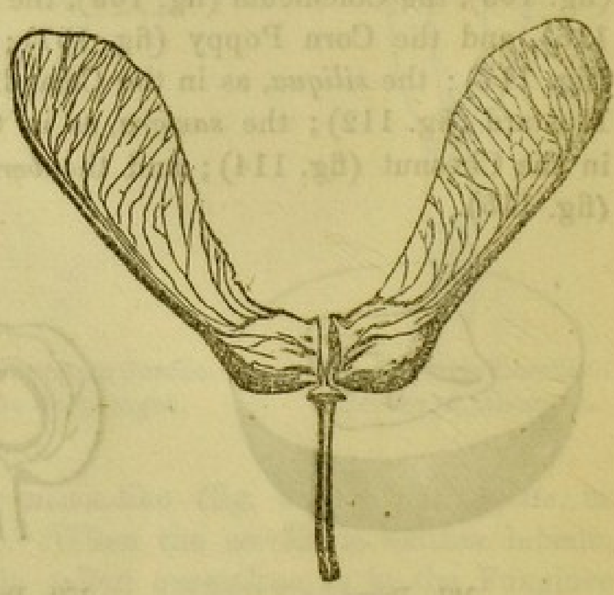
110. Capsule of the Iris.



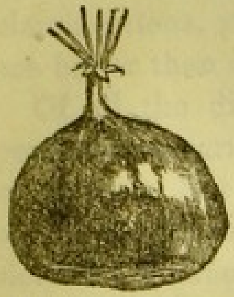
111. Siliqua of the Celandine.



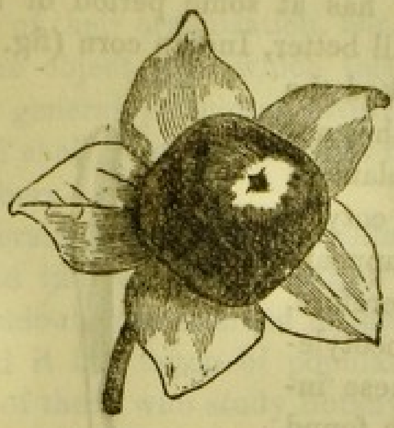
112. Silicule of Mustard.



113. Samara of the Maple.

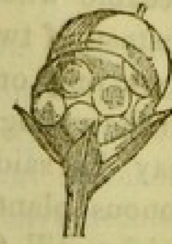


114. Nut of the Chesnut.



115. Berry of the Deadly Nightshade

116. Capsule of the Lychnis.



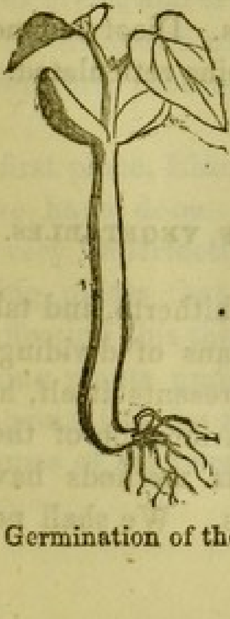
117. Pyxis of the Pimpernel.

§ 20. THE SEED.

The seed, every body knows, is that part of a plant which, being sown, gives rise to a new plant. We might write a whole treatise on the nature and varieties of seeds, especially as concerns their anatomical construction, but much of this information would be out of place in an elementary book; we shall, therefore, content ourselves with recapitulating some points that have already been adverted to in relation to seeds, and shall then mention some general facts concerning seeds which must not be forgotten.

Seeds, the reader will remember, belong exclusively to flowering plants; and we shall presently discover that seeds admit of two natural divisions characterised by a difference of structure—one division corresponding with endogenous, the other with exogenous plants.

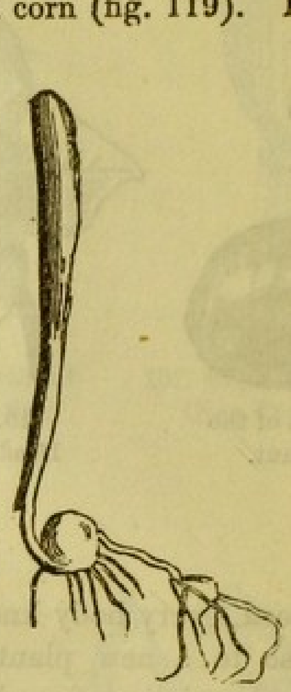
Did the reader ever remember planting a bean for amusement? Most young people have done this, and we will assume that the reader of this book has done it.



118. Germination of the Bean.

After having remained in the earth a few days, the bean throws up a shoot terminating in two little leaves. These little leaves were imbedded in miniature proportions, it is true, in the bean, and might have been recognised there by careful examination; however, by planting the bean they are rendered still more evident (fig. 118.) These two seed-leaves are termed *cotyledons*, and the bean possessing two of these cotyledons is termed a *dicotyledonous* plant.

Again, perhaps the reader has at some period of his life planted a grain of wheat, barley, or, still better, Indian corn (fig. 119). If he has done this, he may have remarked the result to have differed from that noticeable when the bean was planted. Instead of two seed-leaves, or cotyledons, only one in this case appears on the young plant, which, therefore, may be said to be a monocotyledonous plant. Extending these inquiries still further, it will be found that all plants which grow by external depositions and possess reticulated leaves—in other words, all exogenous plants—yield dicotyledonous seeds; and, as an inevitable consequence of this deduction, all plants which grow by internal depositions, and possess straight-veined leaves, yield monocotyledonous seeds.



119. Germination of Indian Corn.

Thus, then, it follows that even already the reader is so far master of the principles of botanical classification, that he could indicate the grand division of the vegetable kingdom to which any plant belonged by one of three classes of signs, namely, the signs of the section of the trunk, the signs of the leaf, and, lastly, the signs of the flower. We may, therefore, divide the various members of the vegetable kingdom as follows :—

Cryptogamic, or flowers not apparent.	
Phænogamous, or flowers apparent.	Endogenous. Monocotyledonous parallel-veined leaves.
	Exogenous. Dicotyledonous leaf-veins reticulated.

§ 21. FURTHER CLASSIFICATION OF VEGETABLES.

All the general principles we have discussed hitherto, and taken advantage of, have merely furnished us with the means of dividing vegetable growths into three; the question, therefore, presents itself, how we are to continue the division, how arrange the classification of the hundreds of thousands of plants which exist? Various methods have been at different times proposed for accomplishing this. We shall not mention them in the order of their organisation, nor shall we fully describe them, such not being the object with which this little book is written. We shall mention the general principles involved in effecting some of these classifications, and shall point out in what respects certain classifications are better than others.

Of all the different schemes of classification which have ever been proposed or carried into execution, that of the celebrated Swede, Linné or Linnæus, has undoubtedly attained to the greatest popularity. Indeed, so firm is the hold it has taken of popular appreciation, that no inconsiderable number of those who study Botany still fancy they have nothing better to learn than the number of pistils and stamens which are contained in different flowers, totally unconscious of all natural alliances. Suppose that some eccentric ethnologist should adopt the grotesque idea of classifying human faces according to the number of wives the individuals of each race were in the habit of marrying. Suppose that in reference to this master-idea the ethnologist should arrive at the conclusion, that inasmuch as Mussulman Turks, and Mussulman negroes, and Mussulman Kalmucs and Malays, all marry a great many wives, that for this reason Turks, and negroes, and Kalmucs, and Malays, must be all similar races of men. Would not such a classification awaken a smile at its grotesque whimsicality? Would it not be considered an eminently false classification, not to say absurd?

Yet this is almost the parallel case to that of Linnæus, when he effected his celebrated artificial division of plants according to the number and portion of the male and female parts (*stamens* and *pistils*) of flowers. The cases are remarkably similar in all that relates to our argument, for although it is the manner of a Mussulman gentleman to have several wives, whereas it is the wont of a lady flower to have several husbands; yet this collateral discrepancy does not affect the general deduction.

Nevertheless, the artificial classification of Linnæus has acquired a celebrity so great, and is so interwoven with popular botanical ideas, that it cannot be dismissed with the casual notice we have already afforded it. Let us, therefore, proceed to examine the general principles on which it is based.

In the first place, Linnæus divided plants into cryptogamic and flowering, as we have done. The department of cryptogamic Botany was, however, very imperfectly known to Linnæus; it was to the classification of flowering plants that his chief efforts were directed, and it is on his mode of effecting this that his botanical fame depends. Linnæus arranged all flowering plants under twenty-three classes, founded on the number and arrangement of the male parts (*stamens*) of the flower.

The names of his twenty-four classes are as follows:—

1. Monandria	..	1 stamen.
2. Diandria	..	2 stamens.
3. Triandria	..	3 ,,
4. Tetrandria	..	4 ,,
5. Pentandria	..	5 ,,
6. Hexandria	..	6 ,,
7. Heptandria	..	7 ,,
8. Octandria	..	8 ,,
9. Enneandria	..	9 ,,
10. Decandria	..	10 ,,
11. Dodecandria	..	11 to 19 stamens.
12. Icosandria	..	20 or more on the calyx.
13. Polyandria	..	20 or more on the receptacle.
14. Didynamia	..	4, two long, two short.
15. Tetradynamia	..	6, four long, two short.
16. Monadelphia	..	Stamens joined by their edges into one body.
17. Diadelphia	..	Stamens joined into two bodies.
18. Polyadelphia	..	Stamens joined into many bodies.
19. Syngenesia	..	Stamens joined by their anthers into a cylinder.
20. Gynandria	..	Stamens adherent to pistil.
21. Monœcia	..	Flowers bearing pistils exclusively, and flowers bearing stamens exclusively, on the same plant.
22. Diœcia	..	Flowers bearing pistils exclusively, and flowers bearing stamens exclusively, on different plants.
33. Polygamia	..	Flowers bearing stamens exclusively, or pistils exclusively, or either partially, on one or many plants.
24. Cryptogamia		

From an inspection of this arrangement, we observe that up to the eleventh class the number of stamens alone furnishes the distinctive sign, after which other circumstances are taken cognisance of. These circumstances are sufficiently indicated in the tabular view; but probably it may be desirable to present the reader with the derivation of some of these terms. The term *didynamia* means *two-powered* (δυό, *two*, δύναμις, *power*); the reason why the term is applied will be seen by referring to the tabular explanation. *Monadelphia* means *one brotherhood* (μόνος, *one*, ἀδελφός, *brother*), because all the stamens are connected together. *Syngenesia* is another term signifying a *growing together* (σύν, *together*, and γείνομαι, *I grow*). *Gynandria* signifies *woman-man* (γυνή, *woman*, ἀνήρ, genitive ἀνδρός, *a man*), because the pistils and stamens are attached. *Monœcia* signifies *one-housed* (from μονός, *one*, οἶκος, *house*), for a reason which will be evident. *Polygamia* signifies *many married* (πολύς, *many*, γάμος, *marriage*); the meaning of which term will also be evident by a simple inspection of the table. In order that the student may become practically acquainted with the respective peculiarities of these classes, we shall now mention in connexion with each class a corresponding flower, in which the characteristic mark of distinction may be recognised :—

Examples.	*Classes.*
1. Centhranthus	Monandria.
2. Veronica	Diandria.
3. Iris	Triandria.
4. Plantain	Tetrandria.
5. Pimpernel	Pentandria.
6. Lily	Hexandria.
7. Horse Chesnut	Heptandria.
8. Evening Primrose	Octandria.
9. Laurel	Enneandria.
10. Pink	Decandria.
11. Houseleek	Dodecandria.
12. Strawberry	Icosandria.
13. Ranunculus	Polyandria.
14. Foxglove	Didynamia.
15. Gillyflower	Tetradynamia.
16. Mallow	Monadelphia.
17. Pea	Diadelphia.
18. St. John's Wort	Polyadelphia.
19. Blue Corn-Flower. ..	Syngenesia.
20. Orchis	Gynandria.
21. Arum	Monœcia.
22. Nettle	Diœcia.
23. Pellitory of the wall ..	Polygamia.

With respect to the Linnæan classes, the first thirteen of them are divided into orders founded on the number of free ovaries or styles entering into the composition of the pistil; in *monogynia* the pistil is formed of one single carpel, or many carpels united into one single body by their ovaries or their styles; in *digynia* there are two distinct ovaries, or styles; in *trigynia*, three; in *tetragynia*, four; in *pentagynia*, five; in *hexagynia*, six; in *polygynia* a number exceeding ten. The fourteenth class includes two orders: *gympospermia*, in which the pistil is composed of four achœnia (vide p. 4), having the appearance of naked seeds; *angiospermia*, in which the seeds are included in a capsule. The fifteenth class, or *tetradynamia*, is termed *siliquose* or *siliculose*, according as the fruit happens to be longer than broad, or broader than long. The sixteenth, seventeenth, eighteenth, twentieth, twenty-first, and twenty-second classes, have their orders established in conformity with the number and the mode of connexion of the stamens with the styles (triandria, pentandria, polyandria, monogynia, polygynia, monadelphia, &c.) The nineteenth class is subdivided into *polygamia æqualis*, in which all the central flowers of the capitulum (vide p. 40) contain both stamens and pistils, and those of the circumference pistils only; *polygamia frustata* when the flowers of the circumference contain pistils only, and are sterile; *polygamia necessaria* when all the central flowers contain stamens and those of the circumference pistils.

The botanist who sets about applying the principles of Linnæus soon finds that the same class is made to contain plants of different natural families, whilst others having affinities to each other are widely separated.

It would be unjust to the memory of Linnæus not to say that he recognised the desirableness of classifying vegetables according to their natural alliances, if this could be done; but at the time when he lived a sufficient number of facts to admit of this had not been collected. "All plants," remarks Linnæus, in his botanical philosophy, "are allied by affinities, just as territories come in contact with each other on a geographical chart. Botanists should unceasingly endeavour to arrive at a natural order of classification. Such natural order is the final aim of botanical science. The circumstance rendering such a plan defective now is the insufficient knowledge we have of plants, so many species of which are yet undiscovered. When these species are discovered and described, a natural classification will be accomplished, for nature does not proceed abruptly, as it were by leaps."

These sentiments, made known by the great Swede himself, prove to us that he only intended his artificial classification to be a provisional arrangement.

Waiving the question of its intrinsic utility, the artificial system of Linnæus is not always so easy of application as it might at a first glance be thought. The characters of the stamens and the pistils necessary to be made out before the class and order of any particular vegetable can be determined, are not so easily discriminated as might be supposed. Dodecandria, icosandria, and polyandria, are occasionally very difficult to distinguish one from the other. In didynamia and tetradynamia the stamens are sometimes equal, whilst in other classes, in which they form two series, the inequality is manifest; such is the case in Pinks and Geraniums. Monadelphia and diadelphia are sources of continual mistakes; many plants called monadelphous in the system of Linnæus scarcely present an appreciable junction of the stamens; many plants called diadelphous are really monadelphous. Syngenesia is equally real in the Cyclamen as in the Violet. Monœcia and diœcia furnish many characteristic appearances which are not taken cognisance of; and many other objections might be readily cited.

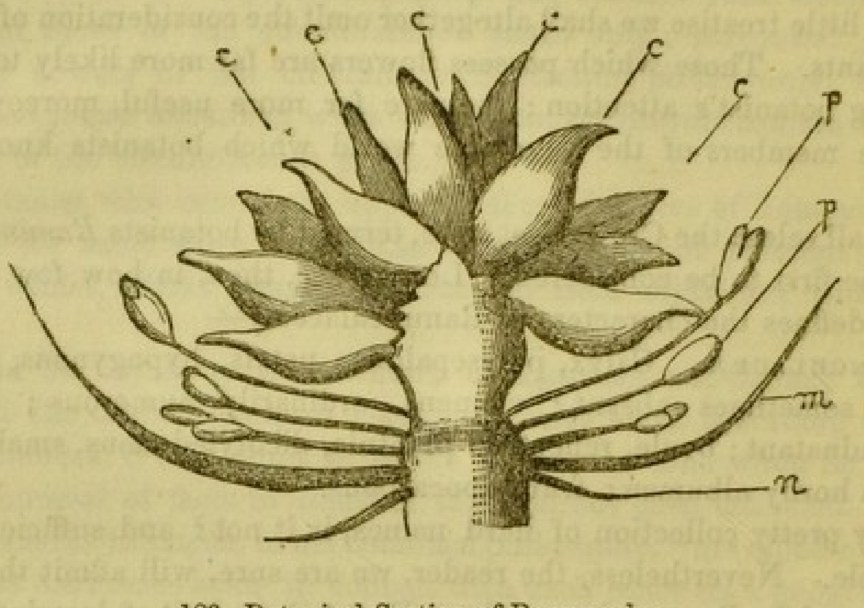
§ 22. ON THE NATURAL ORDER OF FLOWERING PLANTS.

In this little treatise we shall altogether omit the consideration of cryptogamic plants. Those which possess flowers are far more likely to arouse the young botanist's attention; they are far more useful, moreover, and are those members of the vegetable world which botanists know most about.

We shall select the Crow-Foot tribe, termed by botanists *Ranunculaceæ*, as the one first to be considered. Let us see, then, in how few words a botanist defines the characters of Ranunculaceæ :—

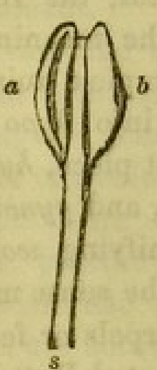
RANUNCULACEÆ. Calyx, polysepalous; petals, hypogynous, in form various, sometimes absent; stamens, ordinarily numerous; anthers, usually adnatant; ovule, reflected; plantule, dicotyledonous, small, at the base of a horny albumen; fruit, apocarpous.

A very pretty collection of hard names, is it not? and sufficiently unintelligible. Nevertheless, the reader, we are sure, will admit that if the characters of the Ranunculus, or Crow-Foot tribe, admit of description in so few words, it is worth while to learn the meaning of these words. Well, then, let us set about it; let us analyse the definition clause by clause. First, then, *calyx polysepalous;* what is the meaning of that? The reader, by this time, knows the meaning of calyx; it is the outside greenish yellow whorl of which the Buttercup flower is composed, and being made up of several parts (*sepals*, and the Greek word, πολύς, *polus*, signifying *many*), the calyx is denominated *polysepalous*, a somewhat important characteristic thus easily conveyed in few words. Now for the second clause, *petals, hypogynous.* As for the word *petal*, the reader knows its meaning already; but *hypogynous*, what is the meaning of that term? Complex words, like complex plants and complex animals, require dissection. *Hypogynous* being dissected, then, into *hypo* and *gynous*, we shall soon arrive at its meaning. In the first place, *hypo* is the almost literal rendering of the Greek word, ὑπό, *under*, and *gynous* is evidently a derivation from another Greek word, γυνή, signifying *woman.* When, therefore, it is said that the petals are *hypogynous*, the sense meant to be conveyed is, that they spring from underneath the carpels or female parts of the flower. A very slight examination of a dissected Buttercup will show that the arrangement of petals is as described; or, if the reader do not happen to possess a flower of this kind, he may convince himself of the truth of the description by reference to the accompanying diagram (fig. 120), in which the little central bodies, marked *c c c*, are the carpels or female parts of the flower; the little thread-like things, *p p*, being the stamens or male parts of the flower; the curved line, *m*, representing the position of the corolla, and the lower curved line, *n*, that of the calyx. Hence the meaning of the term *hypogynous petals* will now be evident, for the curved line, *m*, the representative of their position, is evidently below the little carpels, *c c c*. *Stamens ordinarily numerous;*

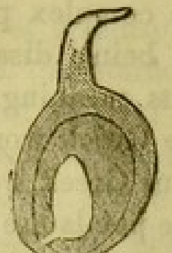


120. Botanical Section of Ranunculus.

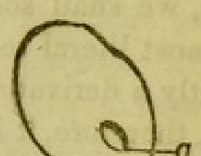
anthers usually adnatant. The general term, *stamen*, the reader already knows to be applied to each of the little threads, *p p*, together with its appendages; the *anther* is the mace-like knot at the upper extremity of the stamen. We have, therefore, to consider the meaning of the term *adnatant*, which signifies grown to a thing by its whole surface; for example, in the Buttercup the anthers adhere to the styles in the manner represented in the accompanying diagram (fig. 121).



121. Adnatant Anthers of the Buttercup.



122. Fruit of the Buttercup.

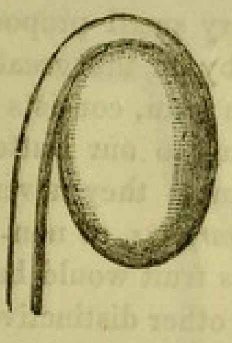


123. Seed of the Buttercup.

Here the anthers are the little projections *a* and *b*; evidently they are attached to the style, *s*, by their whole surface, and not a portion of the same.

Ovule reflected. Let us begin by settling exact ideas respecting the *ovule*; we will then treat about its reflection afterwards. The casual observer of a Buttercup would take the little central protuberances or carpels as they exist in a ripened flower for seeds. They are not seeds, but fruits; very small, but still fruits. If the student possesses a magnifying glass, he may, on cutting a ripened carpel or fruit open, find the real seed inside, presenting an appearance of which fig. 122 is a magnified representation.

Now, if the fruit be so small, what must the real seed be? Nevertheless, by the aid of a good magnifying glass all its various parts may be rendered evident. Fig. 123 is its magnified appearance. When the seed of a Buttercup is cut open, the observer will perhaps at first see nothing but a mass of white flesh, termed by botanists *albumen*; but if the seed have been accurately divided from top to bottom, a little thing will be observed at *a;* this is the *embryo*, and, small as it seems, this *embryo* is the only portion of the seed which represents the future plant. The albumen of the seed is merely so much food for the young embryo to eat before it has grown big enough to shift for itself. It consists of a *radicle*, or representative of the root, and two cotyledons or rudimentary leaves. This the reader might have predicted, without finding these cotyledons, from a consideration that the leaves of Buttercups are reticulated, not straight-veined, from which circumstance they must belong to the dicotyledonous division of plants.



124. Reflected Ovule of the Buttercup.

Still, we have not arrived at the reason why the ovule is said to be reflected; and, indeed, this determination belongs so completely to microscopic Botany, that we should scarcely have explained the meaning of the term, were we not desirous that no expression should appear useless or unmeaning. This reflected state of the ovule the reader will scarcely see even by the aid of glasses. The word, however, means bent suddenly back upon itself, as represented in the accompanying diagram (fig. 125).

At the base of a horny albumen. If the reader refers to a diagram already given (fig. 123), he will see that the embryo really rests at the base of the albumen, as described; and inasmuch as this albumen is very hard, it is termed *horny*.

Thus we have almost got through our analysis of the various terms applied to designate the botanical order Ranunculaceæ. The reader will admit each term has had a meaning, and that, when understood, these terms are very expressive. Perhaps he may think that the remarks concerning the manner of adhesion and the number of the petals are all well enough, but he may, at the same time, think that the microscopic examination of the seed and its fruits are a little far fetched. Nevertheless, the reader will find, when his botanical studies have been a little further prosecuted, that the shape and disposition of the embryo constitute some of the most reliable distinctive marks of various species. We admit, however, that these microscopic signs are, for the most part, unavailable to the botanical student, who must content himself with broader characteristics.

Fruit, apocarpous. This is a proper opportunity for making ourselves acquainted with certain general facts in Botany, not necessarily connected with the Ranunculaceæ, but which a member of that family of plants may serve to illustrate. Referring to the carpels, or the central or female parts of the flower, these will be found scarcely to alter in appearance, except in size, from the first period of inflorescence to the last, when the perianth or floral envelopes fall off, and the fruit is developed. This fruit, in point of fact, consists of nothing but red carpels.

Hence, without any other addition, the fruit of Ranunculaceæ furnishes us with the simplest conditions under which a fruit can exist. All fruit may be defined in strict botanical language to be the matured carpel; but in by far the majority of instances the real botanical fruit is masked by the attachment of other appendages. For example, the carpel, or real fruit, bears a very small proportion to the absolute size of an apple or pear. In these by far the greater portion of the fruit, in the ordinary acceptation of the term, consists of a highly developed and succulent calyx.

Referring to our Buttercup again, the carpels are observed to remain quite distinct; they never adhere; hence the fruit of a Buttercup is said to be *apocarpous*, or non-adherent. Had the carpels been united, then a *syncarpous* fruit would have resulted.

Several other distinctive signs of the natural order Ranunculaceæ might be mentioned; but even fewer than those already enumerated might serve pretty clearly to indicate the true order of these plants; these essential characteristics are the hypogynous stamens and apocarpous fruit. If the student meets with any plant having these characteristics, no matter how different the general appearance of such plant may be from the general appearance of the Buttercup, no matter whether the size is different, the shape or colour of the flower different, still it is almost sure to be a Ranunculus. But what is the use of this classification? the reader may ask. Take a supposed case. You are shipwrecked on some unknown island, or you are a farmer in some unexplored land, and you meet with some gay-looking flowers or tempting-looking herbs; the flowers are apocarpous and the stamens are hypogynous; take care of such plants, neither eat them nor permit your cattle to eat them. They are, most likely, poisonous, this being a leading physiological characteristic of the tribe; and in certain species the poisonous principle is so extremely virulent that death would speedily result from the swallowing of a very minute portion. Such knowledge as this constitutes the really useful part of Botany, not a mere classification of plants without reference to the properties of the members falling under each classification.

Having thus studied the general characteristics of the Ranunculus order, taking the Buttercup as our standard of comparison, let us see how far general appearances may alter without the essential characteristics being interfered with.

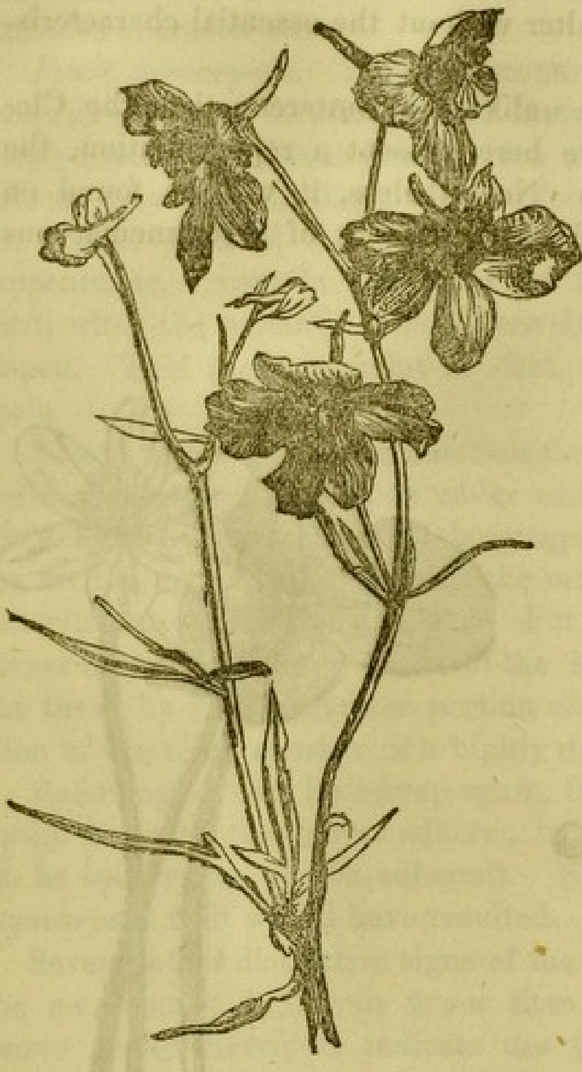
What plant is apparently more unlike the Buttercup than the Clematis, of one species of which we here present a representation, the Clematis Angustifolia? (fig. 125.) Nevertheless, it will be found on dissection to present the essential characteristics of a ranunculaceous plant.

125. Clematis Angustifolia.

126. Hepatica Triloba.

How seemingly different, again, from the Buttercup are the Hepaticas? (fig. 126.) Yet their structure at once points out the family to which they belong.

But the Larkspur tribe, including the Delphinium (fig. 127), differ so greatly in external appearance from the yellow Buttercup, that none but the botanist can see any alliance between them. To his educated eye, however, the similarity is complete. The circumstance in reference to which the term Larkspur is given depends upon a curious formation of one of the sepals of the calyx, something like the spur on a bird's foot; but it is a condition of further botanical importance, thus assisting to indicate a genus, not an order; and colour is of still less botanical importance. Inside the sepals or calyx of a Larkspur are four petals strangely shaped, two of them having long tails. Thus the Larkspur wears a complete mask; but the botanist at once recognises the flower by the essential signs of apocarpous fruit and hypogynous stamens, and once recognised, once referred to Ranunculaceæ, Larkspurs would be justly held in suspicion as poisonous plants, a character which they richly deserve.



127. Delphinium Grandiflorum

Anemones, those pretty flowers with their variously coloured petals and drooping flowers,—these, too, belong to the order of Ranunculaceæ, as also do the large Show-Peonies and the Monkhoods or Aconites (fig. 128), which have also the characteristics of the Ranunculaceæ, as the student who examines them will not fail to recognise.

The reader will now begin to understand the general principles on which a natural classification of vegetables is effected. In the first place, we divide them into cryptogamic and phœnogamous; then we divide the latter into endogenous and exogenous. Next we proceed to establish orders, from a consideration of such characteristics as the position of stamens, nature of fruit, character of seed; and, as we have already seen, we usually give to each order a name derived from some leading genus or subdivision. Thus our principal genus in the *Ranunculus* order is the Ranunculus or Crowfoot; hence the generic name Ranunculaceæ is given; and we subdivide this genus into species by the addition of terms which consideration will render obvious. For example, there is one species of Ranunculus which is more frightfully poisonous than the rest; botanists, therefore, apply to this species the appellation of *wicked*, or *sceleratus*; hence, when the expression Ranunculus Sceleratus is met with, the reader is made acquainted with the following facts in the following order. The plant is a flowering plant, is an exogenous plant, belongs to the order of Ranunculaceæ, to the genus Ranunculus, and is a member of the species designated *sceleratus.*

More than one poisonous principle abounds in the Ranunculaceæ, but of these the alkali, termed by chemists *aconitum*, is the most violent. It is a white substance, something like flour to look at, and so frightfully poisonous that the twentieth part of a grain, or even less, is a fatal dose. Of all the various species of aconitum, that termed Aconitum Ferox is the most dangerous. This plant grows in the Himalaya mountains, and was on one occasion used by the Nepaulese as a means of ridding themselves of us, their invaders. A few leaves of this Aconitum Ferox being thrown into the well, poisoned all the water to such an extent that men or beasts drinking of it were almost infallibly killed.


128. Aconitum Variegatum.

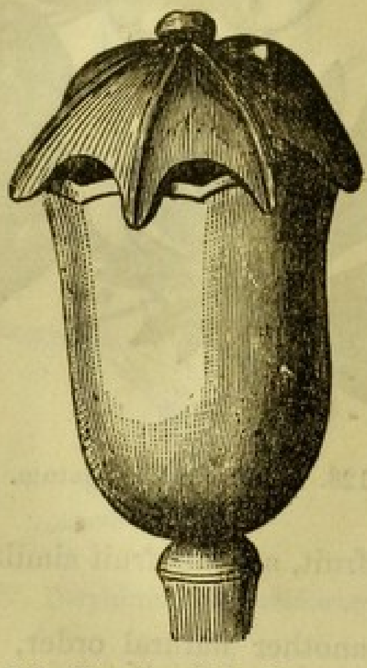
Our space does not admit of more being said concerning the order Ranunculaceæ. We must conclude, therefore, by stating that their fruit, and all fruit similar to it, is denominated by botanists *achœnium.*

Let us now commence the study of another natural order, bearing some affinity to Ranunculaceæ, but differing from it by certain characterestic signs.

§ 23. PAPAVERACEÆ, OR THE POPPY TRIBE.

Characters : Sepals two, three, caduceous ; petals, hypogynous; their number double or quadruple that of the sepals; imbricated in œstivation ; stamens numerous ; ovary unilocular, placenta parietal, sometimes prolonged into vertical plates, at other times filiform; fruit, capsular ; seed, dicotyledonous and albuminous.

Such are the botanical characteristics of this natural order succinctly expressed. Most of the terms employed the reader will understand; the meaning of the remaining terms will become evident as we proceed. The reader may provide himself with a red Corn Poppy as a specimen of the flower, and a White Poppy capsule, procurable at the druggist's, as a sample of the fruit. Like Buttercups, Poppies will be seen on examination to have a great numbers of stamens; these stamens, moreover, are below the carpels, or are hypogynous. Thus far the resemblance of the Poppy tribe to the Ranunculus tribe is complete. But when we come to examine the fruit, what a difference is there! In Ranunculus the carpels remain distinct, and the fruit is, owing to that circumstance, denominated *apocarpous;* in Papaver the carpels unite together and constitute one capsule, the Poppy-head of the shops. This, then, is the grand broad distinction between the two natural orders. The carpels, then, have all grown into one common ovary; but what has become of the *stigma* or upper expansion of the styles? These may be seen at the extremity of the Poppy capsule, as represented in the accompanying diagram (fig. 129), where they may be observed forming a sort of crown. If the capsule be now opened it will be found to consist of one cell, into which various little plates project; the latter are termed *placentas* or *placentæ*; they are the part in a vegetable which gives attachment to the seeds.



129. Capsule of the Poppy.

Such are the mechanical conditions, if we may so term them, in which Papaveraceæ differ from Ranunculaceæ. But there is a well-marked physiological difference also. The Ranunculus tribe are supplied with a watery, acrid, poisonous juice; whereas, in the Poppy tribe, the juice is milky, and usually contains opium. The substance known as opium in the shops is derived from the White Poppy, by making cuts on the ripe capsules, and causing the juice to exude. After exposure for a while to the sun, the juice, at first milky, soon thickens into a dark waxy-looking mass. This is opium, the active principles of which are numerous, but that termed morphia is the chief.

Just as the Ranunculus tribe becomes veiled in the Larkspur, Anemone, Clematis, and Peony, so are the Poppy characteristics obscured in certain plants belonging to this natural order. For example, on some parts of the sea-coast there grows a plant termed the Horned Poppy, on account of the peculiar appearance of its fruit, which, instead of being round like the fruit of a common red or white Poppy, is shaped something like a horn. This appearance is at once explained by the botanist. In the fruit of the ordinary Poppy numerous carpels are united together, and thus a globular body results, just as the orange presents a globular aspect on account of the assemblage of so many easily divisible sections; but supposing many of these sections removed, then the orange would no longer be globular, but elongated. It is thus with the Horned Poppy. Its fruit, like the ordinary Poppy, is *syncarpous;* that is to say, compounded of carpels united together; but their number being fewer, only two, the resulting fruit is necessarily more elongated.

130. Papaver Somniferum

Celandine (Chelidonium Majus) is another genus of the Poppy tribe, in which the fruits are elongated, and for a similar reason. All these species of Papaveraceæ are characterised by having a milky juice, by the presence of which, taken in connexion with hypogynous stamens and syncarpous fruits, members of this tribe may always be discriminated (fig. 130).

§ 24. ROSACEÆ, OR THE ROSE TRIBE.

This is a very extensive natural order of plants, comprehending not only the Roses proper, but Almonds, Strawberries, Apples, Pears, and some others.

Characteristics: Calyx, monopetalous, tubular; sometimes free, sometimes adherent to the ovary; four or five-lobed, imbricated in æstivation; petals equal in number to the sepals, alternate with them, free, inserted on the calyx, imbricated in æstivation, sometimes absent; stamens almost always indefinite, inserted like the petals; pistil, various; ovule, reflected; seeds, dicotyledonous; flowers, ordinarily complex; inflorescence, varied.

Perhaps the best specimen for affording the general characteristics of the Rose tribe is a Strawberry flower. Supposing the reader to have provided himself with one of these, he will at first be struck with a general resemblance to a Buttercup flower. In both the carpels and the stamens are numerous, but the following leading distinction between them may at once be seen. In the Buttercup the stamens do not grow from the calyx, so that the latter may be altogether removed without in any respect disturbing the former. If, however, we attempt to dissect a Rose or a Strawberry flower in this manner, we shall soon find it impossible to remove the sepals of which the calyx is composed without at the same time removing all the stamens. This distinctive characteristic was known to Linnæus, and embodied by him in the distinction between his icosandria and polyandria, as the reader will observe, if he turns to p. 52.

This peculiarity in the insertion of stamens in flowers of the Rose tribe is shortly indicated in botanical language by the term *perigynous.* We have already seen that the term *hypogynous* means below the carpel; therefore, the reader will now be prepared to understand that perigynous means around the carpel; and this is expressive of the mode of growth of stamens in the Rose tribe. Had we not, at an early period of our labours, explained the nature of the Strawberry itself, that point would have to be explained now; but the reader is already aware that the real botanical fruits of the Strawberry are those little seed-like things scattered over the surface of the part we eat.

Very nearly allied to Strawberries in their botanical aspect are the Cinquefoil or Potentilla plants. Their flowers are almost exactly like those of the Strawberry, but Strawberries, nevertheless, do not result. The torus, which becomes juicy and delicious in the Strawberry, remains hard in the Potentilla.

Raspberries and Brambles are also members of the Rose tribe, with which they agree in the easily recognised essential characteristic of perigynous stamens. There is a sort of general resemblance, too, between the fruits of the Raspberry, Blackberry, and the edible portion of the Strawberry; yet the botanical distinction between Raspberries and Blackberries on the one hand, and Strawberries on the other, is amazingly great. The very part we eat in the Strawberry is the portion we throw away in the Raspberry and Blackberry (fig. 132). The fleshy torus or receptacle of the Strawberry becomes in the latter a white, insipid, spindle-shaped core,

132. Blackberry (Rubus Cæsius.)

whilst the edible part is a real fruit, or rather an assemblage of real fruits, matured ovaries. How are we to know this? the learner will ask. Simply thus. Did he never observe that each of these little berry-like elevations is surmounted or terminated by a sort of hair? Now these hairs are nothing more than the styles of carpels, the lower portions or ovaries of which have expanded in order to become fruit.

Let us now examine a Rose, not so much for the sake of learning any new points respecting the flower, as for the sake of gradually making ourselves acquainted with the structure of such fruits as Apples and Pears.

Perhaps we had better commence with the fruits, as a Rose flower has little to teach us. After the petals of a Rose have all fallen away, there remains, as everybody knows, a sort of bulbous-looking thing, which, if split open, contains little hairy prominences termed seeds in ordinary language. In reality, these are fruits containing the seed, and the external envelope in which they are contained is nothing more than a calyx. This peculiar conformation will be readily demonstrated by considering the various parts of a Rose flower, and the changes which these parts undergo. If we open a Rose flower, we see numerous stamens but no pistils. On looking still more attentively, the tops of pistils become evident, that is to say, their stigmas, but their styles are

133. Pear Blossom.

hidden. If a vertical section of the flower be now made, the stigmas will be seen to proceed from ovaries affixed, as already described, to the calyx, and hidden by the envelopment of the latter, which surrounds them on all sides, only little throat-like openings being left.

Here, then, the calyx, not growing to the fruits or carpels, although surrounding them, can readily be separated. But after the examples of botanical transformation which we have already seen, the reader will not be surprised at the information that, in certain members of the Rose order, the calyx not only surrounds the carpels, but actually attaches itself to them; thus becoming what we should term in ordinary language a portion of the fruit. This is the case with Apples and Pears, which are composed each of five carpels, recognisable by the five seed vessels closely enveloped in a fleshy calyx. What we term the eye of an Apple is nothing but the remains of the calyx surrounded by withered stamens.

A precisely similar structure is observable in the Pear (fig. 133), the Quince, and the Mountain Ash; the fruit of the latter, indeed, resembles common Apples in every respect except size and colour. The Hawthorn is also a Rosaceous plant, belonging to the sub-order *Pomeæ;* hence the structure of the fruit, *Hips and Haws*, should resemble the structure of an Apple. On a casual examination this does not seem to be the case, for

134. Rosa Centifolia.

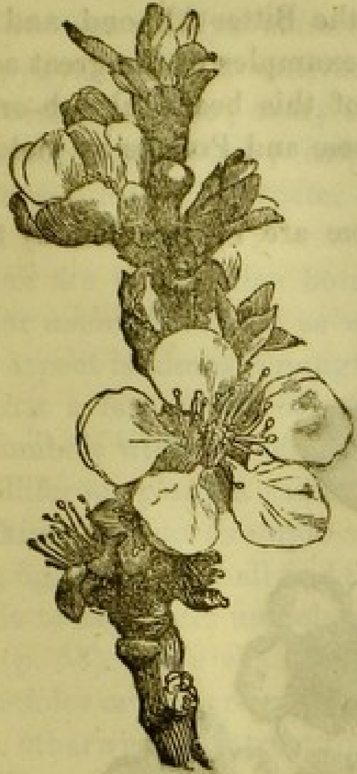
whereas the Apple contains internally some parchment-like cavities, the fruit of the Hawthorn contains some things which resemble seeds enveloped by a long covering; this long covering, however, is no other than a thickened condition of the parchment-like compartments of the Apple.

The Apple tribe (sub-order Pomeæ) is thus seen to be nearly allied to the Roses proper; the Almond tribe (sub-order Amygdaleæ), containing Almonds, Peaches, Apricots, Nectarines, Plums, &c., is still more nearly allied, however little one might anticipate such resemblance from a casual examination of the fruit. The reader will remember that in the sub-order Pomeæ, the ovary, or lower portion of the united carpels, is inferior; that is to say, the calyx grows around it, adheres to it, and appears above it. In the Rose proper no such adherence takes place; hence the ovary may be said to be *superior;* in Amygdaleæ, or the sub-order of Rosaceæ, containing Almonds, Plums, Nectarines, &c., the ovary is also superior; hence the truth of our remark, that this sub-order was more nearly allied to Roses proper than is the sub-order Pomeæ. If the flowers of Peaches, Plums, Nectarines, &c., be examined, they will be found to be made up of a corolla of five petals, a calyx of five sepals, and numerous stamens arising from the sides of the calyx; these are all characteristics of the Rose tribe. Instead, however, of many carpels, like the Roses proper, the members of the Almond tribe have each only one, which ripens into the sort of fruit termed by botanical writers a *drupe.* For other specimens of the Rose tribe we refer the reader to figs. 134 and 135.


135. Rosa Rubiginosa.

Let us now examine the chemical and physiological characteristics of the Rosaceæ. The sub-order *Roseæ,* containing the Roses proper, does not include one noxious plant. On the contrary, the Strawberry yields us a delightful article of food, and the fruit of some species of Rose is made into conserves. The leaves of this sub-order are usually astringent, and so in like manner are the petals; those of the garden Roses are frequently used by medical men for the preparation of astringent draughts. Need we call attention to the fragrance of Roses? That fragrance depends on the presence of a volatile oil, which admits of being extracted from the flower petals. It constitutes the otto or ottar of Roses.

The sub-order *Pomeæ* is also harmless, if we except the seeds and flowers of certain species which contain a minute amount of prussic acid; not sufficient, however, to be injurious. The fleshy part of pomaceous fruits is frequently an agreeable article of food, containing much sugar in the sweet varieties, and various acids, of which the malic is the principal. In the sub-order *Amygdaleæ* (figs. 136, 137, and 140), the amount of prussic acid, which becomes accumulated for the most part in the leaves, petals, and seeds, is often very great; nevertheless, the poisonous principle rarely extends to the fleshy pericarp



136. Apricot (Prunus Armeniaca).

137. Peach (Amygdalus Persiaca).

138. Scarlet Bennet, or Avens
(Geum Coccineum).

139. Ladies' Mantle
(Alchemilla Vulgaris).

or edible portion of the fruit. The seeds of the Bitter Almond, and the leaves of the common Cherry Laurel, furnish examples of the great accumulation of prussic acid in certain members of this beautiful sub-order, which is also further distinguished from Roseæ and Pomeæ by yielding gum, which the two latter never do.

Other plants belonging to the order Rosaceæ are represented by figs. 138 and 139.

140. American Apricot.

§ 25. UMBELLIFERÆ OR APIACEÆ. THE UMBELLIFEROUS OR PARSLEY TRIBE.

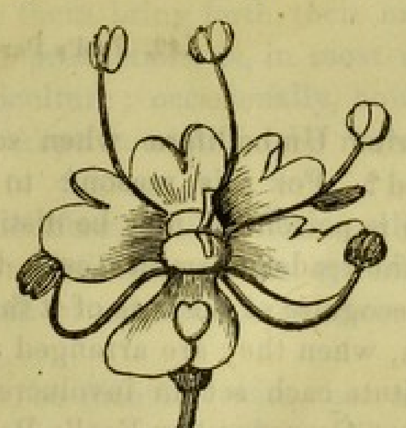
Perhaps there does not exist a natural family of vegetables more distinctly marked than this. Their general aspect alone, without going into anatomical minutiæ of structure, is almost sufficient to distinguish them; nevertheless, we will indicate the botanical characteristics of this great natural order.

Characters: Calyx adherent to the ovary; petals, five, inserted upon an epygynous disc; æstivation valvular, involute; stamens five, alternate with the petals; ovary inferior, two-celled uniovular; ovule, pendent, reflected; styles two; carpels separating at the base; seed dicotyledonous; leaves alternate, simple, often divided, petiolate, in an involucre.

Such are the precise botanical characteristics by which the umbelliferæ or *umbrella berries*, as we may call them, are known; but, we repeat, their aspect is almost enough to distinguish them from other plants; not but that a few plants of other orders bear umbels, and many seem to bear umbels without doing so; but, generally speaking, the aspect of an umbelliferous plant is sufficient to characterise it.

Taking for our example a specimen of Fool's Parsley (*Æthusa Cynapium*, fig. 142), we shall find the floral part to consist of a compound umbel; that is to say, little umbels attached to the stems which constitute large ones (p. 38). We shall find, both in the small and large umbels, that the peticles or flower-stalks shoot forth from points exactly opposite each other, otherwise the structure would not be an umbel. Take, for example, the Elder tree. A general examination of its flower would lead one to suppose that the Elder was an umbelliferous plant; but, on examining it more attentively, the petioles, or flower-stalks, do not branch off at a point exactly opposite each other; hence the inflorescence of the Elder tree is not that of an umbel, but of a cyme. Nevertheless, in the Geraniums, and some other plants, the inflorescence is really umbelliferous; hence the existence of an umbel is not quite sufficient for the botanist to rely upon in the discrimination of a plant belonging to the natural order *Umbelliferæ*. Let us, therefore, examine some of the remaining characteristics enumerated at the beginning of this description.

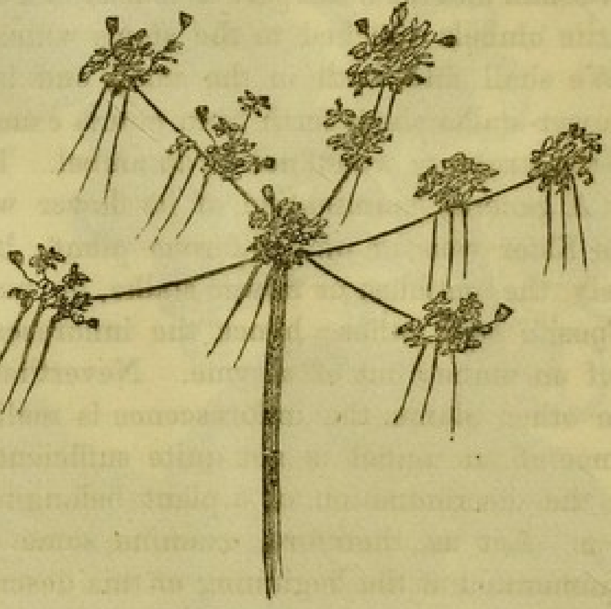
If we examine the flower of a Parsley plant, we shall discover that the calyx is almost absent. The petals, five in number, spring from a narrow line or border. There are five stamens, each arising from between two petals.



141. Parsley Flower.

As in the Apple, the ovary in an umbelliferous plant is inferior—that is to say, it appears below the calyx and corolla, inasmuch as the latter springs from above it.

What, then, is the fruit of an umbelliferous plant? We hear frequently enough of Carrot, Parsley, Celery, and Carraway seeds, but we do not hear of Carrot, Parsley, Celery, and Carraway fruits. Nevertheless, all these are fruits, not seeds. The real seed is imbedded within the structure of a surrounding mass, as we found to be the case in the Apple and Pear. There the surrounding mass is fleshy and easily separable; here it is hard and firmly adherent; therefore the so-called seeds of umbelliferous plants are fruits of the kind which botanists denominate by the term *achænium*. All these fruits separate naturally when ripe, or admit of ready separation into two parts, and they are all furrowed; moreover, the nature and direction of these furrows differ in each species; of the order, consequently, they are an important means for enabling the botanist to distinguish umbelliferous species. The two grand peculiarities, then, of the umbelliferous tribe are, first, the presence of umbels, secondly, the inferior fruit separable into two portions. Why did we select a sprig of Fool's Parsley, as a specimen to illustrate



142. Fool's Parsley (Æthusa Cynapium).

the tribe Umbelliferæ when so many more readily obtainable plants existed? For this reason: to show in what respect Fool's Parsley, which is poisonous, may be distinguished from the culinary Parsley.

If the reader examines each terminal umbel of the Fool's Parsley, he will recognise at the base of it three leaf-like things, which are bracts, and which, when they are arranged as we find them in umbelliferous plants, constitute each set an involucre. The student will observe that in the Æthusa Cynapium, or Fool's Parsley (fig. 142), these bracts all point outwards, by which characteristic sign may the Fool's Parsley be distinguished not only from common Parsley, but from all wild umbelliferous plants.

Whilst treating of these bracts, which in Umbelliferæ constitute the involucrum, the reader's attention may as well be directed to certain modifications of form which bracts are capable of assuming. Thus, in the

Oak they grow together and give rise to the acorn cup (fig. 86); in the Pine-apple they grow together, become fleshy, and constitute the part we eat; in the Fir cone they constitute the scales; in Umbelliferæ, however, they assume the appearance of leaves, which, indeed, is their general or normal aspect. With regard to the physiological and chemical characteristics of the Umbelliferæ, they may be stated to depend on the presence either of an odorous volatile oil, or a poisonous matter. Everybody is aware how agreeably odorous are the so-called Carraway seeds; everybody is aware of the poisonous nature of the Hemlock; and the noxious character of the Fool's Parsley has already passed under notice. Umbelliferous plants may, therefore, be designated in general terms as *suspicious* plants, comprehending, however, a far greater number of innoxious than noxious species; the latter may be generally discovered by their agreeable, the former by their disagreeable odour.

In certain species of this natural order the innocent and the noxious principles are combined. This is the case in the wild Celery, which in this condition is a rank plant, altogether unfitted for food. The change which ensues when Celery is cultivated in gardens we are all aware of; but the reason of that change merits a few remarks. Garden Celery, as the reader knows, is carefully buried in the earth, not only its root, but much of its stem being totally deprived of light. Under this treatment, the buried portion of the plant becomes etiolated or bleached; becomes, in point of fact, botanically considered, diseased; that is to say, the poisonous secretion of the plant is no longer elaborated, the odorous principle alone being formed. A consideration of the nature and effects of etiolation leads us to a correct appreciation of the functions which those parts of vegetables exposed to the air and sun, especially leaves, are destined to perform, and points out the necessity of giving vegetables abundant air and light, if we would have them bring forth their natural productions. To stimulate those natural productions is, in most cases, the main object of agriculture and horticulture; occasionally, however, as in the example of Celery, the object kept in view is the reverse of this.

The odorous principle in certain Umbelliferæ is of a resinous character; thus asafœtida is the produce of an umbelliferous plant growing in Persia. Opoponax and ammoniacum, both so valuable in medicine, are also the produce of umbelliferous plants.

Many of the Umbelliferæ contain sugar, so identical with that of the cane in every respect that sugar loaves may be made of it. Thus the presence of sugar may be recognised by the taste in the root of the Carrot and the Parsnip; also, in the root of Celery, although less evidently. Indeed, sugar may be regarded as a pretty general concomitant of the umbelliferous structure; even in the juice of the poisonous Hemlock it may be discovered by chemical tests.

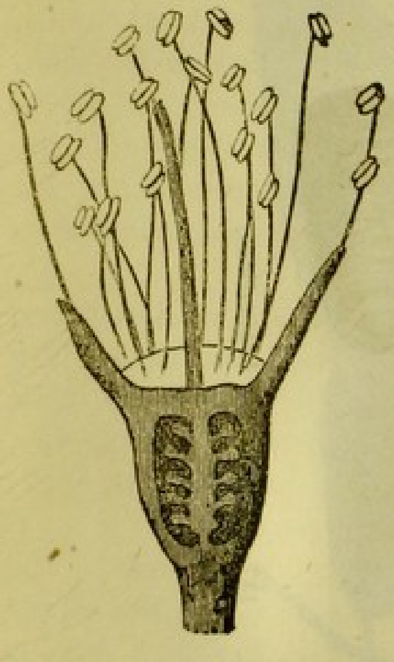
It would be a needless task to occupy space in pointing out the various uses of umbelliferous plants to man. The so-called Carraway, Coriander, and Aniseseeds, flavour our pastry and confectionary; Carrots and Parsnips are amongst the most favoured articles of our food; even the noxious Hemlock yields a valuable medicinal substance, *conia;* and the resin-yielding umbel-bearers pour forth their treasures in great profusion. By far the greater number of this family have white flowers; some, like the fennel, have yellow flowers, and a few have blue ones. Of the latter kind are most of the Eryngo genus, and the beautiful Didiscus Cæruleus, of which we now give a representation (fig. 143).

143. Didiscus Cæruleus.

§ 26. MYRTACEÆ, OR THE MYRTLE TRIBE.

Characteristics: Calyx, adherent; petals, in number equal to the divisions of the calyx, inserted on a disc around the throat of the latter; æstivation imbricated, rarely absent; stamens, ordinarily indefinite; ovary, usually two to six-celled, pluriovular; ovules, pendulous, reflected or curved; style, simple · fruit, dry, or a berry; seed, dicotyledonous, exalbuminous.

Such is the long list of general characters by which botanists recognise a plant of this great natural order; nevertheless, myrtles, like many other members of the vegetable world, have a sort of physiognomy of their own, more easily recognised than described. Perhaps the fragrant odour diffused by these beautiful plants is one of their most prominent characteristics. All the substance of a Myrtle is more or less saturated with this odorous matter. Now we find it assumes its greatest power in the bark, now in the flower buds, now in the leaves; but it is everywhere present more or less. Supposing the reader to have before him a leaf of the common Myrtle, he need not be told that the leaf is odorous, especially when crushed between the fingers. Now, in what does the odour consist, and where does it come from? This, like the greater



144. Section of the Flower and Ovary of a Myrtle.

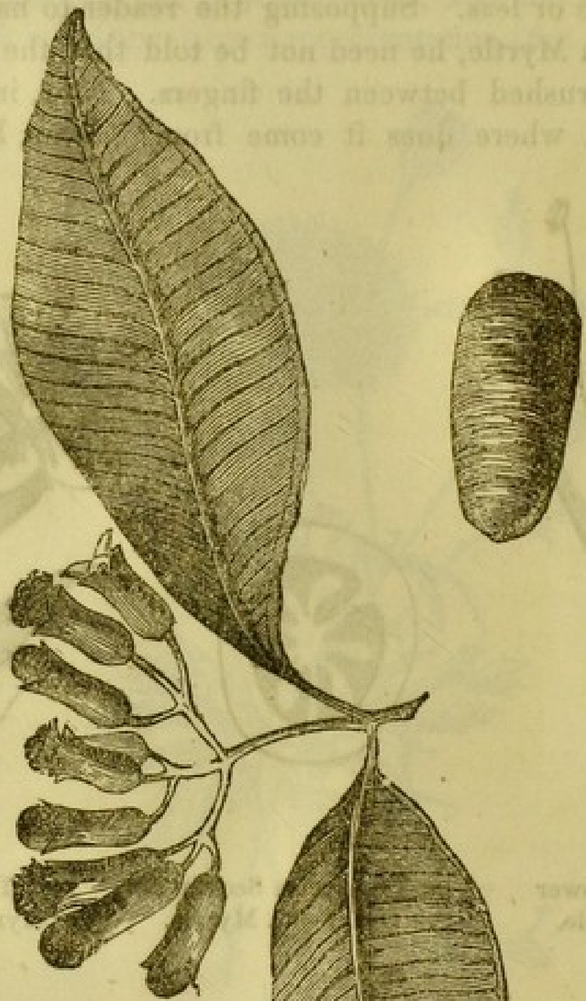
145. Transverse Section of the Ovary of a Myrtle.

146. The Common Myrtle (Myrtus Communis).

number of odorous principles furnished to us by the vegetable kingdom, is a volatile oil, and in the Myrtle leaf it is secreted by specific organs, denominated *glands*. If a Myrtle leaf be held between a candle, or other source of light, and the eye, these little glandular bodies will be seen like so many specks; it is within these glands that the volatile oil remains encased. Glands are not necessary for the secretion of volatile oil, nor are they necessarily confined to leaves. They exist in large quantities in the skin of members of the Orange tribe, and it is from them that the inflammable volatile oil is emitted when a piece of orange peel is squeezed between the fingers. Although the characteristic of agreeable odour is a very good common sign by which we may be justified in expecting that a plant may, in certain cases, belong to

Myrtaceæ, nevertheless it is a very loose sign when taken apart from others. We can only arrive at a correct botanical comprehension of the Myrtaceæ by studying some of the generic characters mentioned in our preceding list.

If the specimen of common Myrtle under examination be a sprig, not a single leaf, the student, before he lays it down, should observe that the leaves are *opposite*, not alternate (fig. 146). Let us now examine the flower.

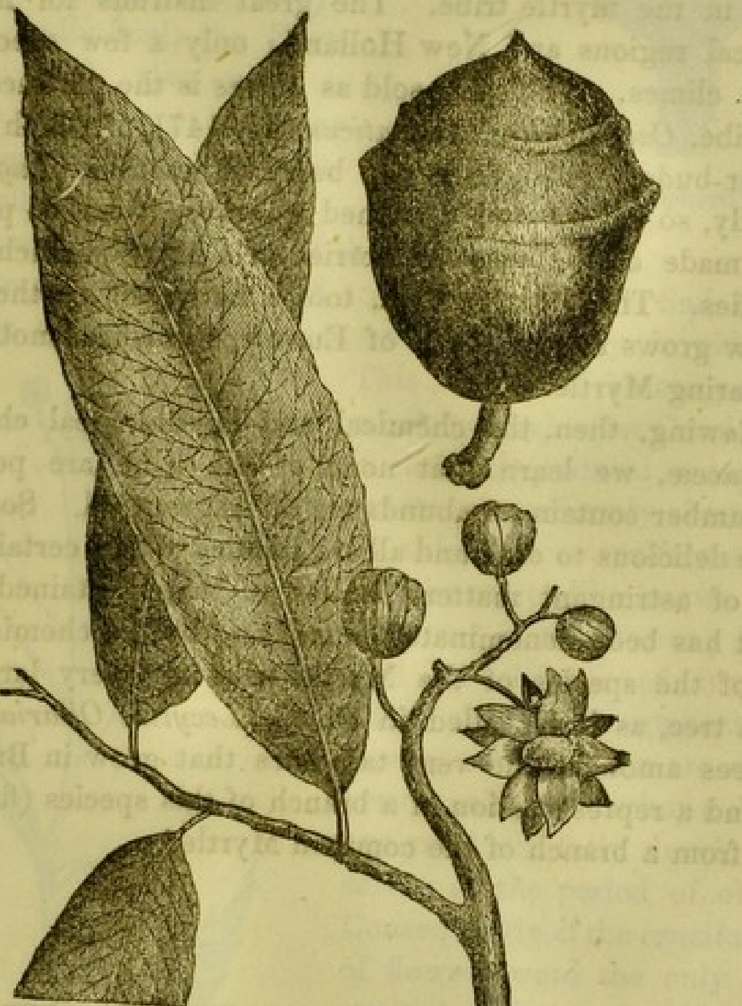


147. Caryophillus Aromaticus.

The particular species under consideration has a calyx of five divisions, and there are also five petals, but in certain species these floral parts are generally four. The stamens are numerous, as will be readily observed; and the reader need not be told at this period of our labours that it is necessary to ascertain whether these stamens grow from the calyx or the receptacle. They grow from the calyx, as will be readily distinguished;

the ovary is inferior. It contains three little cells, and each cell contains many ovules; and it shoots up one style, which terminates in a stigma so very minute that it cannot be seen by the naked eye.

The diagrams (figs. 144 and 145) are a vertical section of the flower and ovary of a common Myrtle; and a transverse section of the ovary with adherent calyx, or rather the fruit with adherent calyx. If the reader examines fig. 145, he will observe that the number of seed cells in the species of Myrtle under consideration is three, or, to use the language of Botany, the ovary is *trilocular*, or three-celled. If the reader now



148. Lecythis Ollaria.

refer to the list of characteristics of this family, he will find the expression, "ovary, two to six-celled," which signifies that the number of cells may vary between two and six.

By well considering the characteristics already discussed, the student will be at no loss to recognise an individual of the Myrtle tribe, even without taking into consideration minute microscopic peculiarities.

Let us now proceed to mention a few particulars in connexion with the dimensions, natural habitation, and properties of this beautiful and useful botanical order.

The stem of Myrtaceæ is generally woody, the leaves opposite or alternate, simple, entire, rarely stipulated; frequently, as we have seen, provided with secretive glandular appendages, imbedded in the parenchyma. The flowers are complete, regular, solitary, or irregularly agglomerated. The greater number of myrtaceous plants have berries for their fruits; but some others, the principal of them being Australian plants, have a dry hard fruit; these, too, have alternate leaves, which is not usual in the myrtle tribe. The great districts for myrtles are the intertropical regions and New Holland; only a few species existing in temperate climes. The spice sold as cloves is the produce of one of the Myrtle tribe, *Caryophillus Aromaticus* (fig. 147), of which cloves are the dry flower-buds. Allspice is the berry of another (*Eugenia Pimenta*). Guava jelly, so valued and esteemed wherever it can be procured, is the conserve made of the mashed berries of a Myrtle which grows in the West Indies. The Pomegranate, too, a native of northern Africa, but which now grows in the south of Europe, furnishes another example of a fruit-bearing Myrtle.

In reviewing, then, the chemical and physiological characteristics of the Myrtaceæ, we learn that none of the tribe are poisonous. The greater number contain an abundance of fragrant oil. Some yield fruits which are delicious to eat; and all are imbued with a certain, but variable, amount, of astringent matter, similar to that contained in oak bark, whence it has been denominated *tannic acid* by the chemist.

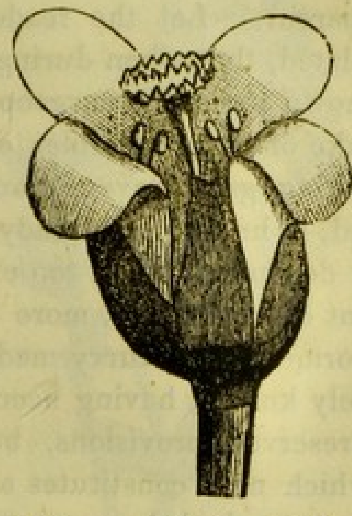
Many of the species of the Myrtle tribe are very large trees. The Sapucaya tree, as it is called in Brazil (*Lecythis Ollaria*), is one of the tallest trees amongst the very tall ones that grow in Brazilian forests. We append a representation of a branch of this species (fig. 148). How different from a branch of the common Myrtle!

§ 27. CRUCIFERÆ OR BRASSICACEÆ, THE CRUCIFEROUS (CROSS BEARING) OR CABBAGE TRIBE.

Already, in an early part of the present work, we had occasion to make a statement respecting the *cross-bearing* flowers that we hope the reader has not forgotten. We mentioned that a strange plant being referred to this natural order, such plant might at once be considered harmless, and probably very good to eat.

Let us now go a little more minutely into the characteristics of these *cross-bearers*. They are these: Sepals, four, free; petals, hypogynous, four, free, cruciform; stamens, six, tetradynamous; ovary, bilocular, placenta parietal; fruit, ordinarily a pod; seed, dicotyledonous.

Let us now proceed to the application of such of the preceding characters as may be necessary. Firstly, the propriety of the term *cruciferous* will be rendered evident from an examination of the appended diagram representing the flower of a plant termed Shepherd's Purse, one of the cruciferous family (fig. 149).


149. Flower of Shepherd's Purse.

This same individual, the Shepherd's Purse, shall also serve to teach us yet something more regarding the peculiarities of the natural order Cruciferæ.

Let us now examine a branch of the plant (fig. 150).

Directing our attention at first to the flowers, we find them to be arranged after the manner of a raceme, and totally devoid of bracts.


150. Branch of Shepherd's Purse.

This absence of bracts pervades the whole natural order Cruciferæ, which is the only natural order in which bracts are uniformly absent. Hence by this sign a cruciferous vegetable may be as readily known as by the structure of the flower; indeed, the sign of absence of bracts has a wider sphere of application. The flowers of Cruciferæ are at the best very small, but perhaps they might not yet have fully developed themselves at the period of observation. Consequently, if the cruciferous shape of flowers were the only guide, the student might not be able to wait for the sign of discrimination; whereas by noticing the absence of bracts, he would know the plant under consideration to be cruciferous, and knowing this, he would be assured of its harmlessness at least. Most probably it would be good to eat, either in the form of salad or cooked.

The advantages of being thus able to refer an unknown plant to a harmless and useful order we need not specially indicate. They will be self-apparent. Let the reader consider the bearing of this anecdote. It is related, that when during Anson's voyages his crews disembarked in unknown parts, the surgeon, fearful of poisons, would not suffer them to partake of any vegetables except grasses, notwithstanding the scurvy was making great ravages amongst them. Now, the reader must be informed, if he do not already know, that the scurvy is a disease almost entirely dependent upon too exclusive diet of salt meat, without accompaniment of vegetables, more especially vegetables of succulent character. Formerly the scurvy made great ravages in our navy; at present it is scarcely known, having been banished, partly by the administration of fresh preserved provisions, but chiefly by the administration of lime juice, which now constitutes a portion of the rations of every sailor. If Anson's crew had been provided with fresh vegetables to eat, their scurvy would have been cured; and they knew it. How great, then, must have been the fear of the surgeon, and how valuable is the knowledge of Botany!

Returning to our investigation of the distinctive signs by which cruciferous plants may be known, we shall merely call your attention to the fact that each flower has six stamens, of which two are more spreading also shorter than the others; hence the denomination *tetradynamia* (or four-powered) in the Linnæan or artificial classification, and this is another essential characteristic of cruciferous plants. The other characteristic signs being for the most part microscopic, we pass them over without notice.

Cruciferæ are dispersed all over the surface of the globe; the greater number, however, inhabit the northern temperate zone, more especially of the old world; between the tropics they are rare, and when they exist, are found on mountain elevations; beyond the tropic of Capricorn they become less frequent, even more so than beyond the tropic of Cancer.

When we mention that Cabbages, Sea-kale, Mustard, Cress, and Radishes belong to this order, we shall have stated enough to demonstrate the utility of its species. When we state again that Wall-flowers and Stocks are cruciferous plants, the reader will see that utility is not the only claim which the Cruciferæ present to our notice.

The Cruciferæ are imbued with an acrid volatile principle dispersed throughout all their parts, and frequently allied with sulphur. To this volatile principle cruciferous plants owe their piquancy and their peculiar odour, which, after putrefaction, is ammoniacal; thus proving the Cruciferæ to contain the chemical simple body, nitrogen, ammonia being a compound of nitrogen with hydrogen. In many species of Cruciferæ there exists in connexion with the odorous principle also a bitter material and a fixed oil; the latter is chiefly developed in the seed. The active principles of annuals belonging to this order reside in the leaves, those of the perennials in the root. Certain species, the leaves of which are inoperative, produce very acrid seeds. Many Cruciferæ grow mild by cultivation, which augments their amount of sugar and mucilage. The anti-scorbutic properties of many Cruciferæ have been known from times of great antiquity; the species which possesses the greatest fame in this respect being the Cochlearia Officinalis, a drawing of which is represented (fig. 151).

151. Cochlearia Officinalis.

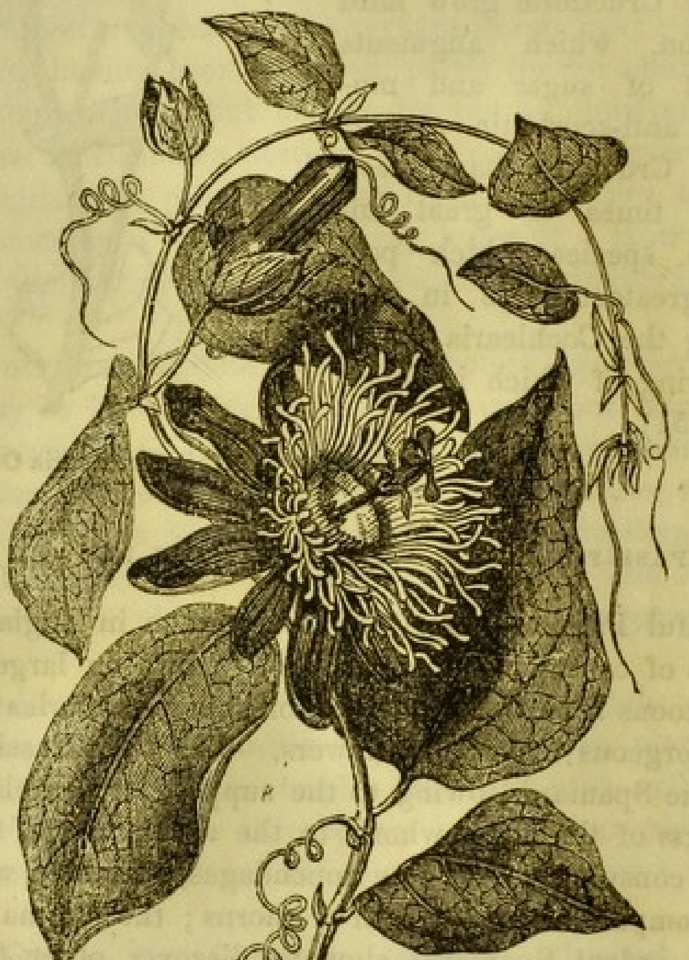
§ 28. PASSIFLORACEÆ, OR THE PASSION-FLOWER TRIBE.

The beautiful Passion-flower, now so common in England, is a native of the forests of central America, where it grows on large stems which hang like festoons from the boughs of forest trees, interleaving them in a network of gorgeous leaves and flowers. The term Passion-flower was applied by the Spaniards, owing to the supposed resemblance presented in various parts of the floral whorls to the accessories of Christ's crucifixion. The conspicuous ray-like appendages, sprinkled with blood-like spots, were compared to the crown of thorns; the stigma is cruciform; nor were the ardent Spaniards slow to discover other fancied resemblances, which eyes less prejudiced than their own in favour of a dominant idea can scarcely recognise.

Characteristics: Perianth free, petaloid, biserial, tubular urceolate, ordinarily furnished at its throat with one or more series of filaments. Stamens sometimes inserted upon the throat of the perianth, or upon its base; sometimes hypogynous, attached to the support of the ovary; ordinarily equal in number to that of the external divisions of the perianth. Ovary stipulate; three or five placental; three or four styles terminated by club-like stigmas; ovules reflected; fruit a berry; indehiscent or capsular three or five valved; seed dicotyledonous; embryo straight, central.

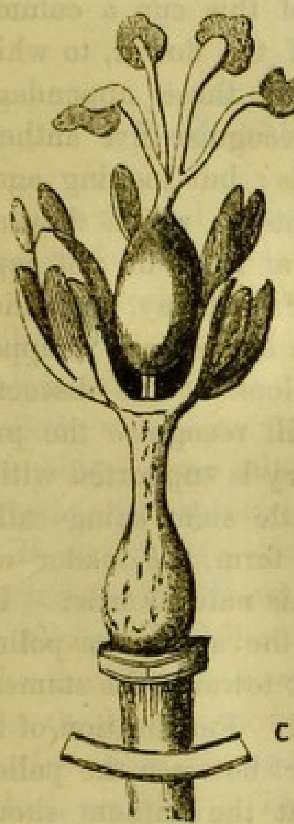
We shall be able to individualise the Passion-flower order without giving ourselves the trouble to appeal to all the characteristics mentioned. Nevertheless, botanists who penetrate more deeply into the study of plants, find it necessary to appeal to all the characteristics mentioned.

Many species of Passion-flower are now common enough in our gardens. For the purpose of examination, we shall select an individual of the species termed *Amabilis*, the representation of which we subjoin (fig. 152). The student will first observe, on glancing at the broad charac-

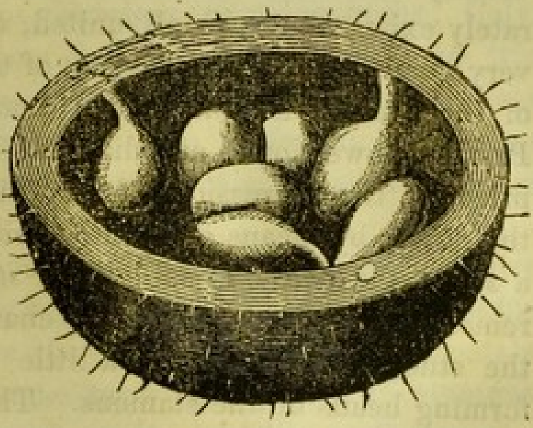


152. Passiflora Amabilis.

teristics of the specimen, that the flower is supplied with three large bracts, so arranged that they constitute what botanists term an *involucrum*. Proceeding inward, we next arrive at what? The calyx? It should be the calyx judging from its position, but the appearance of its separate parts (sepals) is different from the appearance of those sepals we have already met with. They are not green, but coloured like the petals of most flowers. We have already mentioned, however, that amongst the other transformations of parts which occasionally ensue, the transformation of the calyx into the appearance of a corolla is not unfrequent. So frequently, indeed, does this occur, that mere green colour is not to be regarded as more than a collateral circumstance. The external floral whorl is always considered by botanists as a calyx, whatever its colour may be. That colour is often very brilliant, as in the fuschia, for example, where the gay looking part of the flower is not corolla or aggregation of petals, but calyx, or aggregation of sepals. This assumption by the parts of the calyx of the appearances usually presented by the corolla gives rise to what botanists term a *petaloid* perianth. The student will find this term comprehended in the list of characteristics peculiar to



153. Vertical Section of the Passion-flower.



154. Transverse Section of the Passion-flower.

Passion-flowers. The term *petaloid* means, like or resembling a petal; the termination, *oid*, being derived from the Greek word, εἶδος (*eidos*), *likeness*, which word, in composition, changes *eid* into *oid*. Directing the eye to the lower part of the petals, they will be observed to rise from a shallow cup-like body, to which also are attached the petals and other portions of the flower.

As regards the petals themselves, they are coloured similarly to the colour of the inside of the sepals, and are of the same colour on both sides, by which circumstance they may be distinguished from the petals, as also by the circumstance of their not having a little horn, which may be found on examination springing from each of the sepals.

We next arrive at the filamentary rays which imaginative Spaniards compared to the crown of thorns! What are those rays? They are petals modified in shape until they almost present the appearance of stamens. This modification, and yet more frequently its converse, stamens modified into petals, is not at all unfrequent in many flowers as the result of cultivation. In the Passion-flower tribe, however, it exists as the usual condition of the flower. Let us now proceed to examine the reproductive, or fruit and seed-producing portions of the flower, which are very peculiar. We have already mentioned a cup-like body in connexion with the structure of a Passion-flower. It corresponds with the letter *c* in the diagram (fig. 153). In the centre of this cup a column-like body is observed rising aloft in the centre of the flower, to which certain appendages are attached. The nature of these appendages will at once be obvious. Externally, we easily recognise five anthers, and internally we recognise the club-headed pistils; but looking again at the stamens, we search in vain for the filaments to which they are usually attached. These filaments do not exist, at least do not separately exist; they are all united, *soldered*, as the French say, and it is a very good word, to the *support* of the ovary. This expression, "support of the ovary," is new to us; but if the reader look at his dissected Passion-flower, or at our diagram (fig. 153), he will recognise the propriety of the expression; for in this tribe the ovary is supported within the flower by means of a little stem. Now this little stem being called a *stipes*, the ovary is said to be *stipitate*. This term, the reader will remember, occurs in our list of characteristics of this natural order. Let the student now examine a little more in detail the anthers or pollen-forming heads of the stamens. These do not point towards the stamens, but in the opposite direction, which is very unusual. Fertilisation of the ovule depends, as we need not repeat, upon contact between the pollen-dust and the stigmas; hence it would seem that the anthers should always point towards the stigmas. In most cases they do so point towards them, but in the Passion-flower tribe we find an exception to this rule.

Fig. 154 represents the transverse section of the ovary containing the seeds. The fruit, or ripened ovary, in all species of Passion-flower is egg-shaped, differing in size according to the species. The blue Passion-flower produces a fruit about the size of a hen's egg; but in other species the fruit is much larger, and contains a delicious pulp.

Passion-flowers, we have seen, are both agreeable and useful from the beauty of their flowers and the flavour of their fruits; many species are medicinal. The pulp surrounding their seeds is in some cases sweet, in others acid; the latter serve as the basis for the preparation of acidulated drinks, not only agreeable, but medicinal. One species, *Passiflora Rubra*, contains a narcotic principle which is sometimes employed as a substitute for opium. *Passiflora Quadrangularis* is cultivated for the refreshing pulp surrounding its seeds, but its root is very poisonous. In European gardens a large number of species of Passion-flower are now cultivated, amongst which may be cited as the chief, *Passiflora Cærulea*, or the blue Passion-flower; this being the commonest of all. Of this flower the *Passiflora Amabilis* (fig. 152) is a *hybrid* or cross race between *Passiflora Alata* and *Passiflora Princeps*. Its flowers are scarlet, and exhale a delicate odour. The *Murucuja Ocellata* is a hot-house species, bearing deep-red flowers. *Tactonia Mollisima* bears rose-coloured flowers, and is a climbing plant, requiring a greenhouse for its culture.

§ 29. CUCURBITACEÆ, OR THE CUCUMBER TRIBE.

This natural order is allied by many characteristics to the Passion-flower, for which reason we treat of it in this place.

Characteristics: Flowers monœcious, diœcious, or polygamous; Calyx with tube adherent to ovary; stamens free, or monadelphous, or tria-delphous; anthers turning outwards; ovary three to five, rarely one-car-pelled; seed dicotyledonous, exalbuminous; stem uniformly herbaceous, climbing leaves alternate, palminerved, each furnished with a lateral stipule; inflorescence, axillary.

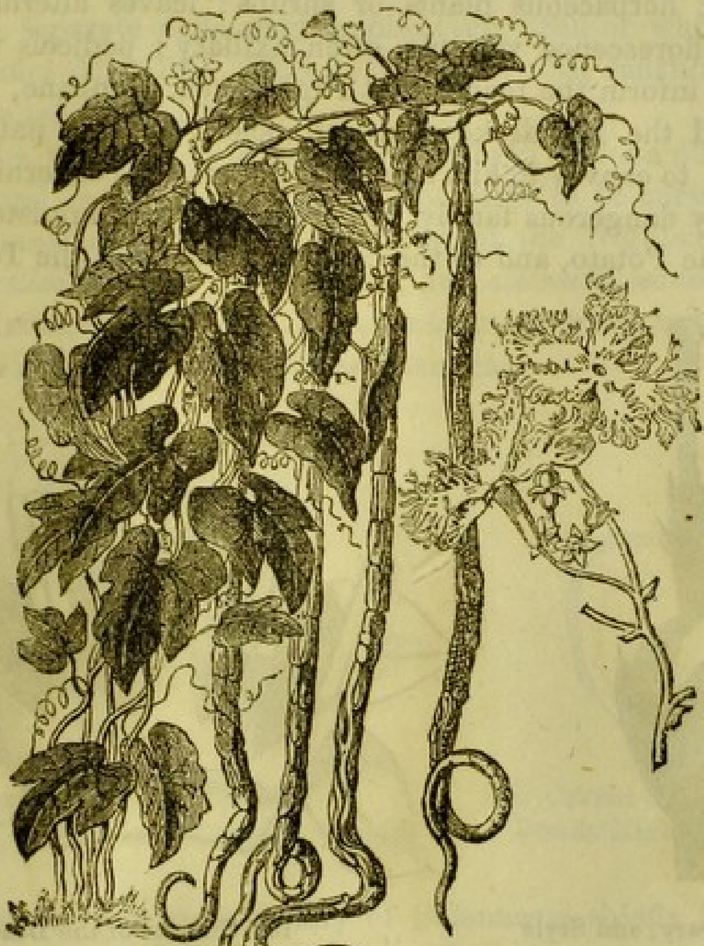
If we compare the parts of the flower of a common Cucumber flower with those of a Passion-flower, a similarity in many respects will be found to hold good. Like the Passion-flower, the calyx has the colour of petals; like the Passion-flower, there is the same growing together of stamens; like the Passion-flower, the ovary has one cavity, and the arrangement of seeds within the ovary is similar. Moreover, both orders yield fruits which are juicy. These are strong resemblances. Let us now examine the parts in which the two natural orders are dissimilar. In the first place, then, on referring to our characteristics of the order, we find that the flowers in Cucurbitaceæ are monœcious, or diœcious, or polygamous, which means that some flowers are male and others female; the male flowers and the female flowers sometimes exist on the same plant, some-times on different plants, and at other times on both. In this important particular, then, Cucurbitaceæ differ from the natural order we have just finished considering. Moreover, the Cucumber has very rough leaves, which the Passion-flower has not; the Cucumber has an inferior ovary, the Passion-flower a superior; the Passion-flower has rays, the Cucumber flower has none. Nor does the distinction between the two natural families end with a mere difference of form and parts. The chemical character of their secretions, as we shall find by and by, differs also. The Passion-flower tribe are uniformly harmless as regards every part except their root; whereas every member of the Cucumber order contains a poison. The Cucumber, or Gourd family, occurs naturally in all tropical and sub-tropical regions; its members are more rare in temperate climes, but the shortness of their life, usually limited to one summer, admits of the cultivation in Europe of many tropical species.

The greater number, if not all the members of Cucurbitaceæ, contain a bitter poisonous principle presenting many degrees of intensity. In the Colocynth it attains its maximum, and, being extracted, furnishes us with a valuable medicine. In the ordinary Cucumber the poisonous bitter

155. Momordica Charantia.

principle is usually but little developed; never to the extent of being dangerous, although frequently enough to be disagreeable. In the Melon, sugar is the principal secretion; nevertheless, the bitter principle so prevalent in the family is not wanting; it exists in the outside rind of the fruit, and to a still greater extent in the roots, which are violently emetic. Colocynth has already been mentioned. Bryonia, another species, is still more violent in its action. The common Cucumber

(*Cucumis Sativus*), although capable of growing in the open air of our climate, is a native of India and Tartary. The species called *Dudaim* is cultivated in Turkey on account of the delicious odour of its fruit, which, however, is possessed of an insipid taste. Gourds are certain species of Cucurbitaceæ with very large fruit. Although our garden Cucumber possesses no great claims to beauty, it is otherwise with certain species. The Momordica Charantia, for example, is a very beautiful Indian plant, the leaves and fruits of which differ in external appearance from almost



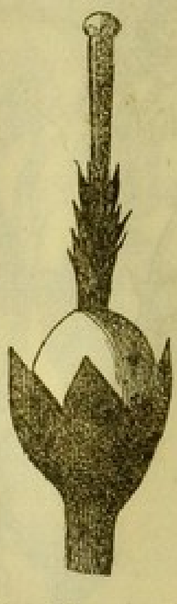
156. Trichosanthes Colubrina.

every species of the Cucurbitaceæ (fig. 155). Less beautiful than extraordinary is the species named *Tricosanthes Colubrina* (fig. 156), the fruit of which resembles huge serpents hanging from the parent stem. It is a native of central America; its leaves are more than a foot in diameter, and its flowers disposed in corymbs; the corolla is white, and bordered by a long hair-like fringe; hence the specific term *Tricosanthes,* which means, in Greek, *hairy flowered.*

§ 30. SOLANACEÆ, OR THE NIGHTSHADE TRIBE.

Characters: Calyx free; corolla regular; stamens inserted on the tube of the corolla, their number equal to that of the divisions, and alternating with them. Anthers bursting longitudinally, rarely by pores, at the apex; ovary two-celled; style continuous; stigma simple; pericarp with twenty-four or many cells; either a capsule with a double dissepiment parallel with the valves, or a berry with placentæ adhering to the dissepiment; herbaceous plants or shrubs; leaves alternate, undivided, or lobed; inflorescence variable, often axillary; pedicels without bracts.

When we inform the reader that Nightshade, Henbane, Tobacco, Stramonium, and the Mandrake plant, all belong to this natural order, we state enough to convey to him a general impression concerning Solanaceæ. It is a highly dangerous family, although one that ministers to our sustenance in the Potato, and to the comfort of many in the Tobacco.



157. Calyx, Ovary, and Style of the Deadly Nightshade.

158. Flower of the Deadly Nightshade cut open.

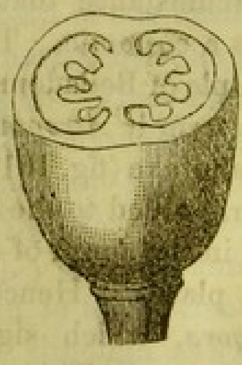
The best flower the reader can select for making himself acquainted with the characteristics of Solanaceæ will be that of the common Deadly Nightshade. Let it be procured with leaves attached, for they merit observation. The leaves, it will be seen, are alternate, which, in this family, constitutes an important generic distinction.

Let us now observe the flowers (fig. 157). We find them to consist of a calyx in one piece or sepal; hence the flower is monosepalous. We find, moreover, that the calyx is furnished with five tooth-like projections, which would have resulted in the generation of five different sepals, had the progress of indentation gone far enough.

The corolla, also, consists of one part or petal; hence the flower is *monopetalous*. Our second diagram (fig. 158) represents one of these flowers cut open in such a manner that the mode of insertion of the stamens is evident. Like the calyx, the corolla is also five dentated. Remark, now, how the stamens are attached. They spring from between the dentated processes or lobes of the corolla; and this is invariable for all the genera and species of Solanaceæ, serving to distinguish their members from those of *Primulaceæ*, or the Primrose tribe. If the reader examine the construction of a Primrose, he will find what we say to be true.

If we now proceed from the flower to the ovary, and transversely divide it, two separate cells may be observed, each of which contains a number of ovules (fig. 159). This ovary, when ripe, constitutes the fruit, a small two-celled black berry.

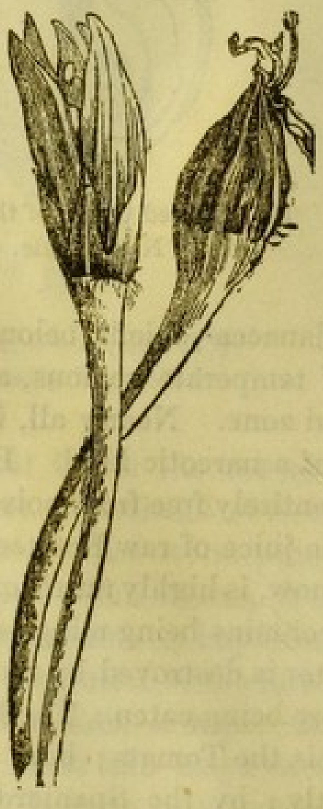
If a seed be transversely divided, the embryo will be observed coiled up within it, and is, therefore, said by botanists to be curved (fig. 160). Finally, the most essential characteristics of the Nightshade tribe are *superior two-celled ovary*, *regular flower*, and *alternate leaves*. The latter peculiarity distinguishes them from the Gentian tribe, with which their appearance in other respects is almost identical.



159. Transverse Section of the Ovary of the Deadly Nightshade.

160. Curved Ovule of the Deadly Nightshade.

Numbers of the numerous family of Solanaceæ chiefly belong to the tropics, very few species being natives of temperate regions, and none existing in either northern or southern frigid zone. Nearly all, if not all, the species of Solanaceæ contain a poison of a narcotic kind. Even that useful solanaceous plant, the Potato, is not entirely free from poison. The fruits are notoriously poisonous, and even the juice of raw Potatoes is injurious. Nevertheless, the Potato, as we all know, is highly nutritious. This arises from the starch and gluten which it contains being mingled with so little of the poisonous principle that the latter is destroyed by the cooking process to which Potatoes are subjected before being eaten. The Egg plant is one of the Solanaceæ, so in like manner is the Tomata; both are occasionally eaten; the latter, indeed, frequently; by the Spaniards, almost universally. They are both, however, injurious eaten raw. We may here remark, in connexion with the Potato, that the vegetable substance, starch, is largely diffused throughout many poisonous plants, yet, when separated from them, it is invariably harmless. Of this we have a remarkable example in Tapioca, which is nothing else than the baked starch extracted from the trunk of a tree, the *Jatropha Manihot.* The juice of the tree is so poisonous that arrows are poisoned with it; nevertheless, Tapioca is a delicate article of food. The common Deadly Nightshade (*Atropa Belladonna*) grows in shady places, and is an elegant, though dangerous looking plant. Here, as a general rule, we may remark that most plants having dark-green foliage and dark-coloured flowers are poisonous. The Belladonna bears a cherry-like fruit, which is sometimes incautiously eaten by children, and too often with a fatal result. In 1793, some orphans, brought up at the Hospice de la Piété, at Paris, were employed in weeding a botanical garden. They happened to be attracted by the tempting looking fruit of a Belladonna plant, of which they ate a considerable quantity. Fourteen of those unfortunate children died in consequence only a few hours afterwards. This lamentable catastrophe justifies the generic name *Atropa*, from *Atropa*, one of the Fates, who was supposed to cut the thread of life. The specific name, *Belladonna*, signifies *beautiful lady*, and is dependent on the circumstance that the Italian ladies use the distilled water of this plant as a cosmetic. They fancy it improves their complexions. The active principle of Belladonna chiefly resides in the leaves and in the root. Chemists term it *Atropine* or *Atropa.*

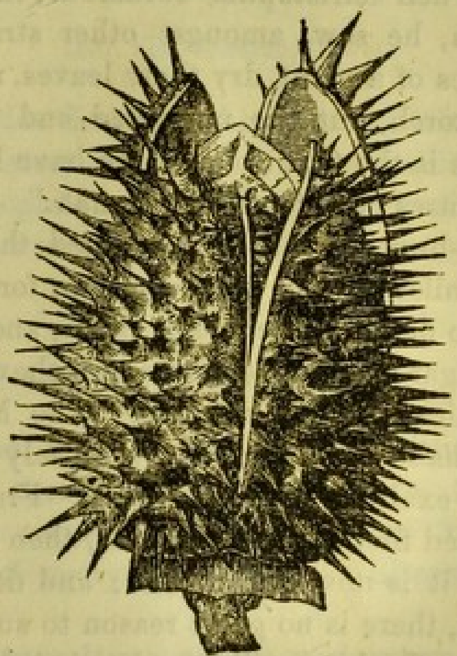


161. The Mandrake
(Mandragora Officinalis).

The Mandrake (fig. 161) is a species very nearly allied to the Belladonna; it grows in the south of Europe, and in dark places. Hence its name, *Mandragora,* which signifies *ornament of caverns.* This plant, known and celebrated from times of very great antiquity, was employed by the so-called sorcerers of ancient times to produce narcotism and disordered visions. Its roots are large, often two-pronged, whence the fancied resemblance to the lower limbs of a man.

Henbane, or *Hyoscyamus Niger*, is another European plant belonging to this genus. It is biennial, and grows amidst the ruins of buildings in the neighbourhood of habitations. Its stem is studded with a cotton-like substance, and it constantly exhales a repulsive odour. Its corolla is palish-yellow, veined with purple. The Hyoscyamus, or Henbane, owes its narcotic properties to the presence of a peculiar alkali. The action of Henbane is far less powerful than that of Belladonna; nevertheless, it may cause death if eaten. A German physician relates that, on a certain occasion, the Benedictine monks of the convent of Rhinon were presented with a salad in which the sliced root of Chicory, as was thought, had been placed. Instead, however, of Chicory, the root was of Henbane. After the repast, the monks went to bed. Symptoms of poisoning soon commenced; the monks were all stupified. The time for matin prayers arrived, and one monk was so fast asleep that his fellows supposed him to be dying, and under this impression administered to him extreme unction. The other monks went to chapel, but they had much better have stayed away; some of them could not even open their eyes, much less read. The vision of others was so disordered that they thought insects were crawling over their books, and employed themselves in blowing and brushing the intruders off. Others, instead of praying, uttered nonsense. In the end, all the monks got well, even the one supposed to be dead; but one poor individual, a tailor, could not thread his needle for a long time afterwards, so disordered was the state of his vision. Instead of one needle the tailor saw three, and as he could not tell the real needle from its ghost-like duplicates, there was slight chance of threading it. This anecdote makes known better than any formal description the physiological action of Henbane.

The Stramonium (fig. 162) is another of the Nightshade tribe (*Datura Stramonium*). It is an annual, and was unknown to the ancient Greeks and Romans, although now common enough, having been brought from central Asia in the middle ages by that wandering race, the Gipsies. Its active principle is called *daturine*, which exists in the leaves and the seeds.



162. Fruit of the Stramonium.

The Capsicum (*Capsicum Annuum*), is another of the Solanaceæ. It is an annual, originally a native of India, but cultivated now in Europe, Africa, America, and Australia. Its berry is conical, smooth, and shining, green when unripe, passing gradually into a beautiful coral-red. In this pod resides a resinous balsamic acrid principle named *capsicine*. Cayenne pepper is Capsicum fruit reduced to powder.

The beautiful Tomato, or Love Apple (*Lycopersicum esculentum*), a native originally of the West Indies, is now cultivated in European gardens, more especially in those of Spain and Italy. In the former country it serves as a daily article of food for almost every social class.

We now arrive at the genus *Solanum*, from which the order Solanaceæ takes its name. It is very numerous in species. Its generic characters may be enumerated as a rotaceous corolla, anthers not opening by longitudinal fissures, but by two points at their summits. The most common species of the genus Solanum is the *Dulcamara*, or Bitter Sweet, a plant which is found growing in almost every hedge in the vicinity of London, known by its sombre foliage, its pendent cymes of pretty flowers, and its deep-red berries.

By far the most important, however, amongst the genus Solanum is the Potato, or *Solanum Tuberosum*, a plant which originally was a native of the Cordilleras, or high mountains of Peru and Chili.

The student will remember that the Potato is not a root, but a tuber. He will also remember the botanical significance attached to the word tuber, which is a sort of aggregation of underground buds studded upon a dense mass of starchy matter and gluten designed for their nourishment.

Tobacco (*Nicotiana Tabacum*, fig. 163) is another plant belonging to the natural order we are considering, and the use—some will say abuse—of which is too well known to require comment.

When Christopher Columbus, in 1492, first set foot in the island of Cuba, he saw, amongst other strange customs, the natives gather the leaves of a plant, dry these leaves, roll them into the form of a torch, light the torch, put the unignited end in the mouth, and breathe the smoke. Such is the first account we have handed down to us of the manufacture and uses of a "mild Havannah." Subsequently, when Columbus and his gold-hunting associates gained the main continent of America, they saw a similar custom everywhere in force amongst all classes, slightly varied as to detail, some using pipes, and others preferring the Cuban method of cigar smoking. Nor were chewing and snuff-taking unknown to the Mexicans and Peruvians. The Mexican priests, in particular, were in the habit of taking snuff profusely for the purpose of clearing their brains and exalting their intellects. From the aborigines of America, Tobacco passed first to the Spaniards, then to the Portuguese, then to the English, and it is now everywhere; and despite a great deal of opposition shown to it, there is no great reason to suppose that Tobacco-chewing, smoking, or snuff-taking will ever be abolished.

Tobacco was first brought into Europe by Jean Nicot, French ambassador at the court of Portugal; hence the name *Nicotiana* given to the genus. It was this ambassador who, we are told, offered the first pinch of snuff to Catherine de Medici. The queen was much pleased with the sensation, history informs us, took to "snuffing" with great ardour, and becoming the acknowledged patroness of snuff, Tobacco was called in consequence *Herbe de la Reine*. Sir Walter Raleigh took some Tobacco from Virginia to England, and became remarkably fond of its use. His example was soon followed even by the most refined courtiers. James I., every person knows, entertained a furious hatred against Tobacco. In the year 1619 he fulminated an edict against it, but Tobacco was more powerful than the king. Pope Urban VIII., in 1624, next set to work to check the use of Tobacco, against which he launched a special bull. The pope did not succeed better than the king. Next in the list of Tobacco stoppers came the Sultan Amurath IV., the Shah of Persia, and the Grand-Duke of Muscovy. These potentates more especially directed their efforts to restrain the habit of snuff-taking; and, disdaining argument which had so signally failed under James, disdaining, also, religious enactments, which had not been more successful under the pope, this precious trio of Oriental worthies thought that the shortest way to check the habit of snuffing would consist in cutting off people's noses. This remedy they carried, we are told, pretty liberally into execution.


163. The Tobacco Flower.

§ 31. LEGUMINOSÆ, OR THE LEGUMINOUS TRIBE.

The structural characteristics of the fruit termed by botanists a *legume* we shall presently enumerate; meanwhile, we will inform the reader that a *legume* is merely another name for *pod*, the sort of fruit borne by the Pea, Clover, Laburnum, and many others which will easily suggest themselves.

Characteristics: Calyx free and monosepalous; corolla perigynous or hypogynous, regular or irregular; stamens double the number of petals, or occasionally indefinite; pistils united into one carpel; fruit a legume; seed dicotyledonous; embryo straight or curved, exalbuminous; leaves, alternate, stipulated.

This is an exceedingly large and exceedingly valuable order of vegetables, all of which present good external marks for distinction, and, moreover, possess a similarity of chemical and physiological qualities.

The great universal characteristic of the Leguminosæ is that from which they derive their name Leguminosæ; let us, therefore, examine the anatomy of a *legume*. A *legume*, then, is nothing more than a long flat carpel, for the most part containing many seeds, and splitting, when arrived at maturity, into two halves. The seeds, it will be remembered, all grow from one commissure or junction line in the inside of the carpel.

As regards relative dimensions, legumes differ considerably, some being longer than they are broad, others the reverse. This circumstance, however, gives rise to no physiological distinction between the two.

Leguminosæ being an exceedingly numerous order, and comprehending plants amongst which differences of structure exist insufficient to justify their formation into different orders, is divided into groups, the distinctions between which will presently come under consideration. One of these groups, perhaps the most important, is the Pea tribe, the members of which are sufficiently familiar to all of us. Independently of the existence of a pod, in these plants there is another striking peculiarity; the flowers are shaped very much like butterflies. Hence arises the denomination papilonaceous (from *papilio*, the Latin for butterfly), by which the Pea sub-division of Leguminosæ is known.

Let us now study one of these flowers a little in detail. The calyx is made up of five sepals, all of which unite in a tube. The corolla is made up of five petals, not all, however, of equal size. One of them is considerably larger than the others, and rises behind them. This petal has acquired amongst botanists the distinctive name of *vexillum* or *standard*. The two shorter petals which stand in front of the *standard* are termed *alæ*, or *wings*. They are protected by a portion of the corolla, formed like a boat, from which circumstance it derives the appellation *carina*, or *keel*.

Next observe the stamens, and you will find that they are collected in groups, or, to use the expression of Linnæus, they are "adelphous." All the common papilonaceous flowers are adelphous; but many foreign species, especially certain natives of New South Wales, *Pultanæus Gompholobimus*, *Daviesias*, &c., are not.

Next come the plants, which, although bearing legumes, are not provided with papilonaceous flowers. This division comprehends Cassias (fig. 164) and their allies. Lastly, we have the Mimosa tribe, the great characteristic of which is the possession of flowers like those of the Cassia in structure, but so very small that they can scarcely be recognised by the naked eye.

The order Leguminosæ is that beyond all others which furnishes the greatest number and variety of substances useful in medicine, domestic economy, and the industrial arts. Many possess a saccharine principle which pervades their roots, the stem and leaves containing but little. Of this kind is the Liquorice (*Glycyrrhiza Glabra*).

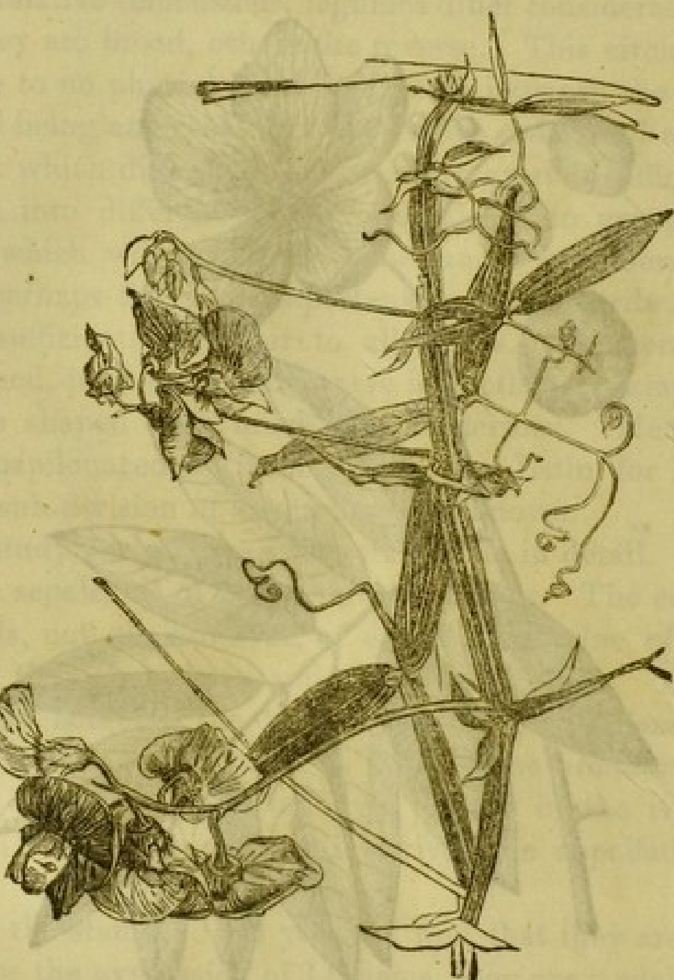
Certain species possess roots furnished with tubers containing starch and sugar. Of this kind is the Alhagi of the Moors (*Alhagi Maurorum*), a native of Asia and tropical Africa. In Persia this vegetable exudes from its stem a delicate manna.

The fruits and seeds of many Leguminosæ, such as the Haricot Bean,

164. The Herbert Cassia (Cassia Floribunda).

gathered before maturity, contain mucilage and sugar, and thus furnish us with a delicate article of vegetable food. If allowed to grow quite ripe, then the seed becomes highly charged with starch, and is used as food in another form. The Peas and Beans of our gardens may be considered as exclusively belonging to temperate climates. Tropical regions, nevertheless, have their papilonaceous substitutes. Amongst the most remarkable of these is the underground Bean of Brazil (*Arachis Hypo-*

gæa), an annual plant, the fruit of which, very soon after impregnation, elongates downwards, penetrates below the earth, and buries itself some two or three inches deep. The fruit having thus dug its own grave, ripens in this curious position, and produces oily seeds very agreeable to eat. In the greater number of species the ripe pod-husk is tough and leathery. In the Carob Bean, however, it is soft and good to eat. The Carot Bean (*Ceratonia Siliqua*) is a very common tree on the shores of the Mediterranean, and its pulpy saccharine fruit is eagerly eaten by animals.



165. The Nosegay Vetch (Lathyrus Latifolius).

It is from the seeds of this plant that the denomination carat weight (four grains) employed by jewellers is supposed to be derived.

Many papilonaceæ have a mucilaginous saccharine stem, slightly bitter and aromatic, and yielding excellent pasturage. Foremost in this list are the Trefoils, Vetches (fig. 165), and Lucernes. The Fenugreek diffuses a somewhat disagreeable odour, yet its seeds are held in great estimation by Turkish ladies, with whom extreme fatness is considered the greatest point of personal beauty, feminine thinness being a quality held in aversion by the Turks. The delicious Tonquin Bean (*Coumarouna*

Odorata) owes its distinctive characteristic to the presence of a sort of concrete fat, named by the chemists *Coumadine*.

Many Leguminosæ of the old world contain an astringent juice, which, being caused to flow from incisions and dried, becomes hardened into substances employed in medicine and the arts. Of this description is the substance resin.

Several American species are used for dyeing; for example, the so-called

166. The Logwood Tree (Hæmatoxylon Campechianum).

Brazil or Pernambuco wood is the produce of a leguminous plant, the *Cæsalpinia Echinata*. Sappan wood (*C. Sappan*) is another, as in like manner is Logwood (*Hæmatoxylon Campechianum*, fig. 166) and Red Sandal wood (*Pterocarpus Santalinus*). But assuredly the most important of all the leguminous dye materials is Indigo (fig. 167), the produce of the *Indigofera Tinctoria*, a native of tropical Asia, but now cultivated in many other tropical regions. Blue Indigo, however, does not exist ready formed in the Indigo plant, but is procured from it by submitting the plants to a sort of fermentation. The chemical nature of Indigo is very peculiar, differing from all other dye stuffs, and does not admit of being explained in few words.

The so-called Aloe wood is a resinous aromatic wood furnished by a leguminous tree which grows in certain mountainous regions of Cochin China. Its botanical name is *Aloexylon Agalloche.*

Copal resin, a valuable constituent of many varnishes, is the produce of a leguminous vegetable, of which the name and even the true locality were long unknown. The tree yielding it is now demonstrated to be the *Hymenæa Verrucosa,* a native of Madagascar, and called by the natives

167. The Recumbent Indigo-plant.

Tanrouk-rouki. Copaiba, Balm of Peru, Balsam of Tolu, and Gum Tragacanth, are also the produce of various species of Leguminosæ. This is a long list of physic stuff, but we might fill whole pages in this way, so fertile in medicinal products are the Leguminosæ. Suffice it to say, that Tamarinds, Cassia, Senna, Gum Arabic, and Catechu (one sort), are all the produce of vegetables belonging to this natural order. None of these medicinal and highly odorous species are natives of our temperate clime, or admit of being grown there except in hot-houses; but we have, at least, the delicate-blossomed, odour-diffusing Sweet Pea.

§ 32. BORAGINACEÆ, OR THE BORAGE TRIBE.

Although many natural orders of plants must be altogether omitted in this work, yet we will at least find space for the natural order containing our general pet, the Forget-me-not.

Characteristics: Calyx free; corolla hypogynous, monosepalous, or regular sub-labiate; stamens five, inserted on the tube of the corolla alternate with the divisions; carpels four, rarely arranged in pairs; seeds invers dicotyledonous, little or no albumen; radicle, superior.

168. The Bugloss, or Ox-tongue (Anchusa Officinalis).

There is a certain tribe of plants which Linnæus termed *Asperifoliæ*, on account of the hair-like projections with which their leaves and stems are studded. Prominent amongst these vegetables is Borage, hence the modern term *Boraginaceæ*, now applied to the order.

Remark the peculiar fashion in which the flowers of a Forget-me-not grow. The stem which bears them is coiled up like the main-spring of a watch, and as the flowers grow the coils unfold. This kind of inflorescence is denominated by the botanist *gyrate*, and is as distinctive of the Borage tribe and certain allies as the minute characteristics enumerated in our preliminary list.

Let us now pay attention to the flower. The calyx consists of five sepals, which remain joined to each other to the extent of half the flower, thus constituting the tube. The border of the corolla is also divided into five lobes. Lastly, we observe five stamens and an ovary, from which springs one style, terminated by a double stigma. In correspondence with four lobes of the ovary, we observe four nut-like things which used to be mistaken for seeds; they are really fruits. This peculiarity of fruit and of inflorescence (*gyrate*) are the grand distinctive characteristics of the Borage natural order, the members of which are all harmless, and many of them the sources of valuable dyeing materials. We insert a drawing (fig. 168) of a plant belonging to this order.

§ 33. LABIATÆ, OR THE LIP-FLOWER TRIBE.

Every person who has attentively examined the flower of a Mint, Sage, or Lavender plant, cannot fail to have remarked the general similarity which its mouth bears to the open jaws of an animal; hence the term *labiate*, or *lipped* (a more expressive one might be found), which has been applied to them.

Characters: Calyx free; corolla hypogynous, monopetalous, irregular; stamens inserted on the tube of the corolla, four or two; fruit composed of four achænia; seeds dicotyledonous, exalbuminous; radicle inferior; leaves opposed or verticillate.

Such are the nice scientific points which characterise the Labiate, but we shall be able to recognise them by superficial characteristics.

Reversing the usual order of our investigation, let us first pay attention to the ovary. When ripe, it displays the four nut-like fruits, termed by botanists *achænia*, as we found in the Borage tribe; and when it is considered that this kind of fructification does not exist in any natural order, save Boraginaceæ and Labiatæ, the value of this characteristic will be evident. Further than this, there is no similarity between the two natural orders. The Borage tribe is insipid, the Labiate tribe powerfully odorous. The Borage tribe has gyrate infloration; the Labiate tribe has not. The Borage tribe has round hairy stems; the Labiate tribe, stems which are square and angular. Flowers of the Borage tribe have a regular, those of the Labiate tribe an irregular, corolla. Flowers of the Borage tribe have five stamens; whereas those of the Labiate tribe have four—two long and two short (fig. 169).

The principal habitat of this natural order is the ancient world, more especially the zone bounded by the fortieth and fiftieth parallels of northern latitude. Their number diminishes towards the tropics and either poles. Beyond the tropic of Capricorn they are seldom found, and are altogether banished from the polar regions.

Most of the Labiatæ contain a volatile oil, a bitter gum-resinous principle, and gallic acid. The purely aromatic species are employed as flavouring matters in domestic economy, and as perfumes, in addition to their medicinal uses.

169. Hyssop (Hyssopus Officinalis).

§ 34. SCROPHULARIACEÆ, OR THE FOXGLOVE TRIBE.

Characteristics: Calyx free; corolla hypogynous, monopetalous, generally irregular, bilabiate; stamens inserted on the tube of the corolla, generally less numerous than the divisions of the latter; ovary, bipartite, bilocular. Fruit capsular, rarely fleshy; seeds dicotyledonous, albuminous.

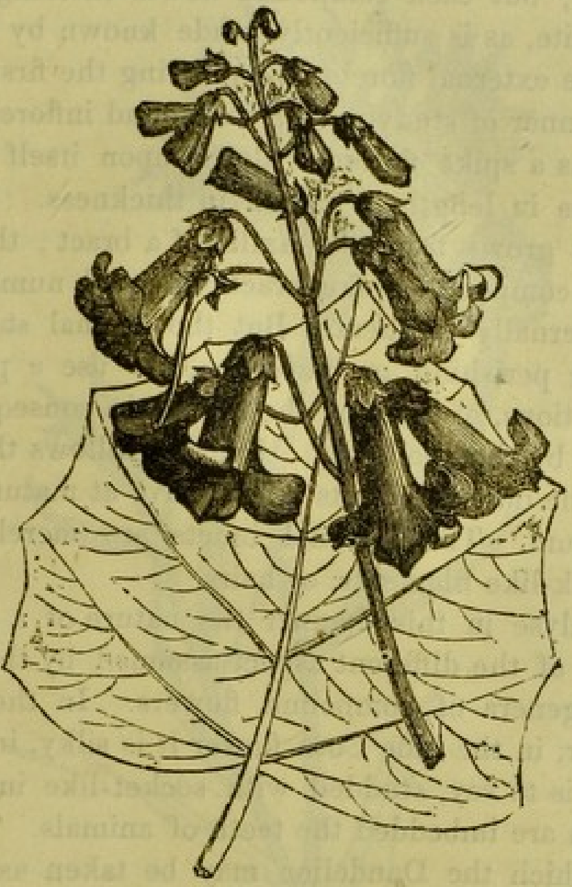
Taking a Foxglove as our specimen, the student cannot fail to be struck with a general resemblance subsisting between a flower of a

Labiate plant and a flower of the Foxglove. In the latter, however, the irregularity of corolla (fig. 98) is still more marked. The ovary, moreover, is different; we no longer see four lobes, but two, each of which is a cell, which, if cut open, displays a great number of seeds.

The Foxglove tribe is not completely banished from any region, although they more especially belong to warmer parts of temperate climes. Between the tropics and in the polar regions they are comparatively rare. The Scrophularia, from which the name of the order is derived, was so

170. The Foxglove (Digitalis Purpurea)

called on account of its supposed efficacy in the cure of scrofulous diseases. Unfortunately, the opinion is not borne out by experience. The Foxglove (*Digitalis Purpurea*, fig. 170) is an exceedingly valuable medicinal plant, owing its efficacy to the presence of a chemical substance termed *digitaline*. Its great use is to diminish the action of the heart, and consequently to lessen the violence of the blood's circulation. Digitalis, however, and all its preparations, are so powerful in their action, that they should never be administered except under the sanction of a medical man. The Foxwort, Veronica, Snapdragon, Monkey-flower, and Verbascum, all belong to the natural order we are now considering; but perhaps the most beautiful species in this family is that the representation of which is now subjoined (fig. 171), the *Paulonia Imperialis*, so named after a Russian princess. It is a native of Japan, remarkable for the beauty of its heart-shaped leaves, and its long, blue, odorous flowers, disposed in panicles.



171. The Imperial Paulonia (Paulonia Imperialis).

§ 35. COMPOSITÆ.

Characteristics: Inflorescence in a capitulum, receptacle, or torus, common, surrounded by an involucre; calyx tubular, adherent to the ovary; corolla epigynous, monopetalous; stamens five, rarely four; anthers united to the tube by their edges; ovary inferior, unilocular, uniovular; ovule erect; fruit an achænium; plant dicotyledonous, exalbuminous; radicle inferior.

Compositæ, of which at the present time not less than nine thousand species are known, constitute the tenth part of the vegetable kingdom, and, therefore, perhaps ought to constitute a class rather than a natural order; nevertheless the type which they present is so characteristic, that, in spite of their great numerical superiority over other natural groups, botanists have continued to regard them as an order.

For the most part the Composite are herbs, generally perennials; certain species are ligneous; indeed, a few are arborescent, constituting trees of large size. The leaves are generally alternate, various as to their form, but always without stipules. The capitula always present the general appearance of a corymb or a cyme; the aggregate inflorescence is therefore definite; but each compound flower entering into the cyme or corymb is indefinite, as is sufficiently made known by the order of floral development—the external florets always being the first to expand. Perhaps the best manner of studying the compound inflorescence is to regard each capitulum as a spike flattened down upon itself in such a manner that what it loses in length is gained in thickness. Upon this normal spike each floret grows from the axilla of a bract; therefore, we ought to find upon this compound spike bracts in equal number to the flowers, and situated externally to them. But the normal state is still further disturbed by the perishing, or "*abortion*," to use a phrase common in botanical descriptions, of some of the florets, in consequence of pressure made upon them by their fellows. Hence it follows that only the bracts appertaining to the outside florets ever arrive at maturity, and form the general involucrum. The internal bracts are merely represented by minute scales, silk-like filaments, or hairs.

When we analyse in this manner the nature of a capitulum, the explanation is seen of the different aspect assumed by the torus, or flower-disc, in various genera of compound flowers. In the Chamomile it is covered with hair, in the blue Corn-flower it is silky, in the Onopordon it is alveolar, that is to say, studded with socket-like indentations, similar to those in which are imbedded the teeth of animals. Finally, in certain Compositæ, of which the Dandelion may be taken as an example, it is absolutely naked.

In the greater number of cases, each floret of a compound flower bears stamens and pistils, as in the Corn Centaury (fig. 92), the full representation of which is given in fig. 172; but in others the florets of the circumference alone are pistilliferous, as is seen in the Chrysanthemum (fig. 100); or even sterile, or devoid of both pistils and stamens. Again, certain remaining members of the Composite order have stamiferous flowers in the centre and pistilliferous flowers on the circumference: of this kind is the Marigold. Finally, there are yet others, the flowers of which are entirely stamiferous, or entirely pistilliferous; and these flowers may be on one or two separate plants.

The calyx, the tube of which is adherent to the ovary and altogether confounded with it, terminates in a limb or free portion, which is subject to numerous modifications of form; thus furnishing excellent characters for the distinction of genera. It is completely effaced in the Chrysanthemum (fig. 100); it forms a crown in the wild Chamomile and Tansy; and is developed in tooth-like protuberances, or lamilar scales, in the Sunflower, Tagete, Bidens, Helianthus (fig. 81), and Chicory. Frequently it degenerates into hairy or silk-like filaments, forming a plume.

The stamens are inserted upon the tube of the corolla, and are alternate with its divisions; the pistil is composed of a single carpel; the ovary one-celled, uniovular. Certain fanciful botanists, having regard to

172. The Corn Centuary (Centaurea Cyanus).

the aggregation of many individual florets in a compound flower, have imagined this great natural order as representing the citizen tribe of vegetables—as being more elevated in civilisation, so to speak, and as deserving to take precedence of all other natural families. To decide on the matter of precedence is in no case an easy task; but it is certain the Compositæ contain a great number of highly valuable plants; it is certain, too, that extraordinary means are taken by nature for their generation and preservation. How beautiful the provision made for the dispersion of their dry fruits commonly termed seeds! These fruits, which the reader will now remember are termed by botanists *achænia*, remain upon the torus, or receptacle enclosed by the withered bracts, until ripe; they are then dispersed. Various methods are adopted to bring about this dispersion, and they are all beautiful. In some species, as the Chevreulia Rampant, the torus, after the withering of the floral envelopes, shoots up in the form of a spire, thus presenting every facility for the achæniums to escape. In other species, as the Carpesie and Tussilago Pas-d'ane, the torus becomes, during the ripening of the fruit, inverted in such manner that the fruits are emptied, as it were, out of their sockets. In the Chamomile the same result is accomplished by the assumption by the torus, as the fruits ripen, of a globular instead of a plane condition. In the Onopordium, the alveolar processes become so contracted during the ripening of the fruits, that the latter are extruded; but amongst all provisions made by nature for the distribution of the fruit of Compositæ, perhaps the most beautiful consists in the plume, or aigrette, with which some are furnished. This plume is nothing else than the dried limb or free portion of the calyx. In the genera which have this appendage, it is worthy of remark, that the involucrum is supplied with long, serrated, imbricated bracts, which surround the achænia, protect them, and favour their ripening. In certain species, the involucrum opens of itself as soon as the fruits arrive at maturity, thus allowing the latter to escape and float on their winged appendages; in others there is another provision. The involucrum, instead of opening spontaneously, has a tendency to remain closed. Whilst the wing-like appendages of the achænia are yet unripe and devoid of elasticity, there is nothing to prevent the closing tendency of the involucrum from taking effect; but no sooner do the fruits ripen than their plumes or wings, tending to expand the outermost ones to a horizontal position, force open the involucrum by their spring-like elasticity, and the fruits are now free to move in obedience to the first passing breeze. In this way the achænia are transported often to the distance of several miles. Not content even with this beautiful provision in all its simplicity, the plumes of certain Compositæ, mindful, as it would seem, of their citizen-like traditions, aggregate together into a compound plumule. In this manner occasionally a mimic cloud of Dandelion fruits may be seen pursuing their devious course to some unknown spot.

We must not omit to mention, while discussing the various means taken advantage of by nature to promote the dissemination of Compositæ, a very grotesque arrangement possessed by certain species, in virtue of which animals are made the unconscious bearers of the precious vegetable charge. The Proteus-like bract, which we have already seen competent to assume so many shapes, becomes in certain species of this natural order hooked, covering each torus with hundreds of claw-like arms. Who has not seen this curious provision on the Burdock, though, perhaps, the utility of this curious appendage has not suggested itself. The use of this hook, no doubt, is for the purpose of causing the torus to lay hold of the skins of animals or other passing objects.

The Compositæ being a natural order which includes so large a number of species, some kind of subordinate classification becomes necessary. Botanists are by no means agreed as to the best method of accomplishing this. Perhaps the system of De Candolle and Endlicher is most generally convenient: according to which the order Compositæ is divided into three series; first, Liguliforæ; second, Labiatifloræ; third, Tubulifloræ. These sub-families are divided into eight tribes, which are again divided and sub-divided until each final species is arrived at.

There are a few natural orders, which, regarded in the *tout ensemble* of their general characteristics, approach the Compositæ. The little family of Calyceraceæ presents a great analogy with them, both as regards the inflorescence and the structure of individual flowers. It differs from Compositæ, however, in the circumstances that the seed, instead of being erect at the base of the ovary, is suspended from the summit of the latter; that the embryo is inclosed in a fleshy albumen; that the radicle is superior; that the style, always undivided, is terminated by a capitular stigma. Next come the Dipsaceæ, of which the greater portion resemble the Compositæ, by their inflorescence being that of a capitular involucrum; but which differ from the family in the circumstance of imbricated æstivation and free anthers, by the presence of an involucrum surrounding each flower, by the adhesion of the ovary to the calyx at its upper portion only; lastly, by the pendant and albuminous seed.

The great family, Compositæ, is dispersed all over the globe; nevertheless, the number both of species and of individuals rapidly diminishes towards either pole, and slightly towards the equator. They chiefly inhabit temperate and hot regions, more especially tropical islands, and littoral portions of tropical continents. America is richest in the greatest number of species. Herbs belonging to this order grow in climates which are temperate and cold; shrubs in regions still hotter; and trees in the hottest of all. Moreover, the latter are exclusively confined to intertropical and antarctic islands. Tubulifloræ are numerous between the tropics, Ligulifloræ in the northern temperate region. Labiatifloræ are rare out of America, where they abound between the equator and the tropic of Capricorn. Whatever may be the locality of any one species belonging to this order, it is rare that such family can be naturalised elsewhere. In this respect the Compositæ are peculiarly unbending; neither care nor culture will generally suffice to effect a permanent reconciliation between the transported plants and their new homes.

The immense family of Compositæ furnishes mankind with numerous useful products, some of which shall now be rapidly enumerated. The radiated Tubulifloræ, regarded in the aggregate, may be said to contain in the flower a bitter principle combined with a resin or volatile oil; associated with these there is frequently discoverable in the root a material something resembling starch, and designated chemically by the specific name *inuline*, because it is chiefly found in the Elecampane (*Inula*). According to the mutual proportions in which one or another of these bodies may predominate, the various species become endowed with different medicinal properties. Some are tonics, others excitants or stimulants, others are astringents. The great genus Artemisiæ, represented throughout all the world by different species, furnishes us with various bitter aromatics, the properties of many of which have been celebrated from periods of very high antiquity. Two species, *Artemisia Absinthium*, and *A. Pontica*, are indigenous. Southernwood, or *A. Abrotanum*, originally from the East, is now cultivated in our gardens, and of world-wide reputation for its penetrating odour. All these species owe their properties to the presence of a bitter principle, a peculiar acid, and a volatile oil.

Perhaps the most valuable product of the Composite family is a volatile oil, acrid in some species, only bitter in others. Pre-eminent in the list stands Chamomile, useful in so many diseases. *Arnica Montanum*, a plant which grows in Germany, Switzerland, and France, also owes its medicinal qualities to the presence of a volatile oil.

The genus Helianthus deserves special notice for the products which it yields. *H. Tuberosus* is a perennial plant, indigenous to Brazil, though now cultivated in various European countries. Its subterraneous stem produces enormous tubercles, charged with inuline, and therefore very nutritive. Their odour is nauseous, but their taste agreeable; consequently, after being well seasoned, they may be eaten by man. They resist the attack of frost, in which respect they are different to most tubers, and consequently furnish good winter fodder for cattle. The Helianthus Annuus is familiar to most of us as a showy floral ornament. The Sunflower, however, has other merit than this. Its seeds afford, by expression, large quantities of a fixed oil admirably adapted for the purposes of illumination and the soap manufacture. We shall now conclude this notice of radiated Tubulifloræ by mentioning the Synchodendron, a tree fifty feet in height, and the largest of the Compositæ. It is a native of Madagascar, in the deep valleys of which island it grows; and although it does not furnish a product useful to man, it aids him in another way. When the Synchodendron flowers, the natives know the best season has arrived for sowing their rice.

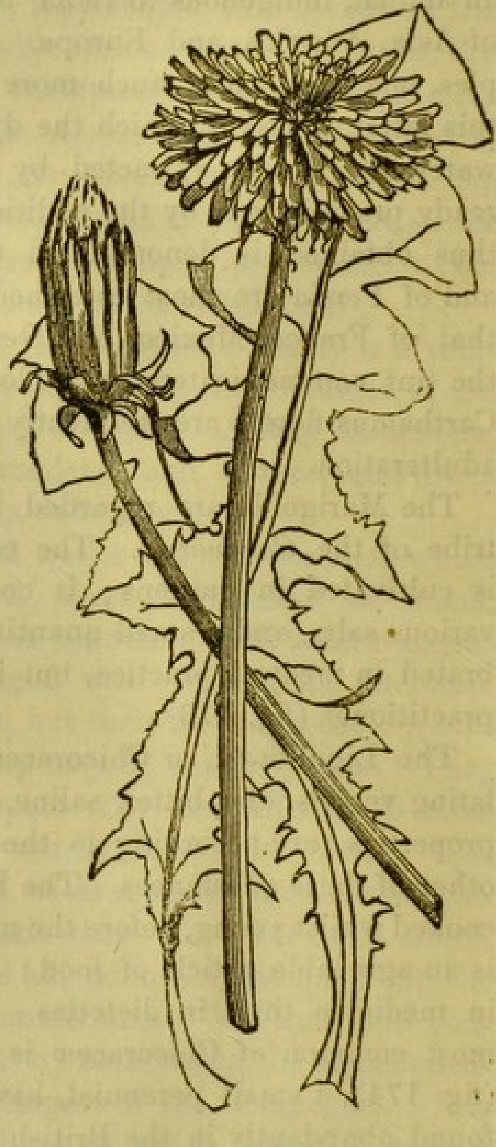
The genus Cynara (Artichoke) comprehends many species, of which one, the common Artichoke (*C. Solymus*), is familiar to most of us. The part which we eat in this vegetable is the bracteal involucre, or rather the fleshy base of each bract, and the common receptacle. The Italians are more expert in turning the Artichoke to account. They tie all the petioles together into one mass, curve the plant at right angles, and surround it with earth. In this manner, not only the capitulum, but the whole upper portion of the plant becomes etiolated, or bleached, and forms a sort of Cabbage head. The latter is eaten by the Italians raw as a salad.

Several individuals of the *Carthamus* tribe of Compositæ are conspicuous on account of the colouring matters which they yield. Of these, the *Carthamus Tinctorius*, or Safflower plant, is the most valuable. It is an annual, indigenous to India, but now cultivated in various other parts of Asia, America, and Europe. Its florets contain two colouring principles, one of which is much more soluble in water than the other. It is this latter, however, which the dyer seeks. Although rather insoluble in water, it is easily extracted by alkaline leys, from which it admits of ready precipitation by the addition of an acid. The colouring principle thus obtained is denominated *Carthamine*. The carthamine of Egypt and of Persia are most esteemed; that of Spain follows next in order; that of France, Mexico, and Germany is of less value. Unfortunately, the tint communicated by Safflower, although beautiful, is very fleeting. Carthamus florets are frequently mingled with those of true Saffron as an adulteration.

The Marigolds are regarded by the generality of botanists as a subtribe of the *Carduaceæ*. The common Marigold (*Calendula Officinalis*) is cultivated in gardens; it contains a bitter mucilaginous substance, various salts, and a small quantity of volatile oil. It was formerly celebrated in medical practice, but is now scarcely employed by the general practitioner (fig. 173).

The Liguliflorae, or Chicoraceæ, contain a milky juice in their circulating vessels, also bitter, saline, resinous, and narcotic principles. Their properties vary according to the predominance attained by one over the other of these substances. The herb part of several of the Chicoraceæ, if cooked whilst young, before the milky fluid has become completely formed, is an agreeable article of food; but the Chicoraceæ are more celebrated in medicine than in dietetics. One of the most useful as well as the most common of Chicoraceæ is the Dandelion (*Taraxacum dens Leonis*, (fig. 174), a small perennial, having a wide distribution. Not only is it found abundantly in the British isles, but throughout Europe, Asia, and northern Africa. The Chicory (*Cichorium Intybus*), remarkable amongst indigenous Compositæ for its blue flowers, is scarcely less common than the Dandelion, and, perhaps, equally valuable as regards the results it yields. The root of wild Chicory is employed in medicine; that of garden Chicory, when dried and roasted, is the object of a considerable commerce, being employed as a substitute for, or an adulteration of, Coffee. We should remark, however, that throughout Germany and France the Coffee-drinking public has become so accustomed to the flavour of Coffee mixed with a certain amount of Chicory, that simple Coffee is never by preference employed. Endive (*C. Intybus*), so much employed as a salad, is also one of the Chicoraceæ, etiolated, or bleached, by protecting it during growth from the direct action of air and light. Two varieties of Endive are known to gardeners; one with large oblong leaves, very slightly charged with the bitter principle; the other more decidedly bitter, and having leaves which are very much sub-divided and crisped.

173. Marigold.



174. Dandelion.

The genus Lactuca, or Lettuce, is a very important one belonging to the sub-tribe Chicoraceæ. All the members of this genus are characterised by possessing a bitter acrid juice, and being strongly odorous. All the Lettuces contain wax, caoutchouc, or india-rubber, albumen, a resin, a bitter crystallizable matter, and a peculiar volatile principle. Most of the Lettuce genus are medicinal, the predominant medical quality of each being determined by the preponderance of one principle. Even common garden Lettuce, in the condition in which we eat it as a salad, is known popularly to be endowed with soporific properties; but the narcotic energy is most strongly developed in the *Lactuca Virosa*, an annual or biennial plant growing in central Europe.

Passing on now to the radiate sub-tribe of the natural order Compositæ, let us first direct our attention to the cosmopolite but modest Daisy (*Bellis Perennis*), which spreads on the verdure its yellow disc surrounded with blue rays, springing up at the earliest dawn of spring, and gladdening our sight until the winter blasts return. The pretty Daisy is associated with our earliest recollections of fields and flowers; it has inspired the pastoral bards of many lands, and formed the subject of many beautiful verses. Every one knows how ornamental are Daisies to the green turf of meadows; but only the intelligent farmer knows how dear is the price paid for the ornament. The Daisy, unostentatious as it is above ground, encroaches sadly, with its rhizomes and spreading roots, on the Grass tribe, which is the special object of culture;—hence the grazier should extirpate our little Daisy friends by all means in his power; to him they are rather foes than friends. The Chrysanthemums are all beautiful species, many of which are cultivated in England. The Indian Crysanthemum, as it is called, is a native of China, where it is a great favourite. It flowers very late in the year, thus furnishing us with a floral Christmas ornament. Its compound flowers grow to the size of three or four inches in diameter.

The Asters are sturdy perennials, which contribute by their large and highly-tinted compound flowers much to the embellishment of a flower-garden. Most of the exotic Asters have been introduced from America; nevertheless, that of greatest beauty, the China Aster (*Callistephus Sinensis*), originally came from China. The extensive genus, *Gnaphalium*, which is divided into many secondary genera, comprehends many ornamental plants, known under the general designation of *Everlastings*. The greater number of these species are indigenous to Africa and America. But of all the radiate sub-genus of Compositæ esteemed for the beauty of their flowers, the most popular, the most cherished, the most beautiful, is the Dahlia, with the description of which we shall terminate this notice of the family Compositæ.

The genus Dahlia, or Georgina, is characterised by having an involucrum, of which the exterior bracts, about five in number, are reflected, and the internal ones, from twelve to twenty in number, arranged in double series, are membranous at their summit, thick and fleshy at their base. The achænia, or fruit, are surmounted by two short points. The stem is herbaceous; leaves opposed and pennatifid. The species most cultivated in our gardens, which it embellishes during the autumn, is the *D. Variabilis* or *G. Coccinea.* It is a native of Mexico, whence it was transported to Spain about 1790, and a specimen was sent from Madrid to France in the year 1802. At first the French gardeners cultivated it as a greenhouse plant, but they soon discovered the Dahlia to be capable of flourishing in the open air. From this time the plant was rapidly disseminated, and many varieties began to appear. The flowers of the primitive species were all simple, the disc yellow, the rays arranged in two series, dark scarlet and velvety in appearance. In 1810, varieties sprang up possessing lilac, rose-coloured, and saffron-yellow rays. In 1818, double-flowered varieties were obtained, with cornet-shaped tubular florets constituting an imbricated Rose. Since that time so many varieties have sprung up, that their mere enumeration would be impossible.

§ 36. VALERIANACEÆ.

Characteristics: Calyx adherent to the ovary; corolla monopetalous, epigynous; stamens ordinarily less numerous than the lobes of the corolla, and non-herent. Ovary three-celled, two of which cells are barren, the third containing one seed ; ovule pendant ; seed dicotyledonous ; radicle superior.

The Valerianaceæ, which derive their name from Valerian, one of the principal genera, are either herbs, with slender roots, or perennials, having an almost woody rhizome, generally containing odorous matter. The radical leaves are tuft-like, petiolate, simple, opposed, and without stipules (fig. 175).

The flowers of most of the Valerians contain both pistils and stamens, though certain members are monœcious, others diœcious. Usually the inflorescence is a cyme, sometimes a corymb. The tube of the calyx is attached to the ovary; the limb of the calyx divided into three or four parts. The corolla, inserted into the margin of a disc crowning the ovary, is tubular, and shaped like a funnel. Its tube is often spurred at the base, its limb generally divided into five lobes, and sometimes irregular. The stamens inserted upon the tube of the corolla alternate with the divisions of the latter. Their number is rarely five, more frequently four, the fifth, or internal one, being suppressed ; sometimes three, by the suppression of the lateral stamens. Lastly, in certain cases only the innermost stamen becomes developed. The anthers are bent inward ; the ovary inferior, composed of three carpels, forming three ledges, two of which are empty, the third alone fertile. The ovule is reflected, and hangs from the cell ; the style is simple filiform, terminated by two or three stigmas, which are sometimes coherent into one. The fruit is dry, indehiscent, ordinarily unilocular by disappearance of the barren cells; never containing more than one seed; embryo straight; cotyledons oblong, exceeding in length the radicle.

The Valerianaceæ are for the most part inhabitants of the ancient continent, being chiefly restricted to central Europe and the Mediterranean region, and the Asiatic district of the Taurus and Caucasus, from which a few species have wandered to Nepaul, and Siberia, and Japan. In the tropics they are unknown, except in certain mountainous regions. In Chili and Magellan several species are not unfrequent; but North America only possesses one.

175 Valerian of the Pyrenees (Valeriana Pyrenaica).

The Valerianaceæ are a natural order, concerning the medicinal qualities of which all persons are agreed. The active principles are a volatile oil, and an acid termed the valerianic acid, which chemists now make artificially. The perennials are more efficacious than the annuals, probably because in the latter the active principles have not had sufficient time to develope themselves. The smell of Valerian is very peculiar;

some people think it agreeable; a far greater number, however, are of a contrary opinion. Amongst cats there is no such difference of sentiment. These animals are very partial to the odour of Valerian, and eagerly scratch up such plants of it as they meet with in their rural explorations. Valerian is now employed by physicians in the cure of spasms; formerly its employment was directed to the cure of the far graver disease, epilepsy. Report states that Fabius Columna, a Neapolitan noble, who lived in the sixteenth century, being a great sufferer from epileptic

176. Centranthus Ruber.

attacks, and deriving no advantage from physicians, set about learning Botany, in order that he might discover the medicinal properties of vegetables, and thus become his own doctor. Notwithstanding the common proverb, that the man who is his own doctor has a fool for his patient, the Neapolitan did not study Botany in vain. After trying a host of plants, he at length alighted on Valerian, and cured himself of epilepsy. Without intending any disparagement to the skill and perseverance of this resolute gentleman, it may be permitted to hazard a doubt whether the disease which afflicted him was really epilepsy.

Let us now proceed to an enumeration of the principal Valerianaceæ, commencing with the *V. Officinale*, which is the species most commonly employed. This plant is generally distributed throughout Europe, where it frequently grows in humid meadows, rarely in dry and sandy places; its stem is furrowed, its leaves pennisecate and covered with down. The *V. Phu* is a German species, cultivated in our gardens, the radical leaves of which are simple and lanceolate, the flowers white. The Valerian of the Pyrenees, already figured *V. Peranaica*, is grown for the sake of ornament. *V. Sichensis* is a North American species, and valued beyond every other by the Russians. The ancients vaunted the medicinal qualities of the Celtic and Indian Nard. The former (*V. Celtica*) grows on the mountain summits of Styria and Carinthia; the latter is a native of the Alps. Both are still the objects of a very considerable commerce, large quantities being sent every year to Turkey and Egypt from Trieste, whence they find their way to the interior of Africa and India.

The Indian Nard, termed *Spica Nard* by the ancients, was in great favour; not that it was exactly a medicine, but it was thought to secure the affections of any lady or gentleman to the opposite party giving it. Unfortunately, we do not exactly know the plant to which the ancient term refers; botanists imagine it applies to a genus called *Nardostachys*. However well attested by ancient testimony the efficacy of Spikenard may be, still, in our times, it may be doubted whether the mineral kingdom be not more potent than the vegetable in securing the affections of young ladies.

The chief ornamental plant furnished to our gardens by this natural order is the *Centranthus Ruber* (fig. 176), remarkable for its floral panicles. The corolla is purple, red, white, or lilac, furnished with a spur-like projection at its base, and only containing one stamen. Its root possesses the usual odour of the Valerian tribe.

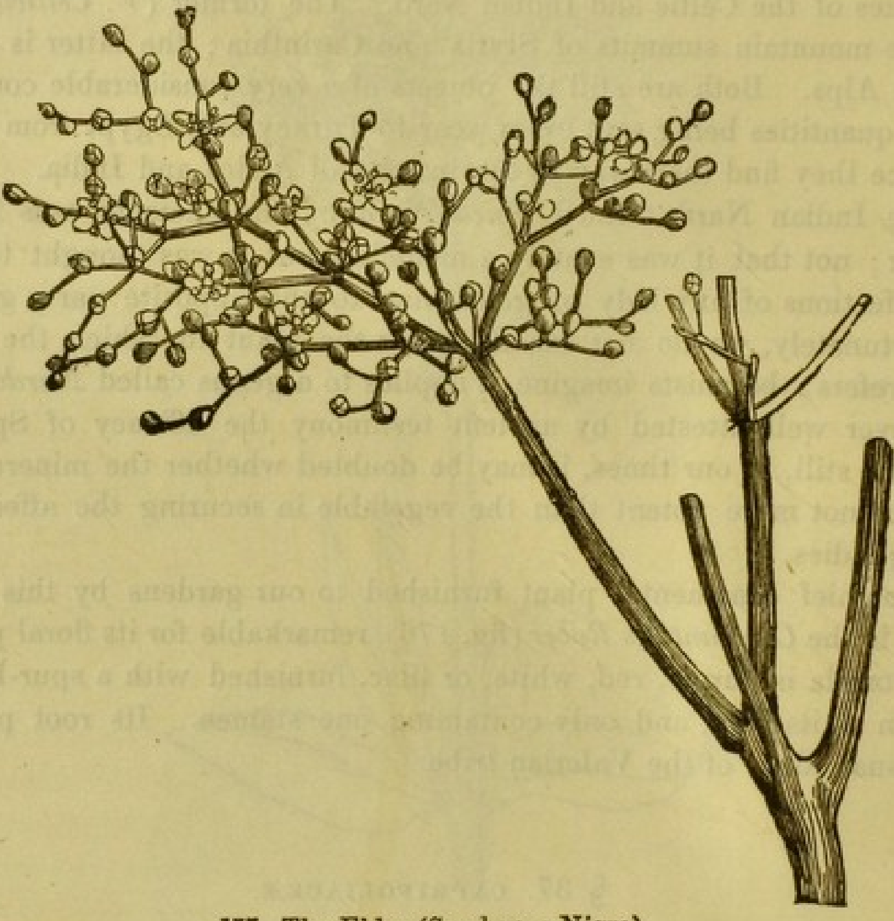
§ 37. CAPRIFOLIACEÆ.

Characteristics: Calyx adherent to the ovary; corolla epigynous; stamens inserted upon the corolla; ovary inferior, two or more celled, containing one or more seeds; seed dicotyledonous, albuminous; leaves without stipules.

The Caprifoliaceæ are for the most part trees or shrubs, some of them climbers. The leaves are opposite; stipules absent, or represented by hairs or glands situated at the base of the petioles. The flowers are complete, regular, or almost irregular, disposed in a head or terminal corymb springing from axillary peduncles. The limb, or free part of the calyx, is cleft, or five dentated. The corolla is tubular, or infundibiliform, or rotate, having a five-partite limb, ordinarily regular, imbricated in æstivation. The stamens are in number equal to that of the divisions of the corolla with which they are alternate. A very familiar example of a member of this natural family is the common Elder (fig. 177).

The natural order of Caprifoliaceæ is usually subdivided by botanical writers into two tribes, Loniceraceæ and Sambuceæ.

The Caprifoliaceæ chiefly belong to temperate or cool regions of the northern hemisphere. They are more abundant in central Asia, in the north of India, and in America, than in Europe. Certain species pass beyond the limits which seem to be imposed by nature to the family, and



177. The Elder (Sambucus Nigra).

penetrate into tropical climes; but not being able to support the full rigour of a tropical sun, they take refuge on mountain elevations. A small number of the Elder genus, that truly cosmopolitan family, is met with in Chili and in Australia.

The Loniceraceæ, or Honeysuckle sub-tribe, those beautiful and delicately-scented plants, are general favourites as ornamental members of the vegetable world. Nor is ornament their only quality; many of them have another claim to our regard as medicinal agents. The berries of the common Honeysuckle are eminently purgative, although but rarely employed in medical practice. The Symphorine (*Symphoricarpos Parvi-*

flora), a small North American species, bearing small flowers and bright-red berries, which, appearing towards the end of summer, form such an agreeable ornament in our gardens, is also useful as a medicine. Its root is astringent, and is employed by the North Americans as a febrifuge. The *Linnæa Borealis* is an herbaceous evergreen plant, very prevalent in the forests of Sweden, which, being the native country of Linnæus, the plant has been dedicated to him. Like the common Honeysuckle, it is a creeper; but its infloration is different, each stem terminating with two

178. Viburnum Opulus.

campanulate or bell-shaped flowers, rose-coloured within, white externally. This plant, also, is employed by the Swedes as a medicine.

In addition to the Loniceraceæ already mentioned, there are many beautiful species cultivated in our gardens. Among the Honeysuckles, we have the Virginia Honeysuckle (*L. Semper Virens*), the stem of which is climbing, the leaves yellow or white below, the flowers bright-red externally, beautiful, but inodorous. Then we have the Honeysuckle of

Japan (*L. Japonica*), a climbing species, termed in its native country Gold and Silver Tree, because its flowers are first white, then yellow. Finally, we have the Tartary Honeysuckle, which is not a climbing plant. It has leaves of a bluish-green; flowers rose-coloured externally, white internally; and ruddy fruits. Passing on to the consideration of the Elder tribe, the common Elder tree (*Sambucus Nigra*) first comes under our notice. It is quite a cosmopolite, known almost everywhere, and consecrated by ancient traditions. Every part of this tree diffuses, when bruised, a disagreeable odour, and a bitter acrid juice exudes. Its berries are familiar in England as the basis of Elder wine. In many parts of Germany they are boiled, and in that state eaten as a favourite article of food. The *Viburnum Opulus* (fig. 178) partakes to some extent the properties of the common Elder. The *V. Lantana* possesses berries and leaves which are slightly astringent, but the external bark is so acrid that in some countries it is employed as a blister.

§ 38. RUBIACEÆ, OR CINCHONACEÆ.

Characteristics: Calyx adherent to the ovary; corolla monopetalous, epigynous; stamens inserted upon the corolla; ovary inferior, two or more celled, containing one or many seeds; seed dicotyledonous, albuminous; leaves stipulated.

This family, one of the most important in the whole vegetable kingdom, derives its name from *Rubia* (Madder), one of its principal genera. The Rubiaceæ are either trees or shrubs, sometimes herbs, especially those indigenous to Europe. The leaves are opposed, or verticillate, and furnished with stipules. Their stipules are subject to various variations. Sometimes they are neither coherent amongst themselves nor with the leaves; sometimes those appertaining to the leaves are joined together; sometimes there is a coherence between the stipules of the same leaves, or even between those of all the leaves. Lastly, sometimes they constitute limbs altogether resembling ordinary leaves, and assume a verticillate aspect easily distinguished from real leaves, thus arranged by the absence of an axillary bud. The flowers are complete, or very rarely incomplete by abortion; ordinarily regular, their disposition is various, either in the form of cyme, or panicle, or capitulum; they are generally free from coherence, although occasionally joined to each other by their calyces. The calyx is adherent by its tube to the ovary; its limb is tubular, or trunculated, and effaced. The corolla inserted on the tube of the calyx is infundibiliform, campanulate, or in few cases rotate; its limb is four to six partite, the parts being ordinarily equal to each other; valvular or sometimes gyrate in æstivation. Stamens inserted on the tube of the corolla, their number almost invariably equal to that of the divisions with which they are alternate; anthers introrsal; the ovary crowned by a fleshy disc, more or less prominent, generally formed of two carpels, constituting two cells, one, two, or many ovulate. The ovules, reflected or curved, are pendent or erect, or otherwise definitely fixed; style simple; stigmata bifid or pluratifid, varying according to the number of the carpels. The fruit is a capsule, or a berry, or, finally, a drupe.

Rubiaceæ, being a very large natural order, is usually divided into the two sub-orders, *Coffeeaceæ* and *Cinchonaceæ*. The Rubiaceæ may be distinguished from all other natural orders by their inferior ovary, their monopetalous corolla, their opposed simple stipulated leaves; they are allied by many stray points of resemblance to Caprifoliaceæ; but they also present many analogies to other natural orders, a circumstance not to be marvelled at considering how vast is this family.

The medicinal Rubiaceæ owe their properties to the presence of alkaline substances, bitter and astringent matters, and fixed acids. The bark of many species is febrifuge, the root of others is emetic. Certain members of this natural order possess tonic qualities; many are resinous and astringent. The berries of some species are edible, and others furnish a valuable dye stuff.

Madder (*Rubia Tinctorum*) is a perennial vegetable, having a long straggling root, square knotty stems, upon the angles of which grow coarse bristly hairs; the leaves are verticillate; the flower is small and of a greenish-yellow colour; the berry is black. Madder is indigenous in the East and centre of Europe, but its cultivation is now successfully prosecuted in many districts of the west, being of great utility in the dyeing process. Chemists have succeeded in extracting the colouring matter in the condition of purity, and have denominated it *alizarine*, the name being derived from the term *izari*, or *alizari*, by which Madder is known in the Levant. Alizarine is volatile, hence it may be obtained by sublimation. The dyeing properties of Madder have been known from times of very great antiquity. Strabo relates that he saw this plant cultivated by the Gauls of Aquitaine, who called it *Varancia*, whence is derived the French word *garance* for Madder. During the middle ages the Normans cultivated it largely in the country about Caen, and exported large quantities.

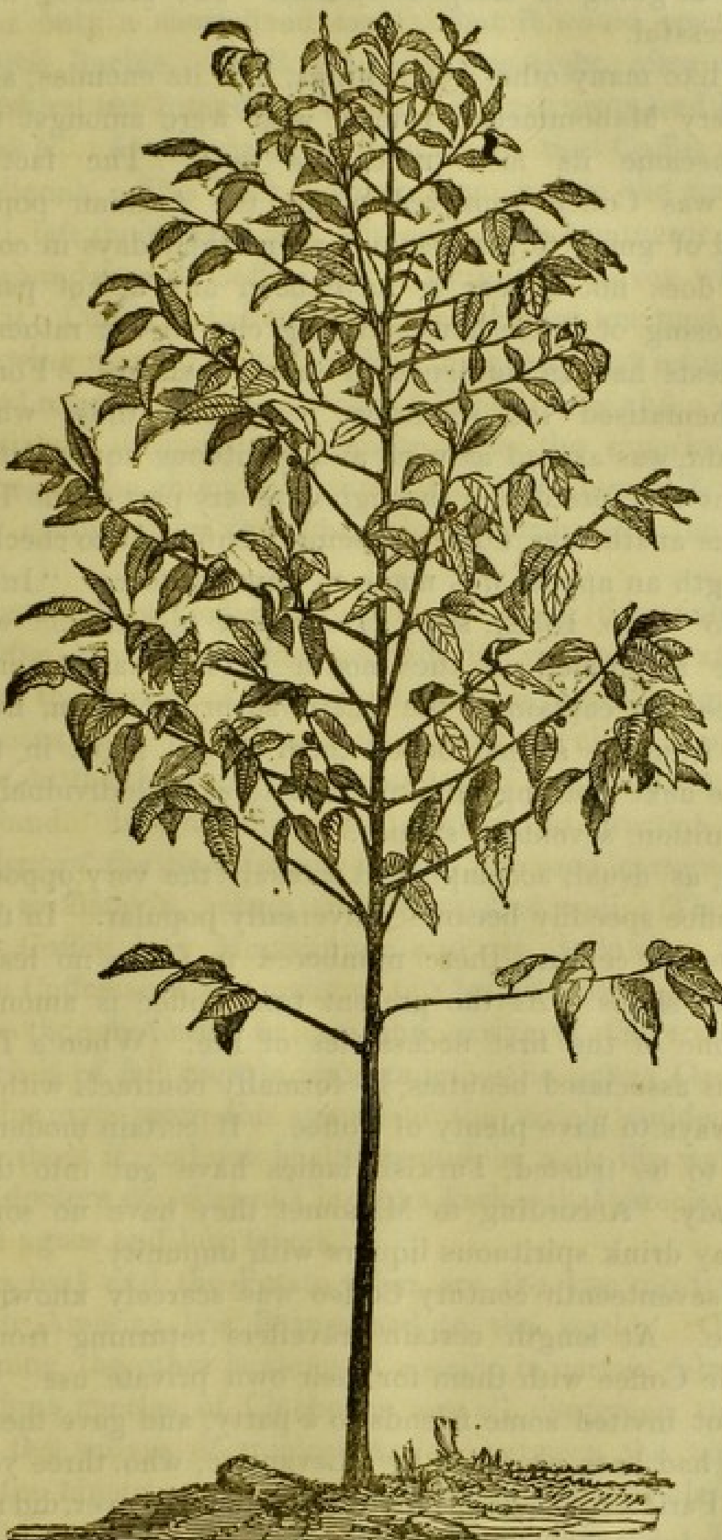
It is a curious circumstance in reference to the colouring matter of Madder, that it penetrates the whole organism of animals which eat it, and dyes their bones. Many other species of the genus Rubia furnish a red colouring matter; amongst these we have the *R. Peregrina*, *R. Lucida*, *R. Angustifolia*, *R. Longifolia*. Many foreign species are also tinctorial. India possesses the *R. Mungista*, Chili the *R. Relboun*, the West Indies the *R. Guadalupensis* and *Hypocarpia*.

Ipecacuanha (*Cephaëlis Ipecacuanha*) is an exceedingly valuable member of the family Rubiaceæ. It is a little shrub which inhabits the forests of Brazil. Its root is about the size of a goose-quill, yellow in colour, and furnished with a gray bark disposed in the form of rings very close together. The stem is one or two feet high; the leaves disposed in pairs. The active properties of Ipecacuanha reside in the bark of the root.

Perhaps the most important individual of the Madder tribe is the Coffee plant (fig. 179), which belongs to the sub-order Coffeeaceæ. Coffee is the produce of an evergreen shrub, a native of Abyssinia and Arabia. The fruit is a berry about the size of a Cherry, covered with a pulp sweet in taste and not very thick. Inside this pulp are two seeds separated from each other by a parchment-like membrane. These seeds are the well-known Coffee. The Coffee has been frequently analyzed; chemists have found in it several oily gums and albuminous matters, but the valuable principle is crystalline, and denominated *Coffeine.* Every person knows that Coffee is rendered adapted for culinary purposes by the process of roasting, but the precise agency of this roasting process is not understood.

It was only in the fifteenth century that Coffee was transported from Abyssinia to Arabia Felix. But if Arabia be not the native land of Coffee, it is at least its most prosperous adopted home. Nowhere does the plant flourish better, nowhere is the resulting Coffee so delicious in flavour, especially that grown in the country of Yemen, in the environs of Mocha. The Orientals, it is well known, first introduced the use of Coffee into Europe; but when they, the Orientals, first became acquainted with the beverage is still uncertain. An Arabian author of the fifteenth century, named Shehabeddin, states that the mufti of Aden, in the ninth century, was the first who used Coffee as a beverage; but it is certain that at this period the use of Coffee was known in Persia. According to vulgar tradition, the discovery of Coffee is due to Mollah Chadelly, whose memory is held in reverence by all true Mussulmans. This pious man, afflicted with sorrow at the thought that he could not keep awake for the performance of his nocturnal devotions, besought Mahomet to indicate some means by which sleep might be chased away. Mahomet, touched with pity, as well he might, seeing that his own honour was concerned, so brought matters about that a herdsman came to acquaint Mollah Chadelly of the curious fact that his (the herdsman's) goats could not go to sleep after they had partaken of Coffee berries, but kept frisking about all night long. The mollah, taking the hint, at once prepared a good strong dose of Coffee. He drank it, and was delighted beyond measure at the result. Not a wink of sleep did he get; delicious sensations crowded on his brain; and his midnight devotions were so fervent that he at once communicated the precious secret to some dervises, who, imitating his example, beleaguered the prophet, now in the seventh heaven of bliss, with unceasing prayers.

According to another tale, the discovery was made by the prior of a convent of Maronites, who, on receiving the report of a camel-driver to



179. The Coffee Shrub.

the effect that his beasts could get no sleep after having browsed on the Coffee plant, at once bethought himself what a good thing Coffee would be for his monks, who, like the Mollah Chadelly, appear to have been torpid, sleepy fellows, and had acquired the disreputable habit—not quite obsolete now—of going to sleep at church. The practice, we are told, was quite successful.

But Coffee, like many other good things, had its enemies, and, strange to say, the very Mahommedan priests who were amongst the first to patronise it became its most rancorous foes. The fact was this. So generally was Coffee approved of by the Arabian populace, that people, instead of going to the mosque, spent their days in coffee-shops; and as there does not appear to have been any act of parliament to enforce the closing of coffee-houses during church—or rather mosque—hours, the priests had an audience of empty benches. Forthwith the mollahs anathematised the seductive berry and those who used it. Coffee, they said, was as bad as wine and spirituous liquors, if not worse. Its employment was interdicted throughout every part of the Turkish empire. Religious anathemas, however, being insufficient to check the growing evil, at length an appeal was made to physical force. "In the year of the hegira 945" (A.D. 1538), says an Arabian historian, "whilst large numbers were assembled in the month of Rhamadan, employed in drinking Coffee, the captain of the guard surprised them, hunted them ignominiously from the shops, locked them up all night in the pasha's house, and the next morning administered to each individual, by way of salutary admonition, seventeen stripes."

Persecution, as usual, accomplished a result the very opposite to that intended. Coffee speedily became universally popular. In the first half of the seventeenth century there numbered in Cairo no less than two thousand coffee-shops. At the present time Coffee is amongst Eastern Mussulmans one of the first necessaries of life. When a Turk adds a new wife to his associated beauties, he formally contracts with her friends that she is always to have plenty of Coffee. If certain modern accounts, however, are to be trusted, Turkish ladies have got into the habit of drinking brandy. According to Mahomet they have no souls to lose, hence they may drink spirituous liquors with impunity.

Before the seventeenth century Coffee was scarcely known in France even by name. At length certain travellers returning from the East brought a little Coffee with them for their own private use. In the year 1647, Thevenot invited some friends to a party, and gave them Coffee to drink; but he had been preceded by a Levantine, who, three years before, established at Paris a coffee-shop; his speculation, however, did not succeed. It was in the *beau monde* that Coffee first become popularised. The Turkish ambassador at the French court, Soliman Aga, was in the habit of offering Coffee after the manner of his country to those who attended his levees. The ladies of the French court no sooner heard of this custom than they expressed their desire of tasting the seductive liquor; where-upon the Turk, being a polite man, as all Turks are, invited the ladies to his house, and gave them Coffee to their hearts' content. Madame de Savigné was opposed to this fashion; she did not approve of Coffee; said it was only a short-lived taste; that it would pass away and be forgotten like Racine. Well, the lady was right, after all, though not after the fashion she intended; Coffee has past away and been forgotten, "*like Racine!*" About the same time it was that Coffee first came into favour at Vienna. The Turks, driven from before the walls of that city by Sobieski, left their camp in the hands of the conqueror. In this camp there was abundance of Coffee, and a retinue of slaves whose office was to prepare it. Coffee had already been introduced amongst the Londoners in the following manner. An English merchant just returned from Constantinople brought with him a pretty Greek wife and a store of Coffee. He immediately started a coffee-shop under the superintendence of his wife. Other coffee-shops speedily arose, but Cromwell, then in power, set himself against them and closed them, fearing lest they might injure the taverns.

All the supplies of Coffee imported for a long time into Europe were obtained from Arabia. It was brought by way of Alexandria and the Levant; but the pashas of Egypt and Syria imposed enormous taxes upon it. Europeans then began to obtain it by the channel of the Red Sea. Holland took the lead in this commerce; next followed France, and lastly England. In 1699, the Dutch, under the direction of Van Horne, first president of the East Indies, having procured certain Coffee plants, sent them to Batavia, where they flourished well. The French next introduced Coffee into Martinique; and we, following their example, planted the Coffee shrub in many of our tropical colonies.

Valuable though Coffee be, we now arrive at the consideration of a genus which is of far greater importance,—the genus *Cinchona*. Coffee is only a luxury; were the supply of the article suddenly to fail, we could do without it, and our health would be none the worse; but what would the doctors do without Cinchona bark—that precious medicine so valuable in agues and low fevers?

Cinchona bark and the Potato tuber are the two most precious donations which America has bequeathed to the world. One secures us against famine, the other is almost a specific in certain febrile diseases.

The various species of Cinchonas are all evergreen trees or shrubs, inhabiting the valleys of tropical Andes, between the tenth parallel of north and the nineteenth of south latitude, growing at elevations varying from 3,600 to 9,800 feet above the level of the sea. The trunk and larger branches are cylindrical, but the young boughs are tetragonal, covered with the cicatrices which correspond to the presence of former leaves and stipules. The bark, which is bitter, contains two alkalies, quina and cinchonia, both in combination with an acid termed the *kinic*

The wood is white—becoming yellow with age; the leaves are opposed, entire, veined, petiolate, the cells of their epidermis being in many species swollen by a liquid, giving rise to small conical elevations. The petiole is short and semicylindrical; the stipules are caduceous, ordinarily free, cleft at the internal portion of their base by small lanceolated glands, which secrete a gum-resinous matter; the flowers are disposed in terminal panicles; the corolla is white, roseate, or purple, and of a delicate odour; the pedicels are bracteolate at their base.

180. Cinchona Calysaya.

In commerce the varieties of Cinchona bark are very numerous. They are all comprehended, however, under the four general heads of yellow, gray, white, and red bark.

The tree which yields the *C. Calysaya* (fig. 180), or royal yellow bark, bears oblong, lanceolate, ovoid leaves, obtuse at their points, tapering off towards their base, marked with clefts at the bifurcation of the veins; filaments considerably shorter than the anther; capsule ovoid, scarcely equal in length to the flowers. The bark of this species is preferred to that of all others on account of its containing more quina and less cinchonia, the latter alkali not being so valuable as the former.

The gray Cinchona of Losca (*C. Condaminea* of Humboldt and Bonpland) has lanceolate, oval, or pointed leaves, glabrous, and shining above, marked with furrows inferiorly corresponding with the bifurcation of the veins. The indentations of the calyx are triangularly pointed or lanceolate; filaments equalling or even exceeding the length of the

181. Cinchona of Lima (C. Micrantha).

anthers; capsule oblong or lanceolated, much longer than the flowers; seeds elliptic, indented on the margins. It is this species which was first observed and described by the botanist Condamine. It is the same plant that was formerly described under the name of *C. Micrantha*, also Cinchona of Lima (fig. 181).

Red Cinchona (*C. Nitida* of Rinz and Pavon) has olovate lanceolate leaves, tapering off towards the base, glabrous on both sides, shining above, covered with a slight down below, not marked with furrows at the axillary juncture of the nerves; capsule lanceolated, twice as long as it is wide; seeds imperfectly denticulated. The bark of this species is grayish white externally; its chemical composition differs from that of the preceding in the circumstance that besides cinchona and quina there exists in it a third alkali resembling these in general qualities, but containing more oxygen; it is termed *aricina.* White Cinchona bark is not employed in medicine. The discovery of the medical properties of Cinchona bark is enveloped in great obscurity; all that we know about it for certain is this:—Before the year 1638, that is to say, one hundred and fifty years subsequent to the discovery of America, not even the Spaniards were acquainted with the febrifuge qualities of Cinchona bark.

Were the natives themselves acquainted with it? Humboldt answers this question very positively in the negative, and refers the discovery to the Jesuit missionaries, who, being in the habit of tasting the bark of every tree they hewed down, at length discovered the precious febrifuge. Other authors of repute contend that the virtues of Cinchona bark were known to the Indians long before the advent of the Spaniards; but the question again arises, how they first became acquainted with its properties? To account for this the ridiculous tale has been invented, that certain animals, whilst labouring under fever, happened to gnaw the bark of one of the Cinchona trees, and were cured forthwith. Far more probable is it that some Cinchona trees having been laid prostrate by tempests into a pool of water, and the latter becoming charged with the medicinal principle, some person labouring under fever drank of this water, was cured, and published the result. The remedy first became popularised in Europe through the agency of Count Chinchon, viceroy of Peru, whose wife was cured of intermittent fever by its administration.

The new remedy, however, was badly received in France and Italy. The faculty set their faces against it. Physicians who dared to prescribe its use were persecuted, and it was only the patronage of Louis XIV. which ultimately rendered it popular in France. This monarch, suffering from intermittent fever, was cured by an English empiric named Talbot, by means of a secret remedy. This was no other than Cinchona bark. Louis XIV. purchased the secret for the sum of forty-eight thousand livres, and bestowed yearly a pension of two thousand livres on the Englishman, besides giving him letters of nobility. Three years subsequently the remedy was published; it was a highly concentrated vinous tincture of Cinchona bark. Cinchona trees grow in the densest forests of Peru. The task of discovering them, removing their bark, and conveying the latter to the place of export, is troublesome, difficult, and dangerous. In these forests there are no roads. Frightful precipices intersect the

Gathering of the Cinchona Bark.

path of the cascarillero, or bark gatherer, across which it is difficult to pass, even whilst unembarrassed by a load. So soon as the treasure of bark has been secured, these difficulties and dangers proportionately increase, so that the comparatively low price at which Cinchona bark may be procured is in itself a matter of surprise. A representation of the gathering of Cinchona bark is given on p. 127.

§ 39. CONVOLVULACEÆ.

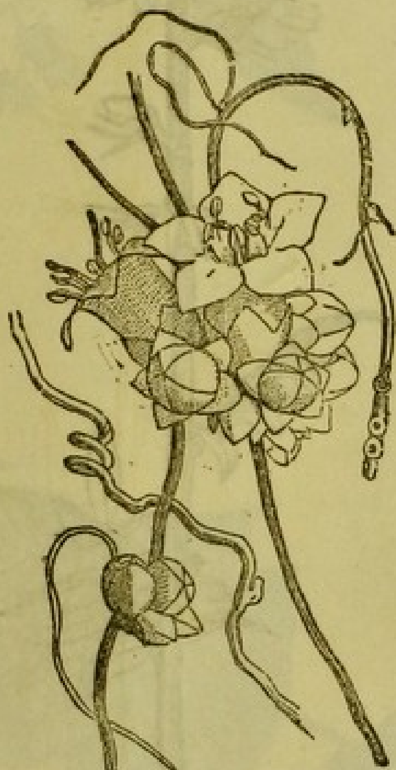
Characteristics: Calyx free, corolla hypogynous, monopetalous, regular; æstivation contorted; stamens inserted into the tube of the corolla, their number equal to that of the lobes; ovary two to four celled; ovules

182. (1) Ipomœa Tyrianthina. (2) Convolvulus Tricolor.

solitary or twin, erect; fruit capsular or bacciform; seed dicotyledonous, curved, imbedded in mucilaginous albumen; radicle inferior.

The Convolvulaceæ derive their name from the property which most, although not all of them, have of climbing up other plants. They abound in the torrid zone, in low marshy situations, especially near the sea. In proportion as the distance from the equator diminishes, so do the Convolvulaceæ become more rare. In temperate climates only few species exist; and in the frigid zone they are altogether absent. The predominant medical quality of the Convolvulaceæ is that of purgative. Jalap and scammony are both derived from this natural order. Even the roots and tubers of our own native species are purgative, though, in consequence of the low price of jalap, they are at present never employed for this purpose.

It is scarcely necessary to append an engraving for the purpose of giving the reader a general idea of the external characteristics presented by this natural order. Nevertheless, we do this that we may introduce three beautiful species, the *Ipomea Tyrianthina, Convolvulus Tricolor* (fig. 182), and *Cuscuta* (fig. 183).



183. Cuscuta.

§ 40. POLEMONIACEÆ.

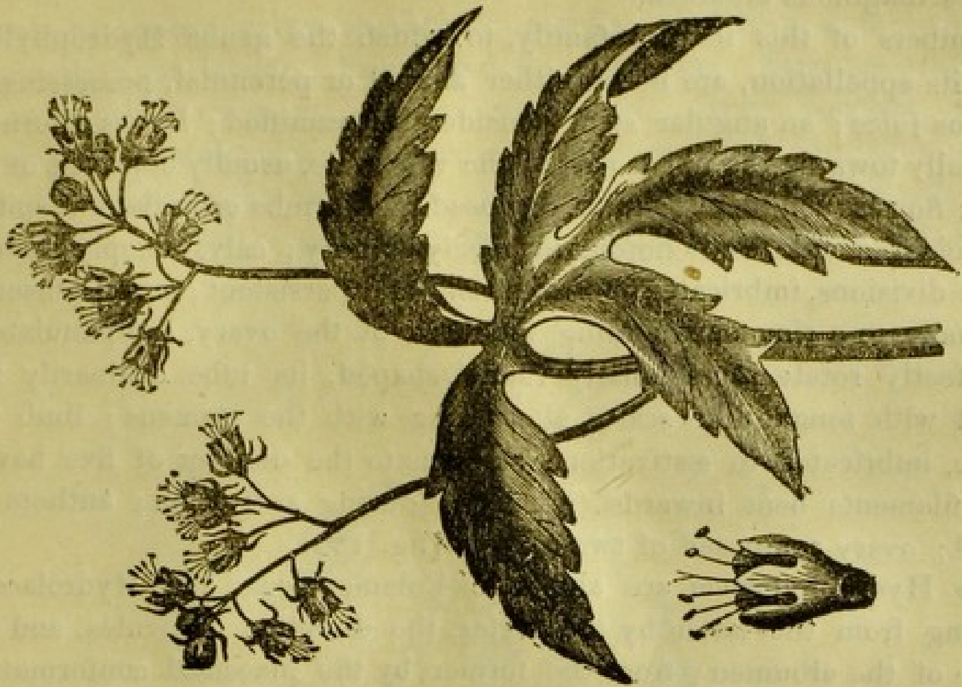
Characteristics: Corolla hypogynous, monopetalous, regular, stamens inserted upon the tube of the corolla, in number equal to its lobes, and alternate with them; ovary three to five celled; placentæ parietal; fruit capsular; seeds erect or ascending, dicotyledonous; straight in a fleshy albumen.

The student cannot look at a member of this natural family without being cognisant of a general similarity between this natural order and Convolvulaceæ. Not only is the general aspect of the flower similar, but there is also a certain similarity of anatomical structure. In both the ovary is tripartite, the flower quinquepartite; but the Polemoniaceæ, fig 185. differ in several points.

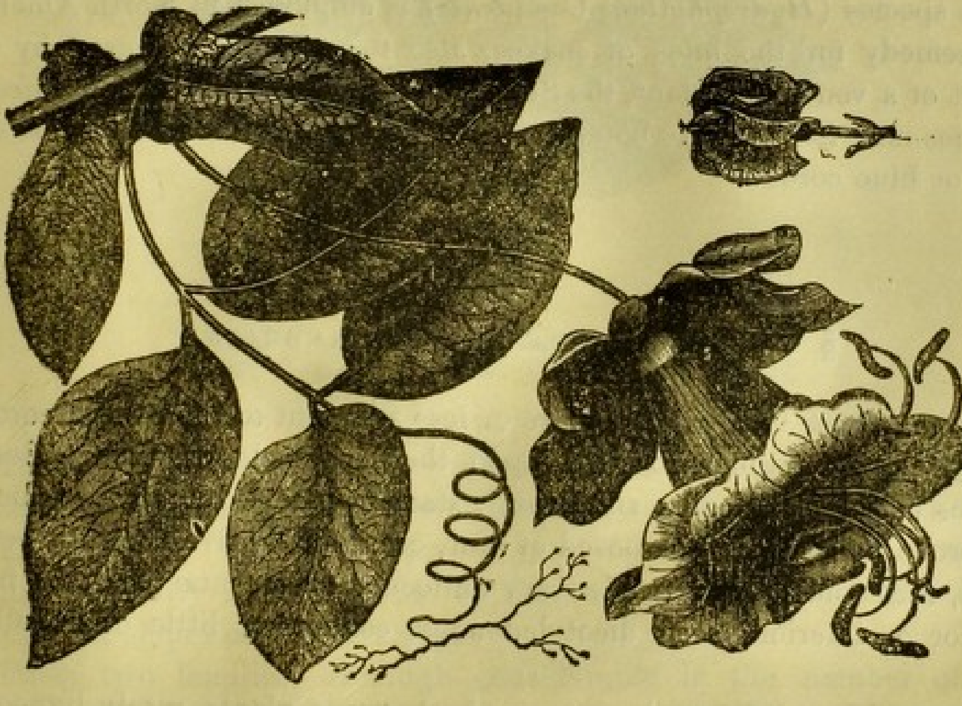
184. Polemonium Vulgare.

§ 41. HYDROPHYLLACEÆ.

Characteristics: Calyx free; corolla hypogynous, monopetalous, regular; stamens inserted upon the tube of the corolla, in number equal to the divisions of the latter, and alternate with them; ovary unilocular or perfectly bilocular; placentæ parietal; ovules solitary or numerous on each side of the placentæ; fruit capsular or almost fleshy; seeds few in



196 Hydrophyllum Virginicum.



195. Cobæa Scandens.

number; seed dicotyledonous; embryo straight, imbedded in an abundant cartilaginous albumen.

Members of this natural family, to which the genus Hydrophyllum lends its appellation, are herbs either annual or perennial, possessing an aqueous juice; an angular stem considerably ramified; leaves alternate, especially towards the upper part of the vegetable, usually deprived of stipules; flowers complete, regular, disposed in corymbs or unilateral spikes, scorpioidal, simple, or dichotomous, rarely solitary; calyx deeply fissured in five divisions, imbricated in æstivation, and persistent; corolla inserted externally to a ring surrounding the base of the ovary, campanulate or imperfectly rotate, occasionally funnel-shaped, its tube ordinarily furnished with tongue-like scales alternating with the stamens; limb five partite, imbricated in æstivation; stamens to the number of five having their filaments bent inwards (introrsal) during æstivation; anthers introrsal; ovary composed of two carpels (fig. 186).

The Hydrophyllaceæ are allied to Polemoniaceæ and Hydrolaceæ; differing from the latter by the styles, the direction of ovules, and the nature of the albumen; from the former by the placental conformation. They are farther removed from Boraginaceæ, although originally confounded with this natural order in consequence of a certain general resemblance of inflorescence.

This family is exclusively American, where abundant species are found mingled with Polemoniaceæ in the temperate regions on this side of the tropic of Cancer, more especially towards the western coast. Between the tropics they are rare, and also beyond the tropic of Capricorn.

One species (*Hydrophyllum Canadense*) is employed in North America as a remedy for the bites of snakes, also for erysipelas caused by the contact of a venomous plant, the Sumach, or Poison Oak. *H. Virginicum*, a species now frequent in botanical gardens, has pennisecate leaves, and white or blue corolla.

§ 42. GESNERIACEÆ AND CYRTANDRACEÆ.

Characteristics: Calyx free, more or less adherent to the ovary; corolla monopetalous, irregular, inserted upon the receptacle or upon a fleshy annulus between the calyx and ovary; stamens inserted upon the tube of the corolla, didynamic, composed of four, occasionally five, the fifth being sterile, occasionally only two; ovary unilocular; placentæ parietal; fruit superior or inferior; seed dicotyledonous, containing little or no albumen.

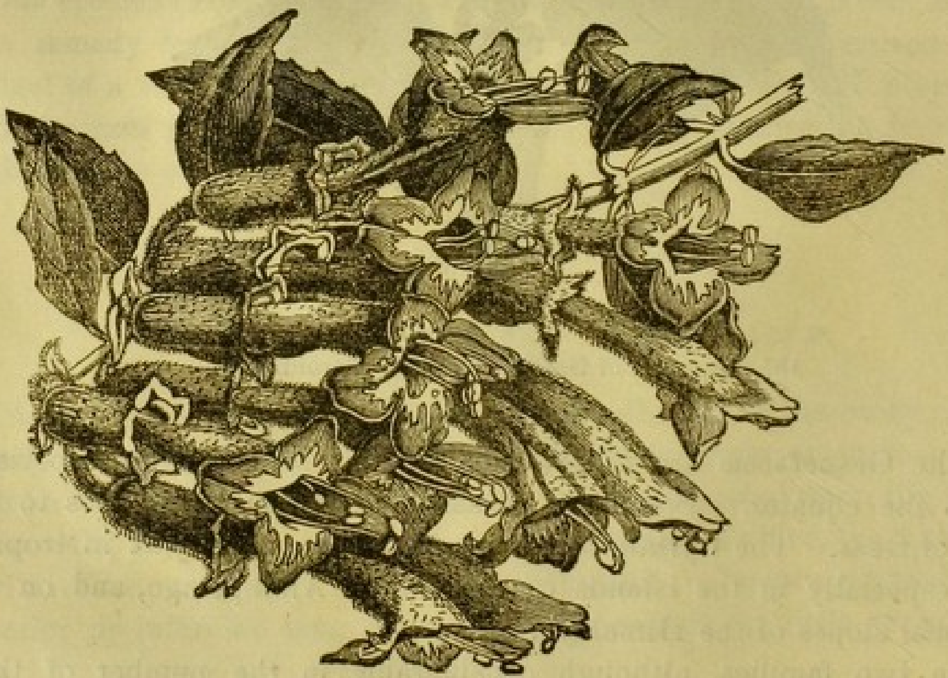
Gesneraceæ and Cyrtandraceæ are herbaceous plants, rarely ligneous, usually possessing a tetragonal ramified stem; leaves generally opposite or verticillate; devoid of stipules, simple and almost always irregular in the length of their sides. The flowers are complete; infloration a cyme, corymb, or spike; calyx persistent; corolla tubular, or funnel-shaped, campanulate, or labiate; imbricated in æstivation. Stamens with two anthers usually coherent, one or two celled. Ovary consists of two carpels, but is unilocular. Placentæ parietal, opposed, one being on the right, the other on the left of the axis of the flower. Ovules reflected; style simple. Fruit a berry or a capsule. Seeds pendent or horizontal (fig. 187).

187. Gesneria of Gerold (Gesneria Geroldiana).

All the Gesneraceæ are inhabitants of the new continent, especially towards the equator. Some are parasites attaching themselves to the trunks of trees. The Cyrtandraceæ grow for the most part in tropical India, especially in the islands of the Indian Archipelago, and on the meridional slopes of the Himalaya.

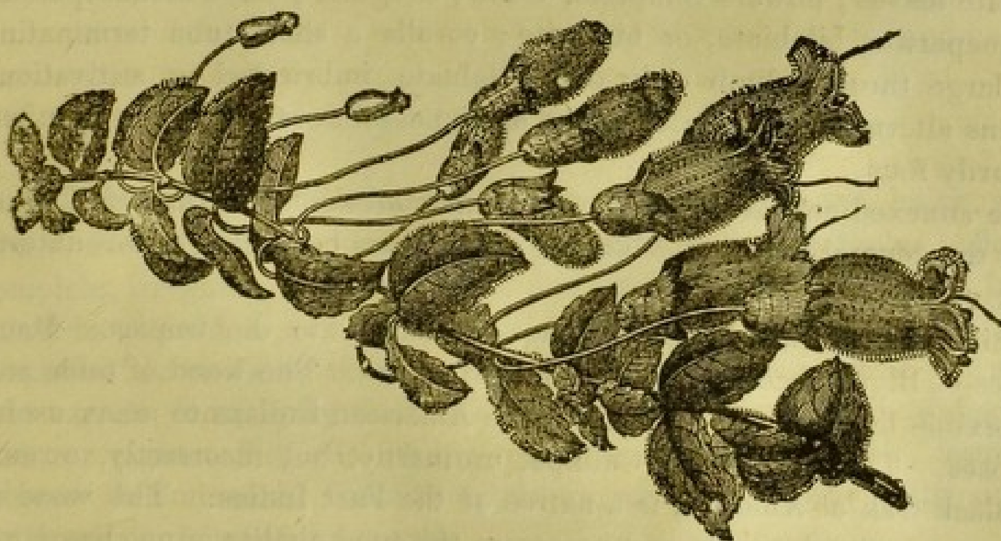
These two families, although considerable in the number of their species, offer but little of importance in respect of useful properties. *Columnea Scandens*, a little shrub of India, bearing pretty blue

189. Chirita Moonii.



188. Æschinanthus Javanicus.

191, Achimenes Multiflora.



190. Mitraria Coccinea.

flowers, is cultivated in our hot-houses. Many other species of Gesneraceæ and Cyrtandraceæ are in favour amongst cultivators; for example, the *Æschinanthus* (fig. 188) and the *Chirita* (fig. 189), of which the representations are given. The *C. Sinensis* is acauliferous; its radicle peduncle is blue or yellow, and divided into two or three pedicels, each bearing a flower. The *C. Moonii* is remarkable for its elevation, its beautiful foliage, and its pale violet corolla ornamented internally with a golden spot.

Mitraria Coccinea (fig. 190) is a little Chilian shrub, which there grows as a parasite on the trunks of trees. Its stem and boughs are weak and slender, its peduncles opposed and unifloral. Its corolla is of a bright red. The *Achimenes Multiflora* (fig. 191) is a Brazilian species, only recently introduced to Europe, remarkable, like all its congeners, for its general elegance of aspect and the long duration of its flowers.

§ 43. BIGNONIACEÆ.

Characteristics: Calyx free; corolla hypogynous, monopetalous, usually irregular; stamens inserted upon the tube of the corolla; ovary one, or two, or four celled; fruit capsular, valves separated by seed-bearing dissepiments, rarely placentiferous; seeds usually horizontal and winged; seed dicotyledonous; embryo straight.

The Bignoniaceæ derive their name from the genus *Bignonia*, dedicated to the Abbé Bignon, a great promoter of Botany. They are generally ligneous vegetables, frequently climbers or creepers, having opposed and stipulate leaves; flowers complete, usually irregular; calyx monosepalous, quinquepartite, bilabiate, or bipartite; corolla a short tube terminating in a large throat; limb ordinarily bilabiate, imbricated in æstivation; stamens alternate with the divisions of the corolla, rarely five in number, ordinarily four.

The annexed engraving of the *Jacaranda Mimosæfolia* (fig. 192) illustrates the general aspect and bearing of members belonging to this natural order.

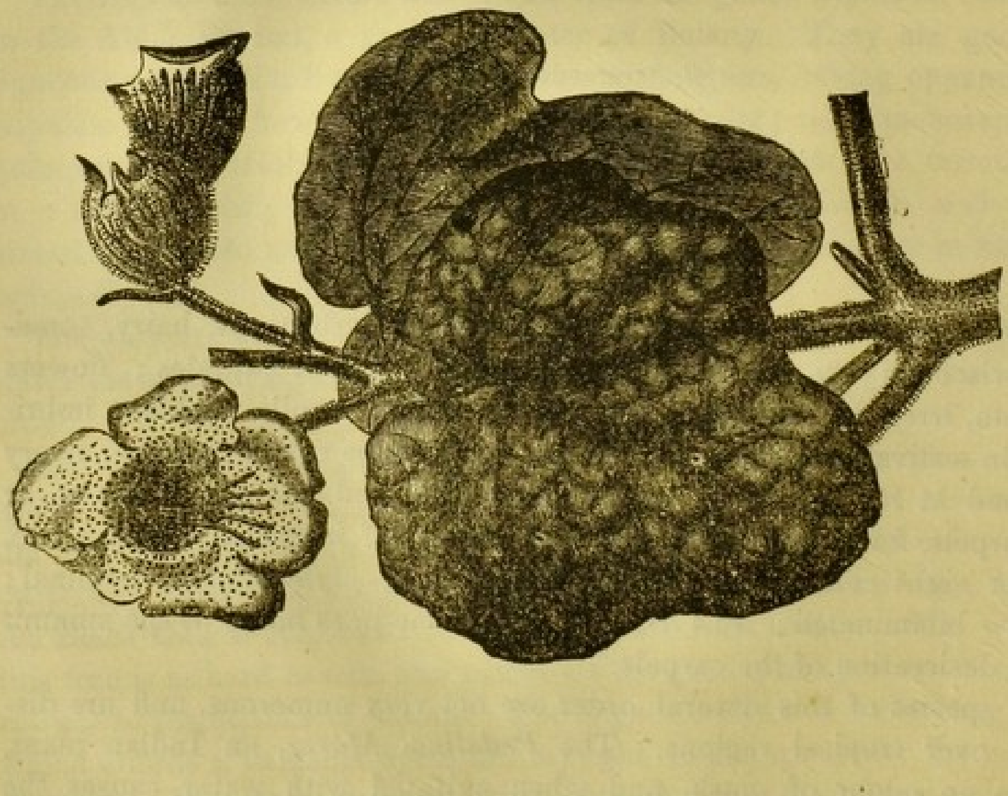
Individuals of this family belong exclusively to the tropics. Many species of Bignoniaceæ furnish useful principles. The wood of some and the flexible branches are applied by the American Indians to many useful purposes. The oak-leaved Catalpa, ordinarily, but incorrectly, termed the Black Oak of America, is a native of the East Indies. The wood of this tree is as hard as oak, and possesses the good quality of not becoming subject to the attacks of worms. The *Bignonia Chica* is a climbing plant, which affords a valuable dye-stuff, brought to Europe under the name of *Krajuru*. The same species of this natural order have been celebrated from times of great antiquity for the fixed oil yielded by their seeds. This oil is especially sought after in the East. Turkish and Egyptian ladies drink a little every morning for the purpose of making themselves fat, thin women being held in great contempt by the Turks.

192. Jacaranda Mimosifolia.

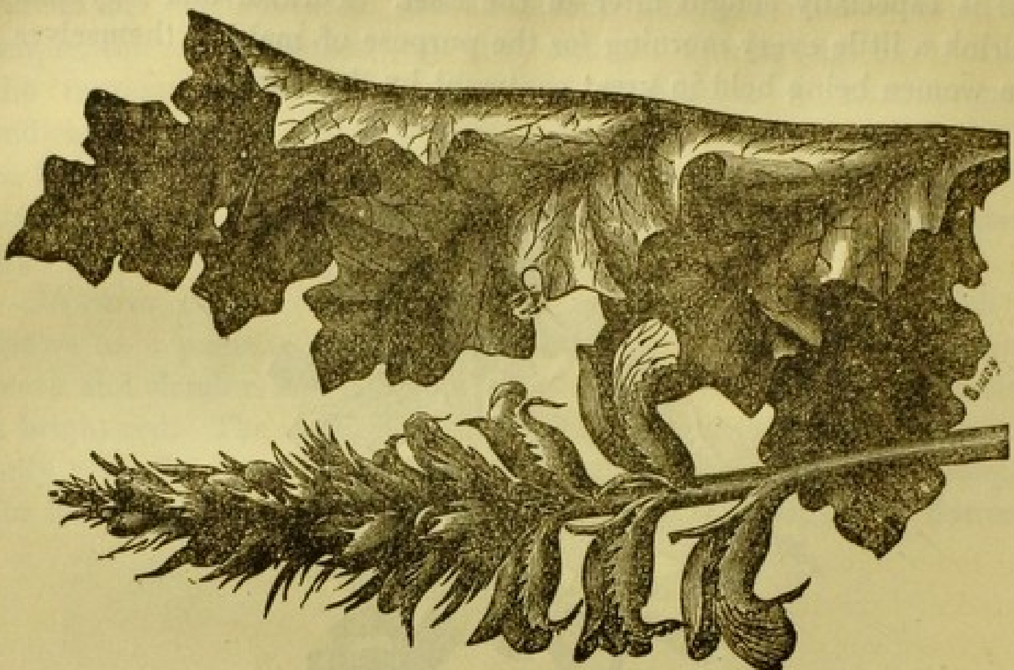
§ 44. PEDALIACEÆ.

Characteristics: These plants are generally herbaceous, hairy, sometimes viscous; the leaves are simple and without stipules; flowers complete, irregular, axillary; calyx five partite; corolla bilabiate, imbricated in æstivation; stamens included in the tube of the corolla; ovary furnished at its base with a glandular disc, and composed of two or four carpels, forming by their different degrees of introflexion either two, four, or eight cells; the ovules are reflected; style simple, terminal; stigma bilaminated; fruit dry or fleshy, sometimes horny at the summit by the desiccation of the carpels.

The species of this natural order are not very numerous, and are dispersed over tropical regions. The *Pedalium Murex*, an Indian plant, diffuses an odour of musk, and when agitated with water, causes the



193, Martynia Proboscidea.



194. Acanthus Mollis.

latter to become viscous like the white of egg. The genus *Martynia* (fig. 193) furnishes many species, all of which are annuals, bearing flowers like those of Digitalis in general aspect.

§ 45. ACANTHACEÆ.

Characteristics: Calyx free; corolla hypogynous monopetalous; stamens inserted upon the tube of the corolla, four didynamous or sometimes two; ovary bilocular; capsule loculicidal and bivalvular; seed dicotyledonous or albuminous; radicle inferior and centripetal.

The Acanthaceæ are herbaceous or ligneous plants, with branching, knotty, articulated stems; leaves opposed or verticillate, simple, and devoid of stipules; flowers complete, rarely solitary, each accompanied with a bract and two bracteoles; calyx four to five partite, sometimes truncated; the corolla is ordinary bilabiate, contorted in æstivation; ovules curved; style simple, terminal; stigma ordinarily bifid; embryo usually curved; cotyledons large and orbicular.

The greater number of the Acanthus order are natives of the tropics; but one, and that the most celebrated, is a native of Greece, and other Mediterranean regions. It is the *Acanthus Mollis*, or smooth Acanthus, a representation of which is subjoined (fig. 194).

The picturesque beauty of the leaves of this species arrested the attention of the painters, and sculptors, and architects of antiquity. The capitals surmounting the columns of the Corinthian order are formed on the general basis of an Acanthus leaf. Virgil alludes to the beauty of the Acanthus leaf in his third Eclogue, in which he makes his shepherd praise two vases modelled for him by the divine Alcimedon, and the handles of which were ornamented with Acanthus leaves:

> Et nobis idem Alcimedon duo pocula fecit,
> Et moli circum est ansas amplexus Acantho.

§ 46. SELAGINACEÆ.

Characteristics: Calyx free; corolla hypogynous monopetalous, subregular, or one or two lipped; stamens two or four, inserted upon the tube of the corolla; achænia two; seed inverted, dicotyledonous; embryo straight, corresponding with the axis of fleshy albumen; radicle superior.

The Selaginaceæ, so named after the genus *Selago*, are all low shrubs, rarely herbs, having alternate or fasciculated leaves, simple and without stipules; their flowers are complete and generally irregular, either disposed in a corymb or a spike; calyx persistent, tubular, or spathose; corolla with four or five divisions, imbricated in æstivation; the anthers are unilocular; the ovary is composed of two uniovulate cells; ovules pendent, reflex. All the Selaginaceæ inhabit the Cape of Good Hope. This family does not possess marked properties, nevertheless many species are odorous. The *Hebenstreitia Dentata* cultivated in our gardens is a shrub about two feet high, with pennatifid leaves in the lower, dentated leaves in the upper part cf the plant. The flowers have a tubular corolla, one single lip, marked with a roseate purple spot; the flowers are inodorous in the morning, but strong and disagreeable at mid-day, whilst in the evening they exhale a delicious perfume. The *Selago Spuria* has small

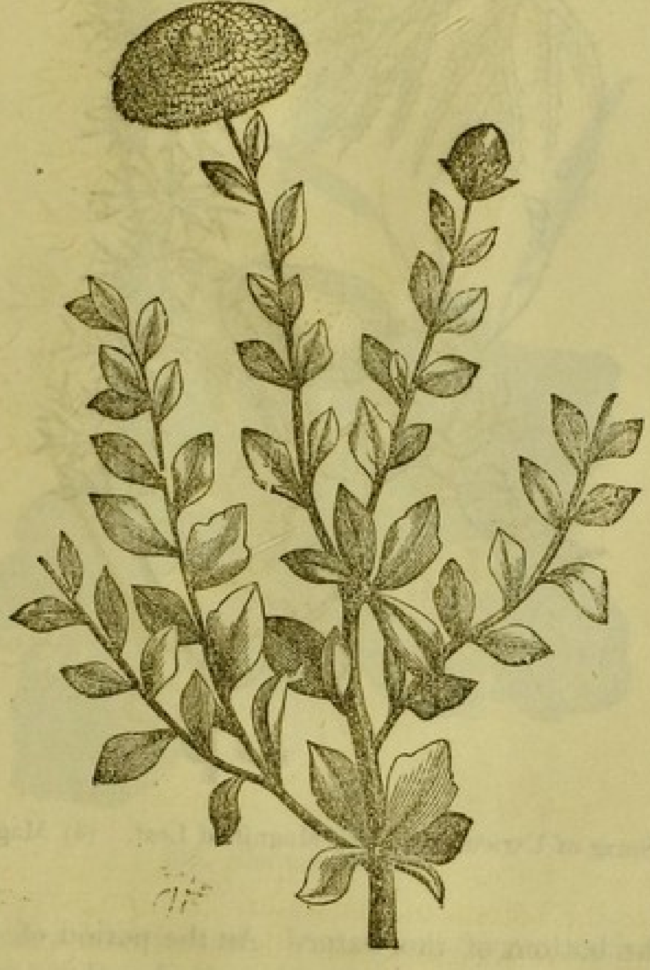
195. Selago Gillii.

oblong leaves and light-blue flowers. The stem of the *Selago Gillii* is flower-bearing and branched; flowers disposed in the form of a loose spikelct. Its flowers, rose-coloured. A representation of this plant is appended (fig. 195).

§ 47. GLOBULARIACEÆ.

Characteristics: Calyx free; corolla hypogynous, monopetalous, bilabiate; stamens four, inserted upon the tube of the corolla; caryopsis with inverse seed; embryo dicotyledonous, in the axis of albumen; radicle superior. The Globulariaceæ derive their name from the genus *Globularia.* They are all shrubs, or under shrubs, or perennial herbs; their flowers are alternate, simple, entire, devoid of stipules; flowers complete, irregular, united into a capitulum upon a convex receptacle, covered with hair, and surrounded with an involucrum; the anthers are first bilocular, and in the young flower become unilocular by the confluence of their cells; ovary unilocular, uniovulate, pendent, reflex; the caryopsis is enveloped by the calyx, sharply pointed at the persistent base of the style.

The Globulariaceæ are inhabitants of temperate Europe. The bitter leaves of certain species are employed in medicine. The *G. Alypum* (fig. 196) was formerly denominated *Frutex Terribilis*, in consequence of the belief that it was violently drastic. Its leaves are still used as a substitute for senna in many parts of central Europe.



196. Globularia Alypum.

§ 48. UTRICULARIÆ.

Characteristics: Calyx free; corolla hypogynous, monopetalous, irregular; stamens two, inserted upon the tube of the corolla; fruit capsular;

placenta parietal, free; seeds numerous, exalbuminous; radicle straight; all aquatic herbs.

The Utriculariæ derive their name from their principal genus *Utricularia*, which is so called from the presence of abundant aërial vesicles distributed over the surface of their subaqueous leaves. These utriculi are rounded in shape and furnished with a kind of moveable aperture. Whilst the plant is young these little bladders are filled with mucus a little heavier than water, which, acting as a weight, cause the plant to

197. (1) Sprig of Utricularia. (2) Magnified Leaf. (3) Magnified Vesicle.

descend to the bottom of the water. As the period of flowering arrives, the utriculi secrete a gas which fills them, makes them specifically lighter, and thus, by lessening the specific gravity of the leaves, causes them to rise to the water's surface. No sooner has the period of flowering terminated, than the vesicles begin once more to secrete the heavy mucous fluid, and the leaves again sinking, the plant arrives at its original situation, and deposits its seeds in the subaqueous mud, there to remain until they germinate and produce young plants.

This family is distributed over the entire world, although chiefly found in tropical regions of the old continents.

§ 49. PLANTAGINACEÆ.

Characteristics : Calyx free ; corolla hypogynous monopetalous ; stamens inserted upon the corolla or upon the receptacle alternate with the petals ; ovary one or two celled, uni-or multiovulate ; fruit one or many seeded ; seed dicotyledonous ; embryo straight or but slightly curved in the axis of a fleshy albumen ; radical inferior. The Plantains are

198. Plantago Major.

perennials, generally herbaceous ; leaves sometimes radical, sometimes cauline, simple, without stipules ; flowers complete, sometimes monœcious, arranged sometimes in the form of a spike, sometimes solitary, or almost solitary : calyx monosepalous, persistent, with four divisions, the divisions almost equal with each other ; corolla tubular or urceolate, its limb three or four partite, regular or almost regular, persistent ; imbricated in æstivation ; stamens four in number, rarely one. The ovary of monœcious species is unilocular ; ovule simple, erect, reflex.

The Plantaginaceæ are not banished from any climate, though they especially inhabit the temperate regions of the northern hemisphere, principally the Mediterranean region and North America. Only few species grow in the low countries of the torrid zone, although not unfrequent upon the mountains.

The root and leaves of the Plantain are slightly bitter and astringent, occasionally a little saline. The long spiked Plantain (*Plantago Major*), of which a representation is given (fig. 198), and other species, were formerly remedies of great repute in the treatment of intermittent fever, but they have now fallen into disuse. The Stag-horned Plantain (*P. Coronopus*) was formerly employed by the ancients as a remedy for hydrophobia, but it is only now used in certain parts of Europe as a salad.

§ 50. PLUMBAGINACEÆ.

Characteristics: Calyx free; corolla hypogynous, monopetalous, or polypetalous; stamens inserted upon the receptacle of the monopetalous tribes, and upon the corolla of those which are polypetalous; ovary uni-

199. Statice Imbricata.

locular; ovule solitary, pendent; seed dicotyledonous; embryo straight, in a farinaceous albumen; radicle superior.

The Plumbaginaceæ are herbs or shrubs, having leaves which are radical, fasciculated, or alternate, cauline, and ex-stipulate. The flowers are complete, disposed in spike, or panicle, or dense involucrum. Calyx monosepalous, tubular, arranged in five folds, or else five partite, persistent. The corolla is composed of five petals, sometimes free, or nearly free, occasionally aggregated, contorted, or imbricated in æstivation. The five stamens are opposite to the petals; ovary with three, four, or five carpels, joined by their edges into one single cell; ovule reflex, pendent from a funiculus springing from the lower part of the cell; style divided into three, four, or five stigmas; fruit sometimes dividing into five valves at its summit, sometimes opening at its base.

This natural order is usually subdivided into the two tribes of Staticeæ and the true Plumbaginaceæ. The general aspect of the first tribe may be seen in the accompanying diagram of the *Statice Imbricata* (fig. 199).

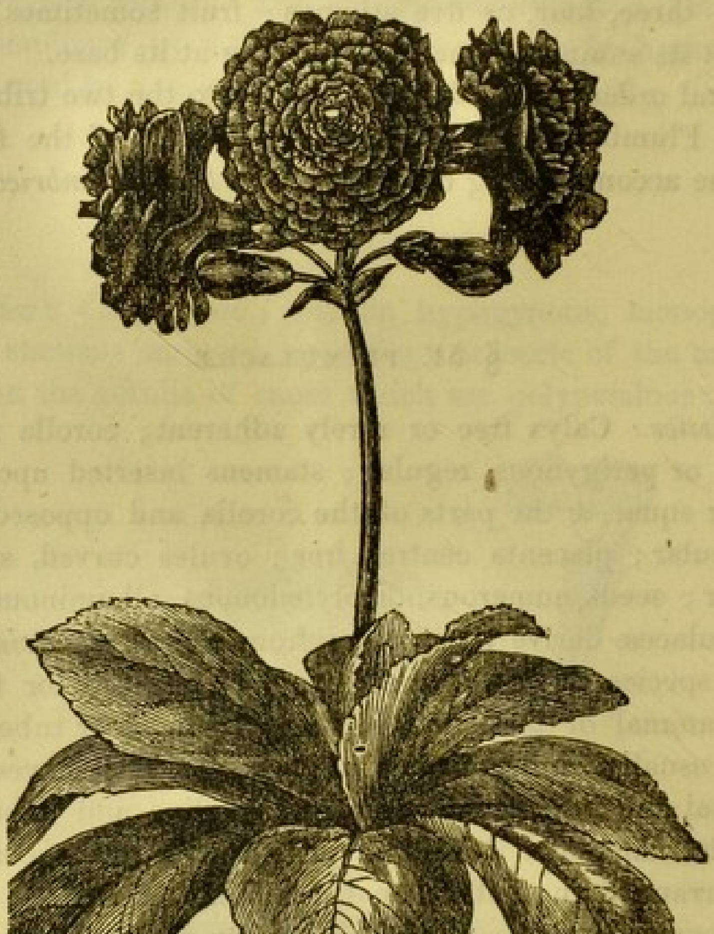
§ 51. PRIMULACEÆ.

Characteristics: Calyx free or rarely adherent; corolla monopetalous, hypogynous, or perigynous, regular; stamens inserted upon the corolla, their number equal to the parts of the corolla and opposed to its lobes; ovary unilocular; placenta central, free; ovules curved, seldom reflex; fruit capsular; seeds numerous, dicotyledonous, albuminous.

The Primulaceæ derive their name from the genus *Primula*, so called because its species flower in the spring. They are for the most part herbaceous, annual or perennial, having a ligneous or tuberous rhizome. The stem is usually subterraneous and short. The leaves are in some species radical and fasciculated, in others cauline and opposite, or verticillate, or alternate, and devoid of stipules. Flowers complete, either solitary or arranged in umbels on the summit of a shaft, or solitary, or arranged in cymes springing from the axilla of the leaves, occasionally terminal in spikes. Calyx monosepalous, usually five partite. Corolla rotate, campanulate, or infundibiliform, or bilabiate, contorted in æstivation, sometimes absent. Ovary composed of as many carpels as there are lobes to the calyx. Placenta for the most part globular, and communicating with the summit of the ovary by arachnoid filaments. Style and stigma simple. Fruit a capsule transversely or longitudinally dehiscent. Seeds ordinarily fixed upon a central hilum; embryo straight in the axis of a fleshy albumen.

The Primulaceæ principally inhabit the temperate regions of the northern hemisphere, especially in Europe and Asia. They not only please the eye by the beauty of their flowers, but also contribute something to the resources of medicine. The common Primrose (*Primula*

Veris) is an indigenous and a very common species, the fresh root of which diffuses a mixed odour of Garlic and Aniseed. It also contains a bitter principle and a volatile oil. It was formerly employed as a tonic, but has now given place to more efficacious remedies. The Auricula, or Bear's Ear, as it is called in some parts of the continent, is employed by the inhabitants of some parts of the Alps as a remedy for consumption. It is equally good with all others proposed at different times as a remedy for that disease.



200. The Black Auricula (Primula Auricula Nigra).

All the members of the Primrose tribe are in great repute as ornamental plants, more especially the Auriculas. These plants are natives of the Alps, and from which horticultural skill has developed several varieties. The Cyclamen (*Cyclamen Europæum*) possesses radical leaves, which are covered with white spots above, and red on their lower surface; the corolla has a roseate tint, and in all the species of this genus the tube of the corolla is turned towards the sky, whilst its limb or free portion is directed towards the ground, as represented in the accompanying diagram (fig. 201).

201. Cyclamen

§ 52. EBENACEÆ.

Characteristics: Calyx free; corolla hypogynous, monopetalous; stamens sometimes equal in number to that of the lobes of the corolla, and alternating with them, sometimes double or quadruple in number; ovary many celled, uniovulate; ovules pendent from the summit of the central angle; fruit bacciform; seeds few in number or occasionally one dicotyledonous, albumen cartilaginous, radicle superior. Trees or shrubs possessing an aqueous juice, and furnishing a wood which is very dense.

Individuals of this natural order have alternate leaves which are coriaceous, entire, and without stipules. Flowers often incomplete, regular, axillary. Calyx three to six partite and persistent. The corolla is caduceous, urceolate, slightly coriaceous, three to six partite, imbricated in æstivation. Stamens inserted at the base of the corolla, rarely in the receptacle. The berry is globular or ovoid, sometimes dry, in which case it opens by splitting.

The Ebenaceæ are found in tropical Asia, the Cape, Australia, and tropical America; a few species are met with in the Mediterranean district.

The members of this natural order are celebrated for the hardness of their wood. Ebony has been celebrated from all antiquity for the darkness of its hue, general beauty, and manifold uses. The ancients obtained it from Ethiopia; at present our supplies are chiefly drawn from the eastern coast of Africa, especially Mozambique. Ebony is either uniformly black or marked with white and yellow stripes. It is a remarkable fact that the wood of the Ebenaceæ only becomes black in aged trees; the wood of young plants is white. The appended diagram (fig. 202) of a sprig of the *Diospyros Hirsuta*, a member of this natural order, illustrates the more evident characteristics of the Ebenaceæ.

202. Diospyros Hirsuta.

§ 53. ILICINACEÆ.

Characteristics: Calyx free, four to six partite; corolla hypogynous, almost monopetalous; stamens four to six, alternate with the petals; ovary two to six or many celled, uniovulate; ovule pendent; fruit drupaceous; seed dicotyledonous; embryo straight at the summit of an abundant fleshy albumen; radicle superior; leaves opposite, simple, without stipules. The Ilicinaceæ are evergreen ligneous plants, with petiolate shining leaves. The flowers are regular, axillary, and small, usually white or greenish in colour. Calyx persistent, imbricated in æstivation, as is also the corolla. Anthers adnatant; ovules pendent at the summit of the central angle of each cell, and reflected; fruit composed of agglomerated drupes.

The Ilicinaceæ are nowhere abundant, but they are more plentiful in north and equatorial America and the Cape of Good Hope than elsewhere. In tropical Asia and in Europe they are comparatively rare.

Most of the species of this natural order contain a bitter extractive principle, to which the denomination *ilicine* is given, and which in certain

203. The Common Holly (Ilex Aquifolium).

species is associated with varying proportions of an aromatic resin and a glutinous matter termed *viscine*. Some species are purely tonic, whilst others are purgative and emetic; a few are stimulant.

The common Holly (*Ilex Aquifolium*, fig. 203) is a small tree distributed between the forty-second and fifty-fifth parallels of north latitude, and which in cold climates is only an unpretending shrub. It grows in greatest perfection in the mountainous forests of eastern Europe. In gardens it is cultivated for the sake of its pretty red berries and the ever-during, intense green of its leaves. By force of culture many varieties of the Holly have been obtained, some bearing leaves devoid of spines, some having black, yellow, or white instead of red berries. Holly leaves were once employed as a febrifuge; they owe their medicinal properties to a principle termed *ilicine*, which admits of being extracted. Ilicine has been proposed instead of quina as a remedy for intermittent fever. From the inner bark of the Holly the substance *bird-lime* is obtained.

§ 54. OLEACEÆ.

Characteristics: Calyx free; corolla hypogynous, regular, composed of four petals, free or coherent; stamens two, inserted upon the corolla; ovary two to five celled, bi- or pluriovulate; ovules pendent; fruit bacci-

204. Olive Tree (Olea Europæa).

form or capsular, indehiscent, loculicidal; seeds pendent, dicotyledonous, albuminous; stem ligneous.

The Oleaceæ are trees or shrubs having opposite petiolate leaves without stipules. Flowers ordinarily complete and disposed in a panicle, cyme, or fascicule. Calyx persistent, four partite, sometimes absent. Corolla sometimes absent, composed of four petals, ordinarily coherent, infundibiliform or campanulate, valvate in æstivation. Anthers attached by their posterior side, ovules ordinarily twin. Fruit in some cases an unilocular drupe, as in the Olive; sometimes a bilocular berry, at other times a bivalved capsule, or, lastly, a dehiscent capsule. The embryo occupies the axis of a central albumen; radicle superior.

The Oleaceæ inhabit temperate regions, especially in the northern hemisphere. They are rare in Asia and tropical America. The greater number of Ash species (belonging to this natural order) are natives of North America. The Lilacs have passed into Europe from the East. This natural order is interesting in the double respect of agriculture and horticulture. The Olive (*Olea Europæa*, fig. 204) is a tree devoid of beauty, but whose utility is immense. The ancients obtained it from the East, whence it has now become distributed over the whole Mediterranean region. Its drupaceous fruit, the Olive, is too well known to need prolonged description. The pericarp of this drupe is charged with a valuable oil, which is obtained by expression. In the manufacture of soap and for culinary purposes olive oil is unrivalled.

The American Olive (*Olea Americana*) bears edible drupes, as is also the case with many exotic species. The most celebrated of these is the Chinese Olive (*O. Fragrans*), the flowers of which are mixed by the Chinese with the leaves of their Tea.

§ 55. JASMINACEÆ.

Characteristics: Calyx free; corolla hypogynous, regular, monopetalous, saucer-shaped, five to eight partite; stamens two inserted upon the tube of the corolla; ovary two celled, uni- or bi-ovulate; ovules collateral, ascendant; fruit a berry or capsule; seeds erect, dicotyledonous, exalbuminous.

The members of Jasminaceæ are usually trees or shrubs, often climbing, leaves ordinarily opposite, without stipules; flowers complete; calyx persistent; corolla imbricated in æstivation; anthers attached by their bases; albumen at first abundant, but towards maturity reduced to a very fine membrane; radicle inferior.

Jasminaceæ are nearly allied to Oleaceæ, from which they, however, differ in certain well-marked characteristics, such as the number of their sepals and petals, the æstivation of their corolla, the ascendant ovules, the endocarp never hard, the erect seeds and albumen almost absorbed.

The principal region of this natural family is tropical Asia; a few species, however, are indigenous to the Mediterranean region. The greater number of Jasminaceæ possess a volatile oil in the tissue of their corolla, not obtainable by distillation. The so-called oil of Jasmine is the product of stratifying Jasmine flowers with some fixed non-odorous oil, generally oil of *Ben*.

205. The Common Jasmine (Jasminum).

§ 56. RHODORACEÆ, VACCINACEÆ, AND ERICACEÆ.

Characteristics: Calyx free or adherent to the ovary; corolla inserted upon an annulus or disc, either hypogynous or epigynous, monopetalous, regular; number of stamens equal to that of the lobes of the corolla, alternating with them, or double their number; anthers bilocular, separate celled; ovary one to five celled, with central placentæ; seeds inverse; embryo dicotyledonous, straight, in the axis of a fleshy albumen.

The plants which compose these three families are united into one by some authors; they are shrubs or evergreen trees. The leaves ordinarily narrow are articulated with the stem, and without stipules;

flowers complete; calyx four to six partite; corolla five or six partite; the lobes varying as to depth, sometimes almost free, imbricated in æstivation; ovule pendent or reflex.

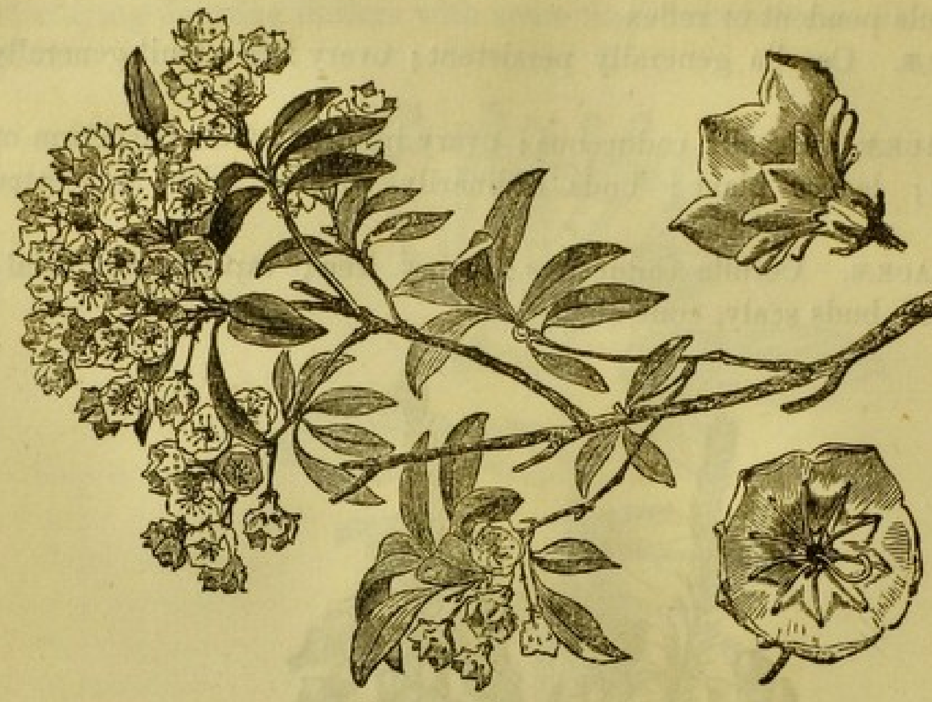
Ericaceæ. Corolla generally persistent; ovary free; fruit generally capsular.

Vaccinaceæ. Corolla caduceous; ovary inferior; fruit bacciform or drupaceous; leaves plane; buds ordinarily covered with imbricated scales.

Rhodoraceæ. Corolla caduceous; ovary free; capsule septicidal; leaves plane; buds scaly, cone-shaped.

206. Erica Fulgens.

The Ericaceæ are dispersed over all the globe; they are especially abundant in the cold regions of the northern hemisphere and at the Cape of Good Hope. The Heaths are altogether wanting in Asia, America, and Australia. Some species of this genus are gregarious, covering immense tracts in western and central Europe, where their presence indicates the soil to be unadapted to the culture of cerealia. The greater number of species belong to the Mediterranean region. The Vaccinaceæ grow for the most part on this side of the tropic of Cancer and in North America. The Rhodoraceæ chiefly inhabit the temperate and cool



206. Kalmia Latiflora.

207. Rhododendron Ponticum.

regions of the northern hemisphere; especially the elevated mountains of America. Beyond the tropic of Capricorn they altogether disappear. Most of the Ericaceæ contain bitter astringent principles, sometimes also a venomous balsam. The berries of certain species are edible. The Vaccinaceæ are especially valuable for yielding a refreshing acidulated fruit. Their leaves are slightly astringent. The Rhodoraceæ are narcotic.

The South American genus, Thibaudia, deserves to be mentioned. The *Thibaudia Melliflora* is a shrub which grows on the Andes in Peru;

209. Macleania Cordata.

its flowers are rich in nectar, and are eaten by the natives. The *Thibaudia Macrophylla* produces berries which the inhabitants of Pasto, in Columbia, submit to fermentation and produce a sort of wine. The flowers of *Thibaudia Quereme* are used by the Peruvians in the composition of an aromatic tincture useful in toothache.

The Rhodoraceæ are remarkable for their narcotic property. The golden-leaved Rhododendron (*Rhododendron Chrysanthos*), a shrub growing in the Alps and northern Asia, has bitter astringent leaves, employed occasionally in medicine. The Kalmias of North America are still more narcotic. If eaten by cattle, they are fatal. *Kalmia Latifolia*, if swallowed, causes a species of drunkenness and delirium, vomitings, convulsions, and frequently death. The intoxicating honey of the Euxine, so celebrated amongst the ancients from the date of the retreat of the ten thousand, derived its qualities from the flowers of the *Azalea Pontica* and *Rhododendron Ponticum* (fig. 207).

Most of the species already mentioned are cultivated in gardens as ornamental shrubs. The Vaccinaceæ, in addition to the genera already mentioned, furnish to horticulture the *Thibaudia* and *Macleania*. *Thibaudia Pulcherrima* was originally brought from northern India; its flowers are disposed in umbels sessile upon the aged and leafless stems.

The corolla of these flowers is tubular, campanulate, palish-red in colour, verging occasionally towards greenish-yellow, marked longitudinally and transversely with lines of deep red.

§ 57. CELASTRINACEÆ.

Characteristics: Calyx free, four or five partite; corolla perigynous, with four to five petals; stamens four to five, alternate with the petals; ovary two to five celled, ordinarily containing one or two ovules; ovules ascending; fruit capsular or drupaceous; seeds generally provided with an arillus; embryo dicotyledonous, straight in the axis of a fleshy albumen; stem woody; leaves provided with caduceous stipules, and ordinarily alternate.

The Celastrinaceæ are usually shrubs, sometimes climbing. Their flowers are regular axillary, disposed in cymes, small green, white, or purple in colour. The base of the calyx is surrounded with a fleshy disc sometimes adherent to the ovary. The petals enlarged towards the base are inserted upon the border of the disc; imbricated in æstivation. The ovary is merged to a varying extent into the disc; ovules reflected. Fruit two to five celled, sometimes dehiscent, either drupaceous, or samaroidal, or, finally, capsular with loculicidal dehiscence. The seeds are enveloped in a fleshy arillus. Radicle inferior.

The Celastrinaceæ inhabit for the most part the sub-tropical regions of the southern hemisphere; towards either pole and the equator they become rare, and none are found in the two frigid zones. The greater number of Celastrinaceæ contain bitter and astringent principles, united with others which are acrid, purgative, and emetic, or simply stimulant. The fruit of certain species is fleshy and edible, the seeds of others contain a fixed oil. The *Celastrus Scandens* is termed by the French *Bourreau des Arbres* (trees' hangman), because it winds so tightly around their trunk that they are strangled.

This species is indigenous to North America. Its bark is emetic. The *C. Venenatus*, a spring shrub growing at the Cape of Good Hope, is dangerous on account of the wounds it causes. The *Maytenus Macrocarpus* is a Peruvian shrub, the leaves of which are acid. The *M. Chiliensis* is an efficacious remedy against the Poison Oak. The decoction of its leaves is employed as a wash for application to parts injured by the former plant. The Kat or Gat (*Catha Edulis*) is cultivated along with Coffee in Arabia, and is in great repute amongst the Arabs as a preventive of sleep. They, moreover, pretend that localities where this plant grows are always free from the plague.

210. Box-leaved Celastrus.

§ 58. AMPELIDACEÆ OR VITACEÆ.

Characteristics: Calyx free; petals four to five inserted upon the border of a hypogynous or sub-perigynous disc; æstivation valvate; stamens five, opposed to the petals; ovary two, three, or six celled; ovules ascendant, erect, or reflected; berry two to six celled; ovule dicotyledonous, straight, very minute, lying at the base of a fleshy albumen; stem ligneous; leaves palmilobed, digitate, or pennate.

The Ampelidaceæ or Vitaceæ are generally trees or shrubs supplied for the most part with tendrils, containing an abundance of aqueous juice, and having contorted knotty branches. The lower leaves are opposite the upper ones, alternate; stipules very small, sometimes absent. The flowers are minute, greenish in colour, arranged in a multifloral panicle or a corymbiform cyme. Calyx very small, obscurely dentated, and nearly entire, surrounded by a disc, on which the petals and stamens are borne. The corolla is polypetalous or almost polypetalous; style very short, stigma terminating in a flattened head. Seeds contained in a thorny shell; radicle inferior.

TRIBE I., VITEÆ, OR THE VINE TRIBE. *Characteristics:* Petals and stamens free; ovary two celled; floral whorls opposed to the leaves.

TRIBE II., LEACEÆ. *Characteristics:* Petals coherent at the base; stamens monadelphous; ovary three to six celled; no anthers.

I. The Vitaceæ inhabit all the intertropical region, and especially that of Asia. Beyond the tropics they are rare, more especially the tropic of Capricorn. None are found indigenous to Europe; and if wild Vines are found in the forests of this continent, the plant is to be regarded as having escaped from domesticity.

The true country of the Vine seems to be Mingrelia and Georgia, between the mountains of the Caucasus, Ararat, and Taurus. The most ancient traditions mention the Vine as having been made use of by man, the culture of which may be said to be commensurate with the advent of man upon the globe.

If we examine geographically the culture of the Vine as at present circumscribed, we shall find the northern limit of the region to be bounded on the western coast of Europe by the embouchure of the Loire. This limit, stretching away to the east, approaches still further towards the north until it attains the fifty-first parallel of latitude at the confluence of the Rhine and the Moselle. Vines which grow to the north of this limit no longer furnish wine, and scarcely yield decent vinegar. The culture of the Vine succeeds in the valleys of the Rhine and Danube. In Hungary it does not prosper north of the forty-ninth degree; and in central Russia it stretches along the northern coast of the Caspian under the forty-eighth parallel. This limit, if viewed in its *ensemble*, corresponds with an arc, the extremities of which rest westward on the forty-seventh, eastward on the forty-eighth parallel, and the curve of which rises as high as the fifty-first degree of north latitude. This curvature is explained by the fact that more heat in given time is furnished to central than to littoral plants. Passing on from the Caspian Sea towards the East, we see that the Vine is not unknown in Bucharia and northern Persia; but on the southern declivity of the Himalaya range it becomes rare, and altogether disappears in the valley of the Indus and the maritime region of Persia. South of the twenty-ninth degree it requires to be protected against the ardour of the sun. Under the tropics the Vine is sometimes planted in gardens. It grows rapidly, but the fruits always wither before arriving at perfection. In North America the Vine is rare, not being cultivated beyond the thirty-eighth degree. In the southern hemisphere the Vines are planted, and arrive at perfection at the Cape of Good Hope, on the coasts of Chili, at the embouchure of the Rio Plata, and in New Holland. It is, however, the south of France which must be regarded as the especial land of the Vine.

211. The Vine (Vitis Vinifera).

The greater number of Vitaceæ contain acids of various kinds distributed throughout all parts of the plant, and in various proportions; sometimes in the pure condition, sometimes mixed with other principles. In the berry of certain species is found a kind of sugar named by chemists *glucose*, otherwise known as grape sugar. It is in consequence of the presence of this sugar that the juice of the berries when expressed ferment and give rise to wine, a drink which we have scriptural authority for saying "rejoices the heart of man." The general theory of wine-making is as follows. The ripe berries contain glucose, much water, a fermentive principle, mucus, tannic, malic, and nitric acids, bitartrate of potash (cream of tartar), in addition to many other salts and colouring matters. The grapes are crushed by the naked feet of workmen in large cisterns of wood or stone. On the expiration of a certain time, fermentation commences amongst the various principles of the grape; the mass becomes hot, owing to certain chemical compositions and decompositions which are taking place; sugar

212. American Vine.

becomes changed into alchohol and carbonic acid, and the liquor becomes inebriating. A scum now rises, which is nothing more than the partially decomposed ferment, and collects in a thick crust. After the lapse of a few more days fermentation ceases. The wine is now formed, and only requires to be cleared. Red wine owes its colour to the presence of a blue resinoid principle resident in the pellicle of the fruit. This principle, insoluble in water, is soluble in alchohol, and therefore colours the wine in proportion as the alcoholic fermentation has become developed. The free acids contained in wine cause this blue colour to change to red. Taking advantage of these principles, nothing is more common than the preparation of white wine from dark grapes; all that is necessary to effect the result being the removal of the expressed juice from the grape husks before alcoholic fermentation has set in.

The preparation of sparkling wines is effected by bottling the juice before fermentation has quite ceased. In this way a portion of carbonic

213. Corinth Grape.

acid, which would have escaped under other circumstances, is forcibly retained and dissolved in the wine.

When grapes are dried they constitute raisins. The drying process is either conducted in the sun or artificially. Raisins of Malaga, of Damascus, and of Corinth (Currants) are all sun-dried. Valencia and all other Raisins are dried by artificial means. The American representatives of the Vine are but poor substitutes for the species of the old world, the berries being harsh tasted and acerb; nevertheless, the American native grape is not altogether despicable.

The varieties of the common Vine now known are far too numerous for enumeration, even in a work like this. Perhaps of all these varieties the one possessing most interest is the little Corinth Grape, which yields our so-called Currants—a corruption, by the way, of *Corinths.* Strange to say, this Grape, if planted very far away from the Grecian Archipelago, ceases to yield the peculiar grape, but degenerates, and furnishes grapes of ordinary size and character. A representation of the Corinth Grape is subjoined (fig. 213).

§ 59. ARALIACEÆ, OR HEDERACEÆ.

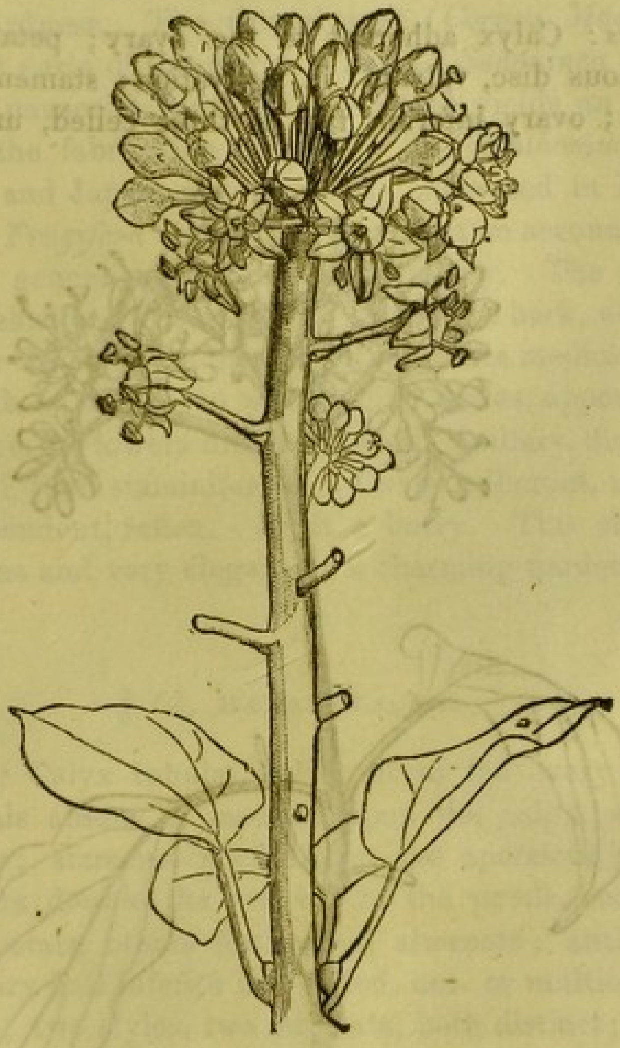
Characteristics: Calyx adherent to the ovary; petals five or ten inserted upon an epigynous disc, sessile; valvular in æstivation; stamens inserted with the petals, in number equal to the latter and alternate with

214. Aralia Racemosa.

them, or double their number; ovary inferior, two or more celled, uniovulate; ovules pendent reflex; styles equal in number to the cells, distinct or coherent; fruit bacciform, dry, or fleshy; seed inverse, dicotyledonous; embryo very small at the base of a fleshy albumen; radical superior.

The Araliaceæ generally possess a woody stem, and have for the most part alternate or stipulate leaves. Flowers regular, capitular, umbelliferous, or in racemes.

The Araliaceæ are inhabitants of tropical and temperate regions of both hemispheres. This natural order has a certain resemblance to



215. The Climbing Ivy (Hedera Helix).

Umbelliferæ, both in general aspect and chemical qualities. In Araliaceæ, however, the aromatic resinous principles are masked by astringent and bitter matters.

The common Ivy needs no description as to general appearance. Its leaves when bruised are aromatic, and their juice, incorporated with fatty matter, constitutes a good application to burns. The Jin-seng (*Panax Jin-seng*) grows in Tartary, China, and Nepaul. Its root contains a bitter, an acrid, and a saccharine matter. The plant enjoys in Asia an immense reputation as a tonic, and sells for three times its weight in silver. *Panax Quinquefolium* grows in North America; its root is collected and sold to the Chinese as a substitute for the real Jin-seng. The *Aralia Nudicaulis* is celebrated as a sudorific, and its roots are used for the purpose of adulterating sarsaparilla.

§ 60. CORNACEÆ.

Characteristics: Calyx adherent to the ovary; petals four inserted upon an epigynous disc, valvate in æstivation; stamens four alternate with the petals; ovary inferior, two to three celled, uniovular; ovules

216. Cornus Sanguinea,

pendent reflected; style simple; fruit drupaceous, two or three celled; seeds inverted; embryo dicotyledonous, straight in the axis of a fleshy albumen; radicle superior.

The Cornaceæ are generally trees or shrubs with opposite, simple, or stipulate leaves. Flowers disposed in a capitulum, umbel, or corymb.

The Cornaceæ are allied with Caprifoliaceæ, from which, however, they may be distinguished by their free petals. They are also allied with Alariaceæ in their general aspect and in the possession of a similar fructification.

The Cornaceæ inhabit the temperate and cool regions of the northern hemisphere. Certain members of the order possess in their bark a peculiar bitter principle termed *corniine*, also an astringent matter. Some produce edible fruits and oily seeds. The greater number possess a wood of great hardness. The Cornel tree (*Cornus Mas*) is generally diffused over most parts of the world. The *C. Sanguinea* (fig. 216) produces bitter and nauseous fruits, but the seed yields an oil useful for illumination and the fabrication of soap. The *Benthamia Fragifera* is a shrub of Nepaul and Japan, now generally cultivated in European gardens. The name *Fragifera* is given to this plant on account of its bearing a fruit similar in general appearance to a Cherry. The *C. Florida* is a North American shrub. It possesses an astringent bark, and is employed as a substitute for Quina in the transatlantic materia medica. The *Aucuba* is a Japanese shrub, an evergreen with shining leaves, opposite coriaceous, sometimes plumose. Flowers diœcious, small, axillary, disposed in panicles, four petaloid, four staminiferous. Ovary adherent, unilocular, uniovulate; ovule pendent, reflex. Fruit a berry. This shrub, which is full of ramifications and very elegant, is a charming garden ornament.

§ 61. HAMAMELACEÆ.

Characteristics: Calyx tubular, adherent to the ovary; limb four to five partite; petals absent or inserted upon the calyx, and alternating with its divisions; stamens indefinite in the apetalous genera, in the petaliferous genera double the number of the petals, some sterile, and opposite to the petals, others fertile and alternate; anthers square or semicircular; ovary half inferior two celled, uni- or multiovulate; ovules pendent reflected; two styles, two stigmata, both distinct; capsule septicidal, having one-seeded cells.

The members of this natural order are trees or shrubs, ordinarily covered with hair arranged in the form of stars. Leaves alternate, petiolate, simple, bistipulate. Flowers almost sessile, disposed in panicles, capitula, or spikes.

The few species composing this natural order are dispersed over North America, Japan, China, India, Madagascar, and the Cape. The Virginian Hamamelis (*Hamamelis Virginica*) is a shrub having yellow fasciculated flowers, the ovary of which does not ripen until the second year. It is cultivated in gardens for the sake of its oily farinaceous seeds; the decoction of its bark and leaves is charged with tannic bitter principles and a peculiar volatile oil. The alder-leaved Fothergillia (*Fothergillia Alniflora*) is a shrub, a native of Carolina, but cultivated in Europe. Its inflorescence is a spike composed of white and odoriferous flowers. Its fruits discharge their seeds with a considerable noise. The *Rhodoleia Championi* (fig. 217) is a small tree recently discovered in China by Captain Champion, in the forests which surround Canton. It is cultivated with facility in the open air of European countries. The leaves of this tree are persistent, its flowers grouped in five, surrounded with roseate bracts, which might be almost taken for a petaloid floral envelope.

217. Rhodoleia Championi.

§ 62. PHILADELPHACEÆ.

Characteristics: Calyx adherent to the ovary, valvate in æstivation; petals in number equal to the divisions of the calyx, with contorted æstivation; stamens a multiple number of that of the petals; ovary three or many celled; placenta central, multiovulate; ovules ascendant or pendent, imbricate, reflex; capsule many seeded; seeds enveloped in a loose testa; embryo dicotyledonous, straight, in the axis of a fleshy albumen, the length of which it equals. The members of this natural order are erect trees, having simple opposite leaves without stipules. Their flowers are complete, regular, white, odoriferous, disposed either in cyme or panicle.

The *Philadelphus Coronarius* is indigenous to central Europe, and a frequent garden ornament. Its flowers are very odorous, and were formerly held in esteem as a medicine. They contain a volatile oil sometimes employed as an agent for the adulteration of oil of jasmine. The *Deutzia Scabra* is a native of Japan, now cultivated in botanic gardens. The Japanese employ the inner bark of this tree as a plaster; its leaves are employed to impart a polish to wood.

218. Philadelphus.

§ 63. CEPHALOTACEÆ.

The genus Cephalotus, which Labillardiere placed amongst the Rosaceæ, and which other authors have annexed to the Saxifrages, is constituted by certain perennial vegetables of Australia, having a short subterraneous stem and leaves united in a tuft, and offering two distinct forms ; one form plane, oval oblong, the other situated a little below the preceding, composed of a petiole dilated into a pair of labiate expansions, the lower one being large, hollowed out like a cup, the upper one smaller, flat, and serving as a cover. The stem is pseudo-cauline, on the extremity of which the flowers expand. The flowers are white and small; the calyx is free, six partite, petaloid, valvate in æstivation,

219. Cephalotus Follicularis.

corolla absent. The twelve stamens are inserted upon the border of the tube of the calyx. The six ovaries are sessile upon a plane receptacle alternate with the sepals, unilocular, uni- or bi-ovulate. Ovules erect, reflex. Fruit composed of six achænia, which open circularly at their base. Cotyledon small, straight, at the base of a fleshy albumen. One species, the *Cephalotus Follicularis* (fig. 219), has been some years introduced into European gardens.

§ 64. CRASSULACEÆ.

Characteristics: Calyx free; petals inserted upon the base of the calyx, in number equal to the divisions of the latter, free or coherent at the base; imbricated in æstivation; stamens inserted with the petals and ordinarily adherent to them; their number equal to that of the petals, or double; free or attached to an axis, each furnished with a scale at its base, and pluriovulate; ovules horizontal or pendent; follicules ordinarily free; dehiscence ventral, sometimes attached to the capsule, in which case the dehiscence is dorsal; seed dicotyledonous, straight, exalbuminous, occupying the axis of a small fleshy albumen.

220. Crassula Coccinea.

The Crassulaceæ are in some cases subligneous herbs, more or less charged with juicy matter; leaves ordinarily simple, deprived of stipules; flowers terminal, corymbous, or in cymes, or agglomerated, occasionally solitary.

The Crassulaceæ grow in the warmer parts of the temperate regions of the old continent. They thrive in the most arid soils, and remain fresh by reason of the humidity they absorb from the air as well as the soil. Nearly all the moisture thus absorbed is retained, because the surface of these plants suffer but little transudation, very few stomata or evaporating pores existing in their structure. All the Crassulaceæ abound in a slightly saline aqueous juice containing malic acid. On account of these constituents, the Crassulaceæ have acquired some celebrity as medicinal agents. A few species are edible. The *Sedum Telephium*, *S. Album*, and *S. Reflexum*, also the *Sempervivum Tectorum* (Houseleek), are frequently employed for stimulating wounds; the Mediterranean Crassulæ possess similar qualities. The *S. Acre*, a plant which grows in sundry places in Europe, contains an acrid principle, in virtue of which it is rubefacient

221. Sedum.

when externally applied, purgative and emetic when administered internally. The root of *S. Rhodiola*, so called from the circumstance of its diffusing an odour similar to that of a rose, was formerly officinal as a sedative. The Greenlanders boil this vegetable and eat it as a pot-herb.

The leaves of *Bryophyllum Colicinum* present a very curious physiological phenomenon, the germs of this plant growing at the extremity of the leaf-nerves.

§ 65. MESEMBRYANTHEMACEÆ.

Characteristics: Tubular calyx consolidated with the ovary; petals indefinite, inserted on the calyx; ovary many celled, placenta applied to the midrib of the carpels, and occupying the lower part of the cell; ovules numerous, curved; stigmas sessile; capsule multivalvular; seed dicotyledonous; embryo surrounding a farinaceous albumen.

The members of this natural order are herbs or small shrubs, and are all natives of the Cape of Good Hope. Their leaves are fleshy, their flowers axillary or terminal, solitary, or disposed in the form of a cymous corymb. Capsule at first fleshy, then almost woody; its cells opening centrifugally. Epicarp thick and coriaceous, separated from the endocarp, which latter is persistent under the form of double membranous triangular leaf-like appendages.

222. Mesembryanthemum Fulgidum.

Many species of this natural order are cultivated for the beauty of their flowers; some, too, are useful. The succulent leaves contain many salts, especially oxalate of lime; some are sapid and saccharine. The *M. Crystallina*, which is a very common growth in the Canary Islands and the Mediterranean region, is charged with gelatinous vesicles, which causes it to appear, when shining in the sun's rays, as if covered with a crest of hoar-frost. The inhabitants of the Canary Islands incinerate this plant for the purpose of extracting soda from its ashes. The fruit of *M. Edulis* is eaten as food by the Hottentots. *M. Fulgidum* is a favourite object of culture on account of the extreme beauty of its deep purple flowers.

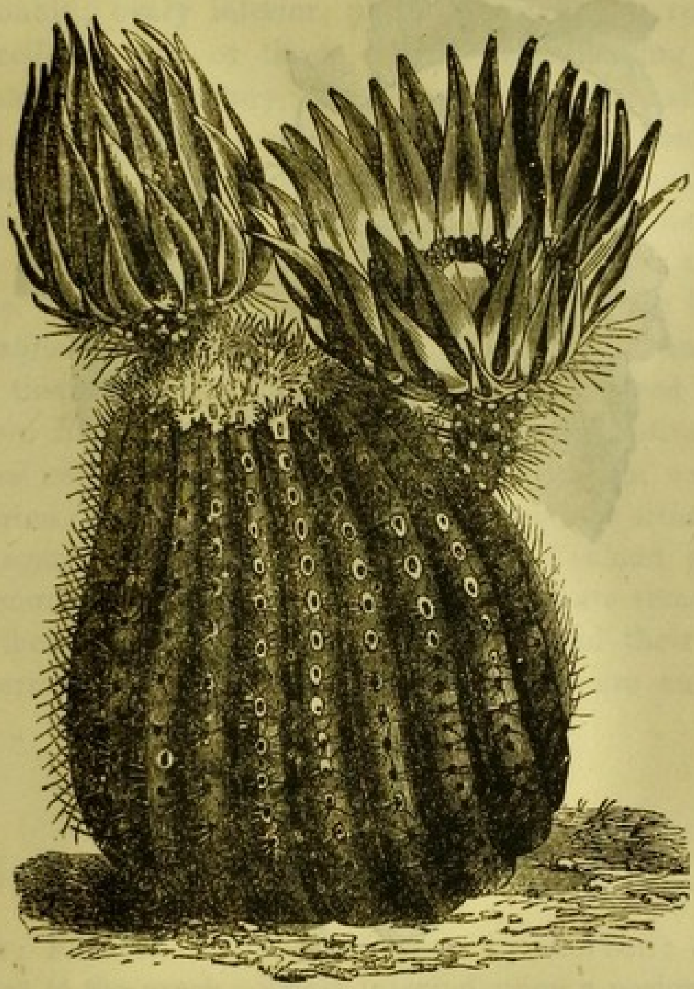
223. Mesembryanthemum Falciforme.

§ 66. CACTACEÆ.

Characteristics: Calyx adherent to the ovary; with pluriserial, petaloid limb, almost confounded with the corolla; petals numerous, pluriserial, imbricated in æstivation, inserted upon the summit of a calycinal tube, sometimes free, sometimes coherent below, and thus forming an elongated tube; stamens numerous, multiserial, inserted upon the base of the corolla; ovary inferior, unilocular; placentæ parietal, multiovular; berry pulpy; seeds numerous, dicotyledonous; embryo straight or curved; albumen absent or scarcely visible.

The Cactaceæ are American plants; they are ligneous and fleshy; their stem is branched or simple by the suppression of buds; cylindrical, fluted, flat, or globular, covered with teat-like tubercles, the representatives of abortive branches. The leaves are generally absent, or at most indicated by a small cushion-like excrescence lying beneath a bud; sometimes perfect, plane and petiolate (*Pereskia*); the buds situated upon the axilla of the abortive leaves are of two orders, the inferior ones are covered with spines, whilst the superior ones are developed in branches or in flowers.

The berries of many of the Cactus tribe are employed in medicine as a remedy for bilious affections. The *Opuntia Communis* has long been naturalised in the Mediterranean regions; also the *Nopal*. Upon these plants thrive the valuable cochineal insect, from which carmine and carmine lake are extracted.



224. Echinocactus Pectiniferus.

§ 67. GROSSULACEÆ.

Characteristics: Calyx coloured, tubular, adherent, prolonged to a varying extent below the ovary; petals inserted upon the throat of the calyx, equal in number to the divisions of the latter; æstivation imbricated; stamens equal in number to the petals and alternate with the latter; ovaries inferior and one celled; placentæ usually two, parietal or attached to the valves; ovules horizontal, reflex; berry pulpy; seeds angular, dicotyledonous; embryo straight in the base of an almost corneous albumen.

Members of this natural order are usually armed with spines situated below the leaf; the leaves are alternate or fasciculated; limb palmilobed; petiole dilated. The flowers are disposed in axillary racemes in the species which are deprived of spines; they are solitary or few in number in these pine-bearing species. The berry is surrounded by the persistent

225. The White Currant (Ribes Albidum).

limb of the calyx. The seeds have a gelatinous testa, in which a long raphé ramifies. The endopleura is adherent to the albumen.

The Grossulaceæ are for the most part inhabitants of the temperate and cool regions of the northern hemisphere. The genus *Ribes* constitutes nearly all the family to which it imparts the distinctive name. Its species contain in their herbaceous portion a resinous aromatic principle. Their fruit is filled with a saccharine mucilage in combination with malic and citric acids, and occasionally astringent matters.

Gooseberry and Currant trees are so well known that any prolonged description of them would be useless. They are amongst the most delicious of cultivated fruit, and furnish no bad substitute for the Vine as a wine-making material.

§ 68. ONAGRARIACEÆ.

Characteristics: Calyx adherent; petals equal in number to the divisions of the calyx, contorted in æstivation; stamens equal in number to the petals, or double; ovary inferior, plurilocular; ovules reflex; fruit capsular or bacciform, two or three celled; seeds having a chalaza winged, interrupted, or filamentary; seed dicotyledonous, exalbuminous.

The members of this natural order possess leaves without stipules; flowers sometimes axillary and solitary, sometimes in the form of corymb or spike. They are chiefly extra tropical, and belong for the most part to the northern temperate zone. Two species, *Epilobium* and *Circæa* are mucilaginous. The ancients believed that the aqueous infusion of *Epilobium Angustifolium* had the property of taming wild animals, and that its vinous tincture was exhilarent when administered to human beings. *Ænothera Biennis* and *Æ. Suaveolens*, originally natives of North America, but now cultivated, like many of its congeners, in our gardens, possess a saccharine root, which is sometimes used as an article of food. *Fuschias* are elegant shrubs, indigenous to New Zealand and North America, now common enough in our gardens. They are remarkable for the beauty of their foliage, their petaloid calyx, and their convolate corolla. The berries of certain New Zealand species are an agreeable perfume.

§ 69. ANACARDIACEÆ AND SPONDIACEÆ.

Characteristics: Flowers ordinarily diœcious by abortion; calyx free, or rarely adherent to the ovary; petals inserted upon a perigynous disc, or else upon a short stipes, equal in number to the divisions of the calyx; sometimes absent; imbricated in æstivation; stamens equal in number to the petals, and alternate with them, or in double or multiple number; carpels ordinarily reduced to one; unilocular or four to five distinct, one alone being fertile; ovule single, ascending, ordinarily free, curved or half reflex; fruit drupaceous or dry; seed dicotyledonous, exalbuminous, curved; stem woody; juice gummy or milky; leaves alternate and without stipules.

The Anacardiaceæ owe their properties to a resinous juice which in certain species resembles pine turpentine; in the greater number of species, however, this resinous principle is mixed with certain acrid matters, which, on contact with the air, becomes black, and imparts to the secretion very stimulating, sometimes venomous, properties. The bitter and astringent principles which some individuals of this natural order contain in their bark and wood modifies the action of the stimulating matter. The fruit of certain species is fleshy, abundant in sugar and free acids; sometimes edible. The seeds contain a fixed oil.

The *Pistachia Lentiscus*, or *Mastic*, a plant cultivated in the Grecian Archipelago, and the *P. Alantica*, native of the Mauritius, are valuable for their product—*mastic*. This substance, employed by ourselves as the

226. Mastic Shrub, Pistachia.

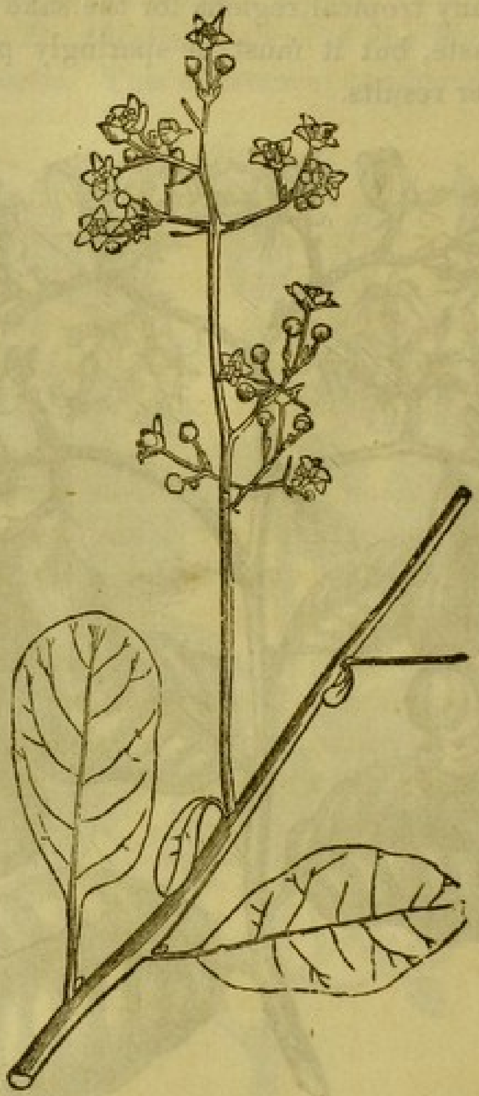
basis of several varnishes, is largely used by orientals as a masticatory, whence its name. By these persons it is believed to purify the breath. The *P. Terebinthus* grows spontaneously in the whole Mediterranean region. From its inward trunk flows a limpid adhesive juice, yellowish-blue in colour, and of a penetrating odour, something between that of citron and fennel. Its taste is balsamic, exempt from bitterness and acridity. This substance, known as *Scio Turpentine*, is rarely pure, and chemistry is unequal to detect the fraud. Its seeds, formerly employed in passive hœmorrhages and dysentery, are at present held in but little repute. The *Pistachia Vera*, originally a native of Persia and Syria, is now grown in the whole Mediterranean region; its oily seeds, under the name of *Green Almonds*, are very agreeable in taste, and are employed by druggists in France as the basis of certain emulsions.

The Mango (*Mangifera Indica*) is a tree originally of Asia, but it is now cultivated in many tropical regions for the sake of its fruit. This is very agreeable in taste, but it must be sparingly partaken of, or much constitutional disorder results.

227. The Cashew Tree (Anacardium Occidentale).

In exchange for the Mango which America has received from Asia, the latter continent and Africa have derived from America the Cashew tree (*Anacardium Occidentale*, fig. 227). It is indigenous to central America and the West India Islands; its nut, small and reniform, termed the *cashew*, grows at the summit of a fleshy panicle like a large pear in general appearance. The pericarp contains a caustic oil; the seed is almond-tasted; the peduncle, named the Cashew Apple, is acidulous, saccharine, and a little acrid, but nevertheless agreeable. From the epicarp a blistering ointment is sometimes prepared, and the entire fruit is useful in certain diseases. Cashew gum exudes from the trunk of the tree, but it is applied to no useful purpose.

The *Anacardium Orientale* is a native of the East Indies. Its immature seeds yield a glutinous matter like bird-lime, and from which the celebrated Chinese varnish is prepared.



228. Fustic Sumac (Rhus Cotinus.)

The Sumacs possess various properties. Fustic Sumac (*Rhus Cotinus*, fig. 228) is indigenous in eastern Europe; its bark, slightly aromatic and very astringent, is considered by some as a good substitute for that of Cinchona; its leaves are also employed in medicine, and from its wood a yellow dye-stuff is extracted. The Curriers' Sumac, *Rhus Coriaria*, is a native of the Mediterranean region. Its acid fruits are used by the Turks as a condiment; its leaves and young shoots are employed by curriers and dyers. The fruit and flowers of the *Rhus Typhinum*, *Gla-*

brum, and *Elegans*, all natives of North America, are employed as condiments. The Jamaica Sumac (*R. Metopii*) secretes a purgative gum-resin from its bark. The *S. Vernix*, or Varnish Sumac, is a Japanese shrub, from the stem of which is obtained by incision a milky juice, which thickens and turns black when exposed to the air, and which, after being dissolved in a drying oil, constitutes the celebrated black Japanese varnish. The *R. Radicans* and *R. Toxicodendron* are both natives of North America, and but slightly distinguishable from each other. When the period of flowering arrives, both these plants secrete an abundant quantity of milky juice, which turns black in contact with the air. This juice is so exceedingly acrid, that if a person sits in the shade of one of the poison Sumacs, his skin becomes violently inflamed, reddens, swells, and covered with pustules. The leaves of this Sumac are recommended in paralysis, dartrous affections of the skin, and even consumption.

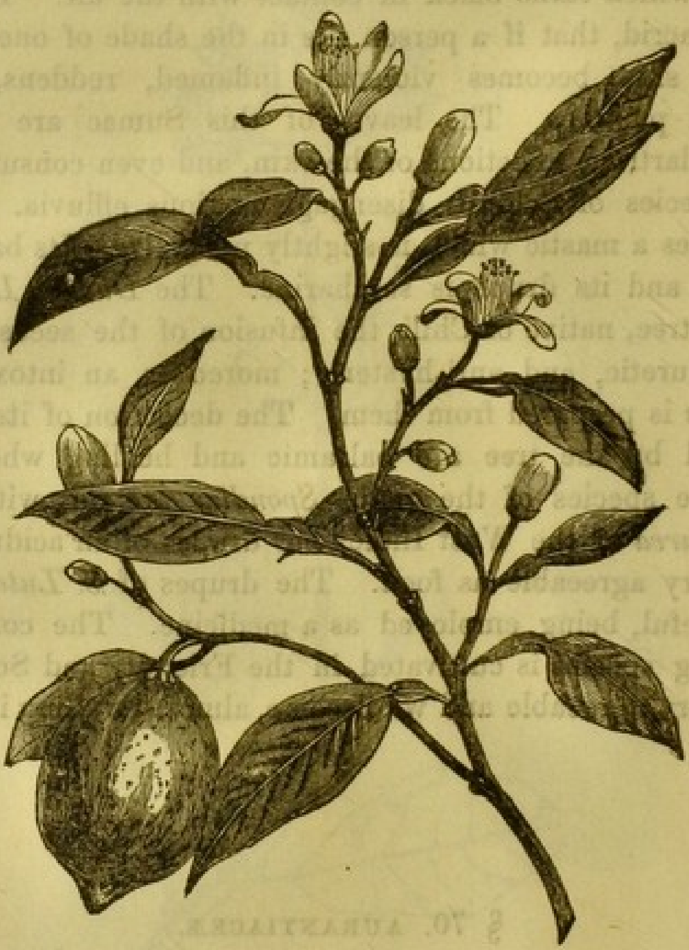
Certain species of Schinus disengage noxious effluvia. The *Schinus Molle* furnishes a mastic which is slightly purgative. Its bark and leaves are aromatic, and its drupe is saccharine. The *Duvaua Dependens* is a little spring tree, native of Chili, the infusion of the seeds of which are stomachic, diuretic, and anti-hysteric; moreover, an intoxicating drink named *Chicha* is prepared from them. The decoction of its bark and the gum secreted by the tree are balsamic and healing when applied to wounds. The species of the genus *Spondias* are not without interest. The *S. Purpurea* of the West Indies has drupes of an acidulated saccharine taste, very agreeable as food. The drupes of *S. Lutea* are smaller, but more useful, being employed as a medicine. The congener of the two spreading species is cultivated in the Friendly and Society Islands. Its fruit is very agreeable and wholesome, almost rivalling in delicacy the Pine-apple.

§ 70. AURANTIACEÆ.

Characteristics: Calyx free, monosepalous; petals hypogynous, free, or almost free, in number equal to the parts of the calyx, with which they are alternate; imbricated in æstivation; stamens in number double or multiple the number of the petals, monadelphous or polyadelphous; filaments ordinarily flat and uniserial; style simple; stigma capitular; berry with thick rind and pulpy endocarp; seeds provided with a raphe, and frequently containing numerous embryos; embryo dicotyledonous, exalbuminous, straight; radicle superior.

The Aurantiaceæ are for the most part natives of tropical Asia, but they are now distributed over all parts of the globe where the temperature is sufficiently high to be congenial to their culture. Their leaves are alternate, without stipules, often growing at the extremity of a flattened petiole, solitary or in corymbs. The bark, the leaves, calyx, petals, filaments, and epicarp, are all supplied with vesicles containing volatile oil.

This beautiful family is, chemically, remarkable for its volatile oil and aromatic bitter constituents; its free acids (principally malic and citric). The Citron (*Citrus*) is the principal genus of the family. The Orange (*Citrus Aurantium*), originally a native of the East Indies, is now cultivated in almost all tropical and warm temperate countries. In France, however, it requires protection during the winter. The Citron (*C. Vul-*



229. The Lemon Tree (Citrus Limonium).

garis) is the most useful species of the genus; its berry, sometimes termed the Bitter Orange, is not edible, but from it are extracted many delicious perfumes, and its pulp makes an excellent confection. It is from the flowers of this species that chemists obtain the essence of neroli. All its various parts are in point of fact more aromatic than similar parts of the Orange tree. The Lime (*C. Limetta*), the Bergamot (*C. Bergamota*), the Lemon (*C. Limonium*), are all members of the genus Citrus; all yield from almost every part of their substance an odorous volatile oil. The celebrated *Eau de Cologne* is nothing more than a solution of volatile oils extracted from many genera of Aurantiaceæ and dissolved in alcohol.

The Cedran was not introduced into Europe until subsequently to the period of Alexander the Great's Asiatic conquests. It is a native of Persia and Mesopotamia.

The Meliaceæ, a sub-family of Aurantiaceæ, are trees or shrubs, natives for the most part of the tropics. Their leaves are generally alternate and without stipules; their flowers are regular, arranged either in a panicle or corymb, cyme or spike. They contain acrid and bitter astringent principles, by virtue of which they are tonic and stimulating. The *Melia Azederach* (fig. 230) is a tree growing in Persia and Syria, but which has been naturalised in Mediterranean Europe and North America. It has very energetic properties, all its parts being bitter and purgative.

230. Melia Azederach.

§ 71. MALPIGHIACEÆ.

Characteristics: Calyx free, five partite, each division ordinarily furnished with two glands at the base; petals five, either inserted upon the receptacle or upon a hypogynous or subperigynous disc; imbricated in æstivation; stamens double in number to that of the petals, sometimes all of them fertile, in other cases partly sterile; filaments ordinarily coherent at their base; ovary composed of three carpels, rarely two, either incorporated with the axis or free at the summit, giving rise to three or two uniovulate cells; ovule reflex, attached to a pendent funiculus ascending by its free extremity; fruit composed of two or three scales, ordinarily samaroidal; seeds inverted, dicotyledonous, exalbuminous, rarely straight, cotyledons ordinarily bent on themselves; radicle superior.

The Malpighiaceæ are usually trees or shrubs, for the most part covered with hairs, which sometimes degenerate into prickles, though not invariably. The leaves are ordinarily opposite, single, devoid of stipules. Inflorescence a cyme or corymb.

231. Malpighia Volubilis.

§ 72. ACERACEÆ.

Characteristics: Calyx free, with four or five divisions, caduceous; petals four or five, alternate with the sepals, inserted upon a hypogynous disc; æstivation imbricate; stamens four to twelve, ordinarily eight; ovary free, composed of two carpels, bilocular and perpendicularly compressed at the line of junction; ovules double in each cell, pendent or

233. The Plane Tree (Acer Plantanoides).

232. The Sycamore (Acer Pseudoplatanus).

curved; fruit samaroidal; seed dicotyledonous, exalbuminous, cotyledons irregularly contorted; radicle descending.

The Aceraceæ are trees with opposite petiolate ex-stipulate leaves, having regular flowers arranged in cymes or corymbs. They all possess a saccharine, limpid, or lactiferous juice, which flows from the plant after incision. One species, *Acer Saccharinum*, or Sugar Maple, is so rich in sugar, that considerable quantities are extracted in Canada and other parts of North America. The sugar is identical with that obtained from the cane, and when refined equally good with the latter.

§ 73. HIPPOCASTANEÆ.

Characteristics: Calyx free; petals hypogynous, four or five unequal, free, imbricated; stamens seven or eight inserted upon a disc; ovary three-celled biovulate; ovules curved; capsule coriaceous, frequently by abortion unilocular; seed dicotyledonous, exalbuminous; stem ligneous; leaves opposite, digitate; flowers arranged in a terminal panicle.

§ 74. HYPERICACEÆ.

Characteristics: Calyx free, four or five sepalous, joined together to a variable extent; contorted in æstivation; stamens indefinite, free, monadelphous or polyadelphous; ovary three to five celled or unilocular; junction incomplete; ovules numerous, reflected or curved; fruit capsular or bacciform; seed dicotyledonous, exalbuminous; stem ligneous or herbaceous; leaves opposite or verticillate, simple entire, ordinarily punctuated with pellucid glands; flowers regular, arranged in a panicle or cyme.

The Hypericaceæ are distributed over the hot and temperate regions of the globe, more especially of the northern hemisphere. All the ligneous species are intertropical.

Almost all contain, in addition to a volatile oil, resinous and balsamic juices which flow abundantly from the ligneous species, and which in the herbaceous ones may be found in the pellucid glands with which the leaves are studded. The Tutsan (*Hypericum Androsæmum*) is a native plant formerly employed in medicine, but now fallen into disuetude. The *Hypericum Perforatum* (fig. 234) is so called in consequence of the sieve-like appearance of its leaves, dependent on the number of transparent glandular points scattered over their surfaces.

The most important member of this family is the Tea shrub. The virtues of Tea depend on a combination of an astringent with a peculiar nitrogenised principle termed *theine*, also in part to a volatile oil.

Two centuries have not yet elapsed since Tea was first introduced to

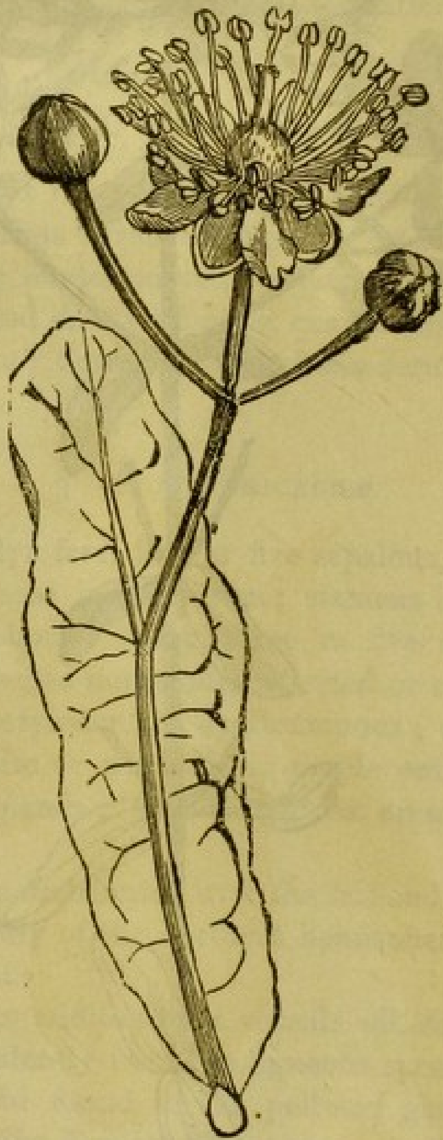
Europe as an article of drink. Everybody is aware that two species of Tea exist—black and green Tea. Both are produced by the same plant,

234. Hypericum Perforatum.

and the difference between the two results from peculiarities of manufacture. Several attempts have been made to naturalise the Tea shrub in Europe, but invariably without success.

§ 75. TILIACEÆ.

Characteristics : Sepals five, caduceous; valvate in æstivation; petals inserted upon a hypogynous disc, four or five or sometimes absent; imbricate in æstivation, often supplied at their base with a scaly appendage; stamens double in number or a multiple of that of the petals, all fertile, or the external ones sterile, free or polyadelphous at the base;



235. Large-Leafed Linden (Tilia Grandiflora).

ovary two to ten celled; ovules reflex; fruic capsular or indehiscent, coriaceous or fleshy; seed dicotyledonous; embryo straight in the axis of a fleshy albumen, sometimes absent; stem ligneous; leaves ordinarily alternate, stipulate; flowers regular, solitary, or in cymes or corymbs.

The Tiliaceæ for the most part are inhabitants of the tropical zone; they contain an abundant mucilage mingled with astringent and resinous matters. The flower of certain species contains a volatile oil; others possess a fleshy sapid fruit and edible stems. The seeds of most species are oily. The Lindens are generally diffused, and in much estimation on account of the beauty of their foliage and the sweet aromatic odour of their flowers. The bark is fibrous, and sometimes turned to account in the manufacture of cordage. The wood, easily worked, is in repute amongst turners and sculptors. The flowers, much sought after by bees, contain an abundance of volatile oil, sugar, mucilage, gum, and tannic acid; their infusion is anti-spasmodic and diuretic. The oily seeds are occasionally employed as a substitute for cocoa.

§ 76. BUTTNERACEÆ.

Characteristics: Calyx four or five partite; petals five, hypogynous or absent; æstivation valvate or contorted; stamens in some species equal in number to the petals and opposite to them, in other species double or

236. The Cocoa Tree (Theobroma Cacao).

multiple this number; filaments ordinarily joined in the form of cupola, or tube, or column; ovary four or five to ten celled, uni- bi- or pluri-ovulate; ovules ordinarily ascendant reflex; fruit generally a capsule; seed albuminous or exalbuminous; stem ordinarily woody, covered with radiating or bifurcated hairs; leaves alternate, simple, stipulate; flowers regular, arranged in panicles, spikes, or glomerules.

237. Carolinea Princeps.

These plants contain an abundant mucilage, to which is generally added a bitter, astringent, extractive matter. The fruit of many species is saccharine; the seeds contain a fixed oil. The most celebrated plant of this natural order is the Cocoa (*Theobroma Cacao*, fig. 236), a Mexican tree, the cultivation of which, however, has now extended to Africa and Asia.

In the midst of its bitter pulpy fruit are found the seeds, which, when roasted, constitute the cocoa of commerce.

§ 77. STERCULIACEÆ AND BOMBACEÆ.

Characteristics: Calyx four or five partite; petals hypogynous, five imbricated in æstivation, often absent; stamens indefinite, monadelphous; anthers two celled, more or less complete; stem ligneous, covered with radiating hairs; leaves alternate, simple, or digitate; flowers solitary, or in cymes or panicles.

Many species of Sterculiaceæ are cultivated in Europe. Pre-eminent amongst these is the Baobab, which remains a small shrub in our greenhouses, but which, in its own country, grows to a size which is indicated by the accompanying representation (p. 190). The *Pachira Insignis*, a tree of central America, has digitate leaves, elongated flowers of a bright red colour, the petals of which are spread out at their summits. The *Pachira Aquatica*, or *Carolinea Princeps* (fig. 237), is a plant which bears very large and elegant flowers, the petals of which are yellow on their upper surface, green below, ornamented with red filaments and yellow anthers.

§ 78. MALVACEÆ.

Characteristics: Calyx free; valvate in æstivation; petals hypogynous, ordinarily joined together into a staminiferous tube; contorted in æstivation; stamens indefinite monadelphous, with unilocular anthers; seed dicotyledonous; embryo curved; leaves alternate, stipulate.

Stem herbaceous or ligneous, usually supplied with radiating hairs; flowers complete, regular, axillary, solitary, or fasciculate, or in a cyme; pollen in large grains, globular, hispid; carpels ordinarily numerous, sometimes five, three, or four ovaries verticillate around a prolongation of the floral axis, sometimes agglomerated into a capitulum, either free or partially coherent. Ovules inserted into the central angle of the cells, ascendant or horizontal, curved. The styles are free above. Fruit sometimes formed of many shells coherent by their margins to a variable extent; sometimes a loculicidal capsule with septiferous valves, sometimes indehiscent, dry, or fleshy. The cotyledons are bent or mutually imbedded. Albumen albuminous, not very abundant.

The Malvaceæ abound in the tropics, their number diminishing towards either pole; their chief property depends on a mucilage which abounds in the greater number, whence the Malvaceæ are celebrated for their emollient properties. In certain species there exists, in addition to

The Baobab Tree.

the mucilage, a free acid, generally the oxalic, the presence of which causes them to be refrigerant, antibilious, and antiscorbutic. The seeds contain a fixed oil. Some species possess tenacious fibres, others seeds which are covered with a substance resembling wool.

Among the indigenous species of this tribe, the Marsh Mallow (*Althæa Officinalis*, fig. 238) is most common.

The Cotton sub-family (*Gossypium*), which belongs to this natural order, are indigenous to Asia and America. Many species are now cultivated on a large scale in every part of the intertropical zone. The laniferous material which envelopes the seeds is the substance cotton. It has been known and used in Egypt from times of great antiquity, and is now distributed over the whole world. Several remains of Greek literature have been handed down to us written on cotton. Cotton seeds yield on expression a fixed oil useful for a variety of purposes.

238. Marsh Mallow (Althæa Officinalis).

Numerous exotic Malvaceæ are now cultivated in Europe; for example, the *Malope Trifida*, an annual of northern Africa, the stem of which rises to the height of about two feet, and which bears flowers of a deep rose colour; the *Kitaibelia*, a biennial Hungarian plant, having lobed leaves and white flowers; the *Althæa Rosea*, a Syrian plant, the varieties of which are extremely numerous; the *Lavatera Arborea*, a native of central France, bearing large leaves and violet-coloured flowers; *Althæa Cannabina*, a native of various parts of central Europe, which has rosaceous flowers, and the stem of which yields a good substitute for hemp;—such are a few of the species of this natural order now familiar in gardens.

239. The Cotton Shrub (Gossypium).

§ 79. GERANIACEÆ.

Characteristics: Calyx free; petals hypogynous or imperfectly perigynous, in number equal to the sepals or fewer; equal in *Geranium*, reduced to four or two in *Pelargonium*; contorted in æstivation, caduceous; stamens ordinarily double in number to the petals; biserial; all fertile (*Geranium*), or partly sterile (*Erodium*, *Pelargonium*), filaments partially monadelphous; carpels five, applied to the prolongation of the axis, and constituting a five-celled biovulate ovary; seed dicotyledonous, exalbuminous, curved; cotyledons bent or contorted; stem herbaceous or ligneous; leaves stipulate, opposed; the upper ones sometimes alternate; flowers complete, regular, or irregular (*Pelargonium*), occasionally solitary, arranged sometimes in a bi-floral cyme; styles joined into a column, which is larger than the floral axis; ovules ascendant, at first curved, then demi-reflected.

Species of this natural order are chiefly found in the extra-tropical regions, more especially at the Cape of Good Hope; they contain tannic

240. Erodium Cicutarium.

and gallic acids, on which account they were formerly employed as astringents in medical practice. The *Pelargoniums* contain a volatile oil, which imparts to them a very powerful but at the same time agreeable odour. The *P. Roseum* and *Capitatum* yield an essence possessing the odour of Roses, and is sometimes employed as a material wherewith otto of roses is adulterated.

241. Pelargonium.

§ 80. BALSAMINACEÆ.

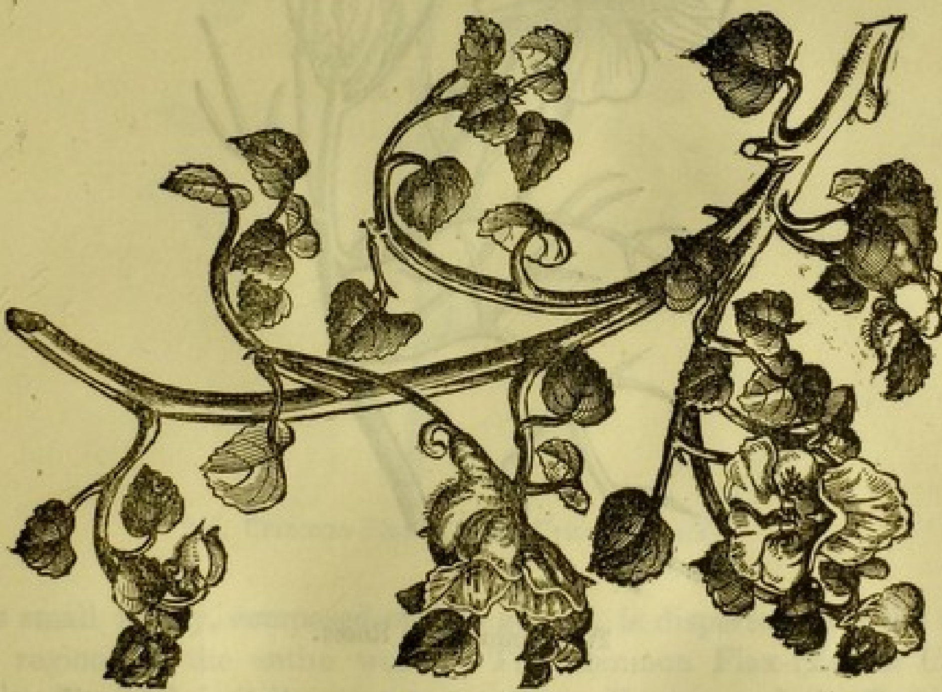
Characteristics: Sepals free, unequal, petaloid; petals five, hypogynous, unequal; stamens five; carpels five, united to a five-celled ovary; ovules superior, pendent, reflex; capsule five celled, five valved, dehiscent; seed dicotyledonous, exalbuminous; embryo straight; stem herbaceous, succulent; flowers axillary.

The Balsaminaceæ are for the most part natives of temperate and tropical Asia. The genus *Impatiens,* so called on account of the elasticity of its seed capsules, which, on being touched, dart out the seeds to a considerable distance, has furnished numerous varieties to horticulture, the most irritable of which is the *Noli me Tangere.* The common Balsam plant, *I. Balsamina,* is an annual, a native of India, now rendered double by culture, and furnishing innumerable varieties. The *Impatiens Repens* is a Cingalese species, the representation of which is subjoined (fig. 242). It has only been recently introduced into European culture.

§ 81. TROPEOLACEÆ.

Characteristics: Calyx five partite, bilabiate, petaloid; petals five, unequal, inserted at the base of the calyx; stamens eight, hypogynous;

243. Tropæolum.



242. Impatiens Repens.

ovary three celled, uniovulate; ovules pendent, reflex; fruit succulent or dry, composed of three shells or samaroidal; seed dicotyledonous; embryo exalbuminous, straight; stem herbaceous, succulent, diffused or voluble; leaves peltate, the inferior leaves opposed and stipulated, the superior leaves alternate and without stipules; flowers axillary.

The Tropeolaceæ inhabit the entire of central America. The genus Tropœolum (fig. 243) is cultivated in Europe. *T. Speciosum* is a very elegant crimson-leaved flower, a native of Patagonia.

§ 82. LIMNANTHEÆ.

Characteristics: Calyx free; petals inserted upon an almost perigynous disc, three or five; æstivation convolute; stamens six or ten; carpels three or five, coherent, uniovulate; ovules erect, reflected; fruit com-

244. Limnanthes Rosea.

posed of two or three achænia; seed dicotyledonous, exalbuminous; embryo straight.

The members of this natural order are indigenous to North America generally annuals, growing in marshy places; their leaves soft and glistening, alternate, their flowers regular. The *Limnanthes Rosea* (fig. 244) is a native of California.

§ 83. LINACEÆ.

Characteristics: Sepals five or four, either free or joined at the base, persistent; petals five or four hypogynous, contorted in æstivation, caduceous; stamens slightly monadelphous, five or four, frequently ten, of which the five external ones are fertile, the remainder barren; ovule four, five, or three celled, biovulate, each divided into two cells; ovules pendent, reflex; styles three to five filiform; stigmas capitular; capsule septicidal; seed dicotyledonous, exalbuminous; stem herbaceous or sub-ligneous; leaves simple without stipules; flowers regular.

245. Common Flax (Linum Usitatissimum).

This small family, composed of two genera, is dispersed over the temperate regions of the entire world. The common Flax (*Linum Usitatissimum*, fig. 245) is indigenous to southern Europe and the East. In France vast tracts are devoted to its cultivation. The testa contains an abundant mucilage, which confers on the seed its emollient properties.

The use of Linseed meal as a poultice material is very familiar. These seeds contain a fixed oil, obtainable by expression, and employed in a great variety of useful operations; it is especially useful as a vehicle for mixing paint. It is naturally a drying oil, and its drying property is further augmented by boiling with oxide of lead.

§ 84. ZYGOPHYLLACEÆ.

Characteristics: Calyx free, five or four partite; petals hypogynous, free, equal in number to the divisions of the calyx; imbricated in æstivation; stamens equal in number to the petals; ovary plurilocular; ovule reflex; capsule loculicidal or separating into shells; seed dicoty-

246. Guiacum (Gajacum Officinale).

ledonous, exalbuminous; embryo imbedded in a cartilaginous albumen; stem herbaceous or woody; leaves opposite, pennate, furnished with stipules.

The principal member of this natural family is Guiacum (*Gajacum Officinale*, fig. 246). It is a large West Indian tree, the wood of which is exceedingly hard, and known by the commercial name of *Lignum Vitæ*.

§ 85. DIOSMÆ.

Characteristics: Calyx four or five partite; petals equal in number to the divisions of the calyx, inserted upon a hypogynous or almost peri-

247. Dictamnus Fraxinella.

gynous disc, ordinarily free; stamens equal in number to the petals, sometimes double the number; ovaries free or coherent to a variable extent; ordinarily biovulate; styles distinct at their base, coherent at their summit; capsule many-valved, having a smooth cartilaginous endocarp opening by its own elasticity into two lobes; seed dicotyledonous; stem ordinarily ligneous; leaves without stipules or provided with two glands at the base of each petiole.

The Diosmæ are for the most part natives of South Africa and New Holland. Their properties are dependent on the presence of a resin and a volatile oil, occasionally mingled with a peculiar bitter principle: this is especially the case as regards the sub-tribe *Cusparieæ*. Among the Cusparias the first in importance is the *Galipea Cusparia*, a tree which constitutes vast forests on the banks of the Oronoco. Its bark is known in commerce under the name of *Angustura*. The *Diosma Crenata* (*Buchu*) is a native of the Cape. Its leaves are employed as a valuable medicine. Many species of Diosma are now cultivated in Europe, among which the *Lemonia Spectabilis*, a native of Cuba, and *Dictamnus Fraxinella* (fig. 247) are the most remarkable. The latter is indigenous to central France, and is noticeable for the large amount of inflammable gas which it secretes, so that if in the evening of a hot day a flame be caused to approach a mass of these plants, the combustible atmosphere around them takes fire, the plants themselves remaining uninjured.

§ 86. ZANTHOXYLACEÆ.

Characteristics: Calyx free; petals hypogynous, equal in number to that of the divisions of the calyx; convolute or imbricated in æstivation; caduceous, rarely absent; stamens equal in number to the petals or double the latter; carpels elevated on a *stipes*, free or coherent at their base, or sometimes completely aggregated into a many-celled ovary, each containing two or four reflex ovules; fruit various; seed dicotyledonous; embryo imbedded in the axis of a fleshy albumen; radicle superior.

The Zanthoxylaceæ are inhabitants of the tropical and sub-tropical regions of America and Asia.

§ 87. MENISPERMACEÆ.

Characteristics: Sepals free, caduceous; petals three, six, or twelve, hypogynous, usually free, sometimes absent; stamens equal in number to the sepals, rarely more; filaments free, sometimes monadelphous;

ovaries many, free, uniovulate; ovules curved; fruit bacciform or coriaceous; seed straight or curved; embryo very large, slightly albuminous, or albumen totally absent; the stems of members of this natural order are flexible, climbing; leaves alternate, simple, without stipules; flowers ordinarily diclinal.

The Menispermaceæ chiefly inhabit the intertropical regions of Asia and Africa. The root of Colombo (*Cocculus Palmatus*), a member of this natural order, a native of eastern Africa, is much employed in medical

248. Menispermum Canadense.

practice as a tonic, as is also the Pareira Brava (*Cissampelos Pareira*), a native of the West Indies. The *Cocculus Indicus* is the fruit of the *Anamirta Cocculus*, a native of tropical Asia, where it is much employed as an agent for stupefying fish. To eat the fish thus stupefied is, however, not altogether free from danger. The active principle of *Cocculus Indicus* is *picrotoxine*, a crystalline alkaloid body scarcely less dangerous than strychnine. Many species of Menispermaceæ are now cultivated in European gardens, amongst which the *M. Canadense* (fig. 248) is most prominent.

§ 88. SCHIZANDRACEÆ.

Characteristics: Sepals three to six; petals hypogynous, six to nine, free, pluriserial; stamens indefinite; ovaries numerous, borne on a stipes, free, occasionally coherent, biovulate; ovules pendent; berries capitulous or on a spike; seed dicotyledonous; embryo straight, small, at the base of a fleshy albumen; stem ligneous, twig-like; leaves alternate, simple, ex-stipulate.

The members of this small family are natives of Japan and North America. They contain a mucilaginous juice devoid both of aroma and of acridity.

§ 89. MYRISTICACEÆ.

Characteristics: Flowers diœcious; calyx two to four partite; corolla absent; stamens monadelphous; ovary single, unilocular; ovules one or

249. Nutmeg (Myristica Moschata).

two erect, reflex; berry capsular, one celled, bi-valved; seed solitary, enveloped by a fleshy arillus.

The Myristicaceæ are trees or shrubs growing in tropical regions; their leaves are alternate, simple, entire.

The Nutmeg (*Myristica Moschata*) is the most celebrated member of this family; it is indigenous to the *Moluccas*, but now extensively cultivated in America.

§ 90. ANONACEÆ.

Characteristics: Sepals three; petals hypogynous, six biserial; valvate in æstivation; stamens ordinarily indefinite, multiserial; carpels

250. Anona Squamosa.

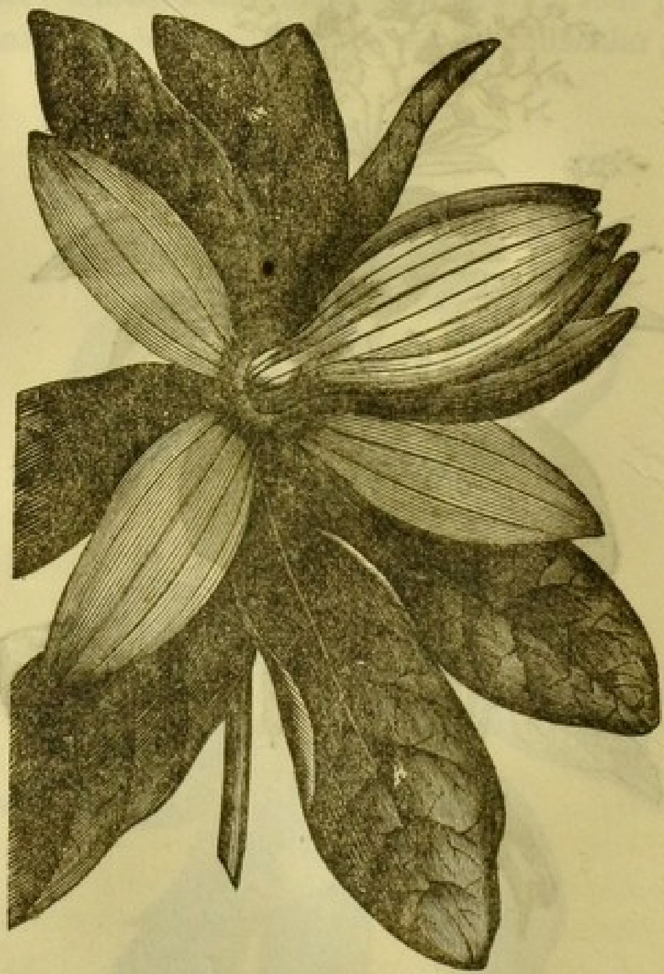
numerous, free, or almost free, composed of one or more erect or ascendant ovules; fruit capsular or bacciform; embryo small, at the base of a ruminated albumen; stem ligneous; leaves alternate, simple, entire, without stipules.

The Anonaceæ inhabit almost every part of the torrid zone; their bark is aromatic and stimulant, sometimes acrid or nauseous. The flowers have for the most part an agreeable odour.

The Anonas produce delicious fruits; *A. Cherimolia*, a native of Peru, is the most celebrated. The *A. Muricata* and *A. Squamosa* (fig. 250) also are good fruit-bearers; the fruits not merely gratifying the senses of taste and smell, but pleasing the eye also on account of their elegant shape.

§ 91. MAGNOLIACEÆ.

Characteristics: Sepals three, rarely two, or four, or six; petals hypogynous at the base of an elongated receptacle, six or more in number, and free; stamens indefinite; ovaries numerous, either free or partially



251. Magnolia Thompsoniana.

coherent; bi- or pluri-ovulate; ovules pendent, reflex; fruit various in character; carpels pedicelled, free, or coherent into a spike; dehiscent or indehiscent, dry or fleshy; seeds having an elongated funiculus; embryo very small at the base of a fleshy albumen.

The Magnolias are beautiful trees of South America and tropical Asia, possessing large, often persistent leaves, and magnificent flowers. The *M. Glauca* is a rustic shrub about fifteen feet high, having leaves yellow beneath, and very odorous white flowers. The *M. Thompsoniana* (fig. 251), a variety of the preceding, is a fine pyramidal tree about twenty feet high, and differing from the *M. Glauca* in the circumstance of possessing larger leaves, and flowers five inches in diameter.

§ 92. DILLENIACEÆ.

Characteristics: Sepals free; petals free, hypogynous; stamens indefinite; ovaries several, free, or nearly free; ovules one or many, ascendant

252. Hibbertia Volubilis.

and erect, reflex; capsules follicular or bacciform, free or coherent; seed dicotyledonous, small, at the base of a fleshy albumen.

Dilleniaceæ are allied to Magnoliaceæ, from which they are separated by the characteristics of the number and lateral position of their stamens, the quinary division of their floral envelopes, always uniserial, and their astringent properties. They differ from Ranunculaceæ in their general aspect, their unilateral stamens, their seed arillus, and their astringent qualities. They are for the most part inhabitants of Asia and America, south of the equator. The bark of many species is employed by tanners. The fruit of many species is sour. The *Hibbertia Volubilis* (fig. 252) is an evergreen climbing shrub, indigenous to Australia.

§ 93. HYDROPELTIDEÆ.

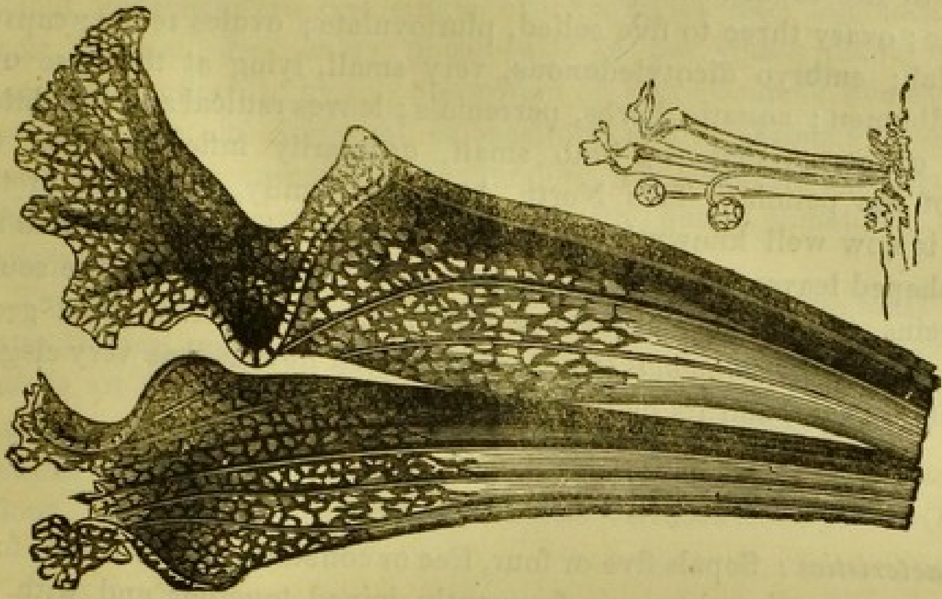
Characteristics: Sepals three or four petaloid; petals hypogynous, equal in number to the sepals; imbricated in æstivation, persistent; stamens double or multiple the number of the petals; carpels two or more, free, two or three superior ovules, pendent, reflex; fruit indehiscent; stem floating; leaves inferior, opposite, submerged, with capillary segments, the upper leaves alternate, and floating, orbicular or peltated in form.

§ 94. DROSERACEÆ.

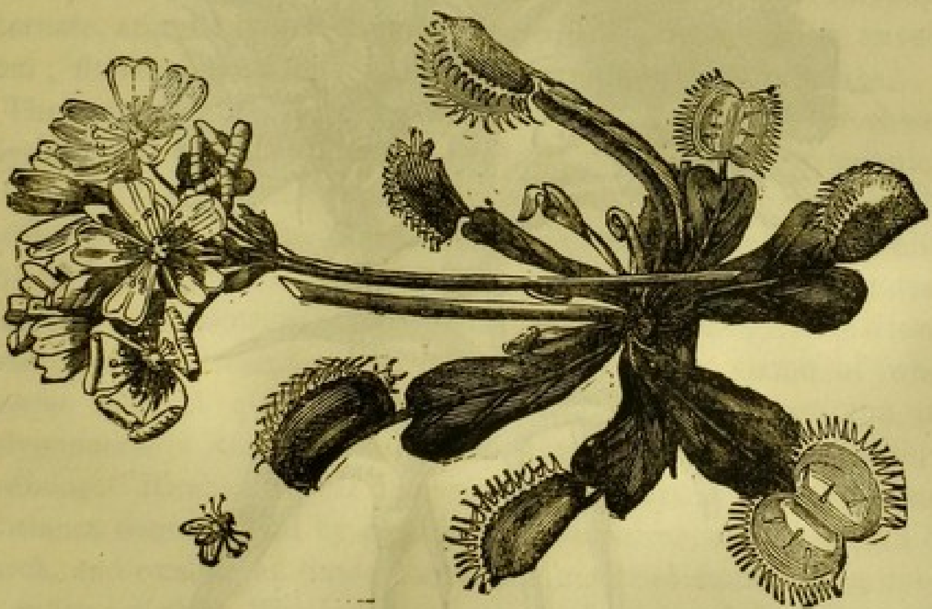
Characteristics: Sepals five to nine, free or almost free; petals hypogynous, five, alternate with the sepals; imbricated in æstivation; stamens equal in number to the petals, or some multiple of that number; anthers extrorsal; ovary free; placentæ parietal; three or ten ovules reflex; styles free; stigmas capitate; capsule loculicidal with seminiferous valves; albumen fleshy; stem herbaceous, occasionally subligneous, covered with glandular hairs; leaves alternate or radical, ciliated and without stipules; flowers solitary or in one-sided racemes.

The principal species belonging to this natural order is *Drosera*, all the members of which are acrid, bitter, vesicating, and generally dangerous.

The *Dionæa Muscipula*, or Venus's Fly-trap (fig. 253), is a biennial plant of Carolina, the excitability of which is fatal to flies and other insects. Its leaves are each terminated by two rounded plates fringed with sharp spikes. Between these two plates is a hinge on which they turn, closing together like the two sides of a book-cover. On the upper face of each leaf there are two or three small glands which secrete a saccharine liquor. This attracts flies and other insects, which, however, no sooner touch the leaf, than the two sides, turning on their common hinge, close upon the insect—thus caught in a trap.



254. Sarracenia Drummondi.



253. Venus's Fly-trap (Dionæa Muscipula).

§ 95. SARRACENIACEÆ.

Characteristics: Sepals three to five; petals hypogynous, equal in number to the sepals, alternate with them, and unguiculated; stamens indefinite; ovary three to five celled, pluriovulate; ovules reflex; capsule loculicidal; embryo dicotyledonous, very small, lying at the base of a fleshy albumen; aquatic herbs, perrenials; leaves radical and petiolated, tubular or cornet-shaped; limb small, ordinarily inflected upon the orifice of the petiole. This North American family, composed of two genera, is now well known in European gardens. The *S. Purpurea* has cornet-shaped leaves, sinuous and ventricose, tinged red along the course of the veins, and on the margins; flowers red, purple without and green within. The *S. Drummondi* (fig. 254) bears red flowers, has very elegant grotesque cornets, and its height is about two feet.

§ 96. CARYOPHYLLEÆ.

Characteristics: Sepals five or four, free or coherent; petals five or four, hypogynous or subperigynous, frequently joined together and with the

255. Dianthus Barbatus and D. Cruentus.

base of the stamens; stamens double in number to the petals, and arranged in two series, the interior ones opposite to the petals, and sometimes equal to them in number; pistil on a stipes, two or three carpelled, coherent into one single ovary; styles free, stigmatiferous on their internal side; ovary plurilocular in the young plant, ordinarily becoming unilocular by the absorption of commissures; ovules curved; fruit capsular and dehiscent, or bacciform and indehiscent; seed dicotyledonous; embryo curved, surrounding a farinaceous albumen; stem herbaceous or subligneous; leaves opposite, entire, sometimes stipuled; inflorescence definite.

The Caryophylleæ are cosmopolites, inhabiting for the most part the extra-tropical regions of the northern hemisphere. The *Saponaria Officinale* is an indigenous plant, the root of which contains a soapy matter, lathering with water almost like soap, a soft resin, and gum. The Carnations are general favourites on account of their floral beauty and sweet odour. A representation of two favourite varieties is subjoined (fig. 255).

§ 97. POLYGONACEÆ.

Characteristics: Perianth herbaceous or petaloid; sepals three, four, or five, coherent to a variable extent; stamens perigynous or hypogynous, four to ten; ovary unilocular, uniovulate, triangular or compressed; ovule, erect, straight; styles two or three; fruit an achænium or caryopsis; seed dicotyledonous, inverted; embryo straight or curved, imbedded in a farinaceous albumen; stem ordinarily herbaceous; leaves alternate, stipulate, the stipules forming an ochrea which envelopes the stem; flowers minute, arranged in cymes, spikes, or corymbs.

The members of this natural family have a similarity of chemical and physiological properties, which confirms the propriety of botanical classification. The herbaceous portions of many species contain oxalic, citric, and malic acids, and are for the most part both medicinal and alimentary. The farinaceous seeds of many species serve as good substitutes for the Cereals. The roots of many species contain astringent matters, united sometimes to a resinous and bitter principle, in virtue of which they possess medical qualities. In the first rank amongst the medicinal Polygonaceæ is Rhubarb, celebrated from times of remote antiquity as a medicine. Rhubarb owes its valuable properties to the presence of a substance denominated by chemists *rhubarbarine*, a fixed oil, a little gum, starch, and oxalate of lime; the latter material constituting one-third of its entire weight. The botanical origin of Rhubarb is still enveloped in great obscurity. The Arabs received it in the tenth century from the Chinese, and made it known in Europe; but the Chinese indicated with considerable vagueness the locality of the plant, and altogether refused to supply any of its seeds or cuttings, even though an equal weight of gold was frequently offered as a premium. Three sorts of medicinal Rhubarb are known in commerce; that of China, which comes to us from Thibet and Canton; that which comes to us through Russia (commonly known as Turkey Rhubarb); and the Rhubarb of Persia. Of the various species which have been brought to Europe and planted in our gardens, the *Rheum Palmatum* is the only one which yields a result at all like that of the Oriental Rhubarb; but it is still distinguishable from the latter. The *R. Australe*, procured originally from the Thibetian mountains, and culti-

256. Rheum Rhaponticum.

vated in Calcutta, still more closely resembles the Chinese Rhubarb; probably, therefore, the medicinal root is obtained from this species, though the subject is enveloped in much doubt.

The *Rheum Rhaponticum*, another species of Rhubarb, grows spontaneously in Thrace and on the shores of the Black Sea. This is the species which was known to the ancient Greek and Roman physicians, who gave to it the name of *Rha*. Subsequently this name was expanded into *Rha-ponticum*, for the purpose of distinguishing the vegetable from another *Rha*, the produce of Scythia, and designated *Rha-barbarum*, whence our modern word Rhubarb. A representation of the *Rheum Rhaponticum* is annexed (fig. 256).

§ 98. LAURACEÆ.

Characteristics: Perianth calycöidal, four to six partite, biserial, tri-nerved, imbricate; stamens perigynous, inserted upon a fleshy disc, springing from the base of the perianth, and persistent, in number double, or triple,

257. Laurus Camphora.

or quadruple that of the sepals, sometimes equal and then opposite to the sepals; filaments free, the internal ones provided with two lateral glands; anthers adnatant, bilocular, or quadrilocular, sometimes all introrsal; sometimes the interior ones introrsal, the others extrorsal; carpels three united into one; ovary unilocular; ovule single, pendent, reflex; style simple; stigma trilobed; fruit bacciform, protected by the base of the perianth; seed dicotyledonous, straight, exalbuminous; stem ligneous;

bark aromatic; leaves alternate, aromatic; flowers axillary, or in a cyme, panicle, or umbel.

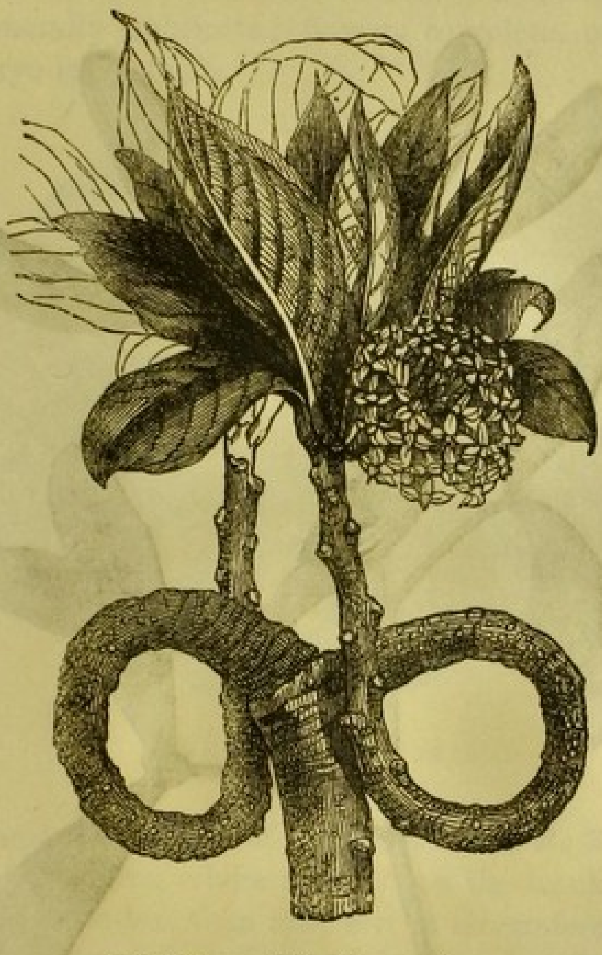
The Bay tree (*Laurus Nobilis*), indigenous to central Europe, is a tree or shrub, with persistent leaves, coriaceous, smooth, and possessing an agreeable odour. The Sassafras (*Laurus Sassafras*) is a native of Virginia, Florida, and Brazil. Every part of this tree is endowed with a peculiar odour, something like a combination of Fennel and camphor. The wood of this tree is employed in medicine. The *Laurus Cinnamomum*

258. Laurus Cinnamomum.

furnishes the aromatic bark known by the name of *cinnamon*. It is cultivated in Ceylon and other intertropical countries. The *Laurus Cassia* is a native of Cochin-China, Malabar, and some parts of China Proper. Its bark is thicker than that of the true Cinnamon tree, and its colour deeper. Camphor is another valuable production from one of the Laurel tribe, the *Laurus Camphora,* a native of Japan; not that the substance known as camphor is only found in this vegetable. In small quantities it exists in many of the natural order Labiatæ.

§ 99. THYMELACEÆ.

Characteristics: Perianth tubular, petaloid; stamens perigynous, their number equal to the divisions of the perianth, occasionally double or fewer; ovary free, unilocular; ovules pendent; fruit drupaceous or in nuts, ordinarily one seeded, exalbuminous; stem usually ligneous; leaves simple.



259. Edgworthia Chrysantha.

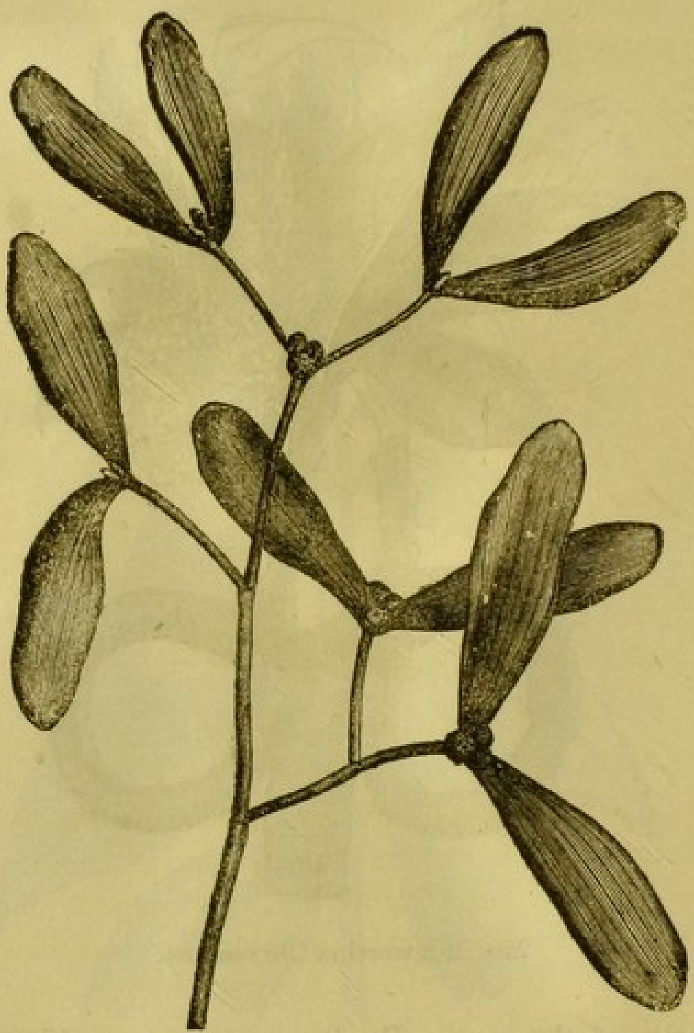
All the species of the genus *Daphne* contain an acrid principle, which gives them a vesicating property. The *Daphne Fortuna* is a very beautiful plant; it was brought from China by Mr. Fortune, some years ago, and is now cultivated in England. This gentleman also introduced the *Edgeworthia Chrysantha* (fig. 259). It is a very beautiful member of the Daphne genus.

§ 100. LORANTHACEÆ.

Characteristics: Calyx adherent to the ovary; petals free or coherent, epigynous, four, six, or eight, valvate in æstivation; stamens opposite to the petals or to the divisions of the simple perianth; ovary unilocular; ovule pendent; berry one seeded; embryo placed at the surface of an abundant fleshy albumen; small dichotomous shrubs, always parasite; leaves opposite, entire; flowers sometimes diœcious.

Members of this natural family inhabit for the most part the intertropical regions. Their bark contains adhesive material, very similar to birdlime, intermediate in its general nature between wax and caoutchouc.

The Mistletoe (*Viscum Album*, fig. 260) is the only species which

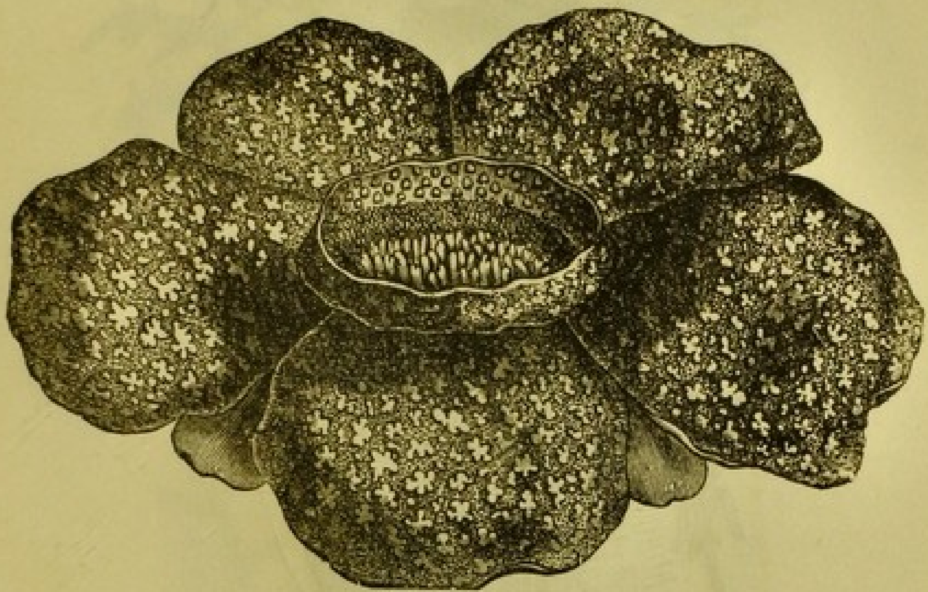


260. The Mistletoe (Viscum Album).

represents the family in our own land. It is a diœcious plant, with thick fleshy leaves, greenish flowers scarcely apparent, and sessile. The Mistletoe was much reverenced by the ancient Druids, who attributed to it various mysterious properties. Even at this day the inhabitants of Java entertain a superstitious respect for the *Ficus Religiosa*, upon which an individual of the natural family Loranthaceæ grows. They believe that the shades of their ancestors wander under the vaulted canopy formed by these curious trees, and are gladdened by a view of the parasites.

§ 101. HYDNORACEÆ, RAFFLESIACEÆ, CYTINACEÆ, APODANTHACEÆ, AND BALANOPHORACEÆ.

These five families constitute the class of so-called Rhizanths, the characteristics of which are as follow. Plants composed of cellular tissue, pervaded by a few vessels; parasites upon the roots or stems of other plants; leaves reduced to mere scales, never green, deprived of stomata, and vessels, generally imbricate; flowers complete, or polygamous, or diœcious; embryo inseparable.

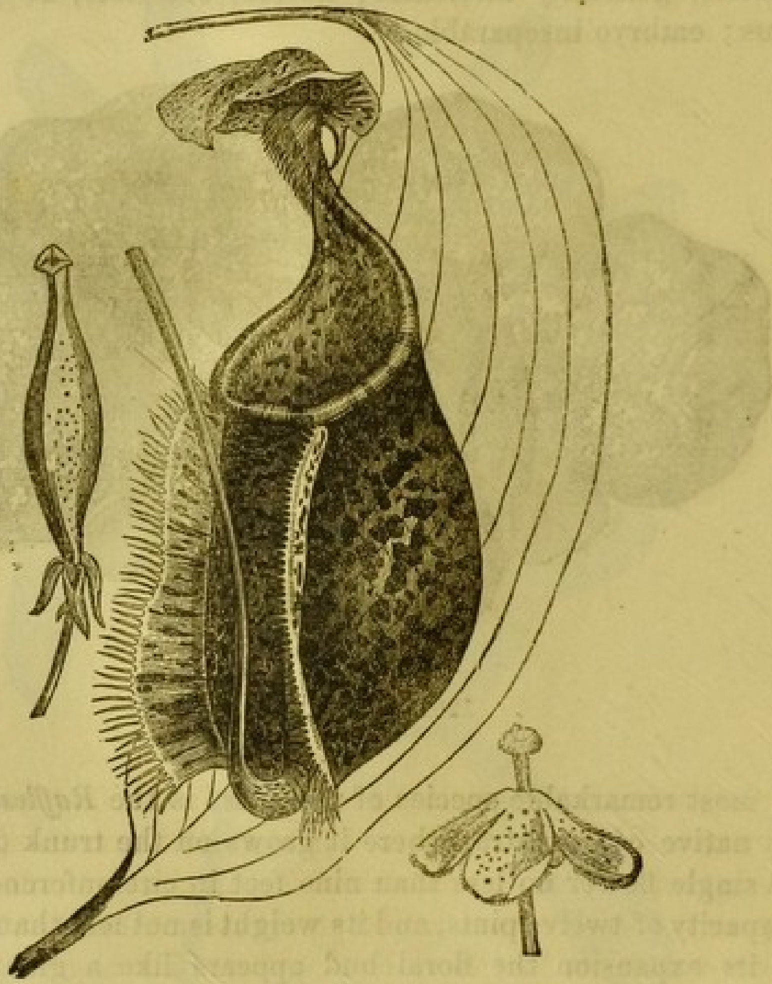


261. Rafflesia Arnoldi.

The most remarkable species of this class is the *Rafflesia Arnoldi* (fig. 261), a native of Sumatra, where it grows on the trunk of a Cissus, and bears a single flower no less than nine feet in circumference. Its nectary has a capacity of twelve pints, and its weight is not less than fifteen pounds. Before its expansion the floral bud appears like a great Cabbage; the bracts soon expand and the perianth becomes developed. Its fleshy colour and cadaverous odour attract flies and other insects, which are necessary to the process of its fecundation.

§ 102. NEPENTHEÆ.

Characteristics: Subligneous plants of tropical Asia and Madagascar; flowers in racemes, diœcious; perianth herbaceous, four partite; stamens sixteen, coherent in a central column; ovary free, four celled; capsule loculicidal. The *Nepenthes*, type of this family, possesses alternate leaves, the petiole contracted at its base, but further on expanding into a flat limb, but its mid-rib is prolonged, and bears a new foliaceous expansion like a pitcher in form, supplied with a cover attached by a kind of hinge, on which it opens and shuts. The pitcher closed at night is open during the day, and secretes on its interior a fluid, insipid in some species, slightly saccharine in others. The largest and finest species was discovered about thirty years ago at Singapore by Sir Stamford Raffles, and has received the name of *Nepenthes Rafflesiana* (fig. 262).



262. Nepenthes Rafflesiana. (1) The Leaf. (2) The Male Flower. (3) The Fruit.

§ 103. PAPAYACEÆ.

Characteristics: Flowers diœcious; calyx very small, five-dentated; petals hypogynous, five—joined into a funnel-shaped body in the staminiferous flowers; remaining free in those bearing pistils merely: stamens ten; ovary unilocular or five-celled; placentæ parietal; berry pulpy; seed albuminous; trees of tropical America with a milky juice.

The *Carica Papaya* (fig. 263) is a tree with cylindrical trunk, simple, and bearing at its summit a terminal tuft of palmilobed leaves. This tree has been known to grow twenty feet in the space of three years. Its staminiferous flowers are in long multifloral racemes. Its pistils are almost sessile. Fruit about the size of a little melon, a delicious article of food, either in its raw state or cooked. The milky juice of the stem and leaves contains a fibrinous matter, which has the singular property, that on pouring

263. Carica Papaya.

a few drops of it into water, and steeping in this water for the space of a few minutes raw meat, the latter becomes remarkably tender. The same result is obtained by enveloping the meat in leaves of the tree, or even by suspending it from the tree; but in any case the meat must be eaten immediately after cooking, otherwise it rapidly spoils.

§ 104. BEGONIACEÆ.

Characteristics: This natural order only contains one single genus, *Begonia*. They are plants inhabiting tropical regions, having alternate stipulate leaves and monœcious flowers; perianth petaloid; tube adherent to the ovary; stamens numerous; ovary inferior, trilocular, multiovular; capsule triangular, loculicidal, three valvular; embryo occupying the axis of a fleshy albumen. These plants contain oxalic acid, the presence of which, in conjunction with stipules and the nature of the perianth, causes them to approach the *Rumex* tribe. Numerous species are cultivated in the hot-houses of Europe, of which the plant represented below (fig. 264) is the newest imported and most magnificent.

264. Begonia Coccinea.

§ 105. EUPHORBIACEÆ.

Characteristics: Flowers diœcious and generally without calyx or corolla; sepals free or joined, ordinarily valvate in æstivation; ovary usually three celled; uni- or bi-ovulate; carpels joined with a central styliferous axis; fruit capsular, with dry or fleshy epicarp separating in valves; seeds pendent; embryo dicotyledonous, straight, in the axis of a fleshy albumen.

The greater number of this species contain a milky, acrid, and poisonous juice, which often holds dissolved, in addition to other principles, a peculiar elastic substance, and occasionally colouring matter. The seeds are oily, the root is sometimes feculent. The *Euphorbiums*, the type of this natural order, present an aspect of great variety; certain members possess a fleshy stem, angular and spiny, very much resembling Cactuses; others

265. The Manchineel (Hippomane Mancinella).

have normal leaves and stems. Many of the African, Arabian, and Indian species furnish an exudation, which, when thickened by the sun, becomes the commercial Euphorbium. The Manchineel (*Hippomane Mancinella*, fig. 265) is a fine tree of intertropical America, celebrated for its peculiarly poisonous qualities. If accounts are to be trusted, it is certain death for an individual to sleep under one of this species; and even rain which touches the skin after having fallen upon the leaves of this tree raises a blister. The Manchineel tree also bears tempting-looking fruit, from which an agreeable odour is exhaled, but even a small portion, if eaten, is certain death.

Castor oil is expressed from the seeds of one of the Euphorbiaceæ, *Ricinus Communis* (fig. 266).

The genus *Manioc* contains two important species, both especial objects of cultivation in many parts of America on account of their feculent root. The *M. Alpi* is eaten by the natives after being roasted in hot cinders;

266. The Castor Oil Tree (Ricinus).

animals eat it raw. The *M. Utilissima* contains in its root a juice charged with prussic acid, or a material which readily produces this acid by decomposition. Nevertheless, the natives where the tree grows derive an abundance of nutritive matter from this vegetable, much of which is exported under the name of Tapioca.

§ 106. CANNABINACEÆ.

Characteristics: Flowers diœcious; perianth of staminiferous flowers, calyciform, perianth of the pistilliferous flowers reduced to a bract; ovary unilocular, one or two styled; ovule single, pendent, curved; fruit a small nut or achænium; seed exalbuminous, bent back; stem herbaceous; leaves stipuled, opposite, or occasionally the superior ones alternate.

The genera *Cannabis* and *Humulus* compose this small family. Hemp (*Cannabis Sativa*), a native of Persia, has leaves palmate or dentate in segments. The individual on which the staminiferous flowers grow has a more withered aspect and sooner dries up than the other, to which the appellation *Female Hemp* is commonly applied. The male individual is that from which the substance hemp is obtained. The Hop (*Humulus Lupulus*, fig. 267) is a well-known plant, having a climbing angular

267. The Common Hop (Humulus Lupulus).

stem and cordate, lobed leaves. Its achænium and its bracted calyx are studded with glands containing a bitter aromatic substance, slightly narcotic in quality, and on which the virtues of the hop depend. It is termed by chemists *humuline*.

§ 107. LOGANIACEÆ.

Characteristics: Corolla monopetalous, hypogynous, four to ten partite; stamens in number equal to that of the lobes of the corolla; ovary two

Virgin Forest in South America.

to four celled, each containing one or more ovules; leaves opposite; juice aqueous; fruit capsular, or follicular, or fleshy; seed dicotyledonous, albuminous.

The sub-family *Strychnos* contains the most remarkable species of this natural order. The greater number possess in their bark and seeds two alkaline principles termed respectively *strychnia* and *brucia*. The action of these on the animal organism is extremely violent. The *Strychnos Tieute* is a climbing plant of the Javan forests, with the juice of which the natives poison their arrows. It is the celebrated Pohon Upas, frequently confounded with another Javanese vegetable poison, obtained from the *Antiaris Toxicaria*, a tree belonging to the natural family *Artocarpeæ*.

The *Curara*, or *Wooara*, is also a poison furnished by another member of the same natural family, the *S. Toxifera*, a native of Guiana. The Indians who dwell on the banks of the Oronoco, the Ipura, and the Rio Negro, employ this substance as a poison for their arrows.

The *Nux Vomica* tree (*Strychnos Nux Vomica*) is perhaps the most valuable of the tribe, furnishing an alkaloid (strychnia) very poisonous, but of great use in medicine.

§. 108 APOCYNACEÆ.

Characteristics: Corolla hypogynous, monopetalous, regular, four or five partite; contorted or valvate in æstivation; stamens inserted upon the corolla in number equal to the lobes of the former; pollen granular; ovary free, bi-carpelled; fruit capsular, or follicular, or fleshy; seed dicotyledonous, straight, ordinarily albuminous; leaves opposite or verticillate; juice milky.

The term *Apocynaceæ* is derived from the genus *Apocynum*, which means the *dog-killer*, certain species being dangerous to animals. The Apocynaceæ are usually trees or shrubs, seldom herbs, and for the most part containing a milky juice.

This natural order is rather frequent in tropical climates, but the number of species is very inconsiderable in our latitudes. The milky, acrid, and bitter juice which flows from many of this natural species imparts to the family an emetic and purgative tendency, which in some species is deleterious. The bark of many Apocyns contains a bitter astringent principle, in other species a tinctorial matter predominates. The fleshy fruit of others is eatable. The seed of many genera is poisonous, whilst that of others is oily and inoffensive.

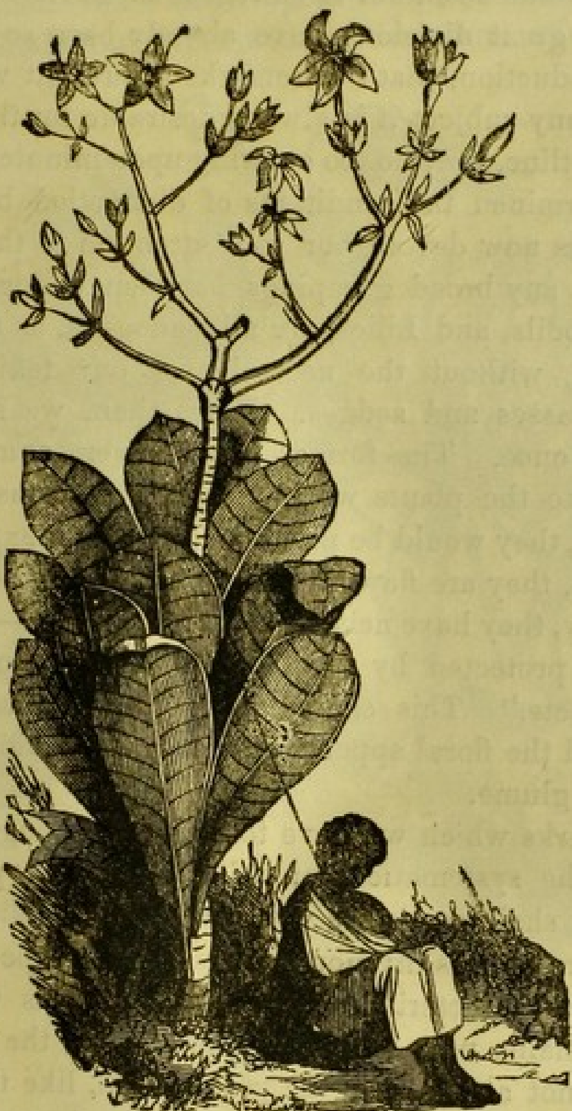
Many species of the genus *Cerbera*, as well Asiatic as American, possess narcotic acrid seeds, sometimes poisonous, but useful as a remedy for the bites of serpents. The *C. Ahovaï* secretes an exceedingly

269. Cerbera Ahovai.

268. (1) Tabernæmontana Longiflora. (2) Roupellia Grata. (3) Dipladenia Atropurpurea.

poisonous juice, which is employed in Brazil for the purpose of stupefying fish.

The poisonous Tanghin (*Tanghinia Venenifera*, fig. 270) is a native of Madagascar, about thirty feet in height, yielding a drupaceous fruit which contains an oily seed, and employed by the natives judicially in the trial by poison. The accuser makes his complaint to the judge, who refers it to



270. Tanghinia Venenifera.

an official denominated the *Ampananghin*, and whose office is the double one of priest and executioner. If sufficient presumptive evidence of crime be forthcoming, the *tanghin* is administered, and the guilt or innocence of the accused is judged of by the result. If he recovers from the effects of the poison, he is proclaimed innocent; if he dies, he is considered guilty, and his goods are forfeited.

ON ENDOGENOUS PLANTS.

Having devoted thus much consideration to exogenous plants, it is time for us to pay some attention to endogenous ones. The distinctions between these two great divisions have already been so fully mentioned in the general introduction, that our remarks at present will be but few.

In the study of any subject it is always desirable for the mind to grasp a certain general outline, previous to entering upon minuter characteristics. Having, then, determined the conditions of distinction between exogens and endogens, let us now devote our sole attention to the latter, and see if we can recognise any broad groupings between endogens themselves. Well, Tulips, Daffodils, and Lilies, are all endogens, as their leaves will abundantly testify, without the necessity of our taking any further trouble; so are grasses and sedges. Here, then, we may recognise a natural division at once. The former have flowers composed of sepals and petals, just like the plants we have already discussed; but as for grasses and sedges, they would be pronounced by an inexperienced person flowerless; indeed, they are flowerless in the ordinary acceptation of the term—that is to say, they have neither calyx nor corolla,—but their reproductive organs are protected by peculiar modifications of those changeable bodies, "bracts." This character of inflorescence is said to be "glumaceous," and the floral appendage of a grass is said, in the language of Botany, to be a glume.

In the few remarks which we have to make on endogenous plants, we shall not follow the systematic plan of giving them precise botanical characteristics, but shall generalise with a view of enabling the reader to regard the members of this division under a broad aspect. In addition, then, to the great characteristics of the endogenous division already enumerated, it remains now to be mentioned that the leaves of endogenous plants are not attached to the parent stem, like those of exogens, by a joint or axil; and that the calyx, corolla, and reproductive organs have a tendency to the number three, or some multiple of that number; whereas the corresponding parts of exogens assume for the most part the number five, or its multiples. Not that the rule is invariable, but it is very general. By examining Lilies, Tulips, &c., and comparing them with exogens, the reader will satisfy himself of the correctness of this remark (fig. 271).

The common garden Asparagus is regarded by botanists as a Lily, as in like manner are the gigantic Dragon-trees, as was noticed at p. 4.

For the most part endogenous plants have no branches, but send one trunk or stem aloft. To this, however, there are a few exceptions.

Asparagus is branched, as everybody knows. The Dragon-tree is also branched, and so is the Doom Palm of Upper Egypt.

Let us now proceed to an examination of the Grasses—vegetables which constitute a most valuable and very well characterised natural order, designated by the botanical term *Graminaceæ*.

The Grasses, though generally unpretending in aspect, are, without doubt, more useful than any vegetable productions whatever. The smaller species clothe our fields with verdure, and afford nourishment to

271. (1) Nankin Lily (Lilium Testaceum). (2) Methonica Leopoldi. (3) Elegant Lily (Lilium Speciosum). (4) Cumingia Trimaculata.

cattle. The large species furnish us with bread and sugar; for at this period of our botanical investigations the reader need not be informed that Wheat, Barley, Rice, Maize, Oats, Rye, and the Sugar-cane, are all Grasses. The slightest inspection of a leaf of one of this tribe suffices to indicate that Grasses are internal growing, or endogenous plants. An examination of the seed affords similar information. These matters scarcely require notice, their perception is so evident. The flower of a Grass, however, is a very curious arrangement of parts, unlike anything which has yet come under our notice; petals and sepals being altogether absent, and the external parts of the flower being exclusively composed of green or brown scales, called *glumes;* hence Grasses are said to possess a glumaceous flower. These scales, to which the term *glume* is applied, are no other than bracts, which we have already seen to be capable of such extraordinary metamorphoses, becoming in the Oak an acorn-cup, in the Pine-apple the part we eat.

Grasses are not excluded from any quarter of the globe; but the number of individuals, though not of species, is greatest in the northern temperate regions. As we approach the equator the number of individuals decreases proportionately with an increase in the number of species. The stem, too, becomes woody, the leaves enlarge, and the organs of reproduction are frequently checked in their development, owing to this luxuriance of vegetation. Grasses have become so transported from one land to another, that it is now quite impossible to determine with certainty the native regions of many species.

Oats and Rye are mostly cultivated towards the north; Barley and Wheat in more temperate regions; Maize in America, and Rice in Asia. The seed, or, more correctly speaking, the fruit, of these afford sustenance to the greater portion of the human species. The analogy of the chemical composition of Grasses indicates not less than their external characteristics their mutual affinity, pointing out the whole family as essentially nutritive vegetables. Their herbaceous part, or, in larger species, their woody stem, is enveloped in a shiny coat of silica, or flinty matter. Internally, the stem contains phosphate of lime, albumen, sugar, and mucilage. The grain, as we will at present denominate the so-called seed, contains starch and gluten in abundance, mixed with a certain quantity of sugar, the amount of which increases towards the period of germination; also, a little fixed oil and various saline matters.

Innocuity and the presence of nutritive principles are the grand characteristics of Grasses physiologically considered. Yet to this description certain species offer an exception: Darnel Grass (*Lolium Temulentum*) is strongly poisonous, owing to the presence of the chemical principle *loline*. *Festuca Quadridentata*, a genus which grows abundantly in Peru, is mortal to cattle which browse upon it. Another species (*Calamogrostis*) is juiceless, and when swallowed by animals injures their throats, rather on account of the flinty matter with which it is profusely coated than because of any poisonous principle. Finally, the rhizome of certain species of the genus *Bromus* is purgative. Amongst the chemical principles contained in many species of Grasses, various odorous matters should not be forgotten. Every person is acquainted with the agreeable odour diffused by hay. This odour depends on the presence of benzoric acid in a species of grass called *Anthoxanthum Odoratum*. The Sugar-cane, moreover, is delicately odorous; its tender shoots filling an apartment with an agreeable fragrance; but the odorous principle is most highly developed in the West Indian Lemon Grass, the leaves of which smell so exactly like those of the Verbena, or Lemon plant, that it is difficult by the test of odour to distinguish between the two. In either case the odorous principle depends on the presence of a volatile oil; indeed, much of the essential oil commonly sold as that of Verbena, is really derived from the West Indian Lemon Grass.

The Sugar-cane is supposed to be a native of the south-eastern portion of Asia. It was totally unknown to the ancient Greeks and Romans, as in like measure was sugar. From south-eastern Asia, the cane was introduced into Arabia; from Arabia it travelled into Egypt, Asia Minor, Sicily, Italy, and Spain. From the latter country it was transported to St. Domingo and continental America. Sugar had preceded the cane in Europe by a considerable period; but there is reason to suppose that the substance, although absolutely identical in composition with that of the cane, was derived, not from it, but from the juice of Palm trees. In Ceylon, the art of manufacturing sugar from the juice of Palm trees has been known to the natives from time immemorial. The manufacture of sugar, however, from the cane was in that island an European introduction. Nevertheless, the Cingalese possessed the cane, and used it by way of dessert. This use of the Sugar-cane still prevails in many countries. Large districts of land in Andalusia are devoted at this very time to the growth of Sugar-cane; not so much with the object of obtaining sugar from the juice, as of furnishing an agreeable dessert.

The corn-bearing Grasses are appropriately denominated *Cereals*, or plants of Ceres, the corn-goddess. Amongst these Wheat takes the first rank. It is more nutritive than either of the others, and adapted to climes and tracts of greater diversities of character. Rice may be correctly described as a tropical water Grass; the conditions necessary to its development being a hot atmosphere and a swampy soil. These conditions only exist in few spots, and fortunately, too, for they are most unfavourable to the health of man.

The Sugar-cane frequently grows to an elevation of twenty feet, and is as thick as a man's arm; but these dimensions sink into insignificance when compared with the Bamboo, which is a veritable tree Grass, giving off lateral branches, and often rising to the elevation of thirty or forty feet.

§ 109. CYPERACEÆ, OR THE SEDGE TRIBE.

This is a natural order very nearly allied to the Grasses, from which they differ, however, in yielding no important product, and in having triangular, whereas Grasses have cylindrical, stems.

§ 110. JUNCACEÆ AND ARACEÆ, THE BULLRUSH AND THE ARUM TRIBE.

These vegetables both possess a very peculiar floral organisation, to which we shall not refer, contenting ourselves with directing the reader's attention to the *spadix*, as the pole-like floral elevation is called, projecting out of a peculiar sheath-like envelope (a bract), termed a *spathe*. This peculiarity points out an alliance between these humble denizens of swamps and hedge-rows and the magnificent Palm trees, princes of the tropical forest, as they have been appropriately termed. They, too, are supplied with this peculiar inflorescence.

§ 111. PALMACEÆ, OR THE PALM TRIBE.

These are not only the largest of all endogenous plants, but certain species are magnificent forest trees, which add a charm to the tropical forest altogether peculiar, and furnish a number of useful products to man;—oil, wine, dates, cocoa-nuts, hemp, cloth *already manufactured!* astringent matter, sugar, and spirit; all these substances, and many others, are furnished by Palms.

Palms are essentially tropical vegetables, and all, except two, are trees of considerable, often of very great, size. There exist, however, two dwarf species, natives of temperate climes. One, the *Chamærops Humilis*, grows in Greece, Italy, Spain, and the south of France; the other, *Chamærops Palmetto*, is a native of North America.

Most tropical localities possess each its peculiar species of Palm trees, and, like cats, Palm trees are fond of their home; seldom thriving when far removed, even though their removal be to a climate and soil apparently similar to those of their native region. There are two exceptions, however, to this rule, and they refer to two very important members of the tribe, namely, the Date Palm and the Cocoa-nut Palm. The latter now flourishes in almost every tropical land; the former is even grown with considerable success so far north as southern Italy and Spain. At Elche, in Valencia, there is a forest composed exclusively of Date Palms, originally planted there by the Saracens. The fruit arrives at moderate ripeness, but is inferior to the Date of Barbary. The greater number of Palm trees like the vicinity of water, and the Cocoa-nut Palm will not grow when removed beyond a certain distance from the sea; whence it happens that there are no Cocoa-nut Palms in Central Africa.

§ 112. CRYPTOGAMIC PLANTS.

These we have already glanced at in a former part of our Outlines. Their organisation is very curious and exceedingly diverse; but in consequence of the absence of flowers, or, at any rate, recognisable flowers, their study is not so easy as that of the floral divisions of nature. The most remarkable tribes belonging to this division of plants are the Mosses, Lichens, Fungi, Ferns, and Sea Weeds, to some of which we shall now direct the reader's attention.

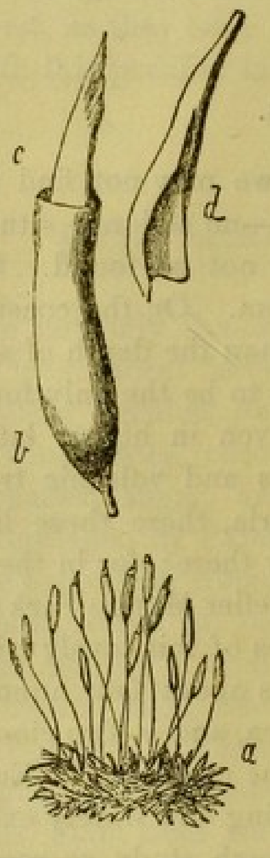
§ 113. MOSSES.

There is no season of the year in which we may not find interest and employment amid the Mosses and Lichens—no soil nor situation where some or other, of one or both families, may not be found. Scarcely any part of the known world is destitute of them. On the coasts of the Icy Sea, where the soil never thaws for more than the depth of a few inches, plants of these kinds are said by travellers to be the only forms of vegetation. In Spitzbergen, Greenland, and even in higher latitudes, they are to be found, as well as on the morasses and volcanic tracks of Iceland; and on the frozen deserts of Siberia, there these little cryptogamous plants may still be seen. Nor only there; for in the arid wastes of burning Africa, it is told us that the traveller Mungo Park was revived and rejoiced by the site of one of the species of this lovely tribe.

The muscology of Britain, which contains about four hundred species, most nearly resembles that of North America, and is also closely allied to that of the northern and central parts of the continent of Europe. It is within less than a century that this interesting and widely extended class of plants has been made the subject of much study or research. The Germans seem to have taken the lead in this branch of Botany, but they have been vigorously followed by many illustrious students of nature among our own countrymen, and new discoveries are daily being made in this department of the vegetable kingdom.

The structure of Mosses is of the simplest kind, Fungi and Lichens alone being below them in the scale of vegetation. With Mosses commence the rudimental characters of root, branches, and leaves, with which parts every plant of this tribe is furnished, and in the place of a flower they have little vessels usually supported on a stalk, and containing the seed. The stems vary from the twelfth part of an inch to a foot in height; few of them, however, exceed four inches, and most being much less. The leaves differ in form, some being egg-shaped, others lance-shaped and very many linear. If examined under a microscope, these will often be found beautifully veined and reticulated; they have generally a bright green hue, which proves the activity of their breathing apparatus; yet there are species brown, purple, and even nearly black, as well as of the palest whitish-green. The edges of the leaves are often toothed, or notched like a saw. Mosses are said to be in fruit when the little seed vessel of which we have spoken is formed.

The fructification of this tribe of plants is very peculiar, and by it, more frequently than by any other part, is the species determined. At certain seasons of the year, we may observe a forest of thin stems



271. Wall Screw-Moss (Tortula Muralis).

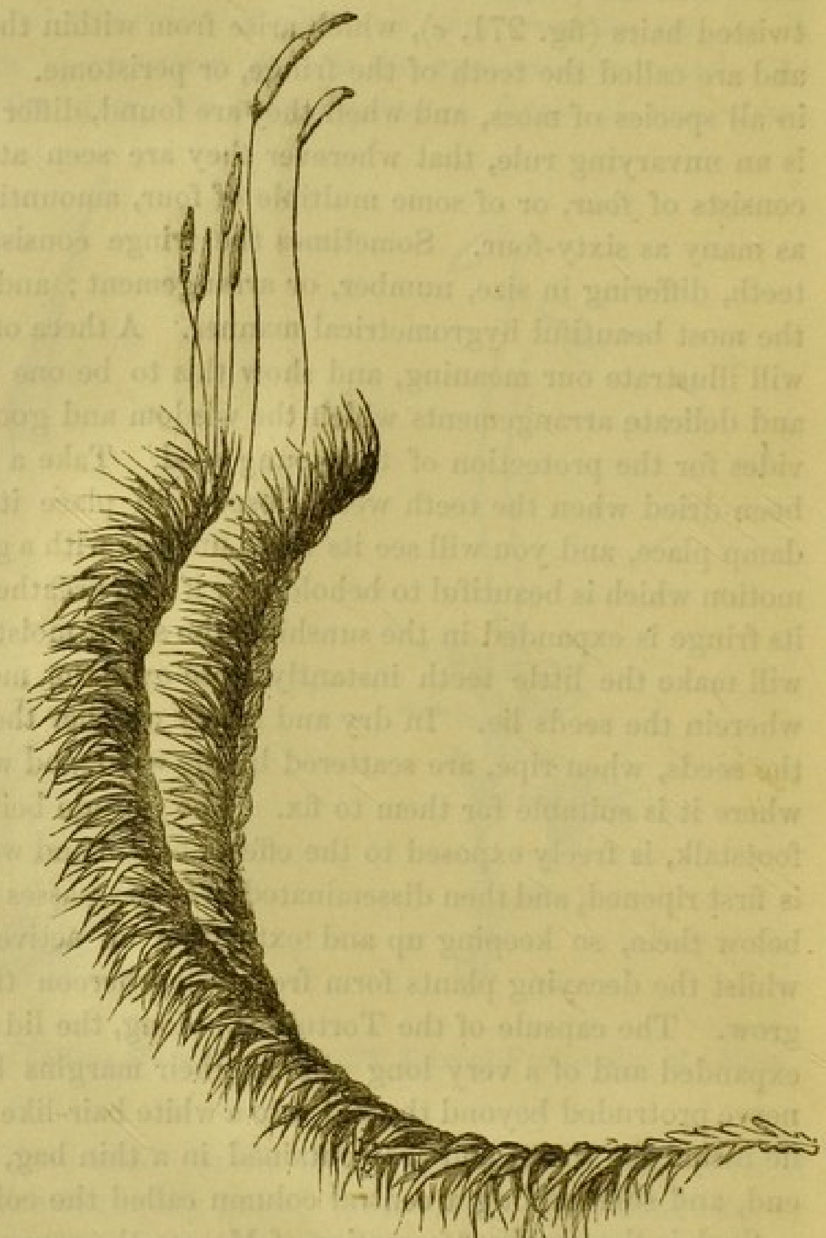
272. Curved Fruit-stalks of a Moss.

crowned with these little seed vessels rising above the general level of the clump of Moss on which they grow; these stalks are called *setæ*, or fruit stalks, and the vessels capsules. Let us take that species of Moss which grows so commonly on almost every wall we see, the *Tortula muralis*, or Wall Screw-Moss (fig. 271 *a*), as our example, and examine it carefully. The Theca (fig. 271 *b*), or fruit of this, has a little cap, like that of a Norman peasant, with a high peak and long lappit (fig. 271 *d*); this is the calyptra, or veil, and forms a sort of hood which, when the fruit is young, is rolled round the theca, so as completely to cover it. As the fruit-stalks lengthen, this veil is torn from its support and carried up on the top of the seed vessel, much as the calyx of the

Escholtzia is borne up on the summit of the petals before they open. Now if we place this seed vessel under the microscope, we shall find that beneath the veil is a lid or covering, which closes the mouth of the capsule; this, when the spores or seeds are ripe and fit to be dispersed, is thrown off, and then new and wonderful objects are disclosed; underneath this lid (which is called the operculum) lies a kind of tuft of twisted hairs (fig. 271, *c*), which arise from within the rim of the theca, and are called the teeth of the fringe, or peristome. These do not exist in all species of moss, and when they are found, differ in number; but it is an unvarying rule, that wherever they are seen at all, their number consists of *four*, or of some multiple of four, amounting occasionally to as many as sixty-four. Sometimes the fringe consists of two rows of teeth, differing in size, number, or arrangement; and this fringe acts in the most beautiful hygrometrical manner. A theca of this same *Tortula* will illustrate our meaning, and show this to be one of those beautiful and delicate arrangements which the wisdom and goodness of God provides for the protection of the young seed. Take a capsule which has been dried when the teeth were closed, and place it in water, or in a damp place, and you will see its teeth unclose with a graceful and steady motion which is beautiful to behold; or if you breathe on a capsule when its fringe is expanded in the sunshine, the slight moisture of your breath will make the little teeth instantly close over the mouth of the vessel wherein the seeds lie. In dry and sunny weather these teeth open, and the seeds, when ripe, are scattered by the wind, and wafted to situations where it is suitable for them to fix. The capsule being elevated on its footstalk, is freely exposed to the effects of sun and wind; thus the seed is first ripened, and then disseminated over the masses of recumbent moss below them, so keeping up and extending an active fresh vegetation, whilst the decaying plants form fresh soil whereon the new ones may grow. The capsule of the Tortula is oblong, the lid conical, the leaves expanded and of a very long oblong, their margins bent back, and the nerve protruded beyond the leaf into a white hair-like point. The seeds lie inside the theca, and are contained in a thin bag, open at the upper end, and surrounding a central column called the columella.

Such is the usual conformation of Mosses, the organs of which we have spoken—root, stem, leaves, and capsule—being present in all, though they vary in form, arrangement, and other particulars, according to the different genera of which they are members. In some the root is longer and more creeping than in others; the stems differ in length and in other points, some being branched, others simple; some feathered with leaves from base to apex, others bare at the base. The shape and veining of the leaves also varies in different kinds, as do the fruit-stalks, some being curved, as in fig. 272, others erect, as in fig. 273. Some proceed from the centre of the plant, as in fig. 272, whilst others are borne on lateral branches, as in fig. 275, and some kinds are devoid of them altogether, the capsule being sessile, and buried among the foliage.

The grand distinguishing features which mark the genera are chiefly found in the form and position of the theca, and the structure of the calyptra, or veil. Our space will only allow of our slightly touching on



273. Erect Fruit-stalks of a Moss.

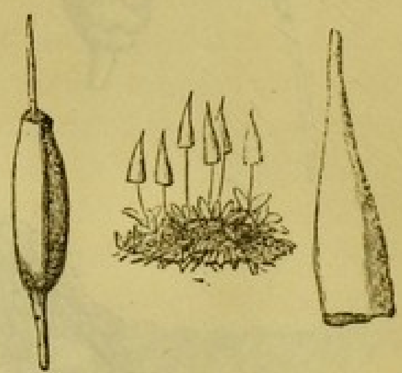
a few of these variations, and those who are disposed to study the subject of Mosses to a greater length, are referred to the "Muscologia Britannica" of Drs. Hooker and Taylor, and other works which bear directly on the topic; but we may adduce a few instances of the distinctions to be found in some of the commonest genera.

In the *Sphagnum* (fig. 274), those pale whitish Mosses which carpet the ground in bogs, the theca is sessile, that which looks like a fruit-stalk being in fact a continuation of the receptacle, and its form is that of a

274. The Sphagnum.

little cup, the mouth of which is uncovered. In the *Barbramia*, the theca is sub-globose, and seated on a terminal fruit-stalk—this has a double fringe, the outer of sixteen teeth; the inner a membrane divided into sixteen segments, each of which is cleft into two parts, and the calyptra is divided in half. The *Polytrichum*, or Hair-moss (fig. 275), has a double peristome, or fringe, the outer of thirty-two, or sixty-four incurved teeth, placed at equal distances; the inner a thick membrane connected with the outer teeth. The veil of this is also divided in half. The *Encalypta*, or Extinguisher-Moss (fig. 276), has a terminal fruit-stalk, and its calyptra is so large, as wholly to cover and conceal the theca, looking like an extinguisher placed over a candle. This species grows

275. Fruit-stalks of the Polytrichum, or Hair-moss.



276. Encalypta, or Extinguisher-Moss.

on wall tops, and appears with the Wall Tortula, and the pretty Cushion-Moss (*Grimmia Pulvinata*), very early in the season. This latter is called by children "Pincushion-Moss," because, when covered with its fruit, it looks not unlike a cushion stuck with small pins. It has an oval theca, the fruit-stalk is rather short and curved, the lid conical, and the calyptra in the form of a mitre. The capsule of *Andrea* is provided with valves, and opens with longitudinal clefts, whilst *Phascum*, and others, have persistent lids. In some of the genera the veil is irregularly rent, in others it is perfect; in some it has the form of a mitre, whilst others are beautifully plaited at the base. The differences in the leaves, growth, &c., of the various kinds are innumerable, yet though the parts differ from each other, the general characteristics which distinguish Mosses from plants of every other tribe are so marked and peculiar, that no one need be at a loss to know a Moss from any other individual of the vegetable kingdom.

277. Cynclydotus Fontanaloides.

Mosses select very various, in some cases singular, habitats; one species is found only on the highest Scotch mountains; another only in a bog near Cork. One very remarkable one grows on the perpendicular face of the white chalk cliffs in Kent and Sussex; others are confined to calcareous rocks, whilst some, as *Cynclydotus Fontanaloides* (fig. 277), will only live beneath the water, or where the spray and dash of the waterfall keeps them continually moistened. There is one kind almost sure to spring up where anything has been burnt on the ground, especially where charcoal has been made, whence its French name, *La Charbonière.* Hooker tells us that most species of *Splachnum* are found only on the dung of animals, particularly of that of oxen or foxes. "One of these, *Splachnum Angustatum*," he says, "which is commonly met with on dung, we once saw growing vigorously on the foot of an old stocking near the summit of Ingleborough, Yorkshire; the same was also found by a friend of ours covering the half-decayed hat of a traveller who had perished on Mount Saint Bernard; and the same was, if we mistake not, found by Captain Parry in Melville Island, vegetating on the bleached skull of a musk ox." This is no doubt that which old Gerard calls *Muscus ex Craneo Humano.* "This kind of Moss," says he, "is found upon the sculls or bare scalps of men and women lying long in charnel-houses, or other places, where the bones of men and women are kept together; it groweth very thicke, white like unto the short Moss on the trunkes of old Oakes; it is thought to be a singular remedy against the falling evil, and the chin cough in children, if it be powdered and given in sweet wine for certain daies together."

Mrs. Somerville, in her "Physical Geography," gives some curious facts regarding Mosses and Lichens on those antarctic lands which are scattered at immense distances from each other round the south pole. She says: "As the latitude increases the vegetation decreases, till at last utter destitution prevails, not a Lichen clothes the rocks, nor a sea-weed lives beneath the gelid waves. In the arctic regions, on the contrary, no land has yet been discovered wholly destitute of vegetable life. The difference seems to arise more from the want of warmth in summer, than from the greater degree of cold in winter." She also states that, "in Terra del Fuego, there is a greater number of plants identical with those in Great Britain, or representatives of them, than is to be found in any other land in the southern hemisphere, and among them forty-eight of the same Mosses."

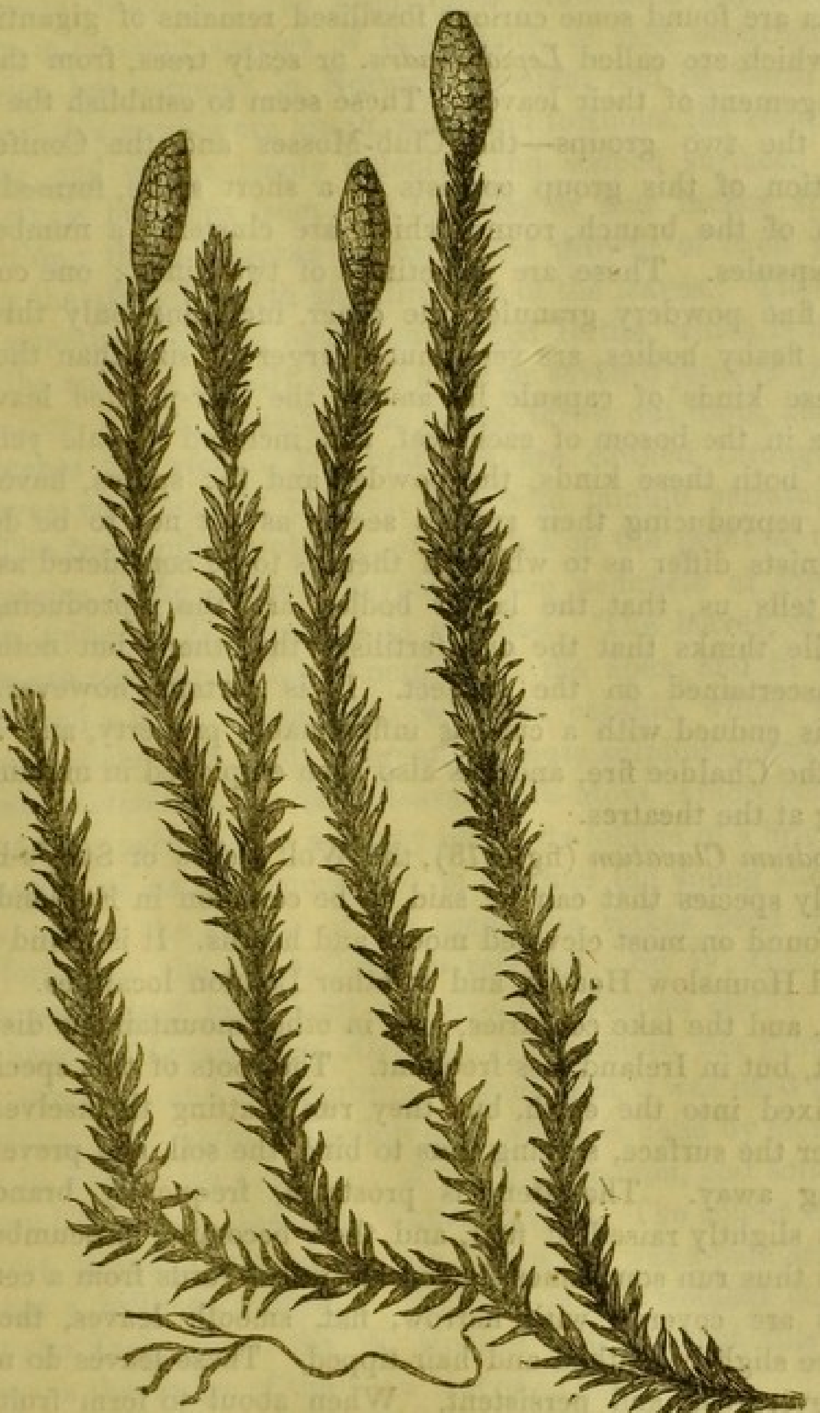
Lovely as is this tribe of plants, we cannot give a good report of them as ministering directly to the life of any part of the animal creation. They do not furnish nectar for the moth or butterfly, nor honey for the bee; nor does any grub or worm find its sustenance from them; and if they are eaten by cattle, or by hares, and other small animals, it is rather by accident than choice. They, however, tend much to the extension and preservation of vegetable life, both by the soil which their decay supplies, and by their power of absorbing moisture and retaining it, which makes them a valuable shelter to the roots of trees and plants. The power which they possess of imbibing, as it were, new life from water after they have long been dry and apparently dead, renders Mosses very useful in the greenhouse. Very beautiful baskets for holding flowers may be made of the longer and more feathery kinds. We have made them often; and never do flowers, whether wild or garden, look more lovely than when clustered within a verdant border of that most delicate and beautiful material, which by proper management may be made to preserve its freshness and brilliancy for many months. We will here give a receipt for their manufacture

A light frame of any shape you like should be made with wire and covered with common pasteboard, or calico, and the Moss, which should first be well picked over and cleansed from any bits of dirt or dead leaves which may be hanging about it, gathered into little tufts, and sewed with a coarse needle and thread to the covering, so as to clothe it thickly with a close and compact coating, taking care that the points of the Moss are all outwards. A long handle made in the same manner should be attached to the basket, and a tin or other vessel, filled with either wet sand or water, placed within to hold the flowers. By dipping the whole fabric into water once in three or four days, its verdure and elasticity will be fully preserved, and a block of wood about an inch thick, and stained black or green, if placed under the basket, will prevent all risk of damage to the table from the moisture. To make such baskets affords much pleasant social amusement for children; and to young people in the early spring, gathering the Moss will be an inducement to a ramble among the sweet lanes and wood-walks where they so richly abound. Then the younger children, both boys and girls, can clean and arrange the Moss in little tufts, whilst the elder girls sew the verdant covering to the pasteboard; and the boys, acting as wire-drawers and carpenters, make the frames, and cut and stain the blocks of wood. And when their joint pleasure in making these things is over, it will be found that few prettier presents can be provided to greet a parent, or sister, or young friend, on a birthday, or other festal occasion, than one of these baskets, lightly and tastefully dressed with flowers, affords. There will also be a constantly renewing pleasure in varying its appearance. One week, Snowdrops and Crocuses will cluster among the mossy edges; then will come groups of "dancing daffodils" and Hazel Catkins, which, mixed with Ivy leaves, make almost the prettiest dressing that can be found for it. In another week or two, Anemones, Hyacinths, and Narcissi will crave admittance into the place of honour; and long before the basket is decayed, Roses, Lilies, Jasmine, and even Carnations, will have sprung into beauty, and had their day in the favourite Moss basket. And all this pleasure will have been obtained at the cost of two pennyworth of wire and cardboard! How much enjoyment may be wrought out of simple materials, when taste and skill combine with unity, good humour, and simplicity of mind! —enjoyments far more full and varied, and more satisfactory than are oftentimes obtained from much more costly and elaborate means, where these qualifications do not preside.

The organisation of the *Lycopodiaceæ*, or Club-mosses, will be found

Wolf's-claw, or Stag's-horn Moss (Lycopodium Elevatum).

well worthy the attention of those who delight in looking into the minutiæ of creation, and desire to find subjects for praise and adoration of the Great Creator in the works which He has made. The order contains but two families, the Club-Mosses and the *Isoeteæ*, or Quill-Worts.



279. Interrupted Club-Moss (Lycopodium Annotinum)

The Club-Mosses have a tough, persistent stem, beset with hard short leaves. There are no veins in their leaves, which are, however, furnished with large stomata, or apertures in the cuticle, for the admission of air to the cellular tissue of the plant, and are for the most part narrow and taper-pointed. The stems are frequently twelve or thirteen feet in length, and in some species raise themselves into an erect position and become woody; thus approximating to the character of some Coniferæ. In the coal strata are found some curious fossilised remains of gigantic Lycopodiaceæ, which are called *Lepidodendra*, or scaly trees, from the mode of the arrangement of their leaves. These seem to establish the connexion between the two groups—the Club-Mosses and the Coniferæ. The fructification of this group consists of a short spike, formed by a prolongation of the branch, round which are clustered a number of two-valved capsules. These are sometimes of two kinds; one containing a mass of fine powdery granules, the other, including only three or four roundish fleshy bodies, are very much larger in size than the granules. Both these kinds of capsule lie among the hair-pointed leaves of the head, one in the bosom of each leaf, and inclosed in pale yellow cases. Whether both these kinds, the powder and the spores, have alike the power of reproducing their species seems as yet not to be determined, and botanists differ as to which of them is to be considered as the seed. Lindley tells us, that the larger bodies are the reproducing organs; Decandolle thinks that the one fertilises the other; but nothing seems clearly ascertained on the subject. It is certain, however, that the powder is endued with a curious inflammable property, and is used in making the Chaldee fire, and has also been employed in making artificial lightning at the theatres.

Lycopodium Clavatum (fig. 278), the Wolf's-claw or Stag's-horn Moss, is the only species that can be said to be common in England, but that may be found on most elevated moors and heaths. It is found on Hampstead and Hounslow Heaths, and in other London localities. In Wales, Scotland, and the lake countries, and in other mountainous districts, it is abundant, but in Ireland less frequent. The roots of this species are not deeply fixed into the earth, but they run matting themselves together just under the surface, serving thus to bind the soil, and prevent it from crumbling away. The stem is prostrate, frequently branched; the branches slightly raised at first, and then becoming procumbent; these branches thus run sometimes for ten or twelve yards from a centre. The branches are covered with narrow, flat, smooth leaves, the edges of which are slightly toothed and hair-tipped. These leaves do not fall off, but are evergreen and persistent. When about to form fruit there are thrown out from various parts of the branches spikes clothed with leaves, longer, narrower, and of a paler green than those which beset the original stem; these branches are crowned with pale sulphur-coloured heads, something like catkins, usually two on each stem in pairs, but in some cases three will start from the same point. On these spikes are the two kinds of fruit which we have described. The capsules which contain them are in this species kidney-shaped, perfectly sessile, and situated at the base of the bracts. Each is two-valved, and full of either spores or powder.

Lycopodium Annotinum, the Interrupted Club-Moss (fig. 279), is another very interesting species of this genus, of rare occurrence in the British Isles, but common in Norway, Sweden, and in North America. The roots of this species are tough, wiry, and tortuous, the stem creeping, very strong, and with a deeply indented and striped surface. It sends out at intervals branches from one to three or four inches apart, in an erect position; these increase annually, the growth of each year being marked by the altered length and direction of the leaves. These upright branches sometimes divide again, and when fertile, which is not always the case, the spike is usually on the sixth or seventh joint of the branch. When mature, the branches become prone, throw out roots, and send up erect branches as before. The branches are clothed throughout with linear leaves very acutely pointed, and with minute serratures at the edges. The fruit spike is oblong, and seated on the point of the branch in this species, being entirely devoid of the peduncle or foot-stalk on which the spike of *L. Clavatum* is elevated. The leaves, or bracts, in the spikes are nearly round, yet pointed at the apex, and in the axil of each is placed a large conspicuous veniform capsule, which, when ripe, opens transversely, and sheds numerous minute sulphur-coloured seeds.

Lycopodium Alpinum, the Savin-leaved Club-Moss, is more common than the last-named species; it is a pretty plant, its foliage of a brighter green than any other of its congeners, and in summer the young shoots have a blue tint. After the escape of the seeds, the spikes bend into a semicircular form, and the bracts become reflexed. Sir W. Hooker tells us that it is much used in Iceland as a dye for woollen cloths. He says, "a vast heap of *Lycopodium Alpinum*, lying before the priest's house, drew my attention, and on inquiring, I found that it was used for the purpose of giving their wadmal a yellow dye, which is done by merely boiling the cloth in water with a quantity of the *Lycopodium*, and some leaves of *Vaccinium Uliginosum* (the Bog Whortleberry). The colour imparted by this process, to judge from some cloth shown me, was a pale and pleasant, though not a brilllant, yellow." Wadmal is the woollen cloth usually worn by the Icelanders. Sir W. Hooker tells us that this species of Club-Moss is the badge of the Clan Macræ.

The Marsh Club-Moss (*L. Inundatum*) is a rather insignificant species which springs up on heaths and commons, especially where the turf has been pared; and neither that nor the Prickly Club-Moss (*L. Selaginoides*) must receive much of our attention, though of the latter we must just notice that this species produces the double sort of fructification which we have named in our account of *L. Clavatum*. The upper capsules contain the minute pollen-like granules, the lower larger grains almost equal in size to the seeds of some flowering plants.

The Fir Club-Moss (*L. Selago*) is the last species on our list. This ascends the summits of our highest mountains, and is also found on the level of the sea. It has been considered as possessing many extraordinary medical properties, but seems an unsafe remedy to meddle with, as, if too much is used, it induces convulsions. There is a curious species of Lycopodium mentioned by Dr. Carpenter as inhabiting Peru, which he says is liable to be entirely dried up when deprived of water for some time. "It then folds in its leaves and contracts its roots, so as to form a ball, which, apparently quite devoid of animation, is driven about hither and thither by the wind. As soon, however, as it reaches a moist situation, it sends down its roots into the soil, and unfolds to the atmosphere its leaves, which, from a dingy brown, speedily change to the bright green of active vegetation."

The Quill-Wort (*Isoetes Lacustris*) is the only other genus comprised under the order Lycopodiaceæ. This is a little plant confined to mountain lakes, and there is but one species in the genus. It has a tuberous root about the size of a Hazel-nut, from which hang tubular white fibres; the leaves are also tubular and rise from the point of the root without any foot-stalk. They are of a bright green, and very brittle. The fruit is very curious, consisting of capsules about the size of swan-shot, imbedded in the very substance of the base of each leaf. Newman says, the Quill-Wort "clothes the bottom of deep and still waters with a perennial verdure." It is found in the little lakes which abound among the Snowdon range. It is said that Dillenius waded into the waters of Llanberis to get it, and Newman glories in the fun of his exploit. "The imagination of a botanist," says he "delights to picture the Sherardian professor in this interesting situation: his shoes with their enormous silver buckles, and his grey-ribbed hose, are seen reposing on the strand; his important bag-wig, and his formidable military hat sharply looped on three several sides, adorn his learned head; the ample skirts of his coat are gathered on one arm, whilst the other grasps his gold-headed cane wherewith to uproot the brittle *Calamaria*." Surely the nymphs and naiads of the lake must have been a little surprised at such an intrusion on their watery pastures!

Such is the structure and character of the tribe which appears to connect the Mosses with the Ferns.

The Liverworts, of which we have next to give some account, come lower in the scale of organisation; they are much varied in size, appearance, and structure, and some of them are of exceeding beauty. They muster under their banner some genera which closely resemble true Mosses; others which are nearer the structure of Lichens, and again others which link them with the Algæ, Jungermanniæ, Marchantiæ, Tagioniæ, and a few other less noticeable genera, are all of this tribe; but they differ so widely from each other that we shall scarcely from their appearance be led to place them in the same order. The similarity of their organs of fructification shows, however, that they must all be considered as belonging to the order *Hepaticeæ*, and we proceed to give a brief notice of a few of the most interesting genera.

The *Jungermanniæ*, or Scale-Mosses, so named from Louis Jungermann, a German botanist, are of a very peculiar and exquisitely delicate structure. The whole substance of the plant is loosely cellular, so much so that, although most of the species are exceedingly minute, the beautiful reticulation of the leaves may often be detected by the naked eye. The herbage consists of a variously dilated frond, often naked, but more frequently covered with small leaf-like appendages. These are often divided, but never truly nerved, and might more properly be considered as dilatations of the frond.

The Scale-Mosses may be considered as divided into two classes: the foliaceous, or those which have the appearance of separate leaves; and the frondose, or those which consist of lobed fronds or thalli.

The former of these divisions is composed of minute plants, which by an unaccustomed eye might be taken for true Mosses, amongst which, in many instances, they are found growing. These are widely spread over the ground on banks and trunks of trees, or other positions in shady woods; some are found on moist Alpine moors, frequenting the beds of torrents, or growing in boggy places, along the edges of springs, or rivulets, whilst we find some species spread out on clay and exposed heaths, exhibiting their pretty purple or bronze foliage where nothing else will grow.

The second, or frondose, division of this tribe is chiefly confined to semi-aquatic positions: they are larger, their leafy parts, or fronds, are thicker, broader, and of a different texture from the foliaceous kinds, and some of them are slimy to the touch; but there are one or two of this division, namely, the Forked and the Downy Scale-Mosses, which grow on stones, trunks of trees, and on shady limestone rocks.

The fruit of this genus is a theca or capsule which rises from a tubular leaf or cluster of leaves called the *perichætium*, and is usually borne on a seta or fruit-stalk. The theca lies involved in this protecting sheath until it is mature enough to make its appearance in the world; the perichætium then opens at the top, and the little theca, unlike the modest little Mosses which never lift their young heads to the light without the covering of their calyptra or veil, suddenly starts up, leaving that organ attached to the point at which it originally grew, and displays itself unveiled to the eye which may be sharp enough to detect its diminutive beauties. This theca is four-valved, in shape much like those of Mosses, but it has no lid, and no central column round which the spores assemble;

instead of this it is furnished with some very curious spiral filaments with which the spores are associated (fig. 280). It is in the possession of these spring-like organs alone that the different families which class under the general name of Hepaticeæ resemble each other, but these are common to the Jungermanniæ, the Marchantiæ, and all the rest of the genera which the order comprises. These organs consist of double spiral threads, somewhat like the tracheæ or spiral air-vessels in plants, only more elastic. They are contained in the same case with the spores and curled up among them, and when the capsule is mature, spring up with a sudden jerk like a jack-in-a-box, and scatter the spores which are around them in all directions. So sensitive are these *elaters*, that even breathing on them will set them in motion after the spores have escaped. The Scale-Mosses chiefly differ from true Mosses in the permanent attachment of the calyptra of which we spoke above, and in having no lid or *operculum*, and no columella. The tubular form of the sheath and the presence of the spiral filaments, just described, constitute the other

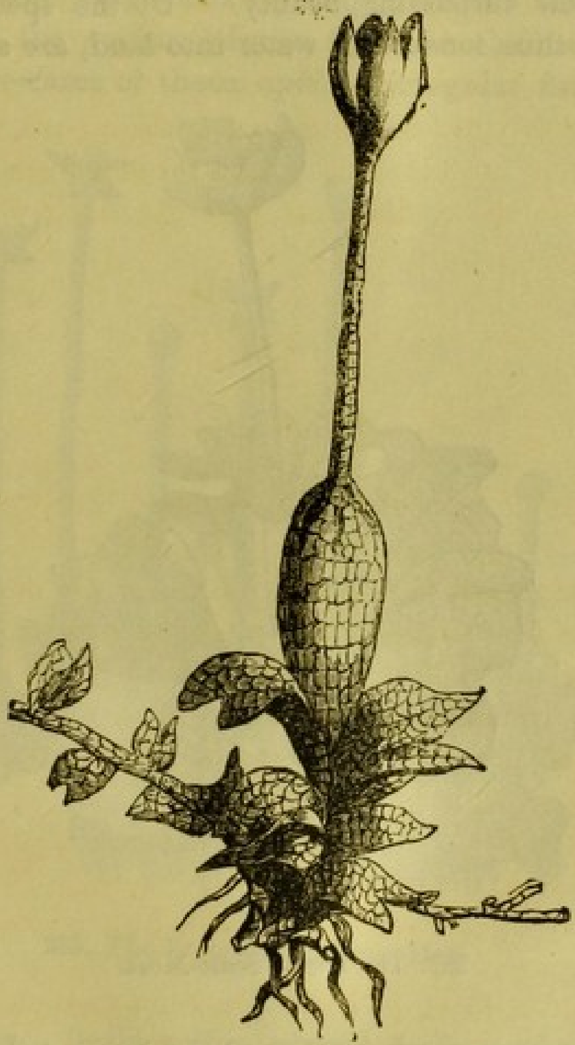
280. Spiral Filaments, or Elaters of Hepaticeæ.

distinguishing features of the genus. Besides the normal fructification, the Jungermanniæ possess a second kind of reproductive organ, by means of which the species are often propagated; these are called *gemmæ*, and consist of minute roundish, or oblong bodies, variously situated, sometimes in the axil of the leaf, at others on its margin, and clustered together in the form of little bells.

The colour of the Scale-Mosses varies through all the shades of green into brown, yellowish, dusky purple, and bronze. The theca is usually black, or deep purple, or dark brown, although occasionally it is nearly transparent.

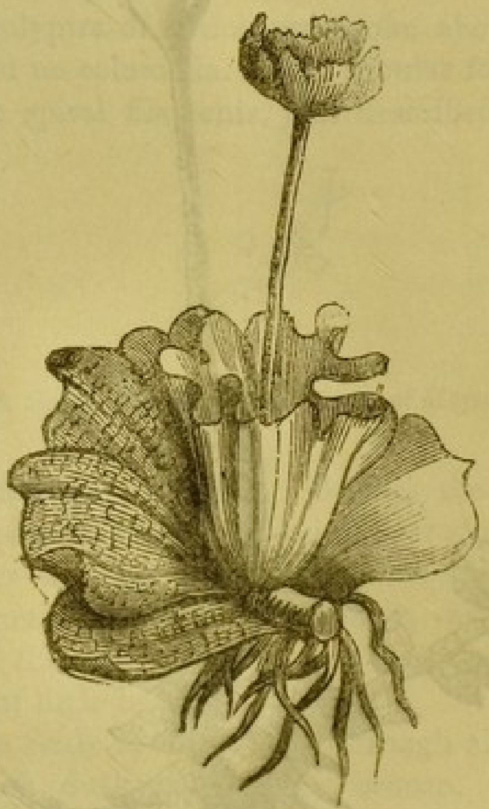
The seta or fruit-stalk is in most cases semi-transparent and as delicately reticulated as the other parts of the plant. Our example, the Pear-shaped Scale-Moss (*J. Turbinata*, fig. 281) shows this very beautifully. This species is one which is frequent in moist shady spots in limestone districts, and we have selected it as illustrative of the highly cellular structure of plants of this tribe. *J. Pusilla* (fig. 282), the Dwarf Scale-Moss, is given for the purpose of exhibiting the beautiful form of its folded sheath or perichætium. The plant is of a tender green, the capsule brown, and the edges of the bell-shaped sheath of a delicate pink. This is given, as are all the other Scale-Mosses of which we present drawings, as they appear when magnified to about six times their natural size.

Sowerby says, in speaking of Mosses, that which may with equal truth be said of the tribes which at present engage our attention, "It is chiefly in the economy of nature that we must look for the utility of these little plants, that she has fashioned with so much care, and for the reproduction and dissemination of which she has invented so beautiful and complicated an apparatus as that described above, though they are destined for the most part to flourish where no human eye beholds that beauty, no intelligence, save her own, can calculate the necessity and advantage



281. The Pear-shaped Scale-Moss.

of their existence. Their ministry is pursued in concert with other families lower in the scale of vegetable being; the smaller species assisting in the production of soil upon newly formed lands, clothing with verdure the most barren spots, and gradually fitting them for the support of the higher order of plants; while the larger are occupied in no small degree in the production of land itself, especially the aquatic kinds, which fix themselves upon the surface of lakes and stagnant waters, already interlaced with the slender stems of the *Charæ*, *Confervæ*, and plants of similar habit, gradually converting the liquid plain into a partially solid one, on which eventually Grasses, Rushes, &c., are capable of growing; thus are formed morasses, which, by a further progress of vegetation, become at length fertile meadows. While thus slowly operating to increase the extent of the habitable world, their influence directly and indirectly affects in various ways, but more frequently, perhaps, unseen and unsuspected, the welfare and interest of those who are too apt to despise their apparent insignificance, and too proud to stoop to the examination of their surpassing beauty." Of the species which render their feeble aid in thus converting water into land, are some of the litttle



282. The Dwarf Scale-Moss.

frondose Scale-Mosses, and also some of the other tribes of the Hepaticeæ. The Broad-leaved Scale-Moss (*J. Epyphilla*, 283), which is depicted of the natural size, is one of these. It is frequent on moist heaths, and in damp woods, and thickets, especially by the sides of wells and rivulets. The slippery Scale-Moss (*J. Pinquis*) is another of this description.

We next come to the family *Marchantiæ*, named from Nicholas Marchant, a noted botanist. It is a pretty and singular tribe, its trivial name, Liverwort, being derived from a fancied resemblance to the human liver; this resemblance was supposed to indicate some special virtue in the plant, as connected with that organ, and in olden time it was considered as a specific for jaundice and other such disorders. The Marchantiæ grow on earth or the bark of trees in damp places, spreading over the ground in the form of a green incrustation, from the lower surface of which root-fibres are developed. This crust or thallus is entirely composed of cellular tissue, the cells of the outer layer being closer in texture than the rest, and forming a thick leathery cuticle, in which are large stomata. The fruit consists of a head of spore-cases, radiating from a central disk called the *shield*, like the spokes of a wheel. The head is mounted on a long stalk springing from a bell-shaped sheath, which starts from the surface of the frond or thallus, usually at the margin. The spore-cases or thecæ open by irregular fissures, either four

283. The Broad-leafed Scale-Moss.

or eight in number. Besides this normal fruit, gemmæ, or detached buds, of quite a different structure, are found on these plants. These are small leafy bodies which spontaneously separate from the parent plant, and when mature are washed out by the rain, and carried abundantly to new localities, where they spring up and grow very rapidly. The form of the thalli or fronds of the Marchantiæ is thus quaintly described by the good old herbalist Gerard: "Liverwort is a kinde of Mosse which spreadeth itself abroad upon the ground, having many uneven or crumpled leaves lying over one another, as the scales of fishes do; greene above, browne underneath." These fronds are variously lobed, their colour is a living green, and when broadly spread over a damp bank or the wall of a fountain or reservoir of water, they form a beautiful object. The Germans have the same name for the tribe as ourselves, and call it *Leberkraut.* The conical Liverwort (fig. 284) is common. It is of a yellowish-green tinged with brown; the peduncle, or fruit-stalk, is white, touched with pink, and fleshy. It springs from a concave disk, usually situated in the marginal clefts of the fronds. The sporules are large, of a dark olive hue. The fronds, when bruised, send forth a peculiar fragrance, like bergamot.

284. Conical Liverwort.

The other example given (fig. 285) is of the star-headed Liverwort (*M. Polymorpha*), a species even more common than the conical.

Of the other genera which the order *Hepaticeæ* comprises we shall say but little, as they are few and, in comparison, insignificant.

Targionia Hypophylla at first sight resembles a Marchantia, but differs in its fructification, which is globose and nearly buried in the margin of the frond; and this, with Anthocerus Punctatus, Sphærocarpus Terrestris, and a few species of a little tribe called Riccia,—on which, as they are for the most part little known and not of much general interest, we shall not enter particularly,—complete the number of the genera contained in this order.

285. Star-headed Liverwort (Marchantia Polymorpha).

§ 114. LICHENS.

The structure of Lichens is very simple, and they occupy nearly the lowest station in the scale of vegetation, the Fungi alone ranking below them. Their origin in some situations is buried in mystery; some have supposed that certain kinds are of meteoric production, a theory which is supported by the facts (as stated by Eries) that the leaves of some Pines near Dresden were suddenly covered, on the side next the wind, with a species of Lichen, and also that on a hot summer day the sails and masts of a ship at Stockholm were instantaneously covered with a coating of a similar character.

Lichens are the first rudiments of vegetation found on many bare rocks in newly-formed islands. How their seeds can have been conveyed to such new and remote positions it is impossible to say; but truly "there are more things in heaven and earth than are dreamt of in our philosophy!" Even in the present day, when painful and diligent research has thrown light on so many subjects which were formerly wrapped in apparently impenetrable darkness, how much of interest yet remains to be elucidated; how many discoveries are doubtless yet in store to reward the earnest and sedulous student of nature! Yet, search as we will, depths will still remain unfathomed, for, "who can search out the Almighty unto perfection?"

Lichens exist exclusively on atmospheric supplies, requiring only air, sunlight, and some degree of moisture, for their support. The simplicity of their structure enables them to exist at altitudes where the air is too thin for the support of plants of the higher orders of vegetation, so that they are found in abundance even at the very verge of the limits of perpetual snow. Lichens, with the Mosses, serve as pioneers of vegetation, having the power of secreting oxalic acid from the atmosphere, which, acting chemically on the stones and rocks below them, produces small hollows in which moisture collects; then comes the frost, seizes on the moisture which has forced its way into the little crevices already formed, and splits the rocks so as to cause it to moulder away; and this process, which is continually going forward, by degrees prepares the surface of the soil to receive larger plants.

A Lichen has neither root, stem, nor branches; it consists of a dry, scaly crust, which sometimes appears almost like a mere powder, but in others extends itself into broad curled surfaces called *thalli*, which have somewhat the appearance and perform the functions of leaves. It bears no flower, but abounds in what is called fruit; this consists in a multitude of spores or seeds, which are inclosed in cases differently disposed on the margin of the thallus, or else growing from or imbedded in its surface. It is usually in the form of shields, or of cup-like receptacles, which are called *apothecia*, from the Greek *apotheké*, which means *a repository*, and are frequently raised on a sort of foot-stalk termed a *podetia*.

There are five tribes of Lichens, 1st, the *Idiothalami*, consisting of those whose apothecia or receptacles differ in colour from the rest of the plant, and are formed of a different substance; 2nd, the *Cœnothalami*, which are those where the apothecia is partly formed from the substance of the thallus; 3rd, the *Homothalami*, where the apothecia is entirely formed of and of the same colour as the frond, or thallus; 4th, the *Athalami*, whose fructification is unknown, they being wholly destitute of apothecia; and the 5th, and last tribe, which are called *Pseudo-Lichens*, are those where the apothecia is black and horny, and imbedded in a receptacle, their sporules in slender tubular cells lying in a pulp, and not spontaneously emitted; these have usually been classed as Fungi, and are in many respects like them. There are numerous subdivisions of these tribes, which we must not attempt to describe, as it would lead us far beyond the limits of our space; neither would it avail us to attempt to follow the learned investigations which have of late been entered into concerning the formation and arrangement of the spores in the different genera, as detailed in a work lately published by the Rev. W. A. Leighton, under the auspices of the Ray Society. Our endeavour must rather be to open the eyes of our readers to the outward beauties of this minute tribe of plants, and to effect this purpose, we must aim at drawing their attention to the appearance and habits of a few of the most common and distinguished of the species. Let us, then, take a ramble together through the woods, and over the hill, down to the sea-shore, and we will describe to the reader the objects which we see.

Observe, as we pass that stone-wall, how very richly it is decked with colours; look at the dark olive and white granulated substances which in places coat its surface, and the broad patches of orange which vary its tinting, and are themselves so beautifully set off by the soft green of the tufted Mosses, now all bristling with capsules; these are all Lichens, and most of them to be classed under our first head as *Idiothalami*, being formed of a scaly crust, with little receptacles growing out of it; among these are the *Lecidéas*, *Gyrophoras*, *Endocarpons*, and some others; but although their colouring is very vivid and varied, this tribe is so minute that, without a powerful magnifier, the parts of fructification can scarcely be discerned. But this is not the case with those broad-spreading thalli which lie on the mossy bank at the root of that old Oak, weaving themselves into a mass with the dead leaves which have fallen from its branches. These belong to the genus *Peltidéa*, and form a part of the second and largest tribe of the Lichen family, the *Cœnothalami*, under whose banner are included the greatest number of the most beautiful and conspicuous species of this extended family. These leaves, or fronds, or, as they are technically termed, *thalli*, belonging to the species *Peltidea Aphthosa*, or the Thrush, so named from its having been considered by the doctors of ancient days a specific for that complaint. They are of a pale olive green, sprinkled over with brown warts, and underneath whitish, with brown branching veins; the edge of the thallus being fringed with white ciliæ or threads, with which it lays hold of the leaves and Mosses below it, and which also probably serve it for the absorption of moisture. If we can find it in fruit, we shall see that some of the lobes of the thallus are drawn up into a sort of foot-stalk, bearing at the point a large red-brown receptacle. The Peltideas (fig. 286) are all much of the same character, broadly lobed and fringed, and bearing their fruit in the same manner on the summits of the lobes. Now let us hasten on to the wood. We told you that the trees even in winter were clothed with most delicate and lovely foliage; look, then, at that clustering bunch of grey filaments which grows on the branch above you, and observe the broader strap-like kinds—some sulphur-coloured, others grey, blackish, or pale green. These are all Lichens, Ramalinas, Usneas, Alectorias, Cornicularias, or others, and all classed under the third head

—the *Homothalami.* A little beyond it we see the *Usnea Barbata* floating upon the air like an old man's grey beard, and others of the same genus; and these are again met by other species, so closely clustering that from a little distance the whole tree appears as if covered by a glaucous coating of Lichen. There is a very curious species which grows in other lands, the *Usnea Florida*, or flowering Lichen. If you gather a piece of it, you will see that it is composed of long branches fringed with fibres of a sort of sea-green, from which proceed at intervals large apothecæ, nearly oval in shape and almost as large as a sixpence, flat and edged round with fine ciliæ or threads an inch long. Gerard calls this the "flouring branched Moss," and says, "there is oftentimes found upon old Okes, Beeches, and such like overgrown trees, a kinde of Mosse having many slender branches, which divide themselves into other lesser branches, whereon are placed confusedly very many small threads, like haires, of a greenish ash-colour. Upon the ends of the tender branches sometimes there cometh forth a floure, in shape like unto a little buckle or hollow Mushroom, of a whitish colour tending to yellownes, and garnished with the like leaves of those upon the lower branches." Now examine that beautiful branching Liverwort (*Sticta Pulmonacea*) which runs up the fine dark trunk of that lofty Elm. It exhibits a broad expanse of lobed thallus of a clear olive green, with a sort of raised veining, which leaves the general surface of the frond depressed and pitted. The under side is very beautiful, the colour a soft buff, the texture velvety, and the parts which form pits on the upper surface rising into rounded protuberances. The apotheca is set on the thallus a little within the margin, and is formed of circular shields of a red hue, and placed in groups of three or four together. The whole of one side the trunk of that lofty tree is densely clothed with this beautiful creeping plant. But let us now draw your attention to the groups of fine Hawthorns which are round us: observe how every twig and spray is beset with a coating of green so vivid, so exquisitely bright, that you can scarcely believe it is not beginning to exhibit its own verdant spring foliage. Gather a branch, and you will find that this too is a Lichen—one of the Parmelias. It is green when young; but when mature, becomes of a brilliant sulphury yellow. Examine the branch you have gathered with a magnifier, and you will see the thallus of the Lichen to be lobed and plaited, the lobes overlapping each other "in much-admired confusion." From the surface of this imbricated mass of foliage stand out very many circular shields, raised like little salvers, and plainly distinguishable by the naked eye, although more satisfactorily defined with the aid of a lens: these are the apothecæ which contain the spores. But now let us proceed to the moor, only observing, that there is scarcely an object that we pass which has not more or less of Lichen-growth upon it: the black patches on those stones, the mealy crust on that gate, the splashes of yellow, and black, and white, and grey, and the tufts of glaucous Moss on the park palings, all are Lichens, and all add to the beauty and diversity of the colouring which enlivens the aspect of the country in winter.

You will by this time be convinced that the family of Lichens is by no means deficient either in interest or in beauty; but a tribe which awaits us on the moor, the *Cladonias*, will, we think, delight you far more than

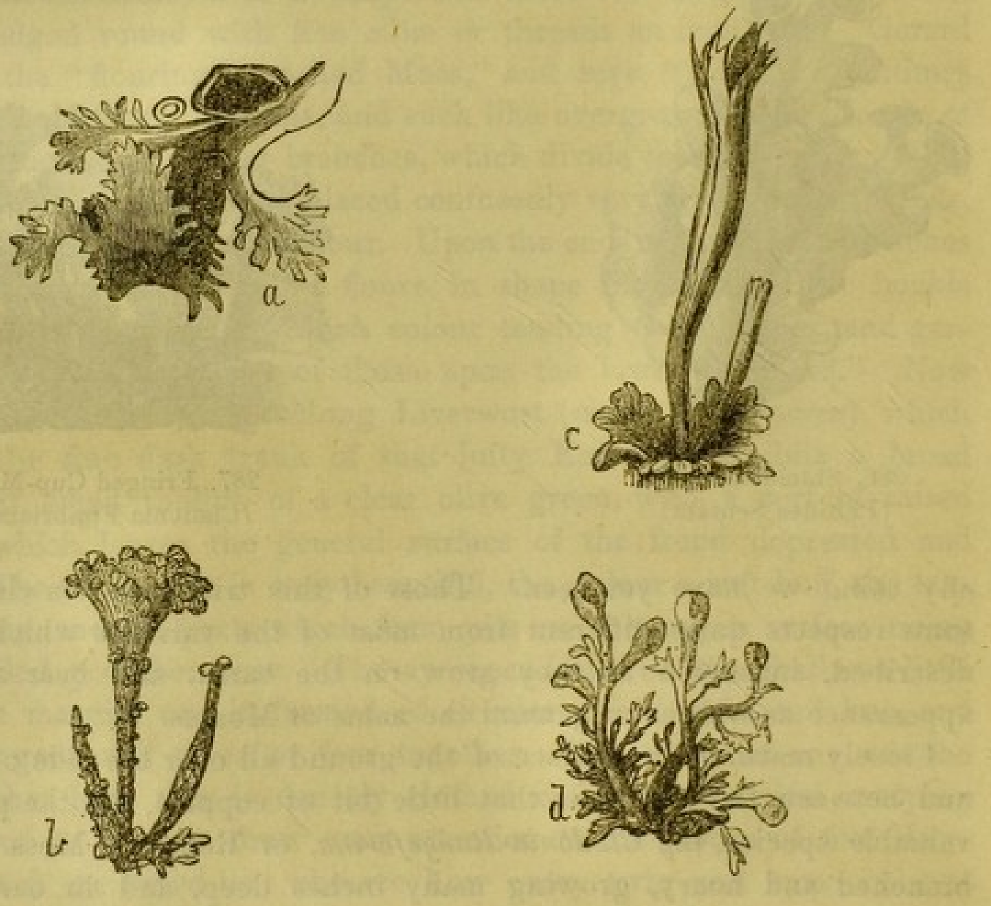
286. Shielded Lichen (Peltidea Scutata).

287. Fringed Cup-Moss (Cladonia Fimbriata).

any thing we have yet seen. Those of this tribe are of a character in some respects quite different from most of the varieties which we have described, inasmuch as they grow on the earth, and bear much the appearance as well as in general the name of Mosses.

Closely matting the surface of the ground all over the side of the hill, and between the bushes on that little bit of coppice, lies the pretty and valuable species, the *Cladonia-Rangeferina*, or Reindeer Moss. This is branched and hoary, growing many inches deep, and in early spring exhibiting a most exquisitely lovely appearance, as the half-melted hoar-frost glitters in the sunshine, and seems to tip its multitudinous points with clusters of diamonds. This species covers acres, indeed, successive miles of ground, in Lapland, especially on those tracts where pine-forests have been burned, and supplies food for the reindeer throughout the long northern winters. Its fruit is borne at the extreme points of the branches in brown clusters. On the banks and walls which divide and flank the moor, are found several other varieties of Cladonia growing in the peat.

There is the beautiful Grey Cup, or Chalice Moss, which sends up from a cluster of grey thalli lovely little cups each about large enough to contain a drop of water, and from the edges of these cups proceed, in the course of time, clusters of other and smaller cups, lifted on long foot-stalks, which again occasionally branch and bear more cups at their points, the edges of all of which are eventually furnished with branches of red-brown, shining apothecæ. This is *Cenomyce Pixidata;* and in the same situations we shall find another species *C. Fimbriata*, even more beautiful than *Pixidata*, for its cups are elegantly fringed at the edges, and it is furnished with delicately crenate thalli, or leaves of a silvery greenish-white, which cluster on the podetia, and on the outside of the cup (fig 287). There are many other species of Cladonia and Cenomyce, all likely to be found on the moor. The autumn is the season in which they are in perfection, although we still find them *in situ*, for

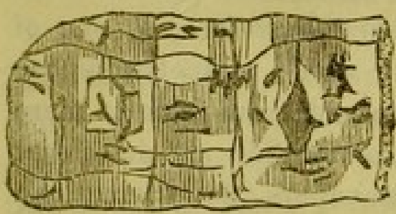


288. (*a*) Borrera Furfuracea. (*b*) Cenomyce Bellidiflora. (*c*) Cenomyce Deformis. (*d*) Sphærophoron Coralloides.

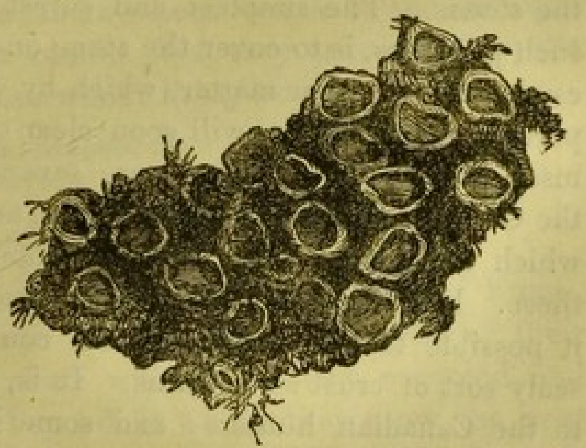
Lichens are very slow in growth and in decay, and will remain for years with very little variation in their appearance. Several of these tribes bear fruit of the most brilliant scarlet hue, as bright as small coral beads, and the silvery grey of their setting makes them more admirable than the jewels of a bride; indeed our jewellers have overlooked a tribe which might furnish many a beautiful type for ornaments, either for a fair lady's dress, or for the decoration of her room or table. The varied forms of these genera deserve some special notice: some, as we have seen, are cup-like; one takes exactly the form of the horn of the stag, this is *Cenomyce Cervicornis*, and is found on the Pentland and other high hills; another, *C. Bellidiflora*, or Daisy-flowered (fig. 288 *b*), grows in stiff scaly tufts on the tops of lofty mountains; whilst another, *C. Deformis* (fig. 288 *c*), is sulphur-coloured, and grows in branching tufts three inches high, and bearing scarlet fruit, at the roots of trees. But we must forbear, for to attempt to enumerate the varied and capricious appearances of all the species of this interesting genus would be in vain, and we must content ourselves with giving figures of a few other varieties, for there remain two of the five tribes of Lichens which we have as yet not noticed.

The fourth tribe, the *Athalami*, contains but one genus, the Lepraria; these are all yellow, and form a sort of leprous crust on rocks, old pales, or trees, the mode of their fructification being as yet unknown.

The fifth tribe, or *Pseudo-Lichens*, contains some very interesting species: the first genus, or *Opégrapha*, is named so from two Greek words signifying *a chink*, and *to write*, because the shields or apothecæ



289. Written Lichen (Graphis Scripta).



290. Cudbear (Parmelia Tartarea).

are cracks upon the surface of the thallus, which look like strange Oriental characters on a pale ground. They are almost always found on the smooth bark of trees, varying in colour, some being black, others white, olive, grey, green, or yellow. There is another genus, *Graphis*, which is even more remarkable for its resemblance to written characters than the Opégrapha; *Graphis Scripta* (fig. 289), and *Graphis Serpentina*, but especially the former, being strikingly like the Chinese character.

But in our admiration of the external character of Lichens, we must not forget to take a glance at their hidden qualities, nor withhold our praise to Him who has given to such simple, and often unnoticed plants, qualities which render them exceedingly valuable to man, and make some of the species highly important articles in commerce.

We have noticed the value of the Reindeer Moss, or, as it is frequently called, Lapland Moss, as the main food of the rein-deer; and there is no necessity to say much of that well-known kind, the Iceland Moss, *Cetraria Islandica*, which is sold in all chemists' shops, and so frequently used as an article of diet for consumptive and weak patients. The *Roccella Tinctoria*, or True Dyer's Lichen, is the orchall of commerce, celebrated for yielding a fine purple dye, for which the Cudbear (*Parmelia Tartarea*, fig. 290), is but a poor substitute, though one which is, nevertheless, in much request, and by collecting which many an industrious peasant in the Highland district gains his living. This Lichen is scraped from the rocks with an iron hoop, and sold in large quantities to the Glasgow merchants. It is no easy process to obtain it, for to dislodge Lichens of the crusting growth which have once established themselves on rocks and stones is hard work. They not unfrequently take up their position on grave-stones, and effect in a few years that which, without their aid, would scarcely be accomplished in centuries, namely, the total obliteration of the name, dates, and other inscriptions which had been on the stones. The simplest and surest mode of dislodging the foe from such positions, is to cover the stone on which they have congregated with earth, turf, or other matter, which by depriving them of their main supporters, air and light, will soon clear off the incumbrance, and make the inscriptions legible. There are several Lichens besides the Orchall and the Cudbear which are used as dyes, and others besides the Iceland Moss which are eaten. The Tripe de Rope (*Umbilicara Pustulata*) is one of these. It is very beautiful in appearance, but one would scarcely suppose it possible that any nourishment could be obtained from such a mere scaly sort of crust as it forms. It is, however, a valuable article of diet to the Canadian hunters; and some English travellers (Dr. Richardson and his company) were for a long time sustained by this strange food alone, when wandering amidst those northern snows in pursuit of scientific objects.

On rocks by the sea we find many species of Lichens, particularly such as belong to the genera Lecidêa, Endocarpon, Urceolaria, &c.; but some of the beautiful genus Ramalina are also found in such localities, and among them that very pretty one the *R. Scopulorum*, or the Ivory Lichen.

We must now leave the consideration of this interesting but almost unknown family; but before we do so we would remind our readers, that there is no branch of knowledge which does not hold out some reward which he who studies it with care cannot fail to attain; and that the health and pleasure gained by the brisk and varied walks to which the pursuit of Mosses and Lichens invite their votaries, at a season when some incentive to leave the fire-side is especially needful, will well reward them for a little effort in the pursuit of this branch.

§ 115. FUNGI.

The Fungus tribe is an important and most remarkable division of the vegetable kingdom, singular in structure, and many of the species exquisite in form and colouring, whilst others are calculated to be extremely valuable as articles of diet or of medicine. The range of growth of the species of this remarkable kind of vegetation is as surprising as the variety in size, form, and colour, which they exhibit. We wander in the dewy meadows in autumn, and we find the grass studded with mushrooms, some eight or ten inches in diameter, others but half-developed and looking like little bunches of buttons on the ground. We see broad rings in the grass, of a deeper green and coarser herbage than other parts of the same field display, and we know them to be the "fairy-rings," which were formerly supposed to have been formed by the midnight gambols of the fairies, when, with nimble feet, they tripped in mystic dance beneath the moonbeams; those whom Prospero thus adjures :—

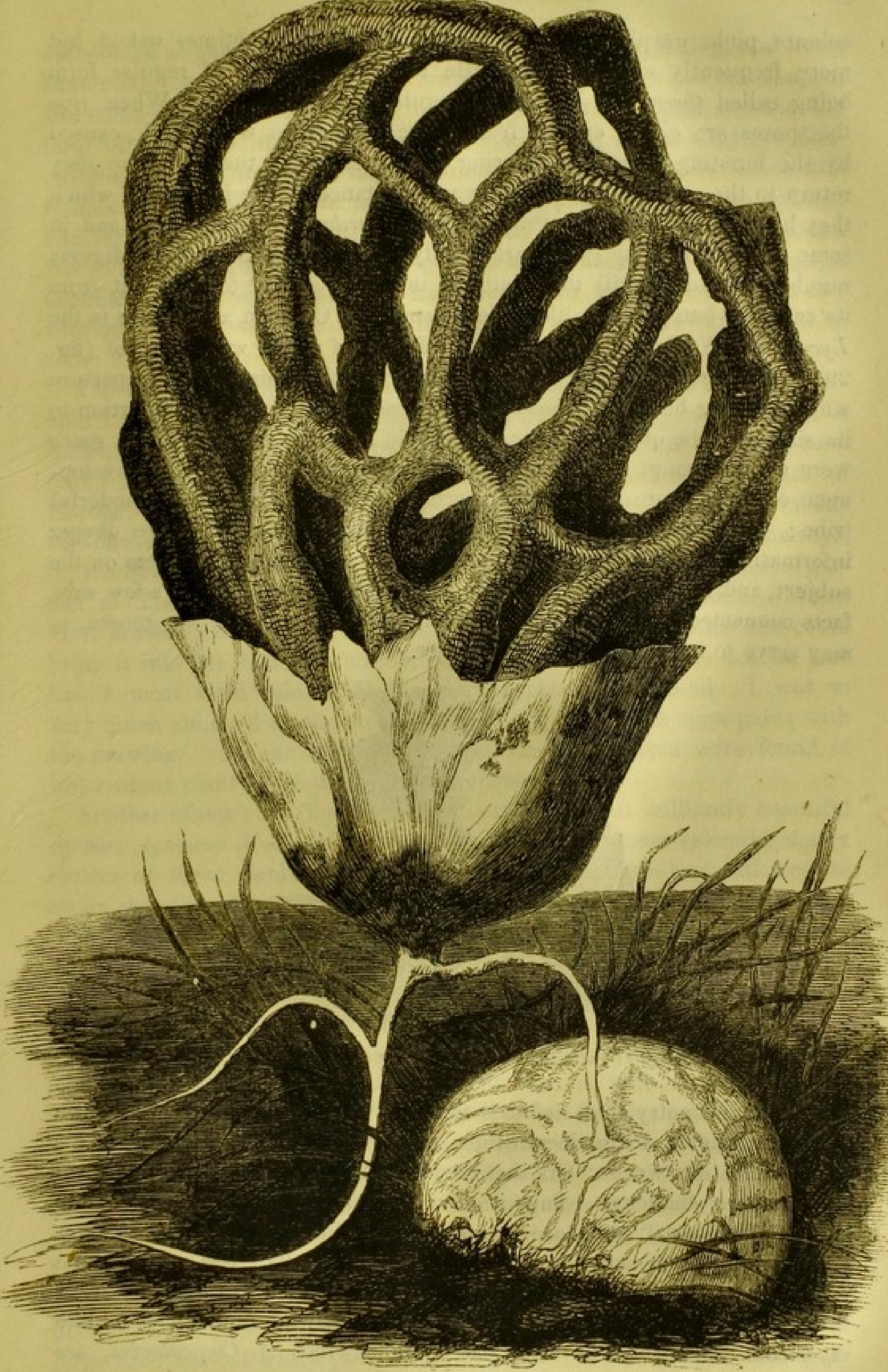
> "You demi-puppets, that
> By moonshine do the green sour ringlets make,
> Whereof the ewe not bites ;—and you whose pastime
> Is to make midnight mushrooms."

These dark rings are now known to be caused by the growth of Fungi, which, it is supposed, spread outwards from a centre, every year of their growth exhausting the soil of the circle which they have occupied, and throwing out fresh germs to one beyond, in which they grow the next year, and then again push beyond it, and occupy a wider range in each succeeding year. As we pursue our ramble, and penetrate into the woods, we look above us, and see huge fringes of fungous growth hanging out from the trunks of the trees, and on the decayed stumps around we perceive the most exquisitely tinted clothing of what, by the sea-side, we should conceive to be shells clustered in shelves one above the other, and all grouped in the most vigorous and beautiful forms; we touch them, and they are wood-like; we take a chisel and hammer, and such hard work is it to chip them off, that we find it easier to take bark and all than to sever these parasites from the trunk on which they have fixed themselves. These beautiful objects are all Fungi. Some of them in form and pencilling much resemble the beautiful Sea-weed (*Padina Pavonia*), but their painting is different, and consists of broad bands of black delicately shading into gray or lavender, and alternating into a soft orange colour, the texture of the upper surface being velvety, like the wing of a moth, and the lower part of a creamy white, full of minute pores which give it much the appearance of coralline formation.

We have had clusters of them brought us from the woods, so beautiful as to induce us to group them as nearly as possible as they would appear in their native habitat, and arrange them for a basket for flowers; and when set off by a massive bunch of roses or dahlias, this structure formed an object as beautiful as it was curious, and lasted for very many months perfectly unchanged in form or colour. Besides these, and a thousand other varieties which infest trees, posts, &c., are a multitude of lovely little gems of all hues, which lie scattered about on the bare heath, or spring out of decayed leaves, bits of stick, wood, &c. Some are scarlet, others orange, snow-white, black, brown, purple, rose-coloured, or green —all glittering in the moisture beneath the bright autumnal sunbeams, and looking like so many jewels. Every object is more or less infested by this ubiquitous race; some spread themselves over our fruits; others attack our bread, cheese, pickles, or other manufactured articles of food. "When our beer becomes mothery," says Dr. Badham, "the mother of that mischief is a Fungus; if pickles acquire a bad taste, if ketchup turns ropy, and putrefies, Funguses have a finger in it all. Their reign stops not here, they even prey on each other. The close cavities of nuts occasionally afford concealment to some species; others, like leeches, stick to the bulbs of plants, and suck them dry; some (the architect and ship-builder's bane) pick timber to pieces as men pick oakum. The *Oxygena Equina* has a particular fancy for the hoofs of horses and the horns of cattle, sticking to these alone. The belly of a tropical fly is liable in autumn to break out into vegetable tufts of fungous growth, and the caterpillar to carry about in his body a *clavarias* bigger than himself." We have ourselves seen several specimens of a curious Australian Fungus, consisting of a sort of stem, about an inch and half high, with a bunch of berry-like appearance at its summit. This takes its root in the head of a species of huge caterpillar, which, having burrowed in the earth preparatory to changing to the pupa state, becomes the prey of the Fungus; and so firm is its hold, that when the latter is pulled from the ground, the caterpillar on which it has fixed itself comes up with it.

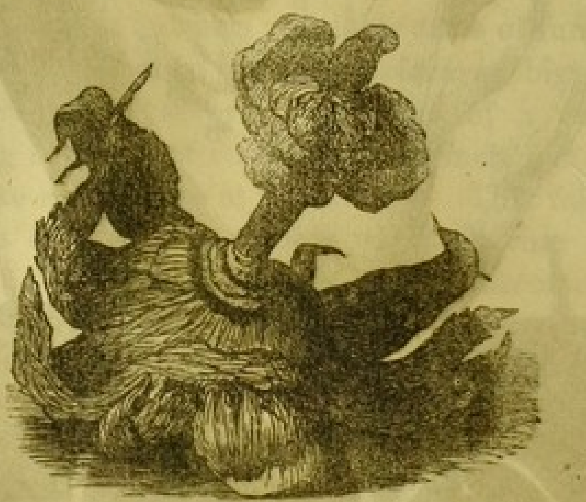
Almost every earthly thing is liable to be infested with some species or other of this tribe; the human teeth produce them, and the wounded flesh of living men. But we must forbear, for we might fill a large volume, were we to attempt to describe all the strange and varied situations which Fungi select for their own especial habitations and sustenance.

The structure of the Fungus tribe is most peculiar, and differs *in toto* from that of any other. Their whole substance may be considered as a mass of reproductive matter. Link, a noted writer on this order of cryptogamic plants, defines the essence of a Fungus to be "sporules disposed in a series in elongated tubular cells, the cells situated in some part of the external surface." The spores of Fungi answer to the seeds in other plants; they consist of round, oval, oblong, or occasionally other shaped bodies, so minute as in most cases not to be distinguishable by the naked eye, but displaying, when viewed with a microscope, various



Clathrus Cancellatus.

colours, pink, purple, yellow, or white; they are sometimes naked, but more frequently closed up in little receptacles, those of regular form being called *thecæ*, and those of irregular form *sporanges*. When ripe the spores are either ejected from these little cases with a jerk, caused by the bursting of an elastic ring which encircles them, or else they return to the earth with the dissolving substance of the Fungus in which they have existed. In the Puff-ball (*Lycoperdon Stellatum*, &c.), and in some other tribes, the spores are wholly internal, and in such prodigious numbers as quite to fill the cavity of the Fungus, and to burst out from its centre, when pressed, like a dense smoke. Of such a structure is the *Lycoperdon Stellatum*, or Stellated Puff-ball, of which we give a cut (fig. 291); the spores issuing in a column from the chimney-like aperture when the bag below is pressed, so suddenly and so high in proportion to its size, as to be quite startling. It would be occupying too much space were we to attempt to give any detailed account of the mode of development of these spores, or of other parts of the structure of this wonderful tribe; we must, therefore, refer such of our readers as desire deeper information on these points, to more learned and elaborate writers on the subject, and restrict ourselves to the single object of supplying a few such facts connected with the appearance and habits of some of the genera, as may serve to interest the general reader.

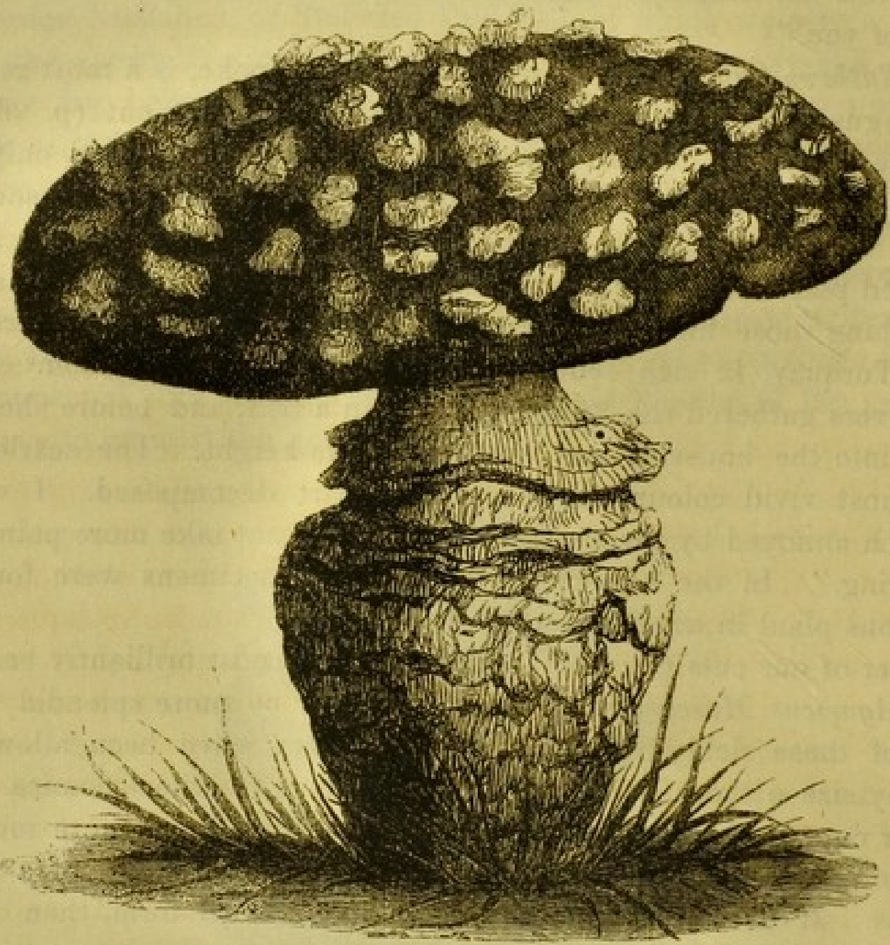


291. The Stellated Puff-ball (Lycoperdon Stellatum).

"What geometry shall define their ever-varying shapes? Who but a Venetian painter do justice to their colours?" says Dr. Badham, in his very interesting work "On the Esculent Funguses of England;" and well may he challenge competition with this Protean family. "As to shapes," he adds, "some are simple threads, like the *Byssus*, and never get beyond this; some shoot out into branches like Sea-weed; some puff themselves out into puff-balls; some thrust their heads into mitres; these assume the shape of a cup, and those of a wine-funnel; some, like *Agaricus Mammosus*, have a teat; others, like *A. Clypeolarius*, are umbonated at their centre; these are stilted upon a high leg, and those have not a leg to stand on; some are shell-shaped, some are bell-shaped, and some hang upon their stalks like a lawyer's wig. Some assume the form of a horse's hoof, others of a goat's beard; in the *Clathrus Cancellatus*, you look into the Fungus through a thick red trellis which surrounds it." Besides these marvellously-varied kinds, there are others: one formed like a nest, another like an ear. "One," says Dr. Badham, "is so like a tongue in shape and general appearance, that in the days of enchanted trees you would not have cut it off to pickle or eat on any account, lest the knight to whom it belonged should afterwards come to claim it of you."

The *Clathrus Cancellatus*, of which we before spoke, is a most remarkable Fungus. Its lower member, as exhibited in the cut (p. 261), is white, the upper lattice-like part a bright coral hue. It has only been found in two places in England, being an inhabitant of the south of Europe. Those two places are the Isle of Wight and Torquay; in this last-named place it has been found in two localities. Mrs. Griffiths says, in describing those first discovered: "It appeared in Mrs. Travers' garden at Torquay, in rich reddish earth, formerly a plantation. When Mrs. Travers gathered the Fungus, it was in a ball, and before she could bring it into the house it had burst up to its height. The scarlet part had a most vivid colour till the darker part decomposed. I was so very much annoyed by the stench, that I could not take more pains with the drawing." In the autumn of 1853 other specimens were found of this curious plant in another part of Torquay.

Another of our cuts (fig. 292) represents that most brilliantly beautiful species *Agaricus Muscarius*. Few objects can be more splendid than a cluster of these richly-tinted Fungi, when they have been allowed to attain any size without being preyed on by slugs or other enemies. The pileas, or cup, is of a vivid orange-red, though sometimes more inclining to a carmine hue, and over it are scattered angular warts of a snowy whiteness. It rises first from the earth in a conical form, then after a time the pure white veil which connects the edge of the cup with the stipes, or stem, gives way, and falls back, discovering the pale lemon-tinted gills which lie beneath it. The root is bulb-shaped, and the Fungus, when extended fully, often five or six inches in diameter, standing on a velvet-like white stem of several inches in height. It is highly poisonous, and is used by the Russians to make an intoxicating potion, called "*moucho more*," which they use to produce a kind of delirium. The coal-mines of Dresden exhibit the interesting phenomenon of Fungi which emit light like pale moonbeams; and Mr. Gardner states, that whilst passing along the streets of a Brazilian town, he "observed some boys amusing themselves with what appeared to be large fire-flies, but which proved, on inspection, to be a Fungus belonging to the genus *Agaricus*, which gave out a bright phosphorent light of a pale green." He next day obtained considerable quantities, and found that a few of them in a dark room were sufficient to read by. Of a few of the varied *forms* of this singular tribe our cuts and descriptions may have given some little idea; but to supply the least notion of the exquisite and most vivid tinting, the soft pencilling and shading which these singular productions display, would baffle the most skilful painter. Their hues are as varied as they are lovely; in one tribe alone, the *Agarics*, we find crimson flecked with white, violet, rich orange, scarlet, yellow of



192. The Fly-blown Agaric (Agaricus Muscarius, small specimen).

every tint, green, pure white, brown of all shades, and a thousand other dyes; over the spreading caps of some of the species of this genus are scattered snow-white warts, some are marked with geometrical figures, and many kinds are covered with a glossy varnish which gives to them almost a metallic lustre. In texture they also greatly differ, some species being so leathery and firm, that they can be sowed together; the *Amadou* is of this character, and has been used by a medical practitioner in extensive sheets for spreading under sufferers from excoriation, it being softer and more elastic than chamois leather. The poor in Franconia, also, make themselves dresses of this Fungus. Some Funguses are hard as wood, others so brittle that the touch of a finger will break them; some are solid and firm, and others slimy and disagreeable to the touch.

They also present immense diversity in both odour and flavour, some species emitting so disagreeable a smell as to be altogether unbearable, whilst others are described as smelling "like the bloom of May." One species smells of onions, another of cinnamon, a third of tarragon, a fourth of apricots and ratafia. Besides these various olfactory effusions, Fungi present us with as illusive and remarkable flavours. To use Dr. Badham's words, "they are sapid, sour, sweet, peppery, rich, acrid, nauseous, bitter, styptic;" a few, and these generally of a dangerous character, have little or no taste; and there are others whose flavour is unlike that of any other substance in existence, and quite peculiar to themselves—that, for instance, of the mould on cheese, a taste well known to all, and much admired by some.

The expansive growth of Fungi, and their varied habitats must next call for a few remarks. Some of the facts supplied us by authors on the former would be considered as scarcely credible, did they rest on less worthy evidence than that which attests them. Sowerby states, that he has placed specimens of the *Phallus Caninus*, or "stinking morel," on his window over night, in the egg-shape, and found them, next day, fully grown; and another author speaks of his placing *Phallus Impudicus* within a glass vessel, and its expanding so rapidly as to shiver the glass to pieces with an explosive detonation as loud as that of a pistol. Carpenter gives an account of a paving-stone, twenty-one inches square, and weighing eighty-five pounds, being raised an inch and a half from its station by a cluster of Toadstools springing up under it; and many other facts, which attest as well the explosive power as the rapid growth of Funguses, are given by different authors, one having been known to attain the size of seven feet five inches in circumference, and the weight of thirty-four pounds, in three weeks, and others the weight of twelve pounds in a few days. But none of these statements, remarkable as they are, are so wonderful as one which is made by Sir Joseph Banks of a circumstance which occurred under his own roof. He states that a friend having sent him a cask of wine, which was too new and sweet for present use, it was locked up in a cellar to mature. At the end of three years, Sir Joseph, supposing that time had now done its work, proceeded to open his cellar and inspect its contents. Little did he think how *time* had been employed, and little did he conceive what would be the contents of that cellar. The door refused to open, and being invincible by gentle means, he had it fairly cut away; but he was no nearer effecting an entrance than before; the cellar was found to be literally full of fungous growth, which had borne the cask aloft to the ceiling, where it stuck, upheld by Funguses, the produce of the wine which had all leaked out and formed this monstrous growth!

But although these monstrous and sudden growths call for our wonder and admiration of the power of Him who can thus produce such huge structures from spores which are invisible to the naked eye, and command that which is so minute to become, in a few hours, an organised structure of such magnitude and such complication of arrangement, we must not let our praise and adoration stop here ; for in the minuter growths, which we shall soon examine, we shall find as wondrous an exhibition of surpassing skill as in these larger products. The microscopic Fungi—those which by fastening on his crops become the bane of the farmer, and are in God's hands a means whereby he can cut off our staple article of food, and "destroy the staff of bread," under the name of "the smut in Wheat (*Paccinia Graminis*), or cause our Bean or Potato crops to perish—are among the most surprising of vegetable productions, and will hereafter engage our attention.

We have already observed that the treasures of food which it has pleased God to provide for us in the Fungus tribe are, if not wholly disregarded, at least by no means duly appreciated by the English. There is, perhaps, no country richer than our own in the esculent species of Fungi; they abound in our woods and pastures, they grow from the ground and under the ground; they spring abundantly out of the substance of dead trees, and are often found on waste lands and heaps of rubbish, from which no other edible produce can be procured; yet, though this is the case, and more than thirty species of esculent Fungi are spontaneously brought forth in England, there are only three or four of these species that are eaten by its inhabitants; all the rest of this abundant supply being allowed to rot under the trees, or to become the prey of field-mice, toads, slugs, and other creatures, to which they afford many a delightful repast.

Throughout the continent of Europe, on the contrary, plants of this tribe are eagerly sought after by all classes of men, and form the chief, if not the sole, diet of thousands, who would otherwise be but scantily provided with aliment. But Fungi are not only the tolerated food of the poorer classes, they are also most highly prized by the rich man and the epicure; and afford, when daintily cooked, many a delicate dish and many a highly-flavoured sauce at the most elaborately-served and highly-expensive tables. In Germany and Italy, immense numbers of the various species of this tribe are sold in the markets, and produce an amount of income which would seem to us almost incredible. In Rome, so important are the Fungi as an article of commerce, that there is a public officer appointed for the express purpose of testing the species exposed for sale, and superintending this branch of the revenue; for in that market a tax is laid on all quantities of Fungi presented for sale exceeding ten pounds in weight. All Fungi brought into Rome are supervised by this officer, weighed, sealed up, and all destined for that day's consumption sent to a central depôt. If, among the contents of the baskets offered, any stale, maggot-eaten, or dangerous specimens are found, they are sent under escort, and thrown into the Tiber; and another very remarkable circumstance is the law, that if any specimen of the common Mushroom (*Agaricus Campestris*) is found, it also is to be *thrown into the river!* So says an unpublished letter of Professor Sanguinetti, "Ispettore del Funghi," at Rome. It is certainly singular that the only Fungus which is freely accepted in all English kitchens, and considered as the sole common kind that is honest and trustworthy, and possessed of no murderous properties, should be the one thus protested against, whether in a state good or bad! "For forty days during the autumn, and for about half that period every spring, large quantities of Funguses, picked in the immediate vicinity of Rome, from Frascati Rocca di Papa, Albano, beyond Monte Mario, towards Ostia and the neighbourhood of the sites of Veii and Gabii," are brought to Rome. "The returns of taxed Mushrooms alone," says Dr. Badham, "during the last ten years, give a yearly average of *between sixty and eighty thousand pound weight;* and if we double this amount, which we may safely do in order to include such smaller untaxed supplies as are disposed of in bribes, fees, and presents, and reckon the whole at the rate of six baiocchi, or threepence a pound (a fair average), this will make the commercial value of fresh Funguses very apparent, showing it here to be little less than £2,000 a year." Besides this, we must consider the dried, pickled, and preserved supplies, which sell at a much higher price than the fresh, from one shilling to one shilling and threepence per pound, and also recollect that this calculation includes only the Roman market, and that every other market-place in the Italian states has its proportionate sale of this wide-spreading branch of the vegetable produce of the land.

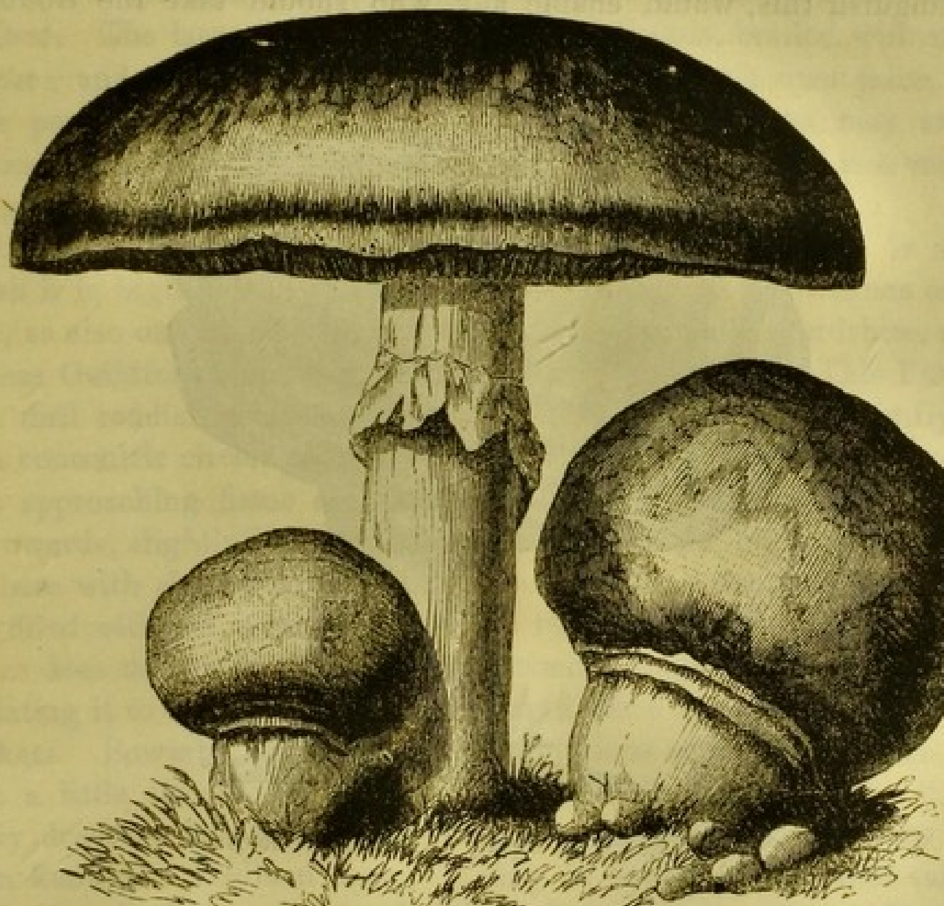
With the above statements fully in our mind, and after having been habitually in communication with many of the families from amongst our peasantry who were but scantily provided with daily food, we found ourselves one day in an extensive pine-wood, near Budleigh Salterston, in South Devon, and saw the ground, which was densely carpeted with the accumulated dead leaves that had fallen from the trees, and lain undisturbed for many years, studded in every direction with Fungi, of every colour and of every shape, in such quantities as that cart-loads might have been gathered there. Huge purple, white, brown, and tawny *Agarics* were there; the deep orange of the *Boletus Edulis* was interspersed with the snowy balls of the *Lycoperdons*, and the delicate apricot tint of the pretty and singular *Cantharellus Cibarius*, with many other beautiful and edible species, were scattered in profusion around me. How could we, under these circumstances, do otherwise than regret that ignorance of the differences of species, combined with the strong prejudice which prevails in England against using any of this tribe (save the two or three favoured individuals), should shut out our poor from the possibility of availing themselves of this rich supply of wholesome aliment, which the bounty of God had provided for them, if they would but be persuaded to use it? It is true, that amongst this extensive collection of Fungi there were some species which would have proved poisonous, and others which would have been but disagreeable food; yet the greater number of them were such as, if properly cooked, would have furnished, not only *wholesome*, but also savoury and pleasant food; and it seemed to us a great pity that they should be so wholly neglected, and left for a prey to reptiles and field-mice.

The chemical structure of Fungi is said to be the most highly animalised, or, in other words, to partake more of the nature of animal composition than that of any other vegetable. Besides the intimations of this circumstance that are afforded by the smell of some of the species in decay, which partakes much of the character of that of putrid meat, and the strong meat-like flavour which some of them possess when cooked, we find the following fact stated—that, "like animals, they absorb a large quantity of oxygen, and disengage in return from their surface a large quantity of carbonic acid; all, however, do not exhale carbonic acid, but in lieu of it some give out hydrogen, and others azotic gas. They yield, moreover, to chemical analysis the several components of which animal structures are made up; many of them, in addition to sugar, gum, resin, a peculiar acid called fungic acid, and a variety of salts, furnish considerable quantities of *albumen*, *adiposine*, and *osmazome*, which last is that principle that gives its peculiar flavour to meat gravy."

Fungi are considered to be highly nutritious, and are said by many of the faculty to be easy of digestion. This latter opinion, though strongly supported by many foreign medical men, is certainly quite in opposition to the generally-received opinion on that subject in England, and also to the ideas of ancient writers. Gerard, the quaint old herbalist, says: "Some Mushroomes grow forth of the earth: others upon the bodies of old trees, which differ altogether in kinds. Many wantons that dwell near the sea, and have fish at will, are verie desirous for change of diet, to feed upon the birds of the mountaines; and such as dwell upon the hill or champion grounds do long after sea fish; many that have plentie of both do hunger after the earthie excrescences called Mushroomes; whereof some are very venomous and full of poison, others not so noisome, *and neither of them very wholesome meat.*" And again—"Galen affirms that they are all very cold and moist, and therefore do approach unto a venomous and murtherous facultie, and ingender a clammy, pituitous, and cold nutriment, if they be eaten. To conclude, few of them are good to be eaten, and most of them do suffocate and strangle the eater. Therefore I give my advice to those that love such strange and new-fangled meates, to beware of licking honey among thornes, lest the sweetnesse of the one do not countervaile the sharpnesse and pricking of the other."

Fungi are classed under two primary divisions—*Hymenomycetes* and *Gasteromycetes*; the seed lying externally in the former, and internally in the latter. These divisions are subdivided into four tribes—1st, *Pileati*; 2nd, *Clavati*; 3rd, *Mitrati*; and 4th, *Cupulati*. In each of these tribes we find esculent species, although most of that description are found in the first tribe, the *Pileati*, and of that tribe the genus *Agaricus* supplies the largest number of any of the genera.

All Agarics are furnished with a fleshy pileus or cap, a stipes or stem,



293. The Meadow Mushroom (Agaricus Campestris).

and gills placed at right angles with their stem. The species of this genus differ widely in size, shape, and colour; but all agree in the possession of the parts which we have named.

Our own favourite Meadow Mushroom (fig. 293), is the first we will describe, of which old Gerard says:—

> "The Meadowe Mushroom is in kinde the best;
> It is ill trusting any of the rest."

Every one considers himself a complete judge of this species, and few hesitate to present at their tables a dish of these agreeable Fungi, without taking any other means of proving their trustworthiness, than that most fallacious mode of directing their cook to stir them whilst dressing *with a silver spoon ;* in full belief that if their juices do not tarnish the silver, there can be no injurious specimen amongst them.

But although this kind is in such general use in England, yet it is by no means more easy to discriminate *it* from other species, than it is to discriminate most other kinds. "No Fungus," says Dr. Badham, "presents itself under such a variety of forms or such singular diversities of aspect. The inference is plain ; less discrimination than that employed to distinguish this, would enable any who should take the trouble to

294. Orange Milk Agaric (Agaricus Deliciosus)

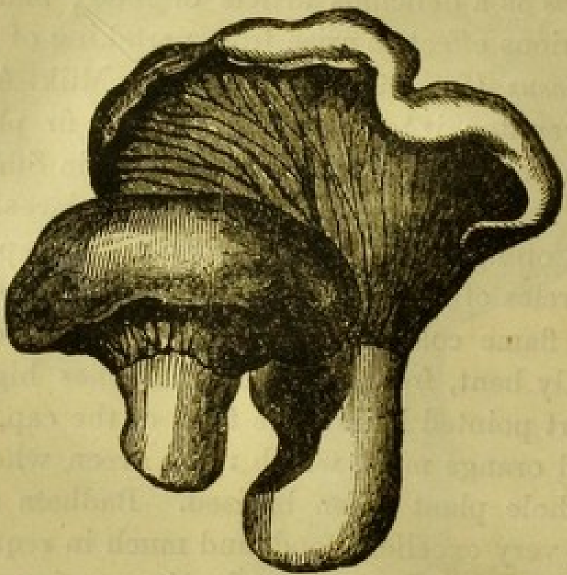
recognise at a glance many of those esculent species which every spring and autumn fill our plantations and pastures with plenteousness." The cap of this Mushroom is in some individuals snowy white and smooth ; in others, brown and scaly ; in some instances the gills are of a delicate pink ; in others of a deep, rusty black ; some grow broad and flat, others in the form of buttons, looking almost like a puff-ball of a soft, smooth texture, and of a pure white colour. The stem in some varieties is nearly straight, as in the larger one in our cut ; in others it is broader, by one-third, at the top than at the bottom, and altogether shorter than it is wide, the under part of the cap being upturned at an obtuse angle with the bulky stem so as to display the coarse-looking, dark gills which line it.

It is a pleasant thing to sally forth early in the day, under the first burst of sunshine which breaks out on a soft, clear morning in September; and to see how the night dews have been at work in hastening the growth of Fungi. We need hardly say that Mushrooms are excellent pickled. The way to do this is to select all the *buttons;* place them skins and all in a stewpan with allspice, salt, and pepper; stew them until they have given out every drop of their juice, and (like children who give and then repent, and take back again) have reabsorbed all those juices, charged with the flavour of the spices amongst which they have been stewing. When this process is completed, add as much hot vinegar as will cover your Mushrooms, boil them just for a minute, and they are finished. The large broad specimens are delicious, broiled with salt and pepper; and the middle-sized kinds, stewed in their own juice, with a little pepper, salt, and butter. Whatever the Italians may say, the *Agaricus Campestris* is a delicious article of food; and it is a very rare thing for any injurious effect to arise from partaking of them.

Agaricus Deliciosus (fig. 294), the Orange Milk Agaric, is another which is in high repute; it may be found in the fir plantations of Scotland, as also on those of the barren hills at Barr in Staffordshire, as well as near Guildford in Surrey, and in some other places. This Fungus is of a dull reddish orange, with a somewhat viscid cap, frequently lined with concentric circles of rather a brighter hue. It has narrow branched gills approaching flame colour; the stem is orange, solid, and tapering downwards, slightly bent, from two to three inches high, and covered at the base with short pointed hairs; the flesh of the cap, or pileus, is firm, and filled with red orange milk, which turns green when exposed to the air, as does the whole plant when bruised. Badham and Loudon agree in stating it to be very excellent food, and much in request in the Italian markets. Sowerby says, "It was very luscious eating, full of rich gravy, with a little the flavour of muscles;" and Sir James Smith, "that it really deserves its name, *A. Deliciosus*, being the most delicious Mushroom known." Badham says, "it may be served with white sauce, or fried; but the best way to cook them, after duly seasoning with salt and pepper, and putting a piece of butter upon each, is to bake them (in a closely-covered pie-dish) for about three quarters of an hour."

Another of the *Pileati* which we must notice is the *Cantharellus Cibarius* (fig. 295), an exceedingly pretty Fungus, of a soft apricot hue throughout both cap and stem; and instead of gills, it is furnished with thick veins or plaits, very elegant in appearance. It is irregular in form, and the stems are seldom, if ever, in the centre of the cap. Loudon says that the best way of preserving them for use is to string them in rows after they have become flaccid, and hang them in a dry place, where they can have plenty of air; they then form a delicious ingredient in rich gravies. Vittadini, an Italian writer on the subject, says that the common people in Italy dry, or pickle them, or keep them in oil for winter use, and recommends, as they are rather tough, to soak them for a night in milk, when they should be gently stewed either with other Fungi or with meat, or else alone.

We have before stated that the greater number of esculent Fungi belong to the tribe *Pileati*, under which head are classed the divisions *Agaricus*, *Boletus*, *Hydnum*, *Polyporus*, *Fistulina*, *Cantharellus*, and several other genera, all of which furnish more or fewer edible species. Of these, however, we find the most under the head *Agaricus*, a division which takes its name from Agaria, a kingdom of Sarmatia. Our English word Mushroom (by which all kinds of edible Fungi are commonly designated) has a French origin, and comes from the word *mouceron*, "originally," says Badham, "spelled *mousseron;* and belongs of right to that most dainty of Funguses, the *Agaricus Prunulus*, which grows amidst tender



295. Cantharellus Cibarius.

herbage and *Moss*, whence its name." *Champignon* is also of French derivation; but whilst that name in France is *generic*, the English make it *specific*, and restrict it to a single species, the *A. Oreades*, or Fairy-ring Mushroom, of which more hereafter. *Agaricus Prunulus* has also a right to the cognomen Fairy-ring Mushroom, for it, as well as *A. Oreades*, *A. Orcella*, *A. Georgii*, *A. Personatus*, and our common Mushroom, *A. Campestris*, has a share in making those mystic rings which in former days scared many a rural hind and maiden, and caused them to deviate from their direct course in passing through the fields where they were to be seen, lest, if they once entered that magic boundary, they should come under the power of the fairies, or (as they were called in Devonshire) *pixies*, and should be by them *pixy-led;* that is, led off into by-ways, and so into some pathless waste. As Puck says :—

"I'll follow you, I'll lead you about a round.
Sometimes a horse I'll be; sometimes a hound.
A hog, a headless bear; sometimes a fire;
And neigh, and grunt, and bark, and roar, and burn,
Like horse, hound, hog, bear, fire, at every turn."

So did these poor country-people fancy the fairies would hobgoblinise them, if once they dared to trespass on their domain.

We will not here enter into the speculations of botanists on the mode by which these rings are formed; it will be enough to say, that it is now generally acknowledged that they are produced by the growth of Fungi. The *A. Prunulus* is reproduced in these rings every year about the same time, the circle continuing to enlarge until it breaks up into irregular lines, which is a sure indication that the species is about to disappear from that place; an unbroken ring being a certain promise of a good crop the next year. It is a large Fungus, and very abundant; Dr Badham says he has collected in one field from twenty to twenty-five pounds weight. Professor Balbi writes to Persoon: "This rare and most delicious Agaric, the *Mouceron* of Bulliard, and the *A Prunulus* of other authors, abounds on the hills above the valley of Stafora, near Bobbio, where it is called *Spinaroli*, and is in great request. The country-people eat it fresh in a variety of ways, or they dry and sell it for from twelve to sixteen francs a pound." It is a thick, convex, fleshy Mushroom, irregular in shape, of a cream-coloured, or buffish, or gray, or reddish tint, with very numerous white gills, and has the advantage of appearing in spring, when few other edible species are to be procured. In Rome, "it is sent in little baskets as presents to patrons, fees to medical men, and bribes to Roman lawyers." How surprised would our learned functionaries in law or physic be to receive a little basket of what they would probably call "Toadstools," in return for their efforts on behalf of their clients or patients!

A. Georgii, another of these gregarious ring-forming species, is one of no small interest; its cap is at first conico-campanulate, and covered with white shreds; but when fully expanded these have all disappeared, and it becomes beautifully white and shining. It grows in pastures, and under trees, and some of the individuals attain a most enormous size. Dr. Withering says: "Mr. Stackhouse had repeatedly mentioned to me a large esculent Fungus found on the sea-coast in Cornwall, which is, I believe, a monstrous variety of this species. Its whole habit is very large, the button as big as a potato, the expanded pileus eighteen inches over; the stem as big as a man's wrist," &c. He also mentions a specimen found on an old hot-bed, which weighed fourteen pounds. But huge as this Fungus must have been, it by no means equals one mentioned by Clusius, in his "History of Plants," which was found in Pannonia. This immense specimen (supposed to have been *Polyporus*

Frondosus), "after satisfying the cravings of a large Mycophilous household, enough of it remained to fill a chariot!"

The Hungarians suppose the Agaric, *A. Georgii*, or, as some authors call it, *A. Exquisitus*, to be a special gift from St. George. It has several trivial names—"the Horse Mushroom," from its immense size; and "White Caps," under which name it is sold for making ketchup. There are so many other interesting species of *Agarics* which invite our attention, that it is difficult to know which of them to select for especial notice. We have named *A. Oreades* and *A. Personatus* as being species which grow in rings. The former is a small buff Mushroom, its common names being Champignon, and Scotch Bonnets. It is very common, according to Badham; Hyde-park produces them abundantly in some seasons. He says, that in the French *à-la-mode* beef-shops, this species of Fungus is in great request, and that it imparts a delicious flavour to rich soups and gravies. When dried (as it is the custom of the French and Italians to use them), these Champignons may be kept for many years, and their flavour becomes improved by the process. *A. Personatus* is sold in Covent-garden Market, under the name of *Blewits*. It is of a pale bistre, or purple lilac, occasionally violet, the cap from two to six inches broad, and the stem from one to three inches high. It grows in rings or in clusters amongst grass, usually appearing in October.

Our cut (p. 275) represents *Agaricus Comatus*, according to Puccinelli, as quoted by Badham, "in great repute about Via Reggio and Lucca." It may be found in meadows and waste places in early spring, and the young specimens are used for making ketchup. It is called the Maned Agaric, from its shaggy edge. The cap is fleshy, white, and scaly, the lamellæ or gills changing to red-purple and to black, and showing their dark hue through the skin of the cap as it advances in age.

Fig. 296 is of a species which grows on wood—*Agaricus Ostreatus*. It may be found on dead trees in spring and autumn. This Fungus varies much in size and colour; but where it has once been found, there it is pretty sure to grow for many successive years. It is a pretty Fungus, varying in hue; but though occasionally found quite white, it is in general of a cinerous brown with white gills, and has either no stem, or one sublateral.

A. Rubescens (fig. 297) is another very delicate Agaric, which grows in woods, particularly of Oak or Chesnut, and is found both in summer and autumn; and *A. Caudicinus* (fig. 298), a beautiful little cinnamon-coloured Fungus, which grows on trees, and is very much prized in southern Italy, is also worthy of our notice; the elegant little white Field Agaric, *A. Virgineus*, which abounds in our pastures in autumn, is also a very attractive species. But space does not allow of our naming any others of this tribe, and we can barely hint at the rich store of food which is offered to us by the other genera of the tribe *Pileati*.

The Maned Agaric (Agaricus Comatus).

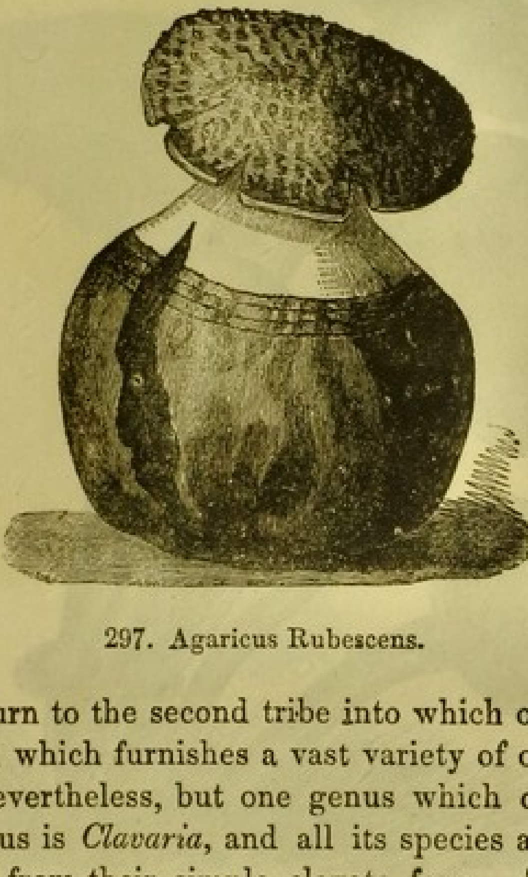
The genus *Boletus* differs from the Agarics in having, instead of gills, a series of vertical tubes, aggregated under the cap and encircling the stem, which look, when seen altogether, like a slice of fine sponge. *B. Edulis* and *B. Scaber* are the species most in vogue, though several others are innocuous and agreeable. *B. Edulis* is a huge Fungus from six to seven inches across; it varies in colour from light brown to bronze, bay, deep brown, &c. The tubes are at first white, then yellow, lastly, of an olive or yellow-green. The stem is always thick and solid; at first white, but changing to fawn-colour; and it is beautifully mapped or meshed with reticulations peculiar to itself. This species seems to have been well known to the ancient Romans, and appears to have been that called *Suillus*. "As to the best manner of cooking *B. Edulis*, this must

296. The Oyster (Agaricus Ostreatus).

be left to the taste of the gourmand; in every way it is good. Its tender and juicy flesh, its delicate and sapid flavour, render it equally acceptable to the plain and to the accomplished cook. It imparts a relish alike to the homely hash and the dainty ragout; and may be truly said to improve every dish of which it is a constituent." So says Dr. Badham, and he is backed by other authorities, who agree in stating *B. Edulis* to be (as its name implies) very excellent eating.

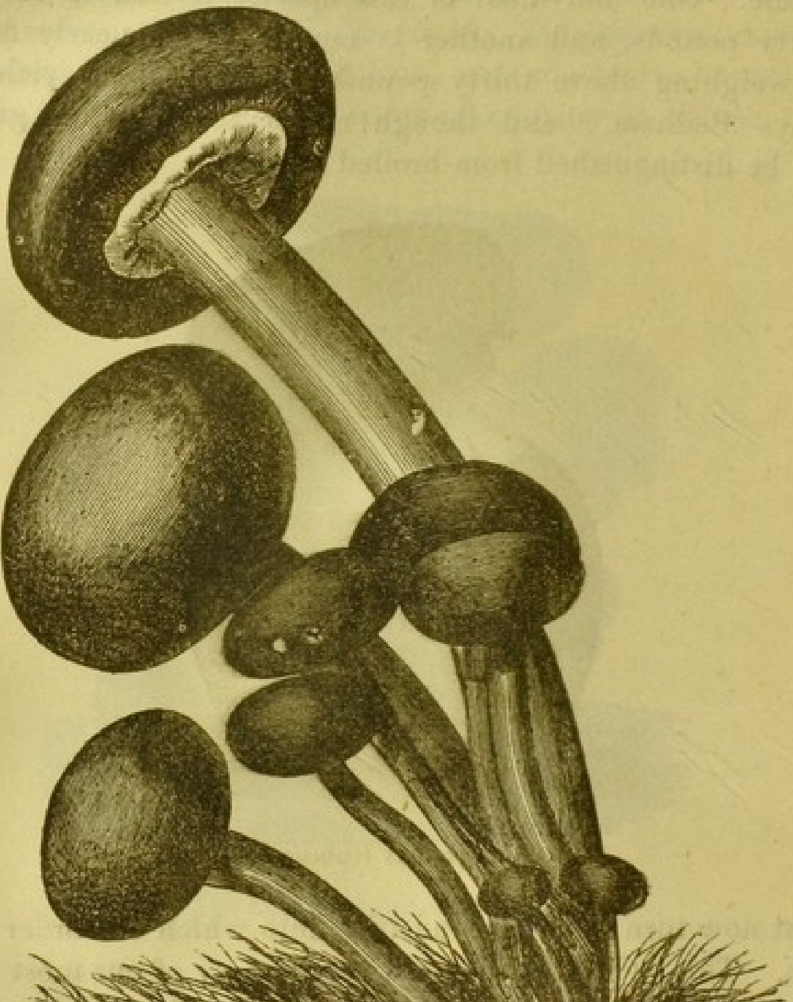
The *Hydnum* is another genus of this tribe, which affords good food. Our figure (299) represents *H. Repandum*, a tawny red species, which occurs in woods of Oak and Pine, growing frequently with others. This is the only esculent species in the genus *Hydnum*, and is said to have a flavour of oysters. In this genus the under surface of the cap presents a series of conical teeth or bristles. For this reason *Hydnum Repandum* is called in Italy *Steccherino*, or "the Hedgehog."

The genus *Fistulina* presents us with but one edible species, *F. Hepatica.* This is that strange-looking Fungus which resembles in its early stages a huge red tongue, lapped out at us from the trunk of some Oak or Chesnut, far above our heads; whence its vulgar name in Italy is *Lingua Quercina*, or *Lingua di Castagna.* In its later growth, it looks more like a lump of dark liver than any other substance, whence its specific name. One individual of this species is said to have weighed nearly thirty pounds, and another is mentioned as nearly five feet in girth, and weighing above thirty pounds. "No Fungus yields a richer gravy," says Badham, "and though rather tough, when grilled it is scarcely to be distinguished from broiled meat."



297. Agaricus Rubescens.

We must now turn to the second tribe into which our order is divided, the *Clavati.* This, which furnishes a vast variety of our most interesting Fungi, supplies, nevertheless, but one genus which contains any edible species. This genus is *Clavaria*, and all its species are esculent. They are called *Clavaria* from their simple clavate form. The whole genus is exceedingly pretty; some of them growing on trees, others clustering amongst grass. *C. Rugosa* is of ivory smoothness and of the purest white. It grows from two to two and a half inches high, is simply branched, but each branch is curved. It grows in clusters, and gives you an instant reminder of a handful of the convoluted kernels of walnuts after they have been delicately peeled for eating. Another yellow species grows widely amongst grass, so as to quite yellow the surface of the place on which it has taken up its abode. We have seen on a hill at Tor, near Torquay, acres of ground on which you could not walk many yards without treading on clustered masses of this pretty pale yellow *Clavaria*, which smells (as does its white congener, *C. Rugosa*) so purely Mushroom-like, that you cannot doubt of its good qualities. *C. Coralloides* (fig. 300), pronounced by Vittadini, *Esculenta Deliciosa*, is erect, white, with unequal branches tipped with red or violet; and *C. Amethystina* (fig. 301), of a most delicate lemon colour. The mode of dressing Fungi of this genus is to cleanse them well from earth, which is apt to adhere to them, then *sweat* them over with a little butter over a clear fire, and



298. Agaricus Caudicinus.

strain them, throwing away the liquor. After this you must stew them for an hour with salt, pepper, chopped chives, and parsley, moistening with a little plain broth, and dredging occasionally with flour; when cooked, to be thickened with cream and yolks of eggs.

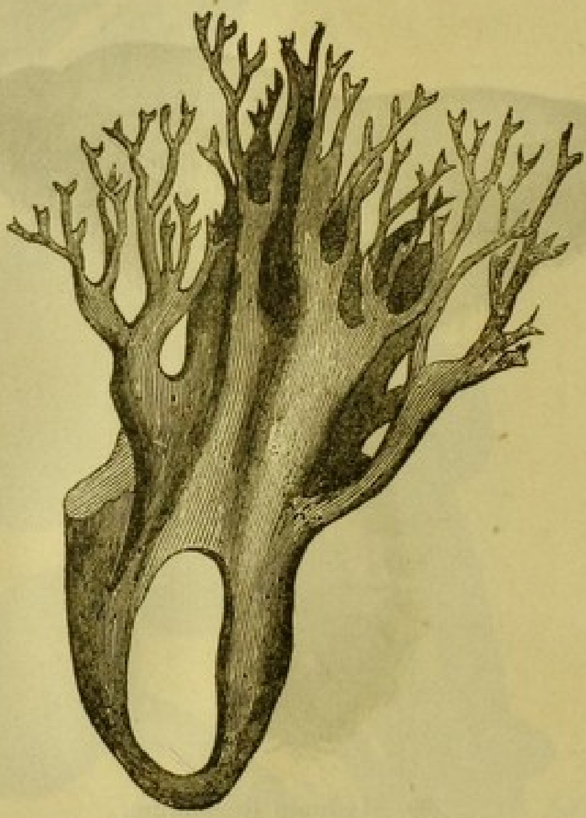
The third tribe, *Mitrati*, ranks under its banners two genera which produce excellent food. The first of these, *Helvella*, gives us two edible species—*H. Crispa* and *H. Lacunosa*. They grow on earth or on very wet wood, and emit an agreeable odour. Though of a permanent character, they are rather fragile, and much like the Morel in flavour, being in Sweden and Germany often confounded with it. In Sweden it is called *Stenmuchla;* in Germany, *Gemeine Morchel*, *Stumpf Morchel*, or Stock Morchel.

The other esculent species of this genus is *Morchella*, which also affords two most delicious edible species—*M. Esculenta* and *M. Semilibera*. The appearance of the *Morchella* is very singular. Its cap varies considerably in shape and hue, and the surface is pitted into little cells, or pockets, formed by folds or plaits of the hymenium, which are called *ribs*. These ribs are very irregular. The cap is hollow, and opens into an irregular hollow stem.

299. Hydnum Repandum.

The *Lycoperdons* next demand our attention. "All those more or less spherical white Funguses, furnished with a membraneous white covering, and filled, when young, with a white, compact, homogeneous pulp, which we call puff-balls, are good to eat:" so writes Dr. Badham; and he adds, that those in most request abroad, and the best, are those which have no stem—that is, no sterile base.

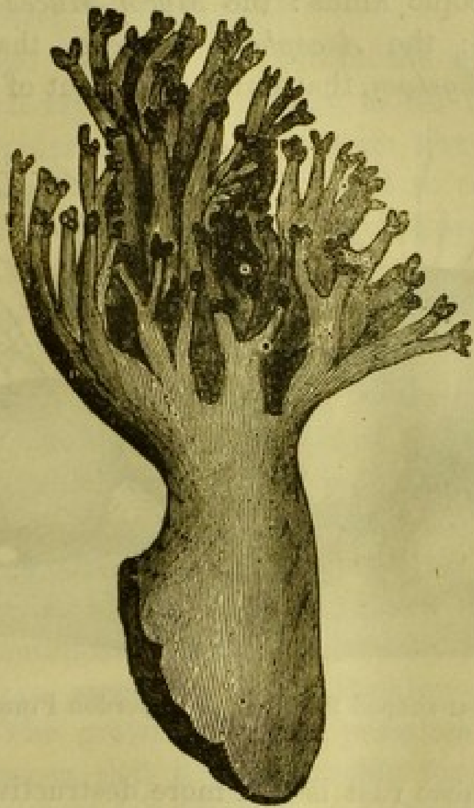
Two species, *Lycoperdon Plumbeum* (fig. 302), and *L. Bovista*, are quoted as the best eating. The former of these may be found, either solitary or in groups, in dry places, and may be gathered in spring, summer, or autumn. Vittudini says: "After the warm rains of summer and autumn, myriads of these little plants suddenly springing up will often completely cover a piece of ground as if they had been sown like grain for a crop. If we dig them up we shall find that they are connected with long fragile threads, extending horizontally under ground, and giving attachment to numerous smaller puff-balls, in different stages of development, which, by continuing to grow, afford fresh supplies as the old ones die off." *L. Plumbeum* is, when full grown, about the size of a walnut. Loudon figures it under the name of *L. Pyriforme*—the Pear-shaped Puff-ball." The other species named as among the best is *L. Bovista*. This is the kind which is used for the purpose of throwing bees into a trance whilst the spoilers rifle their home of all its hoarded treasure. It used also, in former days, to be employed instead of lucifer



300. Clavaria Coralloides.

matches, as it will, when dry, hold fire for a long time, and was often carried by rustics in a state of ignition for the purpose of lighting their cottage fires. *L. Bovista* sometimes grows to an enormous size. The flesh is at first of snowy whiteness, but it should be eaten as soon as gathered, a few hours sufficing to turn it to dirty yellow, and destroying its firmness. When fresh, its thick, white, fleshy substance renders it fit for all culinary purposes. The best method of dressing it is said to be, to cut it in slices, and fry it in egg and bread-crumb. According to Vittudini, you may cut slices daily fresh from the living plant (provided that you do not break its connexions with the earth), and so have "a fine frittura every day for a week," which "frittura" Badham reports to "have the flavour of a rich light omelette."

One more noted species, the *Tuber Cibarium*, or Truffle, must close our imperfect catalogue of edible Fungi. This curious species is found growing in clusters in clayey or sandy soil, some inches under the ground, as also in chalk; and is common on the Wiltshire downs, as well as in woods both in England and Scotland. The form of Truffles is nearly spherical, and their colour approaching black; they are studded over with pyramidal tubercles, and their spawn is phosphorescent and emits light. In England they seldom exceed a few ounces in weight, but on the Continent they are said to attain to many pounds' weight. As there

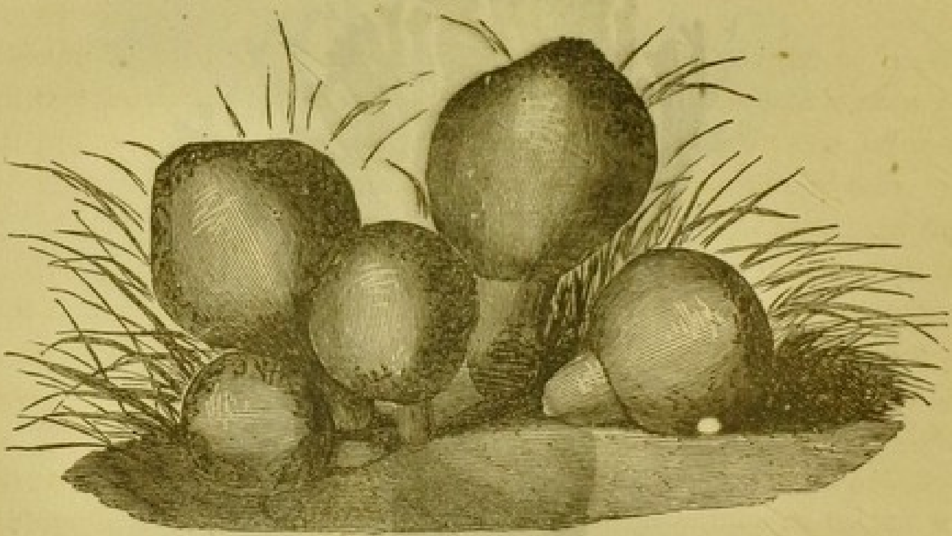


301. Clavaria Amethystina.

is no appearance above ground to indicate where the Truffles lie, there is, of course, difficulty in discovering them; but so keen have men been in their appetite for this delicacy, that they have hit on the expedient of training dogs to scent them out. When the animals nose the prey, they stand, and whine, and scratch on the spot until their masters dig and take possession of the tubers. It is said that a *man* was once known capable of exercising this extraordinary function, and discovering Truffles in the earth by their scent.

Much has been written concerning the means of distinguishing edible from poisonous Fungi, but hitherto no satisfactory rules have been arrived at. Indeed, it seems probable, from some recent experiments, that the harmlessness or otherwise of a Mushroom does not so much depend upon species as upon *locality of growth.* In Russia the natives eat with impunity many species that are reputed poisonous in England; and, on the other hand, species reputed innocent amongst ourselves are frequently productive of dangerous symptoms. It is more than probable, however, that the poisonous principle residing in the Fungus tribe admits of extraction by the operation of preliminary soaking for some hours in vinegar, salt, and water.

Dr. Badham, the author from whom we have so frequently quoted, says: "For the single Mushroom that we eat, how many hundreds there be that retaliate and prey upon us in return. To enumerate but a few, and those of the microscopic kinds: the *Mucor Mucedo*, that spawns upon our dried preserves; the *Ascophono Mucedo*, that makes our bread mouldy; the *Uredo Segetum*, that burns Ceres out of her own corn-fields;



302. Pear-shaped Puff-ball (Lycoperdon Plumbeum).

the *Uredo Rubigo*, whose rust is still more destructive; and the *Puccinia Graminis*, whose voracity sets corn-laws and farmers at defiance, are all Funguses." The main body of those Fungi which make war on man are microscopic; yet so strong and indefeasible are they in their multitudes and their pertinacity, that man has in most instances no power to withstand their forces.

To the list given above, we must add many more. There is the Ergot (*Spermœdia Clavus*), a species which infests grasses and corn. When developed in the latter, it produces the most dreadful disease in those who unfortunately partake of the infected grain. It is chiefly found in Rye, but happily not very frequently met with in this country. This little Fungus, though so dangerous in its effects when eaten, is nevertheless invaluable for its medicinal uses. It is a little cylindrical horn-shaped body; purple-black without, and white or purplish inside.

Whether the injury to human life of which we have spoken is caused by the Fungus itself, or by the decomposed and corrupted state of the corn to which it belongs, is still a matter of question amongst the learned, and one on which we can form no judgment.

The genera which chiefly affect the cereal produce of our land are the *Uredines* and *Pucciniæ*. The former genus takes its name from *uro*, a Latin word, signifying "to burn," or "scorch," the discolorations and spots on the plants infested by these Fungi having been formerly attributed to blasts or injuries caused by the atmosphere or the heavenly bodies. There are two species of this genus that are almost equally dreaded by the farmer; one called the Smut (*Uredo Segetum*), the other, the Bunt (*Uredo Caries*).

The former of these takes its rise within the glume of living plants, and grows with such rapidity as speedily to fill the interior space and burst through the epidermis, when it appears like a profuse black dust, which, if microscopically examined, is found to consist of minute, perfectly spherical sporules. Withering says of this species: "It consists of very minute, egg-shaped, stemless capsules, at first white, but the thin white soon bursting, it pours out a quantity of brown-black powder mixed with wool-like fibres."

The other species, *U. Caries* (fig. 303), is very common in Wheat, and exceedingly injurious, as it not only destroys the ear on which it grows, but every grain with which the infected individuals come in contact. It is included within the germ of the Wheat, and the spores, which are exactly spherical, are longer than those of the above-named species (*U. Segetum*), and quite black. When crushed they emit a most fetid odour, which is communicated to the whole sample of Wheat with which the bunty grains are associated. Mr. Berkley says of all the corn-infecting Fungi: "The growth of these parasites depends so much on accidental circumstances, that it is impossible for the most experienced cultivators to guard against it entirely; but the evil is greatly lessened by careful choice of seed, and by steeping it in solutions of different substances, which destroy the vegetative power of the sporidia of these parasites, &c."

The other genus, *Puccinia*, is of as evil a nature as the *Uredines*. The disease termed the *mildew* in Wheat is produced by one of these (*Puccinia Graminis*, fig. 304), a Fungus so diminutive that a single *stoma* (or pore in a stem or leaf), itself a thing invisible to an ordinary eye, will produce from twenty to forty of these Fungi; and each of these exquisitely minute plants will bring forth at least a hundred spores or seeds. The seeds are not much heavier than air; and it may easily be conceived that even a single stem of wheat or grass, when beset with these mischievous parasites, will not be long in infecting all the corn, not only in the field where the injured Wheat grows, but in all those adjacent to it.

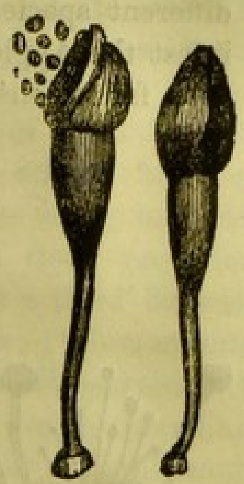
The first appearance of this blight is usually in the spring, or early in the summer, when it arises in the form of orange-coloured streaks, which afterwards assume a deep chocolate-brown. The tufts of this Fungus are dense and often confluent, and forming long parallel lines (fig. 306). The spores are contained in a tubercular double-celled case, and are black; this case is supported by a filiform peduncle or stem, as seen in fig. 305.

But it is not on our corn-fields only that a plague of Fungi rests; these little Pucciniæ attack the leaves of Plum and other fruit trees, devour the fluids of our Bean plants, and scatter themselves in destructive armies over our Raspberry bushes and our Rose beds (figs. 307 and 308). There are some forty or more species which spread themselves in all directions on the leaves and stems of our plants and flowers, nor ever cease their ravages until they have destroyed the vitality of whatever part they touch.

But we must now turn to another class of Fungi—those which beset our dainties under the name of *mould.* There is so interesting an account of this production in a paper published in the pages of a periodical, that we cannot do better than transcribe a part of it as it stands. "If, during the warm weather, we put aside a bit of bread, or a slice of Apple, Pear, Melon, or a Turnip or Potato-peeling, if nothing better is at hand, we shall find in a few days that all those substances will have assumed a mouldy appearance. Take a little of this mould gently off on the point of a penknife, and subject it to the microscope; you see in the moulded bread a grove of tall stalks, each with a round head slightly flattened; in short, a Mushroom in miniature. This is the *Mucor Mucedo* (fig. 310), the Fungus of the bread-mould. While fresh and young, they are of a beautiful milk-white colour; gradually they assume a yellowish tinge. The stalks are so transparent as, under a good magnifying power, to show the cellular structure inside; the bulb also now exhibits, under a thin bark or skin, a number of minute circular bodies, all arranged in a compact form: these are the spores or seeds. After a day or two more, the Fungi begin to ripen, and assume a brownish tint; the bulbs blacken, the skin bursts, and innumerable spores are scattered about, many floating away in the air. This forest of mould, like larger ones, is liable to accidents. You may see in one corner, for instance, that the bit of bread forming the soil has cracked; thus a Fungus has been loosened at the root, and it falls down, we may suppose, with a crash, though we still desiderate instruments to magnify and make audible the sound. Nevertheless, the effects of the fall are visible in the breaking down of neighbouring stems, and in the premature scattering of the seed. You may see, too, sometimes the scattered seeds collect upon one or two plants, and, enveloping them, entirely destroy their vitality, and thus cause old, rotten-looking stumps."

303. The Bunt (Uredo Caries).

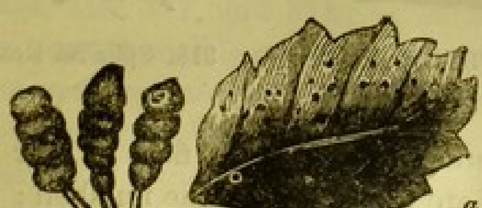
304. A piece of Wheat, natural size, infected with the Puccinia Graminis. (*a*) A cluster of Fungi magnified.



305. The separate Fungi magnified.

306. A section of infected Straw, highly magnified.

307. Puccinia Rosæ. (*a*) Natural size on Leaf. (*b*) The same magnified. (*c*) Separate Fungi, much magnified.

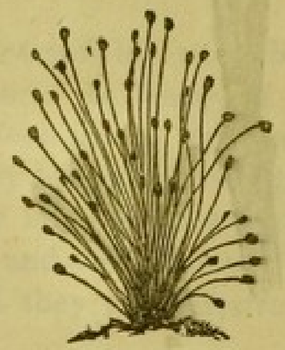


308 Puccinia Rubi (*a*) Natural size. (*b*) Tufts magnified. (*c*) Fungi magnified.

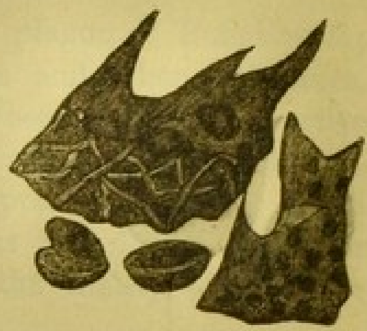
309. Aspergilla Penicillatus.

But it must not be understood that the mouldiness which we find on our eatables is always a crop of the same species of Fungus, or even of different species of the same genus. It is not so. The kinds which infest the Apple and the Pear are different, and those which "rot and then fatten on' our Grapes, Plums, and Raspberries, are all different

310. Mucor Mucedo.

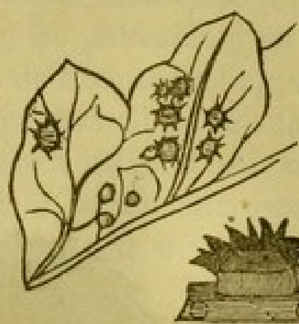


311. Mucor Stercorea.

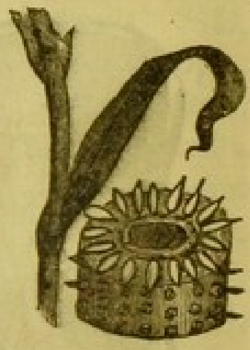


312. Xyloma Concavum.

313. Næmaspora Carpini.



314. Phacidium Coronatum.



315. Dothidea Typhina.

316. Sphæria Reptans.

317. Sphæria Tuberculoso.

318. Sphæria Rosella.

from each other. Then there are other kinds which float in our fermented liquors; whilst others again are found within the nutshell; and even within the innermost cavities of the Walnut. Some, "like leeches, stick to the bulbs of plants, and suck them dry;" whilst others, not content with a vegetable diet, lay hold of the hoofs of horses and the horns of cattle; nay, worse and worse may be said; for instances have been known of the lungs and other organs of human beings having been beset by these all-destructive little beings. It is also recorded that it is a rare thing to find a mouth, whether of man or woman, where the teeth are not more or less the habitats of these vegetables, which, it is said, can be kept off only by the free use of a well-soaped tooth-brush.

Fungi not only prey on objects which are members of other families than their own, but they unscrupulously devour each other. Many of the *Pileati* have parasitic Fungi, which attach themselves solely to them, never attacking any other species. One sort settles itself on dried *Agarics;* another only on moist decaying ones; whilst a third devours only the flesh of a particular *Boletus*. Dr. Badham says: "Few minute objects are more beautiful than these mucidinous *Fungi Fungorum*. A common one besets the back of some of the *Russulæ* in decay, spreading over it, especially if the weather be moist, like thin flocks of light wool, presenting on the second day a bluish tint on the surface. Under a powerful magnifier myriads of little glass-like stalks are brought into view, which bifurcate again and again; each ultimate head ending in a semilucent head, or button, at first blue, and afterwards black; which, when it comes to burst, scatters the spores, which are then (under the microscope) seen adhering to the sides of the delicate filamentary stalks, like so many minute limpets. There is a very beautiful Fungus called the Pencilled Mould (*Aspergilla Pencillatus*, fig. 309), which clusters its pretty beaded tassels on the dried plants in our herbariums. This little plant consists of a stem and a cluster of sporules at the top, not unlike a brush with a handle. *Aspergillus* is the name of the brush with which the holy water is sprinkled in Roman Catholic churches, and from this resemblance the genus takes its name. *Næmaspora Carpini* (fig. 313) is another curious species. This infests the dead wood of the Hornbeam, its singular black spores escaping from their flat cases, and thrusting themselves upwards in the form of tendrils. Then there are the many species of *Sphæria*, which raise their little button-like forms on the branches of trees, and stud them over with sphere-like gems, some yellow, others scarlet, brown, black, orange, white, crimson, and a hundred other tints of richest dye. Sometimes these wonderfully varied little Fungi are sessile on the substance they have selected for their habitat, as in figs. 316, 317, and 318; in others they are raised on stalks. Some have smooth visible orifices, through which the spores escape; in others these openings are hairy; and in some species they are not visible at all.

Besides frequenting living plants, and closely besetting their leaves and branches, Fungi of this genus are found abundantly on the bark of dead branches, and even on the wood where the bark has been removed. They frequent also the flock of *Agarics;* and one species, the Nest-like Sphæria, is found in the little hollows of Bean roots, whilst others cluster on apples that are lying on the ground, the stems of reeds, or even on the naked earth. There are some species which take up their abode and obtain their sustenance from dead larvæ, pupæ, and spiders' eggs; whilst one, cannibal-like, the red Parasitic Sphæria, sucks the blood of some of the species of its own genus. So numerous are the species which rank under this genus, that two hundred and one are catalogued by Berkley.

Racodium Cellare, the Mouse-skin Byssus, is the Fungus which festoons and covers the walls of our wine-cellars. For specimens, Badham refers us to the "London Docks, *passim*, where he pays his unwelcome visits, and is in even worse odour than the excisemen." Loudon tells us that it takes its name from a word "used among the Greeks" for a worthless, worn-out, ragged garment, which has been applied to the present genus in allusion to the dirty, interwoven, cloth-like substance with which it clothes whatever it grows on. *R. Cellare* is the black substance which overruns the bottles of the wine-merchant, and which often hangs in long thick festoons from the sides and roof of his wine-cellars.

There is a very curious species of Fungus which is found overspreading the thing on which it grows like froth. Withering, on the authority of Stackhouse, thus describes it:—"Its first appearance is like custard spilt upon the grass or leaves. This soon becomes frothy, and then contracts around the blades of grass or leaves in the form of little tubercles united together. On examining it in its different stages under the microscope, it first appeared like a cluster of bubbles, irregularly shaped, and melting into one another. In the second stage it appeared imbricated, or tiled, with open cells, the edges of the cells beautifully waved. A blackish powdery matter, on the surface of the cells, now gives the plant a grayish cast. In the third stage, the wavy imbrication disappears, and the plant settles with minute tubercles united together. Some of these are closed; but many of them appear as if torn open, and out of the cavity emerge little downy strings, with irregular-shaped terminations, and other similar irregular bodies on the same strings, like the heads of some of the genus *Mucor*."

We have seen that some of the Fungus tribe are capable of being turned to important uses as a nutritious and wholesome article of diet, and that others have medicinal properties which render them highly valuable. One kind is employed in making ink, another is used in the place of leather, whilst several kinds are serviceable in dyeing. Besides these and other individual uses, the tribe throughout seems to have a special commission to assist in the work of scavengers, by aiding the multitudinous host of grubs, reptiles, and other devourers, in removing decayed matter (both animal and vegetable), which, if left to putrefy, would in many instances become destructive both to the comfort and health of man.

GLOSSARY AND INDEX.

LONDON:

PETTER AND GALPIN, LA BELLE SAUVAGE YARD,

LUDGATE HILL.

CASSELL'S

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