
THE BOOK OF BOTANY

COOKERY

THE

Young Lady's

BOOK OF BOTANY;

BEING

A POPULAR INTRODUCTION TO THAT DELIGHTFUL SCIENCE.

WITH TWELVE COLOURED PLATES, AND NUMEROUS OTHER ILLUSTRATIONS.

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ADVERTISEMENT.

THAT the mental constitution of the fair sex is such as to render them peculiarly susceptible of whatever is delicate, lovely, and beautiful in nature and in art cannot, we think, be controverted; we are not therefore surprised that Botany receives more of their attention and study than any other science. The delicate forms which plants and flowers assume, the rich hues of surpassing beauty which are so softly pencilled there by Nature's hand, the odoriferous fragrance which the lowly violet, the sweet-briar, the little darling,* and many other of Flora's favoured train, scatter around, all conspire to render

* Mignonette.

the science attractive and delightful. Nearly all others yield no pleasure, no gratification, until many a rugged path has been trod, until many a disheartening obstacle has been removed,—but the votaries of Flora are met at the very threshold with every thing that can charm the eye, and gratify the sense, and at every step they meet with fresh charms, and such an accumulation of beauty, as renders it difficult to believe that they are on other than enchanted ground ; and if external forms of loveliness be so attractive, how much more so must those hidden processes be by which those forms " live, and grow, and have their being." The internal structure of plants, their germination, their roots, stems, branches, leaves, flowers, fruit, or seed, and their functions in the economy of vegetable life, are some of those wonders which, while the discovery of them gratifies our thirst for knowledge, cannot fail to excite our admiration of that Great

First Cause—of that Omnipotent God whose goodness and wisdom designed, whose power created, and whose providence directs and controls their existence for the promotion of his creatures' happiness, fitting them for those uses for which he has permitted us to discover that they are most especially adapted.

The Author has endeavoured to render this little volume as entertaining as it will be found instructive. He has sought to compress within the space allowed the most valuable portion of the immense mass of Botanical knowledge. He has described the various parts of plants, their respective functions, and the uses to which they are applied. He has sketched an outline of the history of the science—a brief synopsis of the system of Tournefort, a full introduction of the classification of Linnæus, the "immortal" Swede, and comprehensive yet concise accounts of the various orders of the Natural System, which seems destined to supersede all the previous labours of scientific Botanists. To assist the Author's descriptions there are given nearly one hundred engravings on wood; coloured illustrations of each of the Linnæan classes, and of twenty-two Natural orders.

LIST OF PLATES.

FRONTISPIECE.

Group, composed of the Damask Rose (*Rosa centifolia*); Convolvolus minor; Fuchsia globosa; and Shepherd's Club (*Verbascum*).

ILLUSTRATIONS OF THE LINNÆAN SYSTEM.

ILLUSTRATIONS OF THE NATURAL SYSTEM.

THE BOOK OF BOTANY.

DEFINITION OF THE SCIENCE.

Among the various branches of human knowledge, or among the sciences which elevate and enlighten the mind, and which administer to the wants and wishes of mankind, not one is more interesting, or productive of more rational amusement and gratification, than the science of Botany. Its pursuit is one of innocence and unalloyed pleasure, combined with healthful exercise.

While the Astronomer must prosecute his studies under the veil of night, and the Geologist and Mineralogist are laboriously exploring the bowels and caverns of the earth—while the Conchologist is searching the shores, or dredging the depths of the ocean, and the Entymologist is capturing and impaling his victims in lengthened ranks in his cabinets—while the Chemist is experimenting amid vapours, and dust and ashes; and when the more useful pursuits of the Physician and Anatomist are studied among the faded forms and defunct remains of frail mortality—the Botanist is ranging in the open salubrious air, inhaling fragrance from living beauties, which are ever rising around in the garden, as well as in every field, and in every forest.

His field of action is not confined to any spot dedicated to Flora; he may perambulate the face of the whole earth, and take cognition of the whole vegetable kingdom. Whether he traverses the luxuriant valley, or climbs the mountain's brow; whether exploring the secluded dell,—tracing the river's side, or even searching the lake or ocean's depths—he still finds objects to arrest his attention, and claim his admiration. Should ambition and an ardent love of the science prompt him to visit distant climes, to dive into the depths of intertropical forests, or wander o'er the extensive savannahs of the western world, there he will experience renewed delight at every step, and find new objects of beauty in every scene. When he has visited all those localities, or has stored his mind with written descriptions of them—when he has examined every grade of tree, shrub, and herb, and also the lower tribes which come not under these designations—

when he can call them by names—has learnt how they are cultivated, and can tell what regions of the earth they inhabit,—can place them in divisions according to their constitutional structure, into classes according to the mode of their seminal development, into subdivisions and sub-classes by the position, the presence, or absence of their floral members, and into tribes and orders by their natural affinities—then, but not till then, will the student acquire the title of Botanist; because all the above particulars are comprehended in and constitute the science called BOTANY.

While pursuing the study of plants, one cannot fail to observe that they hold a middle station between minerals and animals. Superior to the first, because they are endowed with life; but inferior to the last as being destitute of sensation.

OF THE MEMBRANES AND THEIR STRUCTURE.

The vegetable frame, consisting of the various members necessary in the economy of the plant, when reduced to its first elements, is found to be a combination of natural fluids, detectable by chemistry, namely, oxygen, hydrogen, and carbon, with occasionally a small portion of azote; besides some other bodies which are commonly called foreign, such as silex, lime, &c. These, together, form the organized structure of the vegetable; and according as one or other predominates so are the consistence of the organs more or less woody or succulent.

OF CELLULAR TISSUE.

Every different member of the plant, from the firmest wood to the delicate corolla of the flower, is formed of cellular matter. It is the universal material of which all the parts of plants are composed, but it is subject to many modifications. The individual cells are distinct hollow spheres, when fully inflated and separated from the tissue to which they may belong; but when connected, as they usually are, with numberless others, they assume many different shapes, according as they are pressed on by each other. Sometimes they are adpressed against others, or depressed, compressed, or elongated, as may be determined by the direction of the growth, or as may be required to complete the member of which they are a part. This cellular material is capable of being spread into thin plates, into the integuments of sap-vessels or air-tubes, or drawn out into lengthened fibres which constitute the strength, tenacity, and durability of the various members. These fibres are formed by a long series of cells, united by their ends, overlapping each other at the junction. They are usually ranged in bundles, the interstices being filled up by cells of another order, and which generally lie across the parallelism of the fibres, and during the growth are extended laterally, or transversely, to the axis of the stem.

Cellular tissue is enlarged in a very curious, and, to many observers, in a most unaccountable manner. It is visibly amplified and extended more or less in one, or, it may be, in every direction, from day to day, or from year to year. The first visible cell is furnished by its own proper integument, to the outside of which are attached an infinite number of others, so closely connected that this vast number collectively only appears as a cuticle to the first opening cell. When the first, however, is partly inflated, the next in contact, and in the direction of the growth, begins to open also, and gradually assumes the shape and size of the first. The third succeeds the second, the fourth the third, and so on, from day to day, till the summer growth is over; or from year to year, in respect of permanent members, during the life of the tree. Thus the cellular membranes are enlarged; the increase of their frames being supplied by the elemental food imbibed from the earth, or inhaled from the air, during the growth; not, however, by forming new cells, or vessels, or fibres, but only to amplify those already in existence.

The above described forms and processes can only be observed by powerful miscroscopes; and with the same assistance intercellular spaces have been observed, which either serve for the conduction of the sap, or for receptacles thereof when concreted.

OF VASCULAR TISSUE, OR MEMBRANE.

When the cellular tissue is diversified with longitudinal tubes, spiral vessels, intercellular openings, and woody fibres, it is said to be vascular; and this is always the state in which it is found in the stems of dicotyledonous and monocotyledonous plants, and, according to its station in or upon the stem, it is called by the different names of pith, wood, alburnum, liber, a combination of which last forms the cortical layers, or bark.

The tubes are either air or sap vessels, and are always larger and more numerous in the inner side of each year's alburnum than in the outer side; acting apparently as a kind of pith to each layer of alburnum. Spiral vessels are discoverable in young shoots, but as they disappear in perfect wood, they may be only common tubes obliquely disrupted by the upward swelling and prolongation of the vigorous growth.

OF THE PITH.

This is the central member of the stem, when present, and differs from the others in being of a much more soft and loose texture, proportionably large when young, but annually shrivelling and becoming dry and sapless as it acquires age. It is only useful in the early stages of the growth, for it soon becomes useless in the generality of trees, and is always the first member that decays. Hollow-stemmed plants have no pith except at the joints, or as an inside lining to the fibrous cylinder.

OF THE FIBROUS AXIS, OR WOOD.

The first concentric layer of wood is called the medullary sheath, and becomes visible in the stem of the seedling tree. It is elongated with the pith which it surrounds, and the first thin layer of parenchymous bark and cuticle which covers it; all three at the same time gaining lateral expansion. At the end of the summer season the growth is arrested—the plant remains dormant until the spring of the next year, when a second growth commences, and progresses during summer, till again arrested by the cold of autumn, or because the paroxysm of the seasonal growth is over; which happens to some kinds of trees long before the cold of autumn is felt.

Now, if we examine a transverse section of the first year's growth, after the growth of the second ceases, we shall see that the pith remains nearly as at first; but that a new concentric layer of wood, called in this stage of its existence *alburnum*, has been added on the outside of the medullary sheath: and, further, we may observe that a new and distinct member has, during the second year, been formed on the outside of the alburnum, and within the first parenchymous bark, which is designated by the name of *liber*, or second cortical layer.

The like process, and additions of alburnum and liber, take place in every subsequent year as long as the tree stands; every year's growth being visibly marked both externally and internally. On the outside a ring is left, and remains visible, where the first year's growth ended, and where the second commenced; but this mark is only temporary, except on jointed stems. The internal marks of the growth of every year are the layers of wood and layers of bark, their number respectively always indicating the age of the stem.

There is, however, this remarkable difference, that, whereas the longitudinal components appear to be continuous in jointless stems from year to year, those of the lateral expansions, namely, the additions of wood and bark, are unconnected, and remain distinctly separate, without the interjunction of their fibrous tissues, and only united by delicate cellular matter, acting like a cement. But in order that the layers of wood may be bound together, convergent partitions of dense cellular tissues (the silver grain of authors, so visible on oak panels) extend from the inner side of the bark to or towards the pith, appearing, on a cross section of the stem, like rays from the centre.

The longitudinal growth is a visible process, and easily understood. The different members which compose the shoot, to whatever length it may grow, are already formed, and lie, during winter, abbreviated in the bud, and are only developed by the summer growth. But the internal growth of the new alburnum and liber, being invisible processes, have perplexed many a learned head to account for their creation. We say creation, because many eminent men consider these members to be so; and we know that as both the alburnum and liber have ceased to live, that is, have lost all capability of being further enlarged, no dilatation of either of these can be the rudiment of the alburnum and liber of the following year; and yet we know that these last-mentioned members must arise from between the alburnum and liber which have just lost vitality. If, therefore, we examine this narrow space, to see whether there be any separate membrane whence the next year's accretion can arise, we find nothing but a thin layer of lymph coating the outside of the alburnum. Now, in this thin jelly-like stratum, neither colour or sign of organization appears; but, notwithstanding, from what we can afterwards discover, this transparent matter is pregnant with vegetable life. For, in the grafting season (February), we find in it the matter which unites the graft with the stock; soon after this we see it protruding over to heal a wound. In May it acquires the consistence of gum, and is then called *cambium;* in July, evident signs of organization appear; and at the end of August (sooner or later, according to the kind of tree), we find it perfect alburnum, replete with all the cellular, vascular, and fibrous tissues of perfect wood.

For the information of the young botanical student, whose attention will be naturally turned to this part of vegetable physiology, it is but candid to add that this phenomenon of internal growth is accounted for in a very different way; namely, by asserting that the sap itself is "organizable;" and that all the membranes of the vegetable fabric are formed of certain accumulations of the proper juices.

Both opinions are submitted to the free unbiassed judgment of the young Botanist; and as a guide to the right understanding of this particular, an established rule in natural history may be propounded, namely, no animal can acquire existence without parental agency; nor can any plant or part of a plant acquire its being, unless derived from a seed, or from some pre-existing organized part of itself.

Every recently imposed layer of wood continues to be called alburnum or sap-wood, as long as it remains of a pale colour; for after a certain number of years the first layers, near the pith, become harder and of a deeper brown hue, when it receives the name of perfect, or heart-wood.

OF THE BARK.

The bark is the exterior covering of the stems of plants; it is either a thin transparent film or cuticle of cellular tissue, as it appears on the stems of herbs, or it is a thick corky case, interspersed with longitudinal fibres irregularly arranged. In some instances it is thrown off in shreds or irregular shaped pieces, in the third or fourth year; in others it is permanent, and becomes at last of considerable thickness. It becomes thicker every year, because of the annual additions of liber imposed on its inner surface; a few of which layers act as sap conductors for some years before they become united to the old outer layers, which are dead, and no longer useful to the system.

As the new growths of wood, and liber within, are constantly pressing the previously imposed layers of bark outwards, the latter must be distended in one way or other. In some trees it is stretched horizontally, without any external fracture; but in the generality of trees, the outside layers of bark are rent into fissures, which increase with the age of the tree, and, opening, give room for the accretion within.

The bark, however, is only an excrementitious part of the plant, because it is only a very few of the recently deposited layers of liber that are really useful. All the hard outer layers may be stripped off without injury to the tree, and, indeed, so well is this fact ascertained, that there is no readier way of renovating the vigour of a weakly tree than by relieving it of its hard scabrous bark.

Whatever may be the qualities which are predominant in the juices of the tree, they are always found concentrated in the bark, and this appears to be a consequence of the atmospheric influences acting in unison with the vital chemistry of the plant.

OF STEMS.

The stems of herbaceous plants are somewhat similar in their general structure to those of trees. They have an external cuticle answering to the cortical layers, within which there is a fibrous cylinder of greater or less thickness; when very thin, the centre is hollow, when thick, the central opening is much reduced, and scarcely perceptible; or if not hollow, it is filled with a soft parenchymous pulp.

The stems of monocotyledonous trees, as the Palms for instance, have a very different structure compared with the dicotyledonous stems already described; for in these there are three distinct members, namely, pith, wood, and bark; the two last increasing outwardly, hence they are said to be *exogenous*. But in monocotyledonous stems, these three members are all mixed together, there being no distinct bark or woody cylinder, or central pith, the increase of the stem arising from the centre; hence such stems are called *endogenous;* the whole body of the stem being formed of coarse cellular matter connected by strong woody fibres, which extend from the crown of the roots to the exterior of the stem in an oblique direction, higher and higher according to the time of their production—the youngest reaching to the very summit of the stem, and connected with the last developed *fronds,* or foliar expansions. Neither in cross or longitudinal sections of these stems are there any marks in the structure to indicate annual or periodical growths, such as are so visible in the trunks of dicotyledonons trees.

The stems, and their structure, already described, are those parts which connect the roots with the branched head. The structure of both roots and branches is similar to that of the stem, except that in the roots there is little or no pith. Between the root and the stem there is a point called the collet, which is peculiarly organized. It is the crown of the root and the base of the trunk. In the generality of plants, all productions below the collet are roots, and descend into the soil; and all produced above the collet are shoots, and rise in the air. Shoots produced from the sides, whether above or under the surface of the ground, are called *runners.* There are, however, many striking exceptions to this as a rule. The roots of some trees appear to be constituted exactly like stems, being studded with buds, whence shoots arise through the soil, and take the name of *suckers.*

OF THE FUNCTIONS OF THE DIFFERENT PARTS OF STEMS.

The pith, from its comparative bulk, central station, and open structure, seems to be of essential service to the young stem, and every shoot subsequently produced. It is probable that its chief function is as a duct for the transmission of air and water ; for if a slender shoot had not a full supply of moisture during the heats of summer it would be very likely to suffer in that warm season. The pith, therefore, having a strong attractive power for moisture, retains it like a reservoir for supplying the surrounding members.

It does not appear to be otherwise necessary to the system; because we often meet with stems which are completely deprived of pith by the depredations of insects, and yet the stem or shoot exhibits no sign of weakness in consequence of the loss. It is the first member which is deserted by the vivifying principle, and, as already observed, it is certainly the first which becomes a prey to decomposition and rottenness.

Every bud which originates on the medullary sheath receives a small branch of the pith into its centre; and if afterwards the bud be resolved into a shoot or branch, the pith maintains its identity and station through the whole length thereof.

OF THE FUNCTIONS OF THE AXIS OR WOOD.

As this is chiefly formed of cellular and fibrous tissues, and constitutes by far the principal bulk of the trunk, it serves to elevate and support the branched head, and collectively is that part of the tree called timber.

It is composed not only of numerous fibres, but also of numerous tubes and vessels, ranging with the fibres, and by which the sap of the tree is conveyed from the roots to the top boughs, to all the foliage, and to every flower and fruit. The sap is always more copious in the new layers than in the older ones, forming the heart of the stem; most of all in the alburnum, and gradually less in quantity as the layers approach the centre. In the last, indeed, the sap becomes coagulated and stationary, and forms what is called perfect timber. This is the reason why the timber at the heart of a sound tree is harder, heavier, and more durable than the outside layers, which have been but recently deposited.

OF THE SPECIAL USES OF THE BARK.

The bark, like the wood, is formed of distinct layers of cellular and fibrous tissues, but of a far more porous and less compact texture than wood. When it first appears on a seedling stem, it consists of a double layer; the outer one or cuticle is a very thin transparent film or web of cellular matter enclosing another layer of parenchyma of a green colour and soft consistence. It hardens by exposure to the air, and is every year thickened by additions of liber imposed on its inner surface. Each year's liber is composed of a beautiful tissue of fibres, resembling lace, the meshes being very imperfectly filled up with cellular matter. The liber grows with the alburnum, and is separated therefrom about the month of August in every year. Several of the most recent layers of liber, like those of the wood, act organically in the system as sap conductors, until they are superseded by new layers within, and the outer ones lose all vitality, and are discharged entirely, or, as has been already noticed, are rent into pieces by the internal growth.

The bark appears to be the natural covering of the tree, and, as such, it is certainly useful; because the new growths of alburnum and liber would never be so gross, nor so soon completed, if exposed to light and air, as when they grow in the dark. And yet it is found by practical experience that bark may become too thick, too compact and indurated; and this to such a degree, that the health of the tree is impaired, and the growth entirely stopped. Nature, however, has made provision against this species of malady in many cases by discharging such encumbrance altogether, or by rending the entirety of the bark, as has already been adverted to.

OF THE APPENDAGES OF STEMS.

Hitherto we have been directing the student's attention to the elementary constituents of the vegetable fabric, and how these constituents are arranged, and increased, together with the purposes they answer, in the stems of plants; we come now to treat of the appendages to the stems or trunks of trees and shrubs, to show how and whence they derive nourishment, and how they are developed in order to answer the grand purpose of their being—the production of flowers and fruit, and the reproduction of their kind.

The most striking and necessary appendage to a plant is its roots. These fix it to the earth, and draw from thence the chief portion of the plant's nourishment. When a seed is laid in the soil, it swells under the united influences of heat, moisture, and air, until it bursts its integuments, and protrudes a spur-like body, which descends into the ground. This soon ejects slender fibrils from its point and sides, each of which is furnished with a kind of mouth called a *spongiole*, by which it imbibes from the soil either aqueous or gaseous nutriment, which passes upwards into the ascending *plumula* or infant stem, which at the same time begins to rear its head in the open air.

There is something truly wonderful in the consideration of the opposite ends of the same body so readily taking opposite directions. The one aspires to full air and light, the other flies from these and dives into the earth in quest of moisture and darkness. Not that roots dislike a moderate portion of air, for it is absolutely necessary to their existence; but dry air is their aversion, as their delicate fibrils, and more especially their tender and sensitive spongioles, would be instantly withered by the contact of dry air. Nor are they hurt by the action of light upon their tender points, if these be immerged in water.

As roots are exceedingly varied in their forms and manner of growth, botanists have assigned to them particular names descriptive of their character; hence there are fibrous, bundled, hand-like or palmated, tuberous, beaded, bulbous and, aerial roots, each of which are different in form, though all are destined to perform the same office, namely, fixing the plant in the soil and extracting from it the food necessary for the plant's subsistence.

OF THE FIBROUS ROOT.

This is the most common of all roots; it is universally that description of root with which trees and shrubs, and a great majority of herbs are furnished. It is remarkable for the number of its divisions and subdivisions, *f.* 1: the first acquire a large size, and extend to a considerable distance from the place where the tree stands; the second are only ramifications of the first, and both are invariably fringed along their sides, and particularly near the ends, with a multiplicity of fibrils, which are the chief agents in the collection of the pabulum of the system. The structure of the larger divisions is exactly similar to that of the trunk, except that they are nearly desti-

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tute of pith; and are increased in diameter in the same way, that is, by annual additions of alburnum and liber. The bark, however, is aggregately thinner, and less compact, and from its spongy consistence, it has probably greater absorbent powers than if it were exposed to full air and light. It is observed that with every year's growth of the head a corresponding and simultaneous production of new fibrils takes place, these organs being reciprocally dependent on each other, the tubular structure of the axis forming the bond of connexion between the moving extremities. In some plants the fibrils are deciduous like the leaves, growing and falling off together.

The directions taken by the larger divisions of the root differ according to their age: the first, and especially the main one, inclines directly downward; but those which are subsequently ejected take a nearly horizontal direction, ranging every year further and further from the first station, and, in many cases, keep at a very uniform depth from the surface.

Roots appear to be attracted by moisture, or heat, or manure; and they will change their first accidental direction to reach any of those substances or soils which are most favourable to their development. Their course is usually from light to darkness; and, to approach the latter, they will take an horizontal, or even an upright direction in a suitable medium.

The *fibrillæ* of herbaceous perennials are mostly annual, for though many of the fibrous processes remain from year to year, it is their active points which are renewable in the spring or at the commencement of the growing season, at whatever time of the year that may happen. For whenever there is any expansion of new foliage or stems, new fibrils must be exserted to collect the new demand of nutriment.

The main roots of a tree are more permanent than the branched head; and this because they are less subject to the vicissitudes of weather, and, moreover, less liable to damage from wind, and accidents from cattle, insects, &c.

It has long been a custom among writers on Botany to consider and to call every part of a plant produced within the surface of the soil *the root.* Hence we have tuberous, as the po-

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tatoe, *f.* 2; and bulbous, as in scilla, *f.* 3; jointed and creeping, as in mint, *f.* 4; but these terms are not strictly correct; for all these are, in fact, not roots, but modified stems. In whatever form they are found, however, they are always accompanied and furnished with roots, which perform their proper functions of nutritive organs. The bulb of a tulip is only a large underground bud containing the proper leaves and fructification. It is a receptacle of aliment, but attracts nothing of the kind for itself: this office is performed by the radical fibrils which issue from its base or radical plate, answering to the collet of trees, and the tuberous crown of herbaceous plants. So the tuber of the potatoe is not a root, but the thickened point of an underground stem or runner; and is nourished by the tuft of fibrous roots at the base of the stem. So the carrot, parsnip, and beet are called roots, though, in fact, their structure shows decidedly that these are all underground stems; and their roots are the numerous fibres with which their points and sides are fringed.

In all modifications of stems, whether they be in much-divided ramifications, as in trees and shrubs, or in the shape of bulbs, as in the onion; or in pulpy protuberances as the turnip; or in jointed runners, as the water-lily (*Nelumbium)*; or in those of the common couch-grass; —all are accompanied by fibrils, which act the part of roots.

These working fibrils, it may be observed, differ considerably in size and outward appearance. Those of the tulip form a thick tuft of hair-like processes, while those of the hyacinth are thick and substantial. And though both answer the same end, their organization may be somewhat different. The latter, having but few fibrils, may have numerous valves or inlets along their sides for the reception of nutriment; and, this from their spongy and bibulous texture, appears the more reasonable.

The thick gouty fibrils of the hyacinth, and many liliaceous plants, are not very unlike the same class of organs produced in the open air. We need not look among the tropical *orchidaceæ* or air plants, for examples of this description of radical fibres; for they may be frequently seen protruded from the branches of the grape vine, from the fig-tree, and even from those of the common May Duke cherry, if growing on a north aspect, and on a damp border. These aerial roots are stiff and substantial, destitute of fibrous processes, and without visible inlets, and yet they inhale aliment of some kind necessary to the system.

And should we extend our view to Indian groves, where the palmæ and pandanaceæ luxuriate, or walk under the Banyan fig, forming

"A pillared shade with echoing walks between," there we should witness roots descending from the highest branches and fixing themselves in the ground.

These are the different forms in which the principal food-seeking organs of plants are presented to us; and though it be highly probable, that plants are furnished with other organs for the induction of their elemental food, yet on the fibrils and valves of their proper roots do they mostly depend for the necessary supplies.

OF THE BRANCHES.

The next appendages of a stem which require notice are the branches. These originate in buds, which first appear on the last year's shoots in the axils of the leaves. These buds are connected with the pith, or, at least, are seated on the medullary sheath or alburnum of the first year of the shoot's growth. This connexion they ever maintain, if they continue to live; and if they die, their place is always visible in the timber when cut up for use. Some kinds of trees, especially among the coniferæ, are very regularly branched; every year's growth consisting of one perpendicular leader, and several lateral shoots which diverge in every direction from the axis. This position of branches is said to be *rotate* or *verticillate*, that is, resembling the spokes of a wheel. Sometimes branches stand in pairs, opposite to each other, and alternately crossing; in which state they are said to be *decussate*. The same terms are used in speaking of the position of leaves or flowers.

In general, branches are irregularly produced from the bottom to the top of the trunk; but as their number increases, they become more and more subdivided into a multiplicity of twigs; when the growth languishes, and the tree assumes its natural stature and outline. As the branches are only divisions of the trunk, they are composed of similar members, namely, pith, wood, and bark; and the magnitude of the stem is always in proportion to the number of branches it is producing, or has produced.

The manner of branching always gives a striking character to a tree. Sometimes all take an erect position as the Lombardy poplar; or extend obliquely upward, or shoot out horizontally, or hang gracefully downward; and sometimes the branches of the same tree assume all these positions; the higher aspiring, and the lower drooping.

OF BUDS.

The stems and branches of all dicotyledonous trees and shrubs are studded with visible or incipient buds. They are of an oval figure, more or less elongated; and, when visible, are generally seated in the *axil,* or angle formed by the foot-stalk of the leaf and the stem. Buds are defended during winter by a series of membraneous scales, which closely cover them from the weather; which scales collectively are called the *hybernaculum.* Buds are the rudiments of shoots and flowers, or of both; and on dissection, all the parts which will be developed by them in the following summer may be detected in the bud before expansion.

On fruit-bearing and flowering plants the fertile buds are easily distinguished from those that produce leaves only. The former are much larger, rounder, and begin swelling sooner than the leaf buds; and this difference is observable six months before their development.

Besides the membraneous scales, some plants have their buds covered with a thick pubescence, or with hair; others are protected by a coat of gum or resin, secreted from among or by the scales. These coverings are mostly deciduous when the buds burst and commence growing. It is said that intertropical trees have no buds, but this is only partly true.

OF THE FOLIAGE.

The next accompaniments of the stem and branches are the leaves. These constitute their chief ornament and beauty. To these we owe the shady coolness and grateful shelter of trees; and the tender freshness of the new-born leaves in spring is only equalled by the rich variety of their fading colours in autumn. The late respectable Agricultural Botanist, Mr. George Sinclair, F.L.S., called the bark of trees a "universal leaf," with a good deal of propriety, because the actual leaves appear to be only exfoliations of the cuticle and parenchymous components of the bark, notwithstanding they are articulated with it in dicotyledonous plants. The structure of leaves is very curious and beautiful; they are usually of a thin and flat figure, and are composed of (commonly) green parenchymous pulp, enclosed by upper and under cuticular webs of thin colourless cellular membrane; and connected by fibrous trachæ regularly disposed, and which have been compared to arteries and veins. The foot-stalk or *petiole*, when present, is continued to the apex directly through the middle of the leaf, and is called the *costa* or midrib. From this, the veins or nerves proceed towards the margin, and inosculating with each other at or near it, connect the whole leaf together in a beautiful frame-work. This is the character of dicotyledonous leaves, *f.* 5; those of monocotyledonous plants are differently nerved; the midrib is divided at the base, and the divisions run nearly parallel with each other to the opposite end or point of the leaf, *f.* 6.

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Leaves are not always flat; those of aloes are thick and fleshy; and their green colour is, in some instances, changed to red or purple. Their forms are almost infinite; Linnæus described above ninety, but that number does not comprise a tenth of the forms which identify or characterise the different species and varieties of plants.

From the numbers, forms, attachments, and positions of leaves, they appear destined to act some important function in the economy of vegetable life. They have been called the lungs of plants; and from their love of light, by invariably presenting their disks to the sun, the effect upon their surfaces must be productive of very great changes upon the fluids they contain. They are said to be inspiratory as well as perspiratory organs; and in their latter agency, are supposed to permit the escape of the watery parts of the sap, leaving only the richer portion to be employed in the enlargement of the plant. It appears necessary indeed that the foliage should possess a perspiratory action, to give accelerated motion to the rising current of the sap; and this may not be unreasonably assigned as their principal use in the economy of the plant.

Other functions have been attributed to the leaves, as not only elaborating the sap into an organizable fluid, of which every other member is formed, but also of preparing the qualities, and increasing the number of fruit.

The leaves of all dicotyledonons plants are deciduous either in the first, or in the second or third year. These last are called evergreens; and some of the pines and firs retain their narrow leaves for ten years or more.

The leaves of monocotyledonous herbs spring directly from the collet or radical plate; and the fronds of the trees belonging to the same class have a similar origin; their bases being permanent and collectively forming the stem of the plant, when the extremities of the fronds are withered and fallen.

Among the numberless forms assumed by

leaves, some are exceedingly curious, of which may be particularised the pitcher plant (*Nepenthes*), *f.* 7, the leaves of which are lanccolate, but the point is narrow and prolonged to a considerable distance, and at its apex bearing a hollow oblong bladder, like a pitcher, which has a neatly formed lid opening at one side by a hinge. A liquor is secreted within the pitcher of a sweetish taste; but neither the special use of the pitcher, or of its liquor,

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has as yet been satisfactorily accounted for by Botanists. The leaves of the Venus' fly-trap (*Dionæa*) are also remarkable for their form and action. The leaves are radical, that is, they spring immediately from the crown of the roots, and in shape somewhat obcordate. The midrib is prolonged beyond the blunt apex of the leaf, and bears on each side two semicircular leaflets attached to the costa by hinges. These leaflets are fringed with bristles like the teeth of a rat-trap, and when the hinge is touched by a straw or a fly, the leaflets suddenly colapse face to face, and catch the disturbing cause in their embrace, and, if a fly, squeeze it to death.

There is another plant which has leaves of a most singular conformation, namely, the *Cephalotus*. The leaves bear cups, closed with a lid, which is sometimes open, and at other times shut. These cups are partly filled with a fluid; but whether condensed from the air, or secreted from the plant, is not established. It is worthy of remark that these pitcher-leaved plants are inhabitants of marshy ground, where it might be supposed they would have no need of constitutional reservoirs of water in the midst of which they grow.

There is another provisional modification of leaves which may just be noticed. The foliage of the *Limnocharis* requires to be sometimes submerged in the water in which it grows; at other times they require to be exposed to the air; when the latter exigence presses, the footstalks of the leaves become inflated like bladders, and buoy up the leaves till they float on the surface.

The sizes of leaves are exceedingly various, differing from the breadth of a needle, to an expanse of several feet. The heaths are examples of very small leaves; and the rhubarb, the *Tussilago Petasites*, and the plaintain (*Musa paradisaica*) are examples of some of the largest. But the largest foliar expansion which has yet been described, is a single *frond* of the talipot palm of Ceylon. This enormous leaf, if leaf it can be called, measures eleven feet from the base to the apex, and sixteen feet across the middle; a most useful production in so warm a country.

Leaves are variously placed with respect to each other: when placed in pairs on the same plane, they are said to be *opposite*, as in the French marygold, *Pl.* 20; if several stand on the same plane surrounding the stem, they are said to be *verticillate*, as in the common mare's tail (*hippuris vulgaris*), *Pl.* 2; but if they stand at regular distances and consecutively on all sides of the stem, they are then called *alternate*, as in birthwort (*aristolochia*), *Pl.* 21. Leaves which spring immediately from the crown of the root are called root or radical leaves, to distinguish them from those produced by the stem and branches.


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Leaves are either simple or compound. The most remarkable forms of simple leaves are as follow:—Circular, or orbicular (*orbiculatum*), when equal in length and breadth, and the circumference an even circular line; Oblong (*oblongum*), three or four times longer than broad—a term used with great latitude, *f.* 9; Roundish (*subrotundum*), approaching the orbicular form, as in the common hazel, *f.* 10; Oval (*ovatum*), of the shape of an egg cut lengthwise, a very common form of leaves, *f.* 11; Elliptical (*ellipticum*), of a similar form to the last, but of equal breadth at each end, *f.* 12;

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Spatulate (*spatulatum*), of a roundish figure, tapering into an oblong base *f.* 13; Wedge-shaped (*cuneiforme*), broad and abrupt at the summit, and tapering down to the base, *f.* 14; Lanceolate (*lanceolatum*), of a narrow oblong form, tapering towards each end, as in tulipa sylvestris, *f.* 15; Linear (*lineare*), narrow, with parallel sides, as in most grasses, *f.* 16; Needle-shaped (*acerosum*), linear, and evergreen, generally acute and rigid, as in the Fir, &c., *f.* 17; Triangular (*triangularis*), having three prominent angles, without any reference to their

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measurement or direction, *f.* 18; Quadrangular (*quadrangulare*), with four angles, *f.* 19; Rhomboid (*rhombeum*), or diamond-shaped, approaching to a square, *f.* 20; Kidney-shaped

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(*reniforme*), a short, broad, roundish leaf, whose base is hollowed out, *f.* 21; Heart-shaped (*cordatum*), according to the common idea of a heart—that is, ovate, hollowed out at the base, *f.* 22; Crescent-shaped (*lunulatum*), like a half-moon, whether the points are directed toward the stalk or from it, *f.* 23; Arrow-shaped (*sagittatum*), triangular, very much





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hollowed out at the base, *f.* 24; Halberd-shaped (*hastatum*), triangular, hollowed out at the base and sides, but with spreading lobes, *f.* 25; Fiddle-shaped (*panduriforme*), oblong, broad at the two extremities, and contracted in the centre, *f.* 26; Lyrate (*lyratum*), or lyre-shaped, cut into several transverse segments,



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gradually larger towards the extremity of the leaf, which is rounded, *f.* 27; Cloven (*fissum*), when the margins of the fissures and segments are straight, *f.* 28 ; Lobed (*lobatum*), when the margins of the segments are rounded, *f.* 29—they are said to be Bilobed, Trilobed, Quadrilobed, according to the number of lobes ; Sinuated (*sinuatum*), cut into rounded or wide openings, *f.* 30 ; Partite (*partitum*), deeply

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divided, nearly to the base—they are Bipartite, Tripartite, *f.* 31, &c., according to the number of divisions ; Laciniated (*laciniatum*), cut

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into numerous irregular portions, *f.* 32 ; Palmated (*palmatum*), cut into several oblong nearly equal segments, about halfway, or rather more towards the base, leaving an entire space like the palm of the hand, *f.* 33; Pinnatifid (*pinnatifidum*), cut transversely into several oblong parallel segments and Pinnatipartite, *f.* 34; Unequal (*inæquale*), when the halves of the leaf are of unequal dimensions, and their bases not parallel, *f.* 35.

The terminations of leaves are various: they are Abrupt (*truncatum*), when the extremity is

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cut off as it were by a transverse line, *f.* 36; Retuse (*retusum*), ending in a broad shallow notch, *f.* 37; Blunt (*obtusum*), terminating in a segment of a circle, *f.* 11; Sharp (*acutum*), ending in an acute angle, which is common to a great variety of plants, as ladies' slipper, &c. *f.* 38; Pointed (*accuminatum*), having an open or awl-shaped point, *f.* 22.

The margins of leaves are described as follow: —Entire (*integerrinum*), as in the Orchis and

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Lily tribe, *f.* 39 ;—this term cannot be applied if there be the least notch or incision; Spinous (*spinosum*), beset with prickles, *f.* 40; Unarmed (*inerme*), opposed to spinous; Fringed (*ciliatum*), bordered with soft parallel hairs, *f.* 28; Toothed (*dentatum*), beset with projecting, horizontal, rather distant teeth of its own substance *f.* 41; Serrated (*serratum*), when the teeth are sharp, and resemble those of a saw, pointing towards the extremity, *f.* 42; Crenate (*crenatum*), or notched, when the teeth are rounded and not directed towards either end of the leaf, *f.* 23, as in ground ivy; Jagged (*erosum*), irregularly cut or notched, especially when otherwise divided besides, *f.* 43.

Compound leaves consist of two or any greater number of leaflets, connected by a common foot stalk; there is the jointed leaf (*folium articulatum*), when one leaflet, or pair of leaflets grows out of the summit of another, with a sort of joint. Digitate (*digitatum*), or fingered, when several leaflets proceed from the summit of a common footstalk. Binate (*binatum*), is a fin-

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gered leaf, consisting of only two leaflets, *f.* 44; Ternate (*ternatum*), consists of three leaflets, *f.* 45; Conjugate (*conjugatum*), or yoked, consists of only a pair of *pinnæ* or leaflets, and is much the same as *binatum*, *f.* 46.

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The surface of leaves is either dotted, rugged, jagged, blistery, plaited, undulated, curled, hollow, veiny, &c.

Many of the terms used in describing leaves are occasionally combined to express a character between the two, as *ovato lanceolatum*, lanceolate, inclining to oval, &c. When shape, or any other character, cannot be precisely defined, *sub* is prefixed to the term used, as *subrotundum,* roundish, &c., &c. By the judicious use of these means all necessary perspicuity and precision are obtained.

Before leaving the subject of leaves it may be proper to mention a distinction made by Botanists, between what are considered real leaves, and other foliar expansions, which may be mistaken for them. The minutely elegant green expansions of ferns, and the stupendous leaf-like productions of palms, not being articulated with the stems, and therefore in this respect decidedly different from dicotyledonous leaves, are called *fronds*, *Pl.* 26, *f.* 4. Linnæus applied this term to the leaves of palms and ferns; but it is also employed in describing the proper expansions of stemless and leafless plants, as the *algæ*, *fungi*, and some of the *hepaticæ*. It is, however, considered that it would be more correct to call the fronds of palms and ferns *radical leaves*, which, in fact, they really are, and apply the term frond to those families which cannot be said to have any leaves.

The insertion of leaves is another circumstance noticed in describing plants: they are radical or caulinar. In either case, they are said to be *petiolate*, *f.* 47, supported on footstalks; or *sessile*, that is, setting close to the crown of the roots, or stem, *f.* 49; or *vaginant*, *f.* 48, that is, sheathing the stem, as in grasses; or *amplexicaule*, *f.* 49, stem-clasping, as in many

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umbelliferous plants; or *connate*, that is, situate opposite each other, and united at the base, as in the leaves of the common honeysuckle. In clothier's brush (*dipsacus*), the leaves are so united as to form a deep cup retentive of rain, for the supply of the plant; or leaves are *decurrent*, that is, running down the stem to a point considerably below the place where they diverge from the stem.

OF THE STIPULÆ.

Next to the proper leaves, another order of what may be called leaflets is to be noticed. In a very great number of plants, the proper leaves are accompanied by two very thin and pointed expansions, called *stipules*, *f.* 50, one on each side of the petiole, and are either united or distinct from it. In some of the grasses the stipula is single, and invests the stalk above the diverging limb of the leaf. This description of stipulæ is exemplified in some of the grasses, and in the bistort, or buck-wheat *(polygonum)*. In the fig-tree it invests the point of the shoot, and is burst off by the swelling of the bud within. In many plants, the stipulæ drop almost as soon as the leaves begin to expand; but in many cases they fall with the leaf. In *pinnated*, that is, winged leaves, there are often two stipulæ at the base of each leaflet as well as at the base of the common petiole: "stipulæ under such circumstances are called stipellæ."—*Linnæ.*

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Stipules are, (especially those which are cotemporary with the leaves) a kind of accessary leaves, and probably are endowed with similar functions. They are sometimes not easily distinguished from certain membranous expansions or *ciliæ* (eye lashes), or glandular appendages of the margin of the base of the petiole, such as are found in umbelliferæ, and many other plants. When stipulæ are attached to, or accompany, the petiole of opposite leaves, their adjacent margins unite and form a cup round the stem. In this state they become what is called an *ochrea*.

OF BRACTEÆ.

The bracteæ are a leaf-like production usually placed between the proper leaves of the plant and the flower. They are often very different from the common leaves, as well in shape as in consistence and colour; when very small, they are called *bracteolæ*; but sometimes they are of considerable size and also numerous. They are particularly conspicuous and persisting on the peduncles of the common lime tree, *f.* 51, (*Tilia*). The cups of the acorn are endurated bracteæ; and the leafy envelope of the common hazel-nut is an appendage of the same character.


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Plants which present their flowers in spikes have almost always bracteæ accompanying each flower, as in some of the hardy orchidaceæ; in the primrose and medlar they resemble the common leaves, and in eucomis the bracteæ are on the top of the stem above the flowers.

On umbelliferous plants the bracteæ, which surround the general umbel, are called an universal *involucrum*, *a*, and those which sur-

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round the divisions of the umbel are called *involucellum*, *f*. 52, *b*. *b*.

It sometimes happens that the common leaves at the bottom of a stem are gradually diminished as they approach the terminal flowers on the summit. In this case the leaves are ultimately resolved into bracteæ; nor is it easy to point out where the leaves end and the bracteæ begin. Their relationship to leaves is particularly manifest in the circumstance of buds being sometimes found in their axils; and, however they may be viewed, their character as accessary leaves becomes perfectly obvious.—*Lind.*

Another and very conspicuous member always attending the flowers is denominated a *spatha*; it is that membranous envelope which involves the flowers of narcissus, snow-drop, arum, *Pl*. 27 · *a*, and the spadix of palms. This, though different in texture, and in its special office, is notwithstanding considered by many Botanists as only a modification of bracteæ.

We are now rapidly approaching the floral members of the plant, but before entering upon the description of them, it may be proper at this stage of our investigation, to notice some other appendages of the stems, or of other parts already mentioned, and which cannot escape the observation of every lover of plants. The first of these to be noticed is—

THE TENDRIL.

This member in the language of Botany is called the *cirrhus*, *f.* 53; or, in common language, a clasper. It is a tough string, produced by some plants which are naturally climbers, but whose stems are so feeble that they require support from any other bodies within their reach. Tendrils are produced by, and proceed from, different parts of plants; from the points of the leaves as in the superb lily (*Gloriosa*), and the common pea and vetch (*Pisum et Vicia*). In the grape-vine and Virginian creeper (*Ampelopsis*), the tendrils are produced from the shoot opposite the leaves; in the passion flower they are axillary; in the cucumber, from the shoot by the side of the petiole of the leaves. Tendril-like processes

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are produced from the bark of the ivy and of the trumpet flower (*Bignonia*), and though these have no convolving power, they have little flattened points by which they firmly attach themselves to the bark of trees, or to the surface of walls. The virgin's bower (clematis) has no proper tendrils; but the footstalks of the leaves have a convolving power, by which they twist round any other slender body for support.

Many tendrils have a most unaccountable mode of convolution; they turn towards the right for about half their length, and if they get hold, continue in that direction; but if they miss a hold, the tendril begins turning backwards the contrary way to make a second trial for support. In the evolutions of vegetation, we may have some satisfactory ideas as to the ascent of a plant in the open air, or of the descent of its roots into the earth ; but of the fibrous structure of a tendril which has such contrary tendencies we can have no conception ; and therefore can only attribute the phenomenon to a law of nature impressed upon this slender member by the Almighty Designer himself.

Tendrils are generally simple, but there are several instances of their being compound and branched; the petiole of the pea is prolonged beyond the pinnæ of the compound leaves, and branched at the point. The tendrils of the grape-vine bear the flowers, which if fertile, no convolution of the stalk of the bunch takes place ; but if barren, it soon begins to curl and assume the office of a clasper. It is only a few of the tendrils at the bottom of each strong well-ripened shoot of a vine that are fertile, all the rest above are naked and barren.

Other processes are called the armature, because they serve to defend the plants from browsing animals. Those are spines, prickles, and stings.

OF THE SPINES.

The spines (*spinæ*), *f.* 54, or thorns of plants, are sharp pointed woody processes issuing from the alburnum of the stem and other parts of the plant. They are produced on the shoots of the hawthorn; from the leaves, as in holly; from the petiole of some compound leaves, as in astragalus; from the *anthodium*, as in the thistle (*Carduus*); from the seed vessel, as in stramonium; or from the seed, as in spinach.

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Many plants which are spiney in a wild state lose their spines when cultivated; and many which are well armed, when young and low, lose their armature when aged, or when out of reach of cattle. The crab-apple and hawthorn are striking instances of this loss of armature; and is accounted for by saying that, when the vigorous growth of youth is subdued, the system is unable to produce any kind of superfluous member.

OF PRICKLES.

Prickles (*aculii*) *f.* 55, differ from spines, in being produced from the bark and not from the

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wood. They are exemplified in the rose and gooseberry; and in these plants they are articulated with the bark, and frequently deciduous. In some instances, the bracteæ become prickles, as is observable in the berberry; a change which appears to be a consequence of luxuriant growth.

OF STINGS.

Stings (*stimuli*) may be considered as only a minor order of prickles; there is this difference however, that besides puncturing the skin, they emit at the same time an irritating juice into the wound, causing inflamation and pain. The common nettle (*Urtica*) is the most familiar example; and there are many other plants which are furnished with a similar defence.

There are many tropical plants, especially among the *cacteæ*, which are profusely covered with horrid spines and prickles; these plants being mostly destitute of foliage, it is probable that these numerous keen-pointed processes act the part of leaves, either in discharging superfluous fluids, or attracting necessary gaseous aliment for the use of the plant.

OF PUBESCENCE.

Under this head Botanists include all descriptions of hairiness found on plants; but as such coverings differ from the rigidity of bristles to the smooth softness of velvet, many terms are employed to describe the character of each.

We are apt to admire the fine fur, the beautiful feathers, and curious scales of animals; but none of these can be compared with the delicacy, the softness, smoothness, and exquisite structure and arrangement of this clothing of plants. On some leaves, or other parts of plants, it is like a soft down (*pubescens*), or hairy (*hirsutus*), or like pile (*pilosus*). Sometimes it is long and soft (*villosus*); or it is short and close, like velvet (*velutinus*); again in other instances, it is close and entangled (*tomentosus*), or standing out like eye-lashes (*ciliatus*), or like bristles (*setosus*), or as hooks (*rostella*), or bearded, if split at the point (*glochidatus*), or if the pubescence resembles cobwebs, it is said to be *arachnoid*.

The structure of these various slender bodies can only be detected by the assistance of the microscope: they appear to be formed of one or more cells of cellular tissue placed end to end arranged in ranks or dispersedly disposed. They are mostly conical; but they are also jointed, and sometimes they are fixed by the middle, their points standing out in opposite directions. In many cases the hairs grow in clusters; and this disposition is also observable in the case of both spines and prickles.

But it would be a long and laborious task to describe all the different forms in which this curious clothing of the surfaces of plants may be seen; and if the investigation of the forms only be difficult, how much more difficult is it for us to assign to these minute and slender organs their special use in the economy of the plant? That they answer some specific purpose connected with the vital chemistry of the system; or are protective, or nutritive appendicates of the same, may be safely affirmed; but this is only specious guessing; as their agency, whatever it may be, is too attenuated and inconceivable to our keenest perceptions.

OF SCALES.

There are many distinct members of plants, which because they resemble the scales of fishes are also called scales; and as they are often disposed in the same manner, the name is the more appropriate. They are usually thin and membranaceous, and appearing to spring from the cuticle. Where they exist in considerable numbers, they give a white leprous hue to the stems or leaves on which they are seated. The leaves of the pine-apple (*Ananasea*), present this appearance, and which is solely owing to the great number of minute scales which invest their surface. These scales are supposed to be hairs under another form, and to have agencies of a similar nature. Leaves so covered are said to be *lepidotus*.

Scales of another character and much larger size are frequently seen on the stems of plants. Those composing the hybernaclum, or bractea of buds already mentioned, may be considered as one description of them; and the thin brown scales, sometimes in great abundance on young shoots of the French tamarix, and on the backs of the leaves of ferns, are another example of those scales called by Botanists *ramenta*. Scales of another character are seen on the stems of the bird's-nest orchis (*Neottia*), and of the broomrape (*Orobanche*); but these are supposed to be only modifications of leaves.

OF GLANDS.

Vegetable glands are little prominent bodies, appearing on different parts. Sometimes they are raised on footstalks, and secrete a juice or fluid, the quality or nature of which has not been ascertained. Glands have been minutely described and classified by specific terms: among which the following are of most frequent occurrence, namely, the *miliary;* the *vesicular;* the *scaly;* the *globular;* the *lenticular;* and the *cupshape;* the last very conspicuous on the petiole of the peach-tree and passion-flower. The vesicular glands are frequent on the young shoots of the vine; and the surface of the ice-plant is covered with those called *papillæ,* and give it a crystalline appearance. The satiny surface of the petals of many flowers, is caused by the presence of numerous papillæ. The lenticular glands are the brown spots found on the bark of willows and other plants; and it is the opinion of M. De Candolle that, they not only indicate where roots would be produced if the brauch were placed in the soil, but that they bear the same relation to roots that buds bear to young shoots.

An inferior order of glands are called warts (*verrucæ*), and are common on the leaves of the tongue aloes, and on the stems of some plants, as in *euonymus verrucosus.* They are not very well distinguished from glands; but when they occur on the surface of leaves, the latter are said to be *scabrous*.

OF STOMATA.

A name given by Botanists to small apertures which they have, by optical assistance seen, or thought they have seen, in the cuticle of the leaves and other parts of plants. There is great difference of opinion concerning these stomata; some affirming that they are really open, and are connected with the respiration of the plant, while others maintain that they are imperforate, and consequently are not passages for any fluid. All, however, admit that they are depressions, and surrounded by a raised rim of one shape or other; and if they have any organic action, they appear to be only useful in air, as they are never seen on submersed plants, nor on the roots. They are only objects of microscopic research, as they are too small to be seen by the naked eye. But at the same time, they evince the wonderful complication of parts required in the fabric of the humblest weed, and consummate skill employed in their creation.

OF SCARS.

There are no natural scars upon a plant, except those from which leaves or fruit have fallen; the former are called *cicatricula,* and the latter may not be improperly named, if called the cicatricula of the fruit.

In the preceding sections we have noticed all the appendages and features of stems, from the branches up to the scars left by fallen leaves and fruit; we come now to the more interesting organs of the vegetable being, and to which all the before-described parts are, in one way or another, subservient; namely, the flowers and fruit. The flowers are composed of various distinct parts, each having proper functions and stations, and which may be treated of in the order of their development,—but first—

OF THE STATIONS OF FLOWERS.

Flowers are variously placed on plants; sometimes they occupy the very centre of the plant, ex. pine-apple, or of the division of the plant—or of the stem or shoot producing them, ex. pear. Such flowers are said to be *terminal;* not only because they stand on the point of a branch, but because this branch or shoot is at this point arrested in its upward career of growth, and its further elongation terminated. In other cases, the flowers are produced laterally, that is, produced from the axils of the leaves, as in the caper-tree and myrtle ; from the *nodes* or joints of the young shoots, as the grape-vine; or from the bark, as in the Judas tree (*Cercis*), and the *metrosideros floribunda*.

OF THE ARRANGEMENT OF FLOWERS.

The arrangement of flowers upon a branch or stem is either solitary, as in the *diosma uniflora* and tulip ; or aggregated, as in the plantain and grape-hyacinth. Each flower is either sessile, that is, setting close upon the branch, or borne on a footstalk called a *peduncle*. These peduncles differ from the other parts of the branch by being destitute of leaves ; or, if they are furnished with any foliar expansion, it is a bractea not a leaf. The peduncle is either simple, as that of a cherry, or divided, as that of the laurestine : its smaller ramifications are called *pedicels*.

In plants which have no branched stem, such as the narcissus or auricula, the peduncle rises directly from the bulb or crown of the root, bearing the flower or flowers on the top. Such a peduncle is called a *scape;* but if it proceeds from a lateral division of the crown, it is called a radical peduncle.

When a peduncle is lengthened out in a straight or slightly zigzag line, as in the flowers of grasses, it is called *Arachis* or axis of the inflorescence. But when this is depressed into a flattened body, and bearing the flowers or florets on its upper surface, it is called the *receptacle,* and this is differently named, according as it is or is not fleshy, or surrounded by an involucrum.

Every different mode of arrangement of the inflorescence has received characteristic titles, and which are particularly useful in descriptive Botany. Hence there is the *spike f.* 56, exemplified in the flowers of the common ladies' tresses (*Neottia*), and its distinction is, that the flowers sit close upon the axis without pedicels; whereas, if the flowers were on pedicels, the inflorescence would then be a *raceme.*

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When the flowers of a spike have neither calyx nor corolla, and when the whole is deciduous after flowering, it is called a catkin (*amentum*), as exemplified in the male flowers of the willow and hazel, *Pl.* 43 ; but if a spike consists of flowers destitute of calyx and corolla, and their place is occupied by bracteæ, and which does not fall off with the flowers, then in such case the spike is called *spicula, f.* 57, and is constantly exhibited in the grasses.

When the flowers are closely set round a fleshy rachis, and inclosed in the kind of bracteæ called a *spatha,* the whole is called a *spadix, Pl.* 27, and is exemplified in the common aruns and palms.

When the raceme is composed of flowers having pedicels of unequal length, the lower flowers rising as high as the upper ones, and with them forming an horizontal plane, a style of flowering called a *corymbus, f.* 58, is then formed.

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If in the expansion of a corymbus, the central flowers are highest, those on the outside being lower, a form called a *fasiculus, f.* 59, or bundle, is the result, this obtains in the Carthusian pink, and is sometimes described as a compound corymbus.

When the pedicels all proceed from a single point and are of equal length, or corymbose, an *umbel, f.* 60, is the character. If each pedicel bears a single flower, it is called simple; but if they divide, and bear other umbels, it is said to be compound.


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If the pedicels of a simple umbel be wanting, and the flowers be seated on a receptacle or enlarged axis, they collectively form a head *capitulum, f.* 61. If this be depressed in form, and surrounded by an involucrum, the composite flower is produced and styled an *anthodium, f.* 62. Florets cover the disk of the anthodium; those in the circumference are *legulate,* that is, a principal part of the corolla is formed like a strap, and project outwardly like rays; and are called florets of the ray; the others, which occupy the central space of the anthodium, are called florets of the disk.

Another form of the inflorescence is what is called a *panicle, f.* 63; this differs from the

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raceme in that the latter bears single flowers on its pedicels, whereas the former bears branches of flowers, and is exemplified in many of the grasses. But if the panicle be very dense, and the lower and highest pedicels be shorter than those of the middle, then the assemblage of flowers is called a *thyrsus, f.* 64. Another modification of such aggregations of flowers is called a *cyme, f.* 65, of which good examples are afforded by the heads of flowers of the elder, and the dogwood. And when clusters of labiate flowers

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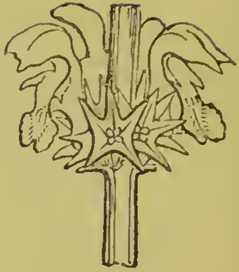

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are produced from the axils of opposite leaves, and almost embracing the stem, they are said to stand in a *verticillus*, *f.* 66, or whirl.

Having noticed the parts of the plant, from which the flowers are produced, and the manner in which they are borne by their peduncles, pedicels, scapes, &c., together with their modes of appearance, dispersedly or associated, we now come to the floral members, which may be noticed seriatim; and first—

OF THE CALYX.

The calyx, or outer cup of the flower, is the most exterior integument, consisting of several leaves in a whirl, either united wholly, or partly by their margins, or distinct; usually of a green colour, and more substantial and rigid than the corolla. These two organs, however, are in some instances so indistinct, and slide so gradually into each other, that their positive identity becomes a matter of uncertainty. This occurs when both the calyx and corolla consist of a great many parts resembling each other, and when both partake of the same colour where they meet. The flowers of calycanthus and the nymphæa afford instances of gradual change in the *sepals* of the calyx, to a resemblance of the *petals* of the corolla.

The best rule, as laid down in the modern schools of Botany, is to consider the first outer whirl of integuments within the bracteæ to be the calyx; and whether that be deciduous, or highly coloured, or membranous, or fleshy. Upon this principle, says Professor Lindley, whenever there is only one series of floral integuments, that series is the calyx. A calyx, therefore, can exist without a corolla; but a corolla cannot exist without a calyx.

The calyx is therefore almost always visible, even although reduced to the dimensions of a membraneous ring. Jussieu has said that the calyx is in all cases easily detected, because it is a continuation of the outer bark or cuticle of the peduncle. This definition is useful as a general rule; but there are some exceptions;

as, when it is deciduous, this continuity is broken, and therefore Jussieu's definition is objectionable. To common observers, the calyx is always sufficiently manifest, as being the outer green member, enveloping the flower before expansion. But there are cases in which the knowledge of the practical and scientific Botanist is required to identify the calyx, because it is sometimes united with, or takes the exact resemblance and colouring of the corolla. One of the most simple of all flowers in its conformation is the tulip; many former Botanists have considered it as being destitute of a calyx; but by the above rule, the three outer floral leaves must be considered calyx, and the three inner ones corolla. The flowers of the common mezerion appear, to the untaught eye, to be also destitute of calyx; but the fact is, that this plant, together with all others belonging to the same subdivision, have the calyx and corolla united.

The divisions of a calyx are called its *sepals;* they are generally longer than the corolla in *œstivation*, that is, while the flower bud is unopened, but much shorter afterward. If the calyx be deciduous it separates at the base; sometimes the sepals drop individually, but at other times they cohere together, and, parting at the base, are thrown off by the growth of the stamens like a cap; in such cases the calyx is said to be *operculate*.

The calyx of composite flowers, such as the daisy, dandelion, and dahlia, is so very different from the calyx of other plants, that it is known by the name of *pappus* or *down*. It is sessile or pedicled, simple or branched; and belongs to the individual florets of the composite flowers, although, from its very situation in the centre of the disk, it is not easy for a tyro to account for such a change of place. It is, however, a conventional rule to consider the hair-like processes borne on the apex of the *ovarium* of these florets a calyx.

If the calyx be distinct from the ovarium or seed vessel, it is said to be *inferior* or free; but if it be firmly attached to the sides of the ovarium, it is then called superior.

When the sepals are united into a kind of cup, the calyx is said to be *monophyllus*, that is, consisting of one leaf; but such a state of a calyx has never yet been seen, although the sepals are often found united by their contiguous edges. Sometimes the calyx is ornamented with glands, or hair, or other description of pubescence, and again by dilatations of its cuticle. These are called appendages; and when such a calyx is described, it is said to be *appendiculate*.

The calyx is divided into seven kinds; — the calyx, properly so called (perianthum), *f.* 67, when it is contiguous to and makes part of the flower. The involucre *(involucrum)*, *f.* 52,

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of Professor Martyn ; this is remote from the flower, and can scarcely be distinguished clearly from a bractea.

The catkin *(amentum)*, as in the hazel, *Pl.* 43, *b*, which consists of a common receptacle, of a cylindrical form, beset with numerous scales, each of which is accompanied by one or more stamens or pistils, so that the whole forms an aggregate flower.

The sheath *(spatha)*, a covering which bursts longitudinally, and is more or less remote from the flower ; as in the arum, *Pl.* 27. The husk (*gluma*), *f.* 68, the popular calyx of grasses, and grass-like plants, of a chaffy texture ; they are usually compressed, embracing each other at the base. The scaly sheath *(perichætium)*, *f.* 69, investing the fertile flower, and consequently the base of the fruit stalk, in some mosses. The wrapper (*volva*),

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f. 70, or covering of the fungus tribe; of a membranous texture, concealing their parts of fructification, and, in due time, bursting all round, forming a ring upon the stalk.

OF THE COROLLA.

In examining the parts of flowers in general, we find, immediately within the calyx, another whirl or rank of delicate, and often highly coloured leaves, and which are significantly called *the flower*, because of their gaudy colour and elegant expansion. This Botanists call the *corolla*; and it is either entire, or composed of separate parts; its divisions are called *petals*, and consequently it is either *monopetalous*, that is, one petaled, or *polypetalous*, that is, of many petals. There is no such thing, however, as a corolla of *one* petal; as it is only apparently so by the union of the edges of the petals with each other.

A petal is described as consisting of two parts; namely, the *lamina*, *f.* 71, *a*, or limb, and the *unguis*, *f.* 71, *b*, or claw. The latter is the narrow part at the base; and is inserted into different members, or into different parts of members, as will be noticed hereafter.

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When the petals are united below, and form what is called a tube, the orifice of which is the *faux* or throat, and the limbs are disposed in various forms and positions, they have received different significant titles, by which they are easily and briefly described.

If the limbs extend like rays from a centre, they are said to be *rotate;* if spread out like a platter, *hypocratiform*, *f.* 72; if like a funnel, *infundibuliform*, *f.* 73; if like a bell, *campanulate*, *f.* 74; and if like lips, *labiate*. When the divisions of a monopetalous corolla do not spread regularly round the centre, but take different directions upwards and downwards, as in the order labiatæ, the upper form what is called

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the upper lip, and the lower, the lower lip, or *labellum*. If the upper lip be arched, it is termed the *galea*, or helmet. When the two lips stand widely apart, the corolla is said to be *ringent*, *f.* 75, or gaping; and if closely pressed together, as in frog's-mouth (*Antirrhinum*), it is said to be *personate*, *f.* 76; because it has some resemblance to a face.

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According as the petals of a polypetalous corolla are arranged the flowers have received different names from Botanists; hence we have *rosaceous*, *liliaceous*, *caryphyllaceous*, and *cruciaceous* flowers, so named, because of their similitude to a rose, a lily, a pink, or to the cross-formed flowers of the single garden stock. If the corolla be very irregular, with one petal very large, and standing over the others like a hood or helmet, as is exemplified in the common monkshood (*Aconitum*), it is called *cassideous*. The corolla of the pea, because of its peculiar butterfly-shape, is called *papilionaceous*, *f.* 77, and consists of five petals; of which the upper one is called the *vexillum*, *f.* 78, or standard; the two side ones are called *alæ*, *f.* 79, the wings; and the two lower ones being united by their lower margins, form the *carina*, *f.* 80, or keel.

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When the flower has no corolla, it is said to be *apetalous*; and when it is very small and forms part of a composite flower, it is termed a *corollula*; and when, as it sometimes is, lengthened at the base into a hollow tube as in orchis and many other plants, this tube is called the spur, or in botanical language *calcar*.

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Those plants which present their flowers in umbels have corollas of very irregular form; the exterior petals being much larger than the inner ones. Such are called irregular; and all corollas are, in description, said to be regular or irregular, equal or unequal.

The petals are deciduous after flowering; some remain expanded only for a few hours; others are more permanent, continuing in vigour for several days, opening in the day, and closing again at night.

There are a few plants which are furnished with two or three whirls of petals, one within the other, in their natural state; of these the magnolia and nymphæa are instances. These are very different from the double flowers of our gardens, which are monstrous, not normal productions.

Of the use of the corolla in the economy of the plant very little is known. It can hardly be regarded as a member for defence, seeing that in many cases, they depart from the only position in which they could serve either as a shade or as a shelter. But the corolla is certainly connected in some way or other with the grand purpose of the plant; namely, the production of seed; for as soon as that is accomplished, and not till then, the petals wither away.

This is a subject on which a little speculation may be allowed:—It is well known that many plants, and particularly exotics kept in glazed houses or frames, are barren, and never ripen seed, unless assisted by manual interposition; and the reason given for this is, because they are deprived of those currents of air, and visits of honey-seeking insects to which they would be exposed in the open air. Everybody has heard of the caprification of figs, by means of an insect; and there is an equally well known fact in the business of gardening; namely, that the seeds of no particular species or variety of the genus *brassicæ* can be produced *pure,* if the flowers are expanded in the near neighbourhood of other flowering species of the same genus. This proves that the pollen or fecundifying dust of the anthers, is transmissible from flower to flower, and also that the dispersion of the pollen within the same flower requires some disturbing cause, either of wind or insects.

And how is the instrumentality of insects to be secured, to effect this purpose of the plant? We answer, either by sight or scent. The honey secreted by flowers is attractive to the one sense, and the splendid colours of the corolla are equally so to the other. Thus, besides the embellishment of the vegetable creation, so productive of delight to the senses of man, the fragrance and beauty of flowers may answer another purpose, no less necessary in the economy of the plant itself than the results are to those beings for whom they were created.

"The colours of the corolla arise from the deposition of reflective atoms of matter in the cellulas of the perenchyma; even white petals are so in consequence of the deposit of a dull white substance, and not because of the absence of colouring."—*Lind.*

OF THE CORONA.

The corolla is often furnished with various appendages, which, in the school of Linnæus, were considered as distinct members of the flower, and as they were supposed to be instrumental in the secretion of honey, they were called the *nectarium*. But by subsequent and more accurate investigation, this member was seen to occupy so many different situations, and in which the agency assigned to it could not be fulfilled, the title has been dropped ; and distinct characters have been substituted, which are considered as more consistent with the improved state of the science.

The place of the nectarium was either upon, or immediately within the petals of the corolla. Sometimes it was described as a nectariferous cavity or claw, at the inner base of the petal ; or as a circle or tuft of hairs in the throat of, or in the shape of a cup or long tube, within the corolla, so conspicuous in the narcissus, *f.* 81.

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In this last state it is now described as the *corona*. In some flowers, instead of being entire, like the edge of a cup, it is split into segments which stand erect above the limbs of the petals, as in *Silene*. In *Stapelia* it forms a thick fleshy mass covering the ovarium, and adhering to the stamens, in which state it takes the name of *orbiculus ;* and this has again certain appendages which have also distinguishing epithets.

Some flowers are furnished with most beautiful coronas; such are the parti-coloured rays which rise within the petals of the passion flower; or which cover the stamens of the iris; or the spurs which are elevated on stalks, as in aconitum; or as the nectariferous spurs attached to the petals of the larkspur (*delphinium*); or to the much more inflated one, called a slipper, belonging to the *Cypripedium*, or ladies' slipper. Such indeed are the great variety of forms assumed by those members of the flower, and which are clearly neither petals nor stamens, that it is matter of difficulty with many Botanists to describe them otherwise than by asserting that they are metamorphosed petals, or abortive stamens.

OF THE STAMENS.

The next rank of members within the corolla and its appendages are the stamens. In number they vary from a single one to a hundred or more; they are the male organs of the flower, and each consists of three parts—namely, the *filament*, *f*. 82 *a*.; but which is not always present—the *anther*, *f*. 82 *b*.; and the *pollen* therein contained. The stamens are variously seated; sometimes on a body in the centre of the flower called a *receptacle*, to be described hereafter; sometimes on the

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petals, or at least attached to them for the greater part of the length of the filament; sometimes they are said to be seated on the inner surface of the calyx; and, in some plants, the anthers deprived of filaments are fixed to the pistillum. In most cases the stamens stand singly; but are sometimes united, either by a brotherhood of the filaments, or by a union of the anthers joined side to side round the style, in which case they are said to be *syngenesious*. The filaments are linear, or flattened like a leaf, and support one anther usually, but sometimes several. The anther consists of one or several cells, generally bursting lengthwise to discharge the pollen. They are of various forms and colours, though for the most part yellow. The pollen is a fine impalpable powder; but when viewed with a microscope the grains appear of very different and curious forms. Some anthers have the power of discharging the pollen in clouds by a peculiar mechanism of the cells.

The stamens of some plants possess a very interesting kind of irritability. Those of the common berberry, when undisturbed, lie upon the petals; but if the inner side of the filament be touched near the base, by a straw or any slender body, the stamen immediately bends itself upward, till the anther touches the *stigma*, the female organ of the flower.

The number, and situation, and comparative length of the stamens, are particulars on which some of the rules of systematic Botany have been, and still are founded; such as when the filaments are combined in one mass, this association is said to be a brotherhood, or an *adelphia*; hence we have *monodelphous, diadelphous, triadelphous,* and *polydelphous* associations; signifying that the brotherhoods are one, two, three, or many fold. And there are also other general terms applied to the stamens, as whether they are *exserted*, that is, standing out beyond the petals; or *included*, kept within, or shorter than the corolla; if all bend to one side, they are said to be *declinate*; if two out of four be shorter, they are *didydamous*; and if two out of six be longest, they are *tetradynamous.*

The manner in which the anthers are attached to the filament is particularly marked by Botanists; when they are fixed by the base, they are said to be *innate*; when by the back, they are *adnate*; when by a single point near the middle, they are said to be *versatile*; because they swing as if on a pivot; exemplified in all the grasses.

The bursting of the anther is called its *dehiscence*, and when this takes place, the female parts of the flower are usually ready for the reception of the pollen discharged from the anther. Without the influence of the pollen conveyed to the embryo seeds already formed in the ovarium, they would be abortive and useless.

This consummation is therefore the principal function of the stamens, and when that is completed they wither away.

OF THE DISK.

In Linnæan Botany, this term was used to identify that flat body on which the florets of composite flowers were fixed. In the modern schools of Botany, the term is used to denote a distinct member which is usually found between the base of the anthers and that of the *pistillum.* It appears in most cases as an entire or broken fleshy ring, sometimes adhering to the calyx, in which case it is said to be *perigynous ;* or it is found surmounting the summit of the ovarium, in which case it is *epigynous.*

The disk is never a very conspicuous member of the flower ; it is only detectable by the scrutinising Botanist, who is constantly using the glass and dissecting knife ; and in drawing up descriptions, it is necessary to be particularly noticed. The use of it, as an organ of the inflorescence, has never yet been appreciated ; for it is rather regarded as a superfluous abortion, than the natural form of a necessary organ.

There seems, however, to be no absolute necessity for arriving at such a conclusion, merely because its use in the system is unknown. Our knowledge of vegetable action is as yet by far too limited, to enable us to say with certainty what is, or what is not, useful in the economy of the plant.

OF THE PISTILLUM.

The pistillum is the columnar body, which occupies the centre of the flower. From its station and importance, it may be considered as the principal compound organ of the system. It is surrounded by the calyx and corolla; and as it is that member whence the fruit and seeds are produced, it may be properly, as it hitherto has been, called the female part of the flower.

The pistillum consists of three parts, namely, the *ovarium*, occupying the base; the *style*, and the *stigma*.

The ovarium, *f.* 83, *a*, is a hollow case enclosing the embryo seeds, and often divided into two or more cells or cavities. It ultimately becomes the fruit; and consequently, whatever may be the structure of the ovarium, such must necessarily be that of the fruit. It is sometimes sunk within the calyx, which continues to be


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the outer integument of the fruit, as is instanced in the *pomaceæ*, or common pear and apple. When so placed, it is said to be *inferior*. But when the ovarium becomes free from the embrace of the calyx, and swells entirely above the sepals, it is then said to be *superior*.

In many cases the ovarium sits closely upon the twig producing it; in others it is seated on a long stalk, as in the passion flower; this stalk is called the *thecaphore*. The interior of the ovarium, as already observed, consists of one, or is variously divided into cavities or locuments. In each locument there is a member, either central, or proceeding from the partitions, angles, or walls of the ovarium, to which the seeds are attached by their umbilical cords called the *placenta*. The seeds, after fertilization, are increased in size, as well as their integuments; and the whole swelling together is called *grossification*. This enlargement of the ovarium ends in the full maturity of the seeds, and in the full maturity of the fruit, to be adverted to hereafter.

The next part of the pistillum is the *style*, *f.* 83, *b*, and which, when present, connects the ovarium and *stigma*. When not present, the stigma is seated immediately on the ovarium, as instanced in the poppy. It is usually taper, or filiform, or thick, and sometimes angular; but rarely flat and coloured, as it appears in iris and in canna.

The style is usually smooth; but in some plants it is thickly beset with hairs. Sometimes these hairs stand in a whirl, or form a cup below the stigma. Many styles are not single, as they appear to be, but composed of several united together; each belonging to a cell in the ovarium, and surmounted by a lobe of the stigma at top.

The stigma, *f.* 83, *c*, is the uppermost part or summit of the pistillum, and is the only member of the whole plant that has no cuticle. It is, therefore, naked, but is always very moist, or covered with soft down or papillæ. This state of the stigma is a provision of nature, in order that the discharged pollen may the more certainly be caught and retained for the purpose of fecundifying the *ovulæ*. In shape the stigma is either round with a notch on one side, or consists of several lobes, or of rays forming a *verticellus* as exemplified in geranium.

Both style and stigma appearing in many different forms, leads careless observers to suppose that some of their appendages are stigmatic, which they really are not; nothing is stigma but the secreting surface, before alluded to, for it is this secreting power which characterises the true stigma, whether it be moist, or papillose, or fungous.

The stigmata are distinct from surrounding bodies, and freely exposed to the contact of pollen, in the great majority of flowers; but in the curious order asclepiadaceæ, they are united with the anthers in a solid mass, of which the angles only that are in contact with the cells of the anther are free and susceptible of fertilisation.—*Lind.*

Although there are no very visible tubes, leading from the stigma to the ovarium, to facilitate the passage of the pollen to its destination; yet the central tissue of the style is of a very loose and porous texture, which seems to transmit the pollen, or its influence, as efficiently.

As the ovarium is a very complicated organ, and particularly in some genera, Botanists have paid much attention to its rudimental, as well as to its mature state; including all its transformations during its progress to perfect ripeness. Such inquiry, says Dr. Lindley, would, perhaps, be of less importance, if none but structure of a very regular and uniform kind were to exist; but considering the numberless anomalies that the pistillum exhibits, it becomes at once one of the most difficult and most essential parts of a student's investigation.

We shall here deem it necessary to give only the most common and simple forms, and distinguishing characters of the different kinds of seed-vessels; in order that the student may not be perplexed by a multitude of names and distinctions, which are fitter for those who have already made considerable progress in the study of the science.

And here we turn with pleasure to that smooth beaten path laid down for us by the immortal Linnæus, and whose system, although departed from by the modern schools of Botany, their teachers still allow, is an excellent introduction to the more recondite system of Jussieu.

Agreeing in this opinion, we shall, therefore, in the first place, proceed to quote what Linnæus wrote as to the titles of the different forms of seed-vessels.

Every different description of seed-vessels was comprehended under one or other of the following characters; namely, *pomum*, *f.* 84, an apple, that is, a pulpy pericarp, or fruit without opening or valves, and generally enclosing a membranaceous capsule, consisting of several cells: — example, the orchard apple. When this membranaceous seed-vessel is uncovered by pulp, it is called a *capsula*, signifying a little chest,

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and which, when ripe, opens spontaneously, either by valves or in some other determinate manner. Sometimes the capsula is without valves, as in the ash; many-valved, as in the woodsorrel *(oxalis)*, or only one-valved, as in the primrose. A pod, *Pl.* 42, was called *siliqua*, which is a dry pericarp or two-valved fruit, with opposite seams to which the seeds are attached. A *silicula*, *f.* 85, is also a pod, but short and roundish, or heart-shaped, as in shepherd's purse (*thlaspi*). *Legume*, *f.* 86, is also a pod, which, when ripe, is dry and long, having two valves and seams, to one of which the seeds are fixed, as in the common pea; it is one-celled, and contains one or many seeds, is rough or smooth, fleshy or membranaceous. When the seed-vessel resembles a bag, it is called a *folliculus*. When it is a pulpy pericarp surrounding a stone or nut, as in the peach, it is called a *drupe*, *f.* 87; and when the pericarp is soft and pulpy, containing one or several seeds, but without valves or capsule, it is called *bacca*, *f.* 88, or berry, of which the currant is an example. Another kind of seed-vessel is the cone borne on fir-trees, and this was by Linnæus designated a *strobile*, *f.* 89; and which is a

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woody *amentum*, the separate carpills of which are covered with scales enclosing the seeds.

These terms are still useful in descriptive Botany, though several of them are no longer used. The particular description of the manner in which the leaves of the plant are metamorphosed into seed-vessels is called *carpology*. When a single leaf is rolled together to form a seed-cell, it is called a *carpellum*; and when there are more pistils than one in a flower, they spring from a whirl of leaves, and are *carpella*. This branch of botanical science belongs to what is called *morphology*, and will be noticed in the sequel. But it appears that this part of the plant has been more closely studied than any other part, by a great number of the first Botanists of the present time; and they seem to have vied with each other who should fix the glossology of this organ and its parts. That terms as significant and comprehensive as possible should be chosen, there can be no doubt; but there is a difficulty in getting those of any one author universally adopted. Dr. Lindley has arranged fruits, or seed-vessels, in four classes, viz.,

1. Apocarpi, containing six divisions: *Utriculus*, one-celled; *Achenium*, one-seeded; *Drupa*, one-celled, one or-two-seeded; *Folliculus*, one-celled, many seeded; *Legumen*, a pod; *Lomentum*, a jointed pod.
2. Aggregati, fruit aggregate: viz., *Elæris*, ovaries distinct; *Syncarpium*, ovaries cohering into a solid mass; *Cynarrhodum*, ovaries distinct, pericarpia hard.
3. Syncarpi, fruit compound: viz., *Caryopsis*, one-celled, one-seeded; *Regma*, three or more celled; *Carcerulus*, many seeded, superior; *Samara*, a key, two or more celled, superior; *Pyxidium*, one-celled, many seeded; *Conceptaculum*, two-celled, many seeded; *Siliqua*, one or two-celled; *Silicula*, one or two-celled, pod rounded; *Ceratium*, one-celled, many seeded; *Capsula*, one or many seeded; *Amphisarca*, many celled, many seeded, pericarpium fleshy; *Tryma*, by abortion, one-celled; *Nuculanum*, two or more seeded; *Hesperidium*, many celled, few seeded; *Glans*, one-celled, one or few seeded; *Cypsilla*, one-

seeded, one-celled; *Cremocarpium,* two to five-celled, inferior; *Deplotegia,* one or many celled—differs from the capsule only in being adherent to the calyx; *Pomum,* two or more celled; *Pepo,* one-celled, many seeded; *Bacca,* a berry, many celled, many seeded; *Balausta,* many celled.

4. Anthocarpi, collective fruits: viz., *Diclesium,* one-seeded, endehiscent; *Sphalerocarpum,* one-seeded, enclosed in a fleshy perianthium; *Syconus,* a fleshy rachis, having the form of a hollow receptacle; *Strobilus,* a cone, the cupilla scale-like; *Sorosis,* a spike, converted into fleshy fruit by the cohesion of the ovaria with its envelopes, ex. mulberrry.

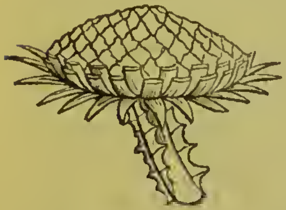
These are the titles used in the language of Botany, for identifying the different forms of seed-vessels and fruits, and the use of which, either in conversation or in writings, very much abridges descriptions.

Botanists make a good distinction between fruits and seeds, by saying that whenever there are any remains of a style or stygma upon the production, it is, whatever may be its size, a fruit; and when no such mark is visible, it is a seed. Thus, the capsule of the poppy, the luscious and inviting forms of the peach, pear, and cherry, are fruits; while the largest nut is only a seed when stripped of its outer investments. The parts composing a fruit are thus denominated: the outer skin is the *epicarpium*, the intermediate pulp is the *sarcocarpium*, and the shell of the stone which contains the ovula or kernel is the *endocarpium*.

As there are several parts of flowers which are either entirely wanting or undeveloped, so we often see fruits, which we call ripe and useful, imperfect in what we would say are the most essential parts of their organization. In flowers the calyx and corolla are united; or if a calyx be present, the corolla is absent: sometimes the anthers have no filaments, and sometimes the stigma has no style. So we find in fruits kernels which have no endocarpium, and berries which have no seeds.

OF THE RECEPTACLE.

The receptacle, *f.* 90, is the point of the peduncle, or branch, on which all the other parts of the fructification are seated. Sometimes it is entirely flat, or a little prominent in the middle, or drawn out into a cone, either solid



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or hollow. In another remarkable case its conical form is reversed, and it becomes a deep and hollow cavity, having the flowers, either male or female, seated on its interior surface. This form occurs in the common fig, the receptacle becoming the pulpy eatable part of the fructification.

In many ordinary cases the calyx, corolla, stamens, corona, and disk, are all seated on the receptacle ; and in describing any of these members it is always noted whether or not they are seated on the receptacle ; this circumstance often constituting a generic distinction.

OF THE OVULUM.

The production of the ovulæ or seeds is the last and most important effort of a plant, whether that result happens in the course of one summer, as is the case with annuals; or in two summers, as occurs in biennials ; or in several summers, as shown in perennials. In the last case it is necessary to explain that, though the flowers and fruit of both trees and shrubs are developed and matured in one summer, yet it is obvious that these are in a state of preparation for several years previous ; some perfecting their flowers in two, others in three, and others again requiring a period of several years to advance a leaf-bud to that of a flower-bud.

In all cases, however, the production of ripe seed is the ultimate effort of a plant, or distinct division of a perennial plant; and by which the kind is reproduced and perpetuated.

Those Botanists who have amused themselves by prying into the hidden processes of incipient vegetation, affirm that the ovulum is a small, semipellucid, pulpy body, borne by the *placenta* (a member in the centre, or attached to the sutores or walls of the ovarium) and gradually acquiring the perfect form of a seed.

The internal structure of the ovulum is exceedingly difficult to determine, either in consequence of its minuteness or of the extreme delicacy of its parts. But it has been minutely examined; and the main object is, probably, to discover whether any, or what change takes place after impregnation; for assuredly, whatever envelopes, or parts, are visible in the mature seed, must be present in its immature state. This notion is even sanctioned by M. Mirbel, one of the most accurate of observers, when speaking of some veins or bundles of tubes, which though very visible in some plants, are invisible in others, although he deems their non-appearance as no proof of their absence. Were this belief more general among those who investigate and describe the immature parts of plants, there would be much less attributed to what are called *spurious* or *accidental* developments.

The results of these microscopic observations are, the discovery that the ovulum is, at first, apparently homogeneous, but as it advances in growth it is gradually enclosed in two *sacs* or integuments, which are open only at their apex,— where, in both these sacs, a passage exists, called the *foramen*. The central part is a fleshy, pointed mass, called the *nucleus*. The exterior sac is called the *primine*, the next within is called *secondine*, and within both these is the nucleus. Besides the two external integuments M. Mirbel has remarked the occasional presence of three others peculiar to the nucleus, which he calls the *tercine*, *quartine*, and *quintine*. The fluid matter contained within the nucleus is called the *liquor amnios*, and is supposed to be that which nourishes the embryo during its growth.

This embryo, when ripe, is the rudiment of the future plant, and contains a basis, whence all the future members of the infant plant are developed. It is a vegetable egg, which has certain characters belonging to itself: the base of a seed is always that point by which it is attached to the placenta, and which is called the *hilum*: the opposite point to this may naturally be supposed the apex; but this is but seldom the case, as the true apex is sometimes very near the *hilum*, and, according to Dr. Lindley, the place of the true apex is indicated by lines concentrated over it,— which lines are visible on the *testa* or outer covering of the seed. If such lines are undistinguishable, another indication of the apex resides in a little brown spot, which, when visible, is called the *chalaza*.

The integuments of a seed are the *testa*: the *embryo* occupies the centre, between which and the testa lies the *albumen*, a substance so called because it often resembles the white of an egg when boiled. The testa is of very various texture; it is horny or leathery, spongy or woody. The surface is smooth or rough, highly polished or beset with hairs.

The embryo occupies the centre of the seed, and, as before observed, is the rudiment of a future plant: it is usually single, rarely double: and divided into three parts: namely, the *radicle*, *cotyledons*, and *plumula*. Some Botanists make a fourth division: namely, the *cauliculus*, or origin of the stem, occupying a line between the radicle and the plumula. If the seed of a dicotyledonous plant be placed in favourable circumstances, the following phenomena occur: the radicle descends and becomes a little root; the cauliculus rises upward, bearing the two cotyledons, which expand above the surface of the soil; and the plumula rising from between exhibits a slender stem and leaves.

This is the usual process of the germination of a dicotyledonous plant; but there are some exceptions to this law: first, in the cohesion of the cotyledons within the surface, instead of unfolding in the air; second, in an increase of their number; third, in their occasional absence; and fourthly, in their inequality. The cohesion of the cotyledons occurs in the horse-chesnut: an increase in their number (or perhaps it may be called a sub-division of the two) is seen in the genus *pinus:* their occasional absence occurs in the *cuscuta:* inequality of the cotyledons is rare, but is observable in the genus *cycas.*

Having thus far reviewed and briefly described the various tissues and members forming the organic structure of flowering plants, we come now to the consideration of certain phenomena and particulars of a more general character, exhibited by, or which affect every grade of the vegetable kindom.

OF THE RE-PRODUCTION OF PLANTS.

To "multiply and replenish the earth" was the high behest of the Almighty Author of nature to all his living creatures—vegetables as well as animals. Nor were the latter gifted with higher powers to obey the mandate than were the former — the innumerable plants which clothed the face of the green earth, and which sprung up after the work of the third day. Then it was that "the earth brought forth grass, and the herb yielding seed, and the fruit-tree yielding fruit, whose seed was in itself, each after his kind." All these new creations continued to yield their seed spontaneously to perpetuate the species, and to fulfil the first omnipotent command.

But though dissemination was the most effectual and most general way of distributing the primitive plants, yet, as there were many birds and beasts which subsisted entirely on seeds and fruits, it appeared necessary that plants should be endowed with other tendencies or powers to re-produce themselves independently of seed.

To show the different processes by which plants re-produce themselves is the object of this section ; and having already described how the ovulum or seed originates and becomes mature, we have here, in the first place, to state how seeds are dispersed and self-sown ; and next, proceed to show how plants increase themselves otherwise than by seed.

When seeds are thoroughly ripe they, in most cases, drop from the tree to the earth, and there remain to be covered with leaves which soon fall after them. This is the only covering they are naturally destined to receive. Some seeds are furnished with *alæ* or wings, by which they are transported in the wind to considerable distances from the place where they grew. Others are furnished with a *pappus*, which, from its curious parasol appendage, is exceedingly buoyant, and are by this wafted far away from the mother plant. Some seeds are beset with hooked hairs, by which they cling to the fur of animals, and consequently are carried far and wide. Others again have long awns, the base of which is spirally twisted, and which, relaxing in dry, and shrinking in wet weather, removes them, by these alternate motions, to a distance from where they fall upon the ground.

In some instances seeds are scattered around by an elastic action of the valves of their capsules. Under the influence of a hot sun, the valves of some seed-vessels, and the scales of others, are suddenly separated with a snapping noise, discharging the seeds with considerable force.

Sometimes birds are the agents appointed to disseminate plants to distant places. The mistletoe is transported by the mistle-thrush, which devour the berries; and cherry stones are planted by both rooks and jays. Aquatic plants are removed from place to place by ducks and other water-fowl, they conveying the seeds not in, but upon their broad bills by accident.

It is hardly worth alluding to the action of winds and running streams in the dispersion of seeds, as these are mere accidents, not the results of design.

Besides the reproduction of plants by seeds, there are other means by which they are increased. Many of them, instead of seeds which may be buried in the ground, or kept in the granary for ages, produce living progeny even in the seed-vessel. This viviparous tendency is exhibited in the onion tribe *(allium)*, as well as by several of the grasses. Even the common winter wheat, in wet seasons, too readily presents this premature germination amid the humid chaff of the ear. In this case we have living plants discharged from the parent instead of seeds; and other plants have not only the power of producing seed in their proper seed-vessel, but also the power of forming and discharging buds from the axils of their peduncles, and their leaves, which have all the prerequisites of perfect seeds. These deciduous buds are curiously constituted, being of a character between a bulb and a seed; and from which as perfect plants are obtained as from either bulbs or seeds.

The complicated power of reproduction is exemplified in several species of the genus *Lilium*, as the bulb-bearing, and tiger lilies for instance; which shows how carefully nature has guarded these plants from extinction.

Most other bulbous stemmed plants are provided with double powers of reproduction. They ripen seeds, and increase themselves by what are commonly called *off-sets*. And it is remarkable, that as the one or other of these organs is increased, in like proportion is the other diminished. If many seeds be ripened, few or no off-sets will be produced, and *vice versâ*. And moreover, if the cultivator would rather have a large increase of off-sets than have both, he has only to deprive the plant of both its flowers and leaves.

A great majority of herbaceous plants have similar powers of reproduction, for while perfecting seeds they are also extending themselves by subdivisions at the root, and some of them have a triple mode of increasing themselves. For instance the strawberry; this fruit-bearing herb not only ripens seed, and extends the crown of its roots by lateral branches or divisions, but it also ejects from its crown another description of progeny, called *runners*, sent off in all directions; so that what with the runners, and secondary runners produced from the first, a strawberry plant, if allowed, would quickly usurp the whole surface of a border, or even that of a whole garden to itself.

Such are the reproductive powers of the strawberry plant; and another useful and well-known culinary vegetable may also be instanced as possessing a power of reproduction in a three-fold way, not much inferior to that of the strawberry. The potatoe bears its bunches of apples well filled with seed; it sends out numerous runners under the surface, to each of which a tuber, greater or less in size, and studded all over with many germs, each of which in the following year forms, or may form, independent plants; and to these tubers and seeds may be added another set of tubers, occasionally produced on the principal stem in the axils of the leaves; and which last, though never used, are equally capable of perpetuating the species as either the seeds or the underground tubers.

Almost all the perennial grasses increase themselves both by seeds and by divisions at the root, as well as by runners both above and beneath the surface of the ground, in which character they are called *couchgrass*, and are a great plague to the cultivator of arable land.

Other herbaceous plants inherit wonderful powers of reproduction; their underground stems are so thickly studded with vital germs or buds, that every the smallest portion of these stems will form new independent plants. These are denounced as weeds, and among others the dock, dandelion, and bindweed (*convolvulus arvensis*), are some of the worst.

Many trees and shrubs extend and multiply themselves by suckers as well as by seeds. The suckers are produced from roots which are beset with buds, like the stems and branches; and which buds are developed, rise through the surface, and become *wavers* round the parent stem. Trees which produce no perfect seeds are most liable to produce numerous suckers:—instance the English elm, and several of the poplars.

These are the various ways in which the different descriptions of plants increase or extend their species; and from which it appears, that they are constituted very like animals in respect of reproduction. Are birds oviparous? so are plants in the production of seeds. Are the beasts (*mammalia*) viviparous? so are plants in producing living progeny, from their seed-vessels, from their stems, and from their roots; and some of the most beautiful adaptations of nature, are exhibited in the arrangement of surrounding circumstances, imposing, as it were, on the insentient plant the best means by which the safety and welfare of their young may be accomplished. A most impressive instance of such adaptation occurs in the habits of the mangrove (*Rhizophora mangle*), a tropical tree growing on the banks of large rivers, and on the sea coast, and even within the bounds of the ocean, as far as low-water mark. Their mode of rooting is peculiar; it consists, not like that of ordinary trees, of divisions of the stem below the ground, but as it were of arches of roots above it, so that a more extended base is formed and a firmer hold established in the loose and swampy soil. From the summit of these bending roots the trunk of the mangrove springs, like a steeple from converging arches on which it is built.

Thus growing within the dry shore of the sea, or within the currents of mighty rivers, the final cause of the peculiar economy described in the germination of the seeds within the pericarp, and before the fruit has dropped from the parent bough, is evident; for, were they to be shed as seeds usually are, they would fall into the water, and be carried far from any place that is fitted for their growth. But by the long radicle first perforating the seed-vessel and descending into the mud, it acts like an anchor to the seedling when at last dropped from the tree. Thus forests of mangroves are formed of vast extent, unsafe to be trodden by human foot, but over which the savage natives pass, leaping or climbing from root to root for many miles, without once daring to trust their weight upon the treacherous marshy ground. (*Bur. Bot.*) There are many shrubs, and a few of our forest trees, which extend themselves by accident, and which may be set down as another mode of reproduction. When a willow tree is blown down, and lies prostrate on moist ground, it immediately ejects fibrous roots into the soil; and from these new established roots numerous young stems ascend and become trees.

Other trees, as the spruce fir for instance, when its lower branches are so extended as to lie on the ground, there take root, and thence send up new stems in every respect like the first.

It was, without doubt, from these accidental circumstances that cultivators were at first taught the art of manual propagation by layers and cuttings, so useful now in the business of the nurseryman. These manipulations, however, will be noticed in another section.

OF VEGETABLE LIFE.

This is a most abstruse subject; it has puzzled many a philosophic mind; hardly two of the wisest enquirers are agreed in their opinions concerning vegetable life. One philosopher has said, "life is the totality of the functions which resist death;" another thinks that "life is a collection of phenomena that occur during a limited period in organized structures;" one lays down what he considers as an aphorism, that "life is the active state of the animal [and vegetable] structure;" another, still more laconic, avers that "life is inherent activity."

The above we give as a kind of preface to the introduction of another and more comprehensive definition lately published, namely, that "life is that energy, or attribute, of organized structures which renders them capable of receiving and of obeying the impulse of stimuli. It is real, or it is potential: real, if the susceptibilities are in operation, as in the case of an animal in motion, or of a plant protruding its buds or blossoms; potential, if the susceptibilities are dormant, as in the case of an egg not hatched, or of a seed not sown; or as in the case of the hybernation, whether of plants or animals. Life originates in precedent life, and terminates in subsequent death, which is an extinction of all vital functions, and of all possibility of vital functions. Taking this definition with its illustration as our text, we proceed to remark that life, in the exhibition of its phenomena, always presupposes the existence of certain peculiar conditions, previous, or concomitant, or consequent, without which it never has been known to manifest itself, and of which the most essential are the following,—parentage, organization, aliment, aeration, temperature, death."—(*Keith's Bot. Lex., p.* 224.)

This definition we think is as complete as any other ever given of the phenomena of vegetable life, there being only one idea which to us appears obscure, namely that the potential susceptibility can possibly be dormant; for surely it is not so, either in the egg not hatched, or the seed not sown; for both these bodies retain their susceptibilities, though from the *absence of stimuli* they are dormant. The allusion to the hybernation of animals is good, but we have doubts whether it be strictly applicable to plants.

If we study vegetation with a view to discover what vegetable life really is, we can only mark its effects: that which is small becomes amplified; that which is closed becomes unfolded; and that which at one time is invisible is soon afterwards exposed to view. We see the shoots lengthened, the leaves developed, and the flowers expanded; and whether these rise from a seed, or from a previously existing plant, for, from one or other, all accretion must proceed, there is no such thing as the beginning of life in a plant. The seed, or bulb, or tuber, or root, or branch, whence it sprung, gave it at once both vitality and form.

We may also mark the circumstances under which such phenomena take place: we shall find that the temperature of the air must be above thirty-two degrees of Fahrenheit's thermometer; that the plant enjoys full air and light; and that a due degree of moisture is in the earth, in which the seed is sown or plant placed.

We may also notice which parts of the plant are undergoing transformation. We see both its height and diametric bulk gradually increasing; we see its additional number of leaves, and flowers, and fruit; and we know for a certainty that all this is a consequence of, and is brought about by the life.

But if, for further satisfaction, we have a wish to know what is going on in the interior of the tree, as well as that which is so visible without, we shall certainly find that the whole frame and bulk of the tree remains exactly as it did twelve months before. Of this there is no increase or diminution whatever, if it be a young dicotyledonous tree. And it will be found that all the new additions of the present year, mentioned above, have been added to the exterior of the last year's frame. This fact, although already stated in a former page, is repeated to show the inquirer that the life has only "a local habitation" in the system, and that it is not resident, or at least not active, in every member of the plant.

The only proof we can possibly have of the seat, or the existence of vegetable life, is in its progressive action. And as it is a well authenticated fact, that neither the alburnum nor liber are ever increased or diminished after they are once imposed, the life must desert them and reside elsewhere.

Where then is its resting place during winter, or in those seasons when it or its susceptibilities are said to be dormant? We must not jump at an answer to this question; we must bring practical facts to bear upon it, and deduce our convictions accordingly.

In the operation of grafting we can easily unite a scion with a stock. The latter has a system of roots; its head is cut off, and replaced by the scion from another tree. A union very soon takes place, not by any inosculation of the fibrous tissues of the two alburnums, or by those of the two barks, but by an amalgamation of a certain viscous matter, which is always present between the alburnum and bark of the scion and stock, and which appears to act like a mutual cement to form the union.

Propagating certain kinds of plants by cuttings is a common practice. A part of a young shoot is selected to be rooted, because it is found that the more active the life is in any part, that part is the most suitable for making cuttings. Watching the process of their taking root when put in the ground, we observe that the rooting takes place in two ways. Sometimes root fibres are put forth at once, and invariably from the space between the alburnum and the inner bark; showing that neither the alburnum nor bark inherit any vital power to eject nutritive organs. At other times the cutting, instead of fibres, presents a callosity, issuing out from between the bark and alburnum, and after a period of a week or two, often longer, also issue rootlets, which descend into the ground.

Now, as neither bark nor wood are ever altered in their form after the summer growth is over, and as these members are incapable of showing any signs of possessing vitality so as to enlarge or extend their first forms, we must conclude that they are, as already said, deserted by the life as soon as they cease to grow.

So, in the case of layers, it is always the custom to twist or make some incision in the part laid in the soil, to facilitate their rooting; and, on examining the rooting part, it is seen that all the new fibres proceed from between the wood and bark, and this, together with what has been observed of cutting, shows decidedly that the life resides between the bark and alburnum in winter; and in this very space all the accretion of new wood and liber during the next summer is deposited.

In this way we can trace the life to its principal station, both in winter and summer. But other queries remain to be put, namely,—Is the life a *thing* which can be seen or felt? Is there no membrane or other body, whence the fibres spoken of proceed? No dilatation of either the alburnum or liber into the space between them?

To the first question we answer, No; the life is not a substantial member of a plant; it is only an "attribute" of certain parts of a vegetable body, which is capable of "obeying the impulse of stimuli," namely, heat, air, light and humidity united in due degrees.

To the second and third questions the reply is—No membrane is apparent, nor is there any visible dilatation of either the alburnum or liber. The only thing visible is a thin layer of viscous matter, which serves to unite the bark with the wood.

But thin and almost imperceptible though it be, this viscid layer is certainly the seat of the life during winter; and it is that which is swelled and fully formed into both wood and bark, in the course of the following summer.

We have stated that heat, air, light and water, are the stimulants of vegetation; but heat, air, and light have no stimulating effect, either individually or collectively, unless moisture be also present; this may be proved by sowing seed in a pan of dry sand. Heat and moisture cannot stimulate unless assisted by air: this is evident from the sound state of seeds which are deeply buried in the earth. Seed or plants may be excited into action by air and moisture; but if light be withheld, they will neither acquire colour, flavour, nor substantiality.

It is the effects of those four elements which collectively operate on the vital principle of plants, and induce development of their expansible membranes by excitement, perhaps, of the fermentive qualities of the juices.

We have said that the life in a tree is only local; this requires explanation. Why, when we look at a fine healthy tree, should we suppose that it is not *altogether* a living individual being? Can it be possible that one portion of such a stately object should be alive and another portion dead? Yes, quite possible; and if the tree be very old, quite and obviously true also. But let us consider a tree which is young and vigorous—say an oak of twenty year's growth; surely, this must be all alive throughout. We answer, No, it is not; and the explanation follows:—In whatever portion or member of a tree the actual life resides, that member is increasing, or may be increased in volume; but all members that are not increasing, and cannot possibly be increased in bulk, are virtually dead; and though not actually decayed, they are verging to decay. All the previously deposed layers of wood and bark, up to the present year, are in the latter predicament; active life has left them, so that all future growth is over.

But though this be fact, yet it must be admitted that both the wood and bark of a healthy tree continue to partake of the *influence of life* long after their first formation. The timber of a young tree just felled is very different from that which has long been converted to use, certainly; because the one is full of aqueous sap, and the other is sapless; and therefore, there is an appearance of freshness and life in the one which is not in the other.

That this must be the case is evident from the consideration, that the organs containing the actual life *clothe the whole exterior surface* *of the tree*; and, as the annual expansion of these organs are the principal, if not the sole cause of the ascent of the sap, as long as there is any connexion between the active members on the exterior and the organization within, so long will the latter show signs of freshness and life, although the actual life has long deserted them. The most recently imposed layers of both bark and alburnum are intimately connected with the living principle, and are chiefly employed in the conduction of sap; and it is obvious that, as long as any portion of the axis of timber is employed as conduits for the sap, it may be said to be a live member of the system; but when the central layers of wood and outermost layers of bark cease to be so employed, they are merely excrementitious, and soon fall to decay.

OF THE SAP.

The sap is the juice found in plants: Botanists describe two kinds or conditions of it, namely, simple and elaborated. The simple sap is that which is first taken into the system by the roots, and before it has become assimilated with the essential juices. Elaborated sap is that which has passed through the organic apparatus, and become fully impregnated with the essential qualities of the system: hence, it is called the perfect sap.

This knowledge of it is obtained by experiment; for as there are several kinds of trees whose juices are capable of being manufactured into sugar, and different descriptions of low wine; if, in withdrawing the sap by plugging, the orifice be made too low on the trunk, the quality is inferior: but the higher the outlet is made, the richer the flowing liquid is found.

The sap ascends from the roots to the topmost parts, and gives rigidity to the shoots and leaves, which they have not if in want of it. Much has been said and written to explain the phenomena of the sap, to common understandings a very simple affair. But simple as it appears to be, all the powers of nature have been assembled, and their various forces united, to account for this simple process. We know that there are many natural syphons of vascular or fibrous matter; such as a piece of porous cane, a strip of sponge, or a piece of list. All these readily absorb and convey water to any moderate height: and if these lifeless bodies act as conductors to such a fluid, surely the cellular, vascular, and fibrous tissues of the vegetable fabric, energetic with life, must also do the same with redoubled activity and effect. If, by the force of the life, vacuums are formed in the higher parts of the system, and at the same time the spongiolæ of the roots are absorbing the moisture of the earth; gravitation is a ready agent to cause the ascent of any lower fluid to a higher vacuum. Heat and moisture are usually combined at the surface of the earth; and so much so, that a notable vapour is constantly arising therefrom: and as the spongiolæ are pervious to both heat and water, why should the erect tubes, and vessels of vegetable stems be not ready conduits to the received fluids?

The sap, in its movements through the system of the plant, is said to be freed from its aqueous portion through the transpiring agency of the leaves, the residue being the elaborated portion, destined for the solidification of the nobler or more permanent parts of the structure.

Sap extracted from plants by any chemical or other mechanical means, or as it issues spontaneously from them, is found of very different qualities, both as to consistence and essential properties. Resins, gums, oils, &c. are common; and the materia medica is beholden to the juices of plants for many drugs, both sanative and poisonous. Those different qualities are compounded by the vital chemistry of the plant, because vegetable food in general is all very much the same.

Although the course of the sap is usually from the roots to the extremities of the branches, it is also transfusible in all directions; and always tends towards any outlet, whether to supply expanding shoots and foliage, or to escape at a wound. During winter it is coagulated by the cold, and nearly stagnant; but becomes liquified on the return of spring, and flows copiously from wounds. It becomes exhausted by the growth, as well as by the heat of summer, and then scarcely flows from wounds. In autumn its motion becomes languid, and at last is again nearly arrested by the increasing cold.

The greater number of vegetable physiologists attribute to the sap the property of being "organizable," that is, its tendency to form itself into the organic fabric of the plant: but this being an invisible process, it is entirely hidden from practical observation, and therefore cannot be practically explained.

When sap flows from wounds it assumes different appearances. In pruning it follows the knife like pure water; in some of the stone-fruit trees it oozes out in the state of gum; and among the cone-bearing tribes it comes out in drops of pure resin. From accidental bruises or wind-shakes, discharges of like qualities continue to pour out, for months and even for years together. The elm tree is very subject to be damaged by the flow of sap from wounds formed by the bases of rotten branches. This discharge is unlike any of the above-mentioned:

it is neither gum, resin, or pure water; but a thick turbid matter, and which contains a considerable portion of sugar, as flies, wasps, and even bees appear fond of it in the summer and autumnal months.

Many methods of extracting the juices of trees for economical uses might be quoted: as the birch wine of the Scotch Highlands; the maple sugar of North America; the gums from Arabia; the asafœtida of Persia (which however is the juice of an herb); the caoutchouc and numerous other gums from India, are all obtained by tapping, or making other incisions in the bark.

These various products show the wonderful powers with which the vegetable apparatus is endowed. Plants of very different kinds, and though grown on the very same description of soil, produce very different and opposite qualities in their membranaceous structure. It therefore appears, that the essential qualities are not compounded by the selecting or attractive energies of the roots, but by the elaborating powers of the cellular and vascular structure, under the united influences of heat, air, and light. For it is well known that in all cases where there is not a sufficiency of air and light, the vegetable products, whatever they may be, are colourless and insipid.

This circumstance shows that, although the quantity of nutritive matter may be absorbed by the roots, its qualities are matured by the influences of various fluids imbibed from the air.

That the juices of trees become concreted, or concentrated, in the first formed layers of both the wood and the bark, is very evident from the greater hardness, compactness, and ponderosity of the heart-wood, and which is easily proved by the process of maceration in a proper menstruum. By this means, colour, virtues, and the pulpy and cellular constituents of the hardest woods are completely banished, leaving only the fibrous skeleton to indicate the original form. This art of extracting colour is well known to the manufacturers of ornamental articles of household furniture, who, by the use of mordicants, can easily give variety to the graining of their polished goods.

In treating of the sap of trees it should not be forgotten to mention one circumstance relative to its spring movement, which is unknown, or, if known, is incomprehensible to many observers. The root is the grand inlet of the sap; and it is natural to suppose that its spring movement would commence at that source of supply; but the contrary is the case. The sap is first liquified, and in motion at the topmost branches of the tree, and long before any motion at all is perceivable at the bottom of the trunk. And indeed when duly considered it cannot be otherwise. The whole superior parts of the system may easily be conceived to be replete with sap, coagulated there by the cold of winter; every vessel and intercellular passage is clogged up, and therefore the fluids in the roots cannot ascend. But soon as the increasing warmth of spring liquifies the sap above, and the bursting buds begin to crave supplies, a movement in the proximate vessels begins, and a flow is *generated downwards*, until the whole, that in the roots also, is in full flow.

But it may be said, as this is an invisible process, how is the true movement known? We answer, by a very common and well known practice of the woodman, called bark-peeling. This business is performed in the spring of the year, and is commenced as soon as the bark parts easily from the wood. But it often happens that the top is partly clothed in green before the bark at the bottom of the trunk will run; and neither felling nor peeling can be performed till the butt can be stripped, because that is the most valuable portion.

This fact of the motion of the sap beginning at the top of the tree, is an unanswerable argument against those who believe that the whole body of sap in the head sinks down into the roots in winter. For if this were really the case, the flow of sap would commence at the root, and not at the top.

This autumnal descent of the sap into the roots is somewhat akin to the "circulation of the sap," maintained as a fact by so many phylologists, both ancient and modern. Soon as the circulation of the blood in animals was discovered, the circulation of the sap in vegetables was supposed to be carried on by a similar law. But as no circulating apparatus could be observed in the interior of plants, the notion was soon abandoned, though there are still a few modern philosophers who strive hard to bolster up the old doctrine, but without success. They yield the idea of a regular circulation; but they cling to the supposition that there is a regular *descent* of the sap as well as a constant ascent. It must be admitted that there are a few practical facts which support, if not the circulation, at least the probability of a descent of this fluid. These facts are, that if a variegated jasmine be budded upon a common green one, the suckers which afterwards rise from the root of the latter will be variegated also; a result which could not happen unless some connexion existed between the variegated graft and the green root. The same circumstance sometimes occurs among the cultivated tribe of hollies.

But if it be allowed that there is a diffusion of the sap in all directions; and if we admit the general opinion that the variegation of foliage is only a disease, we may easily conceive that a casual intermixture of the sap would be sufficient to convey the disease to the suckers. For though the sap be in itself incapable of generating organs in the vegetable system, it may reasonably be deemed capable of transmitting colour.

OF THE ACCLIMATATION OF PLANTS.

Exotic plants, natives of the tropics or the warm parts of the temperate zones, are naturally impatient of cold, and particularly of frost; but as we wish to enrich our collections by the introduction of every ornamental plant that will live in our northern climate, we endeavour to inure the tender beauties of the south by degrees to withstand the cold of our long winter nights, which management is called *acclimatation*.

The first steps are, exposing them as early in the spring, and as late in the autumn, as may be done with perfect safety; or covering them when necessary in winter, and decreasing the covering year after year, until they gain sufficient hardihood to bear all the rigours of our winter. These precautions are always taken in proving whether valuable plants be constitutionally hardy enough to bear a greater degree of cold than they were exposed to in their native habitation; for it is a doubtful matter whether a change of place will so affect a plant as to render its sap and membranes less susceptible of injury from cold merely by gradually exposing it to greater degrees of it. It is true that many plants formerly kept in the greenhouse and even in the stove are now planted in the open air. For instance, the Aucuba was treated as a hot-house plant in 1790, but is now one of our hardiest evergreens; and, no doubt, was equally hardy from the first day of its introduction into Europe. For, on the other hand, we have several exotics which have been in our gardens for nearly two centuries, and are still as tender as they were at first: the potatoe and scarlet-runner-bean are examples.

We may however observe, that inuring a plant to a cold open situation renders it less liable to be hurt by frost than if it had a warmer sheltered place. Plants, even exotics, standing in a northern aspect are always hardier than those exposed to the south. But this is not altogether because the plant becomes more hardy, but because having received less excitement from the sun, it is in a better condition to bear a severe trial. It seems, therefore, that, in the practice of acclimatising plants, placing them in a north aspect during summer is better than placing them, as is usual, in a south exposure in the first year of trial. A north aspect induces a more moderate, or what may be called a more stunted habit; and, consequently the growth, whatever it may be, is of a firmer and more robust texture than if it had been cherished under warmer skies.

The effects of frost too, are locally more or less severe. It always falls with more severity on the plants in the warm sheltered valley, than on those on the bleak hill. Not only because the latter are more hardy, but because they are assailed by frost of less intensity than that which attacks the luxuriant inmates of the humid valley.

All plants are more or less *seasonal:* that is, they grow in one season and rest in another; not, however, according to the calendar, but to their constitutional habits. Between the tropics the warmest season is that in which the native plants take their rest; the herbaceous sorts retire within the surface of the parched earth, and safely repose in the centre of their bulbs, or tubers, or seeds; the shrubs and trees ripen and shed their seeds; all vegetation is in a state of languor, until the *monsoon*, or rainy season sets in. In those torrid climes there are a few exceptions to this rule: their indigenous palms seem to be *ever-growing* plants; as it is observable of them and other congenerous genera, that they are ever progressing in evolving their fronds, and yielding their fruit.

In the temperate latitudes the seasons of summer and winter are more distinctly marked, not only by the change of temperature, but by the appearance and habits of plants. The latter are for the most part all alive in the one season and dormant in the other. And yet in our collections we have many plants which do not obey the impulse of summer, nor the repressions of winter. On the contrary, they are summer sleeping plants; retiring, like their tropical congeners, under ground, until the autumnal rains awake them again to life. These are chiefly bulbs and tubers; and which, resting in summer, are prepared for expansion during winter and the following spring.

With respect to the seasonal habits of plants, and which differ so much from each other under the same atmospheric influences, no good reason can be assigned; and yet, we are fully persuaded that none of these obscure circumstances are exhibited in their evolutions, but are somehow or other necessary to their well-being and reproduction.

It is well known that flowers of very *attenuated structure* are liable to injury, and even destruction from *bright sunshine*, even more, perhaps, than from keen frost. Some flowers expand only in the twilight, or during night, or early in the morning. The evening primrose (*Eonothera*), the great-flowering cereus, and the convolvulus major, are instances of these peculiarities. And in thus obeying a law of nature, we must conclude that this vegetable instinct is a preservative phenomenon. Many of our choicest fruit trees present their flowers early in the season; and probably because a moderate temperature is most suitable for their perfect development.

OF THE COLOUR OF PLANTS.

To account for the various colours of the different members of plants has very much engaged the attention of natural philosophers. It is found that the membranes of plants are invariably colourless, and that it is the qualities of their juices which acquire colour, from the action of the rays of light from the sun. This contained coloured juice is called the *chromule;* and if this be small in quantity, the leaves are pale, or if absent in patches, they are variegated.

There is a double series of the colours of flowers, and which are said to be *oxidated* and de-oxidated: the first is yellow, which passes into red and white, but never into blue; the second blue, which passes into red and white, but never into yellow. It is this law of the transmutation of colours of flowers which induced M. De Candolle to declare, that we should never have a blue dahlia. In the process, says the same authority, of oxidation, we have yellow-green, yellow, orange-yellow, orange, orange-red, red. And in the process of de-oxidation, we have green-blue, blue, violet-blue, violet, violet-red, and red. All these, and other modifications of the chromule, occasioned by the degree of its oxidation, are the cause of the great diversity of colour in the different members of plants.

The colours of flowers are subject to changes, and sometimes so suddenly as to show three different tints in the course of one day; the *Hibiscus mutabilis* is an instance. The natural colours may be changed by the qualities of certain soils or manures laid to their roots; and is an art particularly studied by florists. Indeed to the highly manured composts used for bed and stage flowers, and to their being cultivated in such close order, are to be attributed the vast variety of colours exhibited in the beds of ranunculus, tulips, &c.

The varying tints of the foliage, from light to dark green, and to yellow, brown, and red, in the autumn, is remarkable, and owing, it is supposed, to a change in the composition of their primary principles, accompanied with loss of water.

OF THE DISEASES AND FINAL DECAY OF PLANTS.

Vegetables of every description are liable to disease, to wounds, and eventually death itself. Some diseases as the *canker*, which destroys the bark and deranges the organization of the shoots, is usually attributed to the imbibition of noxious fluids by the roots in unsuitable soils. The oxides of metals, such as iron, so frequent in some sorts of clay, are known to be exceedingly deleterious to many sorts of plants. But the most common diseases of herbs, shrubs, and trees, are caused by parasitic fungi or insects. The parasites are mildew, rust, and numerous other fungi, lichens, and mosses. They are also preyed on by a numerous host of insects, which destroy leaves, flowers, and fruit; blighting the hopes of the husbandman, and blasting the fairest prospect of the gardener. Nor are botanical collections free from the annoyance of some of the smallest, though most pernicious of the insect tribes.

Plants are also subject to the inclemencies of the weather; the sun scorches, and the frosts lacerate; droughts wither, and immoderate rain saddens.

The existence of plants includes very different portions of time. Some spring up and die in a few weeks or months: others survive for nearly two years, and many exist for centuries. The first are herbaceous annuals; the second are biennials; and the last are perennials.

There seems, however, to be no limit to the life of any perennial plant, did not other causes assist in their destruction. Natural decay begins at the centre of the trunk; and the defect extends year after year towards the circumference, and at a quicker rate than new layers of wood and bark are deposited on the outside, where the vitality is still in action. At last the massive trunk is reduced to a mere shell; and then the ruthless storm assails the hollow tree and lays it prostrate. All the aged trees which we see and read of, are hollow; and those which have been shreded as pollards, remain longer entire, because they have no lofty branches which the wind has power to disrupt and tear off.

But there is another description of plants, which may be described. They are those which although ranked among perennials, and continuing to grow for many years, have only a limited period of existence; and, unlike other plants, do not increase themselves by any other mode than by seed. In fact they are *individuals* in the strictest sense of the term. They have no suckers, no buds, no branches; but consist of a stem and fronds only, and a central or terminal fructification; which when developed, and the seeds are ripened, the roots, stem, and fronds, together with the fructifying members, die. This character of vegetables is exemplified in few instances; we see divisions of plants, as the house leek *(sempervivium)*, American aloe *(agave)*, and several others (which are not annuals) perish as soon as their fructing is complete: the maturation of seed being the final effort of the plant, or of one of its divisions. We say of one of its divisions; because compound plants, consist of several parts or branches; these are all consecutively approaching to the flowering state. The first or strongest flowers and dies; followed by the second and third in order; while a succession of young buds or branches are produced from the collet or crown of the root. But this compound structure is very different from the structure of those which we call *individual* plants, such as the *talipot* palm (*corypha umbraculifera*), which flowers but once. This has no progeny except seeds; but these are produced in such great quantity, that, at the death of the lofty parent, thousands of seminal progeny strew the ground far around the spot where the parent grew.

This is an admirable provision of nature, which gives to a plant but *one* way of reproducing itself, and *that* way so wonderfully prolific. Those plants which are constantly increasing themselves by off-sets and runners, or by branches leaning upon the ground, are seldom burdened with seed; but in the case of the palm alluded to, which has neither suckers nor other division, from which art or accident can rear another, it produces at once seed enough to establish an extensive forest of seedlings around. It is reported of this palm, that the scent of its numerous flowers is so overpowering, that the Cingalese inhabitants, living near the talipot palms, cut them down before flowering to prevent the annoyance of their rank aroma.

A BRIEF HISTORY OF THE SCIENCE OF BOTANY.

The preceding sections comprise the more prominent parts of phytological knowledge, which have been collected by the experience, and recorded by the assiduous care of former Botanists. And on taking a retrospective glance over those early times, when the science had as yet no place in the schools, it is interesting to see from what small beginnings the love, and study, and classification of plants, first took their rise.

The first writer of note who treated of vegetation, of the origin and propagation of plants, of their anatomy and structure, and of vegetable life was Theophrastus the Lesbian, who was the disciple of Aristotle, and flourished in the third century before the Christian era. He describes only about five hundred plants; these he has arranged by a method which, however unsystematical, was well suited to the then state of knowledge. He distributes vegetables into seven primary divisions, which are characterised by their place of growth; their size, as trees or shrubs; their use, as potherbs and esculent grain, and their lactescence. This was the short and very imperfect arrangement of Theophrastus, who however is called the father of Botany.

The next botanical writer of repute was the indefatigable Dioscorides, a Grecian by birth, but under the Roman empire. He made a catalogue of all the plants known in Greece, and the adjacent countries; together with their known virtues and economical uses. Although Dioscorides lived four hundred years after the time at which Theophrastus wrote, it is remarkable that he has not added more than about one hundred plants to the former list. Dioscorides arranged his six hundred plants into four classes, namely, alimentary, aromatic, medicinal, and vinous.

This method of classification could not be useful, because the characters were not impressed on their exterior, neither does every part of a plant contain the same qualities; those of the root being often very different from the qualities of the leaves, and these not being objects of sight would prevent the identification of the species.

Nearly cotemporary with Dioscorides flourished the still well known authors Antonius Musa, Cato, Varro, Virgil, and Columella. The two last eminent as agricultural writers; and whose works even on such subjects are still valuable.

Pliny the elder in his natural history, transcribes the lists of plants of both Theophrastus and Dioscorides, together with the names of several new plants which his industry had enabled him to glean from those who were probably not authors. His arrangement is the most ancient one of trees, shrubs, and herbs; and although no botanist, is notwithstanding a useful writer. His catalogue of plants contains above a thousand names; being double the number of those described by Theophrastus.

Galen, so celebrated in medicine, with several other minor writers on the medical virtues of plants, comes next on the stage of botanical history. Galen's plants are more interesting to the student of pharmacy than to the Botanist; and indeed from the time of Pliny, the knowledge, the very limited knowledge of the ancients on this science seemed to have declined, rather than advanced. Systematic botany rational principles had not yet occurred to any one; and all that was done in those barbarous times were only a few translations; and though the names of De Dondis, Bosco, and Cresentius, figure as botanical writers in the fourteenth and fifteenth centuries, they made but little progress in the science. They wrote of plants indeed, but without method, and without knowledge. All was one great chaos; and that man would have undertaken an Herculean task who would have tried to put such materials into order.

In the beginning of the sixteenth century, the Botany of the ancients was restored by some excellent translations, enriched by the commentaries of Fuchsius, Ruellius, Gesner, and Matthiolus. Soon after followed Hieronymus Bock, better known by the name of Tragus, the first of the moderns who attempted a methodical distribution of vegetables. In his history of plants, published in 1532, he divides the eight hundred species there described into three classes only, "founded on the qualities of vegetables, their habits, figure, and size." At this period Lonicer, Dodonæus, L'Obel, Clussius, Brunsfelsius, Monardus, and some others were botanical writers; but their distinctions were not superior to those of Tragus. And were it not that their names are handed down to their posterity, by the plants named in honour of them by succeeding Botanists, their memory would have at this time been quite forgotten.

Botany was in this unsettled and unsystematic state, when Conrad Gesner suggested the first idea of a systematic arrangement of plants. He was a Swiss by birth, and his mind partook of the varied and lofty features of his country. He was soon sensible of the imperfections of every plan of arrangement which had been previously adopted. He saw (what had been overlooked before), that the flower and fruit were the most noble parts of the plant, as well for ornament, as for their functions of reproduction; and he also saw that there was generally a similarity of the several members of flowers, and a general purpose indicated by the seed-vessel, whatever might be its external form or internal arrangement.

It was in 1560 that Gesner, fully convinced of the sufficiency of the permanent characters of the flower and fruit, submitted his idea of an arrangement founded on these organs. He sketched no plan himself; but his idea was not lost, for in 1583, Dr. Andrew Cæsalpinus, a physician of Pisa, and afterwards Professor of Botany at Padua, embracing the idea of Gesner, proposed a scheme of arrangement which has the fruit for its basis. This was the first attempt at systematic botany, and from which all other systems may be said to have taken their rise.

But it was soon discovered that the plan of Cæsalpinus was inconvenient in botanical research. Much precious time was lost in waiting for the maturity of this organ; and all barren plants, especially exotics, which seldom ripen their fruit, would have to remain as nondescripts. "In summer, when plants are in their highest perfection, and the blooming face of nature invites to these innocent and pleasing enquiries, the student who would attain a knowledge of vegetables must not think of deriving it from a method founded on the fruit. Such a method will prove an insurmountable obstacle in his way; the season invites in vain; in vain does inclination lend her powerful assistance; he cannot advance a single step; he becomes chagrined, and probably abandons it in disgust." (*Bot. Lect.*)

In methods founded on the flower, no inconvenience of this kind can exist. The class is mostly determined by that part of the flower which furnishes the leading character; and it often happens that the fruit, though invisible, may be determined from some of the other parts of the flower already developed.

It was upwards of a century after the days of Cæsalpinus, the father of system, that Rivinus, of Leipsic, produced another revolution in the science, by proposing a method founded on the regularity and number of the petals. Thus, it appears that systematic Botany did not all at once attain that degree of purity and perfection to which it has at this day arrived for many systems perished soon after they were projected: with Cæsalpinus died his plan of arrangement; and about a century afterwards Dr. Robert Morison, of Aberdeen, availing himself of the ideas of Cæsalpinus and the learned Rivinus, re-established scientific arrangements on a more solid foundation; and, instead of restorer, has been honoured as the founder of their systems.

Between Cæsalpinus and Morison many celebrated writers assisted to improve the science, and extend the knowledge of Botany. Among these we find Dalechamp, Tabernæmontanus, Porta, Prosper Alpinus, Fabius Columna, two Bauhins, Gerrard, Parkinson, Marcgrave, Hernandez, Passæus, Aldrovandus, and Rheede, author of the *Hortus Malabaricus.*

Morison's Botany was not long in repute, and was only adopted by one subsequent Botanist, namely, Bobart, who in 1699 completed Morison's History of Plants, assisted by Dr. Blair, who wrote some botanical essays. Imperfect as his system was, it furnished many useful hints to Ray and Tournefort as well as to Linnæus. Ray published his first work in 1682, and a much improved edition in 1700. He adopted Tournefort's characters of the genera, wherever his plan would permit. His general history of plants contains descriptions of 18,655 species and varieties. He was followed by Sir Hans Sloane, in his Natural History of Jamacia; by Petiver, in his British Herbal; by Dillenius, in his Synopsis of British plants; and by Martyn, in his Cambridge catalogue.

A cotemporary of Ray, a German of the name of Knaut, endeavoured to improve Ray's system, as Linnæus said, by inverting it; but without much success: he made many alterations but few improvements.

Another cotemporary, Dr. Hermann, Professor of Botany at Leyden, was more successful than Knaut. As a traveller in India, and at his station in Leyden, he not only added a great many new plants to the Leyden garden, but aware of the difficulties and inconsistencies of existing systems, made many valuable corrections and real improvements in systematic botany. He was followed by Rubbeckius the younger: and he(Hermann),seeing imperfections still lurking in his own scheme, set about revising it, when death put an end to his labours. He was succeeded by the celebrated Boerhaave, who was no less solicitous for the enrichment of the Leyden garden, and the interests and advancement of Botany, than his predecessor Hermann had been. He arranged near 6,000 plants, cultivated in the Leyden garden, which he superintended for twenty years, and left it in the highest order to his successor, Dr. Adrien Royen.

From the foregoing brief notices of the progress of Botany, and of the authors who treated of it as a science, it is evident that every writer had the ambition of sketching a new system for himself: and certainly from the time of Cæsalpinus to that of Linnæus many systems were projected which are now forgotten. And being no longer considered as legitimate science we have abstained from noticing many, or indeed any of them in detail. But as we are approaching a brighter era, and as Tournefort was one of these systematists who compressed into his own system several of the excellencies of his cotemporaries and predecessors, we may take a brief view of his system as an anticipation of that far more popular one which will be detailed in the sequel.

SYSTEMATIC BOTANY.

The vegetable kingdom comprises such a vast number of plants, that it is absolutely necessary that some plan of arrangement should be invented to collect into masses the many different tribes, in order to facilitate its study, and render more easy of acquisition a knowledge of the nature and virtues of the various products of the earth, which are proved to be, for the most part, so serviceable to man.

Plants appear to be naturally divided into three apparently distinct classes, namely, trees, shrubs, and herbs. We say apparently distinct, because there is really no well marked boundary betwixt trees and shrubs. A thriving shrub, growing in a luxuriant soil, is only a small tree, and vice versâ. And moreover there are many shrubs aud even herbs, which by their enflorescence and also by their inherent qualities, rank with the largest trees. These classes are therefore reducible to two only, namely, trees and herbs; and these are sufficiently distinct, not only from the texture of their stems, but also by the difference in their magnitude and durability.

Plants, however, are naturally divided into genera and species. The first are families; the second are the individuals of the families. Again, there are affinities among the families, which when associated together are called groups. And, on the other hand, the species leave their specific character and degenerate into varieties.

The great diversity of structure, of outward port, and constitutional peculiarities exhibited by plants, have been the cause of so many systems of classification having been propounded, to give the science something like a fixed character. But as neither the laws for identifying generic nor specific characters were previously fixed or universally understood, scarcely two systematists have hit upon or adopted the same marks of distinction. The greater or more striking features of vegetation were admitted by all; but in the details of classification much difference of opinion prevailed, which will appear by a comparison of the three systems about to be adverted to.

SYSTEM OF TOURNEFORT.

This was invented by Joseph Pitton de Tournefort, a French Botanist, and was studied along with that of our countryman Ray, until both were superseded by the Linnæan system. Tournefort's system had a good deal of originality about it; and was at least ingenious. His method is founded on the presence, situation, figure, proportion, or absence of the corolla. This being the most imposing member of the flower, though no other is more liable to incidental variations, led almost all the earlier Botanists, as well as Tournefort himself, to give it an undue preference in the classification. On this score, therefore, it was to be regretted that he fixed on the corolla as a basis for his system. But still the plan was valuable, as it very much assisted succeeding authors in the formation of their systems.

He divided the vegetable kingdom into two grand divisions, namely, first, all such plants as are herbs; and, second, all those which are denominated shrubs and trees. These together are divided into twenty-two classes: the first seventeen of which are herbs, and the other five contain trees and shrubs: these are again subdivided into one hundred and nineteen orders, but without proper names being applied to them. The characters of the orders are not always correct, as the distinguishing parts are not always present at the same time.

These anomalies rendered his system by no means convenient for the ready identification of new plants: but, notwithstanding this defect, it enabled him to bring together several of the *natural orders,* a result which was duly appreciated by his great successor, Linnæus, as well as by the equally great Jussieu, in his arrangement of the natural orders. In this light, Tournefort will always be respected as a Botanist who began a reformation which was reserved for Jussieu and his followers to complete.

As the greater part of his system is now almost exploded, it will be unnecessary to occupy our pages with obsolete matter: and, therefore, we shall confine ourselves to the numbers and names of his classes, to show his scheme, and to prove that it was really the origin of the Jussieuan system.

DIVISION I.—HERBS.

CLASS I.—CAMPANIFORMES.

Herbs having a simple, regular, bell-shaped monopetalous corolla. This class contains nine sections. We omit giving the genera, because some of them are doubtfully or mistakingly placed.

CLASS II.—INFUNDIBULIFORMES.

Herbs having a simple regular funnel, salver, or cup-shaped monopetalous corolla. This class contains eight sections.

CLASS III.—PERSONATÆ.

Herbs having masked flowers, simple, monopetalous, and irregular: the seeds contained in a pericarpium. This class contains five sections.

CLASS IV.—LABIATÆ.

Herbs having lipped flowers, simple, monopetalous, and irregular: the seeds four, attached to the bottom of the persisting calyx. The sections of this class are four.

CLASS V.—CRUCIFORMES.

Herbs with cross-shaped flowers, simple, tetrapetalous, and mostly regular: the fruit a siliqua or a silicula. This class has ninc sections.

CLASS VI.—ROSACEI.

Herbs having flowers resembling the rose, simple and regular, with from five to an indeterminate number of petals. This class contains ten sections.

CLASS VII.—UMBELLATÆ.

Herbs having their flowers disposed in an umbel, simple, pentapetalous, regular, and having two naked seeds attached to each other. The sections of this class are nine.

CLASS VIII.—CARYOPHYLLEI.

Herbs having flowers resembling the pink, simple, pentapetalous, regular: the claws of the petals long, and attached to the bottom of a monophyllus calyx,—The sections of this class are two.

CLASS IX.—LILIACEI.

Herbs having flowers resembling the lily, simple, regular, monopetalous, with the limb deeply divided into six segments, tripetalous or hexapetalous: the seeds contained in a capsule of three loculaments. This class contains five sections.

CLASS X.—PAPILIONACEI.

Herbs with butterfly-shaped flowers, simple, polypetalous, the fruit a legumen.—This class contains five sections.

CLASS XI.—ANOMALÆ.

Herbs having simple, polypetalous, irregular flowers, which do not conveniently arrange themselves in any of the other of these classes. The sections of these classes are three.

CLASS XII.—FLOSCULOSI.

Herbs with composite flowers, consisting of many tubulose, monopetalous florets, placed on a common receptacle: the stamens united by the anthers in the second, third, and fourth sections. This class contains five sections.

CLASS XII.—SEMIFLOSCULOSI.

Herbs having composite flowers, consisting of many monopetalous, ligulate corollets, placed on a common receptacle, the stamens united by the anthers. The sections of this class are two.

CLASS XIV.—RADIATI.

Herbs having compound flowers, consisting of many monopetalous corrollets placed on a common receptacle: the florets of the disk tubulose, of the margin ligulate. The sections of this class are five.

CLASS XV.—APETALÆ.

Herbs having stamens and pistils but no corolla, the calyx being the only part that envelopes these organs. The sections of this class are six.

CLASS XVI.—APETALÆ ET AFLORES.

Herbs having neither stamens nor pistils but only seeds on the backs of their leaves. This class contains two sections.

CLASS XVII.—APETALÆ ET AFLORES ET ACARPII.

Herbs having neither flowers nor apparent seeds. This class contains only two sections, and includes the mosses and fungi, as well as the algæ, and *polypi,* which the author believed to be vegetables.

DIVISION II.—TREES AND SHRUBS.

CLASS XVIII.—APETALÆ.

Trees and shrubs having stamens and pistils, but no corolla. This class contains three sections.

CLASS XIX.—AMENTACEÆ.

Trees and shrubs having their male flowers, and some of their female flowers also, disposed in an amentum. This class contains six sections.

CLASS XX.—MONAPETALÆ.

Trees and shrubs having monopetalous, campanulate, or infundibuliform flowers. This class contains seven sections.

CLASS XXI.—ROSACEI.

Trees and shrubs having rosacious polypetalous flowers. The sections of this class are nine.

CLASS XXII.—PAPILIONACEI.

Trees and shrubs having papilionaceous flowers, and legumenous fruits. This class contains three sections.

LINNÆAN CLASSIFICATION.

From the above faintly traced outline of the classification of Tournefort, it may be observed, that it was, in fact, the *embryo* of the natural system, sketched afterwards by the profound genius of its author. Tournefort was more fortunate in fixing the character of his classes than in arranging his orders under them ; and seems to have been guided more by the outward semblance of plants than by their internal and structural affinities.

But a day was approaching when the ingenious system of Tournefort, with all those of his predecessors and cotemporaries, were to be discarded and forgotten ; and all the accumulated systematic knowledge of Botany—the results of ages of study, were to pass away like a morning cloud. A rising genius was then appearing on the horizon, who was destined to shed a brighter and more interesting light on the vegetable kingdom than had before illumined it.

A belief in the sexuality of plants had been gaining ground from a very remote period; and about the birth of Linnæus was very partially credited, and soon after demonstrated as a certain fact, by the experiments of that great naturalist himself.

As sexual distinction was most striking and definite among animals; and as his own experience showed that the sexes were even existent on separate plants, and always existed separately on the same plant, it occurred to his vivid imagination, whether or not these sexual distinctions would form a basis for a new system of Botany.

We may easily conceive that while this idea was expanding in his mind: and when the prospect opened to him of how easily by the simple enumeration or position of the male and female parts of a flower, plants could be arranged into classes and orders, he must have enjoyed much mental pleasure and gratification. And besides, Linnæus could perceive that when he could mature and publish his new system, it would be received with eagerness, not only among practical, but among amateur Botanists; because no great stock of previous knowledge was required, nor any irksome labour enjoined. His classes and orders, being for the most part numerical, were easily acquired; and their signification readily comprehended.

Whether or not he felt such impressions—it must have been a source of the utmost satisfaction to him to witness how readily his new system was embraced in almost every part of the civilized world. The very circumstance (the sexuality of plants) not being everywhere known at the time gave an additional motive and impulse to inquiring minds, especially when the acquisition of scientific Botany was to be attained with so little mental fatigue.

The sexual system, as that now under consideration is sometimes called, was certainly the most simple *artificial* method that could be invented for gaining an adequate knowledge of plants. For artificial it decidedly is, as was acknowledged by its author, Linnæus, himself. For before his death he had made some progress in forming a *natural arrangement*, which has been completed, as far as possible, by his successors. But, as his sexual system is still valued, and considered by many eminent men as an inviting and pleasing *threshold* to the science, * it

* "The experience of nearly an hundred years has proved to every unprejudiced mind, that no system has appeared, which can be compared to that of the immortal Swede, for the facility with which it enables any one, hitherto unpractised in Botany, to arrive at a knowledge of the genus and species of a plant."—*Sir W. J. Hooker.*

would be a serious defect in this our little work did we not present a faithful outline of the system of Linnæus.

Excellence is only appreciated by comparison, and the value of any ulterior scheme of classification already made, or to be made, will only be esteemed by comparing it with what has passed, or is passing away.

The Linnæan system is founded on the number, proportion, and situation of the stamens, the male parts of the flower, and the pistils, which are the female organs of the flower; and consists of twenty-four classes, of which twenty-three are flowering plants, and the twenty-fourth is flowerless, or at least has no conspicuous flowers. To each of these classes an indeterminate number of orders belong, and are arranged as follow:—

DIVISION I.—FLOWERING PLANTS.

CLASS I.—MONANDRIA.*

Bissexual flowers having *one* stamen, and containing two orders.

Order I.—*Monogynia*.—Flowers having *one* style or pistil. Examples of Genera herein in-

* The termination andria (*aner*) is the male sign, and gynia (*gyne*), the female.

cluded, Canna, Hedychium, Alpinia, Hippuris, or Mare's-tail, &c. This order contains many beautiful, and several useful exotic plants; of the Genera, four are indigenous to Britain, namely— Centranthus, salicornia (glasswort), tostera (wrackgrass), and hippuris (mare's-tail. We have chosen the mare's-tail for an illustration of this class, *Pl.* 2 ; *a*, flower magnified ; *b*, rooting portion of the stem. This is one of the most simple among perfect plants. It is believed that it renders great service as a purifier of the putrid air of marshes, by absorbing great quantities of inflammable air.

Periantheum inconspicuous; *Stamen*, a simple filament placed close to the germen, bearing a roundish anther of two lobes. Style filiform, simple ; Fruit an achenium with a fleshy albumen.

ORDER II.—*Digynia.*—Flowers having *two* styles. This order contains seven genera already described in books ; among which the callitriche (water starwort) is common in British ditches.

CLASS II.—DIANDRIA.

Bisexual flowers having *two* stamens, and containing three orders.

ORDER I.— *Monogynia.*—Flowers having *one* ſtyle. This order contains a great many genera, some of which have numerous species. Among

the genera we find the olive, the privet, lilac, and well known jasmine; and of one of the species of the genus veronica, we have given an illustration, (*v. chamædrys*), which was formerly used by physicians, in disorders of the lungs, *Pl.* 3; *a*, ripe ovary and calyx. The extensive genus salvia belongs to this order, but it is thought improperly, because it is diandrous by abortion, the lower pair of the stamens being absent.

Generic character. — *Calyx*, four to five parted; *Corolla*, somewhat rotate of four lobes, the fourth narrow (rarely tubular or gaping); *Stamens*, two inserted into the throat of the corolla; *Style*, thread-shape; *Stigma*, round; *Capsula*, two-celled, inversely heart-shaped, many-seeded.

ORDER II.—*Digynia.*—Flowers having *two* styles. This order comprises only three genera of grasses, chiefly natives of Europe. Among them, one is the sweet scented spring grass (anthoxanthum odoratum), which is supposed to impart the delightful aroma to new hay.

ORDER III.— *Trigynia.*—Diandrous flowers, but furnished with *three* styles. This order contains only two genera very nearly allied in qualities, namely, the pepper (piper), and peperomia. They are both natives of the East and West Indies. The first being one of our most important articles of commerce, and universally used as a spice.

CLASS III.—TRIANDRIA.

Flowers having *three* stamens, and divided into three orders.

ORDER I.—*Monogynia.*—Bisexual flowers having *one* style. This is a very large order, and contains a vast number of beautiful species. Almost all the splendid flowering Cape of Good Hope bulbs are included here. The ixias, trichonemas, tritonias, gladeolusis, iriscis, &c., are a few of the most esteemed. Our more familiar, and no less engaging crocus is worthily ranked in this order; an examination of the flower of which will convey a good idea of the general structure of the others. This class we have illustrated by the spring crocus (*c. vernus*), *Pl.* 4; *a*, anther; *b*, pistil; *c*, roots and tuber.

This pretty flower is one of the first to make its appearance in the spring, and is a great enlivener of the parterre from February to April, and may indeed be said to be the herald of Flora's richly garnished train.

> Say, what impels, amidst surrounding snow
> Congealed, the crocus yellow bud to blow?
> Say, what rctards, amidst the summer blaze,
> The autumnal bulb, till pale, declining days?
> The God of scasons—whose pervading power
> Controls the sun, or sheds the fleecy shower;
> He bids each flower his quickening word obey,
> Or to cach lingering bloom enjoins delay.
>
> WHITE.

There are many varieties of the spring crocus, of which the purple is the most beautiful, though the yellow have a more showy appearance in the garden. It is a native of Italy and Spain, and is found growing wild, with petals slightly tinged with purple at the base, in some parts of Switzerland.

Generic characters. — *C.* *Spatha* of one leaf; *Corolla,* tube very long, limb regularly six-cleft; *Stamens,* inserted into the corolla, bearing erect arrow-shaped anthers; *Style,* filiform, bearing a three-parted dilated stigma; *Capsula,* three-celled, many-seeded; *Seeds,* somewhat globular.

Order II.—*Digynia.*—Triandrous flowers having *two* styles. This is also a large order, and contains a principal part of the useful family of the grasses, from the invaluable wheat, down to the puny hair-grass; and from the nutritious sugar-cane, down to the no less wholesome millet. It is, perhaps, the most important order of plants to be found in the vegetable kingdom.

Order III.—*Trigynia.*—Triandrous flowers having *three* styles. This order contains above twelve genera, consisting of annuals, several of which are aquatics, and perennials; all of which are small, and, except to the Botanist, worthless plants.

CLASS IV.—TETRANDRIA.

Flowers having *four* stamens of equal length, separated into four orders.

Order I.—*Monogynia.*—Tetrandrous flowers having *one* style. This order is notable for containing a great number of highly ornamental shrubs, chiefly from New Holland and the Cape of Good Hope. Among these, the banksias, proteas, and warratah (telopea), are pre-eminent. There are also many fine herbaceous genera. From among these last, we have figured one of the most common British plants to give an idea of a tetrandrous flower, *Pl. 5*, the greater plantain (*p. major*), *a*, is a flower magnified; *b*, ovary when fully ripe; *c*, ovary cut perpendicularly with the pistil attached, showing the seeds upon the centre receptacle.

This is a very common plant in England, and its seeds are favourite food for linnets, finches, and many other of our smaller birds, and its leaves are much esteemed for their virtues when applied to wounds.

Generic characters.—*Plantago.*—Flowers in spikes or heads; *Calyx*, four-cleft; *Corolla*, superior, rotate, in four parts, persisting; *Stamens*, elongated; *Style*, simple; *Capsula*, cut round, two-celled, from two to four seeded.

Order II.—*Digynia.*—Tetrandrous flowers having *two* styles. This order contains only four genera as appears by the latest published lists. The witch-hazel (hamamelis), a North American deciduous tree, belongs to this order: the others are inconspicuous plants.

Order III.—*Tetragynia.*—This order contains tetrandrous flowers having *four* styles. It appearing that Linnæus discovered no tetrandrous flower having three styles.

The principal genera of this order are the well known holly (ilex), a British tree, and the equally common pond-weed (potamageton), also a native of this country. A few other British annuals, as the pearlwort (sagina), and the all-seed (radiola), also belong to this order.

CLASS V.—PENTANDRIA.

This extensive class associates all flowers having *five* stamens, and is divided into six orders.

ORDER I.—*Monogynia.*—Contains pentandrous flowers having *one* style. This is one of the largest orders in the sexual system, and consists of every description of tree, shrub, and herb, natives of every quarter of the globe. Here are lofty timber trees, useful fruits and drugs, and flowering plants of matchless beauty. We may name a few of the genera to show the importance of this class and order to Botanists, and to mankind in general. Mirabilis, heliotropium, primula, cyclamen, dodecatheon, phlox, brugmansia, ipomæa, convolvulus, epacris, azalia, plumieria, solandra, solanum, portlandia, campanula, lobelia, caprifolium, gardenia, vitis, viola, ribes, heliconia, strelitzia, musa, &c.

ORDER II.—*Digynia.*—Pentandrous flowers having *two* styles. This is also a large order, and contains many useful herbaceous plants as well as handsome flowers. We have figured one of the species of a very interesting genus; namely, dwarf gentian, (*gacaulis*), *Pl.* 6; *a*, a portion of the corolla with the five stamens; *b*, pistil.

This is termed gentiana acaulis, that is, stemless gentian, because in its natural state, it has no stalk; by cultivation, however, it is made to throw up its corolla on a kind of stem. "This is the species best known and most admired in the garden, on account of the brilliancy of its blue, which is equal to the finest of the metallic blues. The corolla is very large for the size of the plant, therefore it has a fine effect when planted in large clusters; and it demands admiration when viewed singly, as the lower part of the interior of the campanula of the flower forms a fine spotted yellowish star on the rich azure blue ground of the five expanding segments of the corolla, whilst the exterior of the bell is of reddish purple, or deep lilac."—PHILLIPS.

Generic characters.—*Gentiana.*—*Calyx,* bell-shaped, four or five cleft; *Corolla,* somewhat bell-shaped, four to five cleft, the throat naked or bearded; *Stamens,* inserted into the tube of the corolla; *Styles,* at first connate, afterward separate, bearing obtuse stigmas; *Capsula,* one-celled, with two valves at the apex; *Seeds,* emarginate.


a
b

Order III.—*Trigynia.*—Contains all pentandrous flowers having *three* pistils. Here are brought together some fine ornamental and useful shrubs, as the viburnum, rhees, &c., as some economical and medical herbs.

Order IV.—*Tetragynia.*—Pentandrous flowers having *four* pistils. Linnæus, it seems, could find but one genus to be placed here: the type of which is a small bog plant, called in England grass of Parnassus (Parnassia palustris).

Order V.—*Pentagynia.*—This order contains pentandrous flowers having *five* styles or pistils; and in which are arranged some very beautiful and showy exotics; such as the larochea, kalosanthes, and crassula, three very nearly allied genera. Here is also the economical flax (linum), and the curious sundew (drosera), &c.

Order VI.—*Polygynia.*—Pentandrous flowers having *many* pistils. This is a small order, three genera only being associated in it, namely, migosurus, mousetail, ceratocephalus, and Xanthorhiza, yellow-root. The last is a low North American shrub, the two first diminutive annuals.

CLASS VI.—HEXANDRIA.

Flowers distinguished by having *six* stamens of *equal* length. This class is divided into four orders.

Order I.—*Monogynia.*—Hexandrous flowers having *one* pistil or style. This, though chiefly consisting of tuberous and bulbous herbs, may be truly called a splendid order. It comprises most of "the lilies of the field," namely, narcissus, amaryllis, pancratium, crinum, &c. It also contains that king of fruits, the pine-apple (ananassa), together with the aloes, tretillarias, &c. As a type of these interesting and elegant blossoms, we give a figure, *Pl.* 7, of the wild tulip (*t. sylvestris*), to convey an idea of the general structure of the flowers of this class and order; *a*, stamens and pistil; *b*, ovary, cut transversely to show the ovules.

Generic characters.—*Tulipa.*—*Calyx*, of three coloured sepals, bell-shaped, deciduous; *Petals*, three, close within the sepals, and, like them, coloured, naked below; *Style*, none; *Stigma*, three-lobed; *Capsula*, three-sided, three-celled, three-valved; *Seed*, compressed.

Order II.—*Digynia.*—Hexandrous flowers having *two* pistils. This order contains only three genera, one of which is the invaluable rice, the bread-corn of India, and one of the grasses. The others, though curious, are worthless plants.

Order III.—*Trigynia.*—Hexandrous flowers having *three* pistils; except one genus of palm (sabal), and a few bulbs and tubers belonging to *melanthaceæ*, the plants in this order are not of importance. The genus rumex, the dock, constitutes a principal part of the order.

ORDER IV.—*Polygynia.*—Hexandrous flowers having *many* pistils. This is a small order, comprising only four genera, most of them aquatics. The most beautiful of all British plants, as the opinion is, belongs to this order, namely, the water plantain (alisma plantago), common in every secluded pool.

CLASS VII.—HEPTANDRIA.

Consisting of flowers having *seven* stamens. Divided into four orders.

ORDER I.—*Monogynia.*—This order contains all flowers having *seven* stamens and *one* pistil. The most conspicuous plants are the horse-chesnut (Æsculus), and the red flowering ditto (Pavia). Some of the latter are shrubs; and the other trees of the order are African fruits, called by the African name Parinarium. One of the British herbs belonging to the natural order *Primulaceæ*, we have figured on *Pl.* 8: it is commonly called the oval-leaved winter-green (*Trientalis Europæa*), and is found in moist woods.

Generic character.—*Trientalis.*—*Calyx*, seven cleft; *Corolla*, in seven parts, spreading, segments oval-lance-shaped; *Stamens* (*a*), filaments awl-shaped, inserted into the base of the corolla, anthers oval; *Style* (*b*), simple, stigma headed; *Berry*, like a capsule, dry; *Placenta*, central and free; *Seed*, angular, several.

ORDER II.—*Digynia.*—Consist of heptandrous flowers, having two pistils. This order contains a single genus, namely, the Limeum Africanum, a herbaceous perennial found at the Cape of Good Hope.

ORDER III. — *Tetragynia.* — Heptandrous flowers having *four* pistils. This order contains only two genera. The first is an American aquatic, called Lizard's-tail (Saururus); and the other is a Chinese shrub called Astranthus.

ORDER IV. — *Heptagynia.* — Heptandrous flowers having *seven* pistils. This order contains only one genus, namely Septas, of which there are three species, natives of Southern Africa. This genus is appropriately named, as all the members of the flower are divided into seven.

CLASS VIII.—OCTANDRIA.

Flowers having *eight* stamens. This class consists of four orders, namely,

ORDER I.—*Monogynia.*—Octandrous flowers having *one* pistil. An order comprising a numerous tribe of ornamental trees and shrubs. Among many others it contains the almost endless genus of Erica, or heaths. Of this single genus there are above six hundred species described, besides many varieties. Here are also the Ænothera, Fuschia Daphne, Combretum, Vaccinium, &c. We have given a figure of that curious flowering genus Gaura, as a type of the class and order. See *Pl. 9*, which represents the Gaura biennis.

Generic character.—*Gaura.*—*Calyx*, tubular, four-cleft, and deciduous; *Petals*, generally four; *Stamens*, inserted into the calyx, filaments awl-shaped, anthers incumbent and oval; *Style*, simple, stigma four-cleft; *Nut*, four-sided, one to two-seeded.

Order II.—*Digynia.*—Containing octandrous flowers having *two* pistils. This is a small order, comprising only five genera, and, except the Weinmannias, which are West India shrubs, no others require notice.

Order III.—*Trigynia.*—Octandrous flowers having *three* pistils. This order is enriched by the genera Coccoloba and Sapindus; some of the species of which yield good fruits. The genus Polygonum occupies a large space in the order: but except the P. Fagopyrum, which is agricultural, and two or three species which are used by the dyer, a great majority are only weeds.

Order IV.—*Tetragynia.*—Octandrous flowers having *four* pistils. This order contains only six genera, and are all much more curious than either beautiful or useful. The Bryophyllum is curious in bearing its flowers on the edges of the leaves. Paris and Adoxa are neat little British herbs, found under damp woods or hedges, and the Kalanchoe tropical undershrubs are no less curious.

CLASS IX.—ENNEANDRIA.

Flowers having *nine* stamens. This class contains three orders.

ORDER I.—*Monogynia.*—Enneandrous flowers having *one* pistil. Here we find some of the most ornamental as well as the most useful trees of the torrid zone. The delightfully aromatic cinnamomum, whose young bark is so valuable a spice, with its congenerous species yielding camphor and cassia, and from which many useful condiments and drugs are prepared. The genus cinnamomum was established by Dr. R. Brown, and separated from the old genus Laurus, of Linnæus ; a separation sanctioned as much by superior qualities, as by a difference of structure of the flower. Some of the genus Lanrus yield useful timber; and another genus, formerly united with the Laurina, yields the fine West India fruit called the Alligator pear. The major part of the order are lofty trees or shrubs: but two of the genera are herbaceous.

ORDER II.—*Trigynia.*—In this order all flowers having nine staminas and *three* pistils are arranged. But Linnæus, it seems, could find only two genera which belonged to it, namely, the well known Rhubarb (Rheum), and a Carolinian plant called Pleea, a rush-looking plant. The rhubarb is now no less valued as a culinary, as it was formerly as a

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medical plant. In the shape of pies and tarts it is on every table, from the palace to the cottage. Few vegetables unite the two excellencies of nutritious food and mild medicine so intimately as is found in well-cooked rhubarb: and few appear to be so susceptible of improvement in gaining varieties of larger growth and milder qualities.

ORDER III.—*Hexagynia.*— Flowers having enneandrous flowers, with *six* pistils. And of this character there happens to be but one solitary genus, and with only one other congener in the vegetable creation. Of this lone genus, Butomus, there are two species; one Nepalese, and the other (*B. umbellatus*) is a British plant, called the flowering Rush, and of which we have given a figure, *Pl.* 10. It is not uncommon; and usually found growing in ditches cut across low meadows near rivers. It is one of the most beautiful British plants; but the edges of the leaves are so sharp that they cut the mouths of cattle that browse it: hence its generic name.

Generic characters.—*Butomus.*—Flowers in an umbel; *Calyx* like a corolla, of six sepals, decaying; *Stamens* perigynous, filaments awl-shaped; anthers oval and two-celled; *Capsule* six-celled, follicular, many-seeded.

CLASS X.—DECANDRIA.

All plants bearing flowers furnished with ten stamens belong to this class, which is divided into five orders, namely,

Order I.—*Monogynia.*—Decandrous flowers having *one* style. The glories of this order are the incomparable Kalmias and Rhododendrons, the Ledums and Andromedas, all North American shrubs; besides the Arbutus of Europe and the Melastomas of India, with many other interesting genera. There are a good many plants in the fifth and eighth classes that are nearly allied to some of the genera in this; but the number of the stamens only have caused their separation. Linnæus was often compelled to form incongruous associations, and no doubt against his own judgment, in order to be consistent in his plan.

Order II.—*Digynia.*—Here are placed all plants bearing flowers having ten stamens surrounding two pistils. In this order we have the handsome family of African shrubs called Royena, in honour of a director of the Botanic Garden at Leyden. There is also the Hydrangea so common in our court-yards; and the numerous genus Saxifrage, with its varieties, mostly hardy European plants. But the largest genus is Dianthus, which includes many of our sweetest and most esteemed garden favourites. Every species is rendered more or less interesting, by the delicate forms and colours of their blossoms. Even the most minute have a gay sparkling appearance, and the cultivated varieties of the clove are as stately as they are beautiful. We add a figure of one species, namely, the Carthusian Pink (*Dianthus Carthusianorum*), to show the general structure of the flowers, *Pl.* 11; *a*, stamens and pistils divested of the petals; *b*, pistils cut perpendicularly, to show the position of the ovules upon the central placenta.

The habits of the species are so well known they hardly require description. They are all dwarf fibrous rooted herbs, sending up slender jointed stems, crowned with one or more flowers. Generic characters.—*Calyx* tubular, five-toothed, with imbricated scales at the base; *Petals* clawed, mostly toothed or much divided, seldom whole; *Stamens* inserted into a ring embracing the seed vessel; *Filaments* like hairs, *Anthers* two-celled; *Style* thread-shaped; *Stigmas* laterally attached; *Capsule* oblong, opening at the top into four or five slits, one celled, many-seeded, placenta central, free. *Natural order*, *Caryophyllaceæ*.

ORDER III.—Decandrous flowers having *three* pistils. This order contains not many genera: but there are two pretty extensive ones, namely, *Silene* and *Arenaria*; both these genera when closely examined may be called elegant; but they are inconspicuous plants; and many of them are mere weeds. The *Stellaria*, which enlivens our hedges in May and June, with its numerous white starlike blossoms, also belongs to this order; as well as the stinging Barbadoes cherry (*malphigia*), which are South American trees and shrubs, a few others are tropical climbers, and excellent timber are afforded by the genus *Erythroxylon*, or red wood.

ORDER IV.—*Pentagynia*.—Flowers having ten stamens and *five* pistils. In this order we find the *Averhoa*, *Spondias*, and *Buchania*, tropical fruits; and *Cotyledons* or navel worts under shrubs; with the stone-crop (*Sedums*), and the handsome wood-sorrel (*Oxalis*); all of which are interesting to the Botanist.

ORDER V.—*Decagynia*.—All plants bearing decandrous flowers, and having also *ten* pistils, belong to this order. But Linnæus it seems could discover but one genus to constitute the order, and this is a tropical herb called *Phytolacca*, of some value as an esculent vegetable; for its juice as yielding a fine carmine colour; and for its medical qualities. It is the American *Poke*, the Pocan of Virginia. It is cultivated in the South of Europe for colouring wine.

CLASS XI.—DODECANDRIA.

This class comprises all plants whose flowers have *twelve* stamens surrounding one or more pistils.

Hitherto the titles of the classes have been in accordance with the number of stamens. But in this there is discordance, inasmuch as this *eleventh* class is known by having *twelve* stamens. The fact is, that no flowers are known to have exactly eleven stamens. This class is divided into six orders, namely,

ORDER I. — *Monogynia.* — Flowers having twelve stamens and one pistil. In this order above thirty-five genera of trees, shrubs, under-shrubs, and herbs are associated, among which there are some fine flowering shrubs; one genus, (*Garcinia mangostana*) yields delightful fruit; an esculent salad plant the purslane (*Portulaca sativa*); and one of our handsomest native flowers, met with on the banks of rivers, namely, the Purple willow-herb (*Lythrum salicaria*). Except two species of this last, and the asarabacca (*Asarum Europæum*), a hardy medical herb, all the other genera and species are exotics.

ORDER II. — *Digynia.* — Contains flowers having twelve stamens and *two* pistils. There are only two genera, one a Botany Bay shrub, called *Calicoma*, and the other a perennial herb, one species of which is the British Agrimony, a medical plant very common on the sides of fields and high roads.

ORDER III. — *Trigynia.* — Dodecandrous flowers having *three* pistils. In this order there are four genera; one of which, Reseda, contains the useful dyers'-weed (*R. Luteola*), indigenous to Britain; and the fragrant and universally admired mignonette (*R. Odorate*). Another genus is the remarkably grotesque Euphorbia, of which the most striking species are tropical; many are European, and there are as many as fourteen found in Britain, where they are called spurge.

ORDER IV.—*Tetragynia.*—Contains dodecandrous flowers having *four* pistils. This order comprises one genus only, namely, the calligonum (*C. Pallasia*), a plant found on the shores of the Caspian sea.

ORDER V. — *Pentagynian.* — Dodecandrous flowers having *five* pistils. This is a small order, three genera only being ranked in it. The principal is the Blackwellia, East Indian evergreen shrubs, introduced into British collections about 1820.

ORDER VI.—*Hexagynia.*—Flowers having twelve stamens and six pistils. One genus only establishes this order; and but one species has yet been found of it, namely, the cephalotus (*C. follicularis*). It is a New Holland aquatic or bog-plant, its leaves being furnished with beautifully shaped pitchers with lids attached to the apices.

ORDER VII. — *Dodecagynia.* — Includes all plants whose flowers have twelve stamens and *twelve* pistils or styles. This is also a small order, it containing only two genera, namely, Monanthes polyphylla, a native of the Canaries, so named by the late Mr. Haworth, because they present but *one flower* at a time. The other genus is the sempervivum of Linnæus, the houseleek of English Botany. Generic characters.—*Calyx* in from six to twelve parts; *Petals* from six to twelve, lance-shaped, with scales at bottom; *Stamens* seated below the germen; *Stigmas* acute; *Capsules* six to twelve, many seeded. *Nat. ord. Crassulaceæ*: *Pl.* 12, is a figure of the common houseleek (*Sempervivum tectorum*).

Although this order like the preceding is designated by the number of the stamens, and particularly the number of the pistils: yet allowance must be made for variations in the numbers of both; for it often happens that the numbers are more or less.

CLASS XII.—ICOSANDRIA.

All plants having *twenty* or more stamens *inserted into the calyx* belong to this class. The generic characters are *Calyx* hollow, of from five to ten sepals; *Corrolla* of five petals inserted into the calyx; *Stamens* twenty or more, also inserted into the calyx, and often on a prominent ring. This class contains five orders, namely,

Order I.—*Monogynia.*—Icosandrous flowers having *one* pistil. This is a most important order not only as containing the curious and splendid flowering cactæ, but because it comprises a great number of our most useful fruits. Besides the guava, eugenia, pomegranate, and almond; there are also the peach, nectarine, apricot, plum, and cherry.

ORDER II.—*Dipentagynia.*—Flowers having twenty or more stamens inserted into the calyx, and surrounding *two* pistils. This order also contains some excellent fruit trees, such as the pear and apple, the medlar, quince, and Chinese loquat. It also contains the large genus mesembryanthemum, consisting of above three hundred species already described. This last is commonly called the fig-marigold, from the fleshy appearance of the calyx surmounted by the radiate petals.

ORDER III.—*Polygynia.*—Icosandrous flowers having *many* pistils. This order is dignified by the presence of the lovely genus rosa, of which the species and varieties are innumerable. We give a figure of one that is seen in every hedge-row, namely, the common dog-rose (*Rosa canina*), *Pl.* 13; *a*, a perpendicular section of the fruit to show the stamens seated upon the calyx. The generic characters of the rose are as follow: *Calyx* with a pitcher-shaped tube, turbinate and persisting, limb five-cleft, divisions often pinnified or winged; *Petals* five; *Stamens* many, inserted into the neck of the calyx; *filaments* like threads; *anthers* two-celled. *Styles* several, somewhat lateral, or free, or united in a column; *Stigmata* headed. Tube of the calyx becomes a vessel containing the seeds fixed to the sides.

No plant is more regarded than the rose, nor has any plant called forth the skill and industry of the florist more than this. There are in cultivation above twelve hundred species, and varieties; for since the Asiatic roses have been introduced and united by cross impregnation with old sorts, there are now varieties out of number.

Besides the rose, there are several other favourite flowering plants, both shrubs and herbs, in this order, such as the calycanthus and chimonanthus, green-house shrubs; and geums and potentillas, herbs; together with that excellent fruit-bearing herb, the strawberry.

CLASS XIII.—POLYANDRIA.

Flowers having *many* stamens *inserted in the receptacle.* It is here to be observed that the *station* of the stamens is the circumstance which distinguishes this class from the preceding: as the actual number of stamens is not to be regarded.

This class contains six orders, namely,

ORDER I.—*Monogynia.*—This order includes all flowers having many stamens seated on the receptacle, and having in the midst *one* pistil.

There are many fine showy flowering plants in this order, but the common poppy (*Papaver*), being so familiary known, may be pointed to as a good type of the flowers of the whole. We have also here the splendid water-lilly (*Nymphœa*), the lagerstræmia, and the numerous family of Rockrose, one of which (*Cistus albiflorus*) we have figured in *Pl.* 14; *a*, stamens and pistil, divested of the petals and calyx, to show the stamens seated upon the receptacle. This figure with the following generic characters will convey a pretty good idea of the genus cistus:— *Calyx* of five somewhat unequal sepals; *Petals* five, below the germen, and deciduous; *Stamens* below the germen, erect, filaments hair-like, anthers roundish; *Style* thread-like, stigma headed, capsule united to the calyx, five-celled, five-valved, separating in the middle; *Seeds* angularly oval.

There is also in this order the extensive family of Helianthemum or sun-rose, being small shrubs or under shrubs, mostly natives of the south of Europe.

Order II.—*Digynia.*—Contains polyandrous flowers having two styles. One of the most conspicuous flowers in the garden, namely, the peony (*Pæonia*) belongs to this order. This plant is, however, very subject to variation in the number of its styles, having often more than two. From late introductions of many new species and varieties of peony from China, Siberia, and elsewhere, our stock of them is much enlarged: and it is probable that the Chinese have many more varieties still to be looked for. The Fothergilla and Curatella are also in this order.

ORDER III.—*Trigynia.*—In this order all polyandrous flowers having *three* pistils are ranked. The examples are Hibbertia, Delphinium and Aconitum. It is remarked of these three genera that they are not constant in the number of their styles. The larkspurs (*Delphinium*) are a handsome family of border flowers, whether annual or perennial. The wolf's-bane (*Aconitum)* are also ornamental, but possess dangerous qualities. The very common monkshood (*A. napellus)* is one of the most poisonous plants in our gardens.

ORDER IV.—*Tetragynia.*—Polyandrous flowers having *four* pistils. This is a small order, containing only two genera, namely, the butternut (*Caryocar nuciferum*), of which there are three species, and the drimys winteri, a medicinal plant. The nuts of the caryocar are sold in the London markets, under the name of *suwarrow* nuts. All the species yield eatable nuts, and the nuts of *Caryocar butyrasum* abound in oil, little inferior to that of the olive.

ORDER V.—*Pentagynia.*—In this order we have polyandrous flowers having *five* stamens. This is not an extensive order; but a very convenient type of it is in every garden, and in some parts of the country in every hedge-row, namely, the columbine (*Aquilegia vulgaris*). The fennel-flower (*Nigella)*, a common annual in the flower garden, also belongs to this order, and may be referred to as a type of the class and order.

Order VI.—*Polygynia.*—Polyandrous flowers having *five* pistils. This order consists chiefly of ornamental plants; some of which are valued for their magnificence, as the nelumbium or sacred bean, and the magnolias, &c., and many for their early and gaudy appearance, as the hepatica, anemone, &c. Some of our finest arbour plants also belong to this order, as the atragene, and clematis ; and the extensive and varied genus of ranunculus is also here. The winter aconite *(Eranthis hyemalis)*, which bedecks our flower borders so early in January with its yellow blossoms, is one of the genera ; together with its congeners, the helliborous, caltha, &c. It is remarkable that the plants of this, as well as a majority of those in the preceding order, are charged with hurtful or noxious qualities ; they contain an acrid juice which is disrelished by, and injurious to all animals.

We have now arrived at that point in Linnæan Botany at which the classification by the numbers or stations of the male and female organs ceases, and where other circumstances are chosen to identify the classes and orders which follow.

CLASS XIV.—DIDYNAMIA.

This class is known by having flowers of both sexes furnished with *four* stamens, two of which are *longer* than the other two. This difference in the length of the stamens is sufficient to identify the plants of this from those of the fourth class, which have four stamens of *equal length*. This class is divided into two orders.

ORDER I.—*Gymnospermia.*—This order contains all plants agreeing with the character of the class, and having their seeds situated at the *bottom of the calyx* instead of a capsule.

This order is extensive, and comprises a great many very common herbaceous plants, such as the bugle, cat-mint, lavender, mint, ground ivy, horehound, &c., any of which are typical of the whole. Several of the genera are suffruticose, that is half-shrubby, such as the phlomis, the thyme, and lavender, and most of them are fragrant, and much used in salads and cookery as well as in medicine.

ORDER II.—*Angiospermia.*—This order has didynamous flowers, but is easily distinguished from the first order, by having the seeds contained *in a capsule*.

It is a large order, and contains many beautiful flowering shrubs and herbs. The bignonias, tecomas, gloxinia, pentstemon, thunbergia, verbena, clerodendron, digitalis, &c. Of the last named genus we subjoin the generic characters.

Calyx, five-cleft, persisting, segments unequal; *Corolla* somewhat bell-shaped, bellying, limb abbreviated, upper-lip very obtuse, or cleft, lower-lip trifid, middle segment equal with the others or stretched out; *Stamens*, shorter than the corolla, anthers with irregular cells; *Style* persisting; *Stigma* two-lobed; *Capsula* oval, two-celled, many-seeded, placenta thick and central, valves none; *Seed* rough, or punctate.

We give a figure of the purple fox-glove (*Digitalis purpurea*), *Pl.* 15; *a*, a portion of the corolla with the stamens; *b*, pistil; *c*, horizontal section of the ovary. This figure also shows the didynamous (twinned) position of the stamens; but we should wish our young friends to

"Explore the Fox-glove's freckled bell"

for themselves. It is a beautiful, but a baneful plant; it is one of the richest ornaments of our hedge-rows and wood-sides. It embellishes the shrubbery with its spikes of pendant flowers, hanging from their spire-like branches with a grace and elegance peculiar to them. "When these flowers advance from the calyx, they are securely closed at the end by the four clefts of the corolla, which meet so exactly as to prevent the admission of air, until the parts of fructification have arrived at maturity, at which period the lips of the flower burst open in a bell or trumpet-shape, displaying the beautiful leopard spots of the interior of the flower. In this state the corolla remains for some days, until the anthers have discharged their farina, when the mask drops off, that the sun may more readily ripen the seed-vessels." As this plant continues to open fresh flowers for a long time, its beauty is perpetuated for a more lengthened period than most other flowering plants.

CLASS XV.—TETRADYNAMIA.

This class contains bisexual flowers, furnished with six stamens, four of which are *longer* than the other two, and which distinguishes this from the sixth class already noticed.

The flowers of this class are known by having a tetraphyllous perianthium: the *Leaflets* ovato-lance-shaped, concave, and convergent, equal and deciduous; *Corolla* is of four petals, seated on the receptacle, a little longer than the leaflets or sepals of the calyx, the limbs assuming a cruciform position, plane and widening outwards, mostly blunt, sometimes marginate; *Stamens*, filaments six, awl-shaped, the two opposite ones shorter than the other four, the anthers pointed, often arrow-shaped, diverging; inside the short filaments are two glands; *Pistillum*, germen superior, style short or wanting, stigma obtuse, commonly hemispheric; *Pericarpium*, a siliqua or silicula of two valves, mostly two-celled, opening at the base; the *Stigma* is commonly persisting, and forms the apex of the dissipiment (that is, the partition between the cells), extending beyond the valves of the siliqua; *Seeds* roundish, approaching in some instances to a kidney shape, attached by the umbilicus to the edges of the dissipiment, which is prominent beyond the margins of the valves.

The orders of this class were two, distinguished by the form or length of the seed-vessel in the early Linnæan schools; but those distinctions are now dropped, the whole of the plants being arranged under the classical title.

The class contains a great many common, bnt both useful and beautiful plants: among the latter the garden stock is conspicuons: and even the wall-flower is esteemed. As this is one of the best known, we give its generic character. *Calyx*, shut up; Seed-vessel a siliqua crowned by a two-lobed, or capitate stigma; *Seeds* in one series, compressed and margined. In *Pl.* 15 we give a figure of the Wall-flower, (*Cheiranthus Cheiri*, var. *ferrugineus*); *a*, stamens and pistil; *b*, a ripe silicle, showing the dissipiment with the seeds attached.

Here we have also the early flowering Arabis, Alyssum, the Iberis or Candytuft, &c. The useful plants are all the Cabbage tribe (*Brassica*); the Mustard (*Sinapis*); Sea Kale (*Crambe*); Radish (*Raphanus*); together with all the different sorts of cress.

CLASS XVI.—MONADELPHIA.

This class comprises all flowers having *one set* of united stamens.

The corolla is of five petals, and mostly regular, each petal having one margin under and one above its neighbours.

The class contains eight orders, founded on the number of the stamens. And here it may be observed, that in this system the orders are founded on the number of the pistils in the first thirteen classes only, all the others being founded on other circumstances. In this and the two following classes, the orders are very appropriately named from the classes to which the individuals of them would have belonged, but for the circumstance of the filaments being united.

This shows how intimately Linnæus had studied his subject, and what care he took to make a harmonious whole.

Order I. — *Triandria.* — Flowers having *three* stamens united at the base into *one* brotherhood; and which brotherhood confines certain genera here, which would have been more naturally placed in *Triandria*, the third class; because it is evident, that the membrane which unites the filaments together, is a tubulose investment of the germen, and not the dilated basis of the filaments themselves. Linnæus, however, on the plan proposed by himself, placed several genera here, which should have been elsewhere. These genera are ferraria, tigridia, galaxia, and others; all bulbous, or rather tuberous stemmed plants, bearing handsome flowers; and which rank among what are called Cape bulbs.

ORDER II.—*Pentandria.*—Containing flowers having *five* stamens united in *one* set or brotherhood.

In this order we have the genera hermannia, mahernia, erodium, and other interesting plants: but the most admired and conspicuous genus is the passion-flower (*passiflora*), with its many gorgeous species. The tasconia, a genus nearly related to passiflora, is also here, as well as their congener, the murucaja. This last, like one of the passion-flowers, yields esculent fruits, which are fragrant and refreshing.

ORDER III,—*Hexandria,*—Includes flowers having *six* stamens united in one set. Only one genus has yet been found to constitute this order, and that is a small narrow-leaved plant, a native of South America. This genus is the *gillesia graminea,* a bulbous herb, but which is neither useful nor ornamental.

ORDER IV, — *Heptandria,* — Contains all flowers having *seven* stamens, the filaments being united in *one* set. This order contains the beautiful and extensive genus pelargonium, or stork's bill, commonly known as geraniums. So numerous is this genus, that it has been divided by Botanists into thirteen sections, and many subsections; the whole including above two hundred and thirty-eight species, and as many varieties and subvarieties. This genus occupies the whole order; there being, it seems, no other plant which can be associated with the pelargonium by similarity of flowers.

ORDER V. — *Octandria.* — Monadelphous flowers having *eight* stamens. This is, as yet, but a small order; Botanists having only met with two genera which suit the generic characters, namely, Aitonia and comesperma. The first a native of the Cape, the last from New Holland, both green-house plants.

ORDER VI. — *Decandria.* — Flowers having *ten* stamens united in one brotherhood. This order is composed of a great number of genera, some of which have many species. One of the most common is the genus geranium, which formerly contained both erodium and pelargonium. Here are also herbs, shrubs, and trees, from every region of the known world: the bossiœa, crotalaria, aspalatus, genista, cytisus, lupinus, tamarindus, &c., having mostly papillionaceous flowers.

ORDER VII.—*Dodecandria.*—Monadelphous flowers having *twelve* stamens. This order contains twelve genera, all exotics, and mostly from the warmer parts of the globe. The helicteris, dombeya, and Pterospermum, are shrubs and trees: but the greatest ornament of the order is the *astrapœa Wallichi*, a native of Madagascar, which is a splendid flowering tree.

ORDER VIII.—*Polyandria.*—Monadelphous flowers having *many* stamens. This order comprises many very fine flowering herbs, shrubs, and trees. Malva, altheæ, lavatera, pavonia, and hibiscus, are all highly ornamental; and only surpassed by the carolinea, adansonia, bombax, thea, and especially by the camellia, Barringtonia, and Gustavia. Many of these genera adorn our gardens; and the others our green-houses and stoves. For figure of field mallow (*Malva sylvestris*) see *Pl.* 17; *a*, pistil and ovary, showing the styles and some of the stamens attached.

CLASS XVII.—DIADELPHIA.

Bisexual flowers, furnished with *two sets* or brotherhoods of united stamens. The characters of this class are as follow:—*Calyx*, a proper perianthium, monophyllous, five-dentate, the lowest tooth longest, supporting the carina, gibbous and deciduous; *Corolla*, butterfly-shaped, mostly of five petals, sometimes four petaled:—the upper part is the *vexillum*, or standard, the two side petals are the *alæ*, or wings, and the lowest is the *carina*, or keel; *Stamens*, the filaments united in two brotherhoods, usually *nine* united in one brotherhood, and the upper filament solitary, all inclined upwards, and each supporting a single anther; *Pistillum*, germen one, compressed, straight, as long as the united part of the stamens; *Style* one, filiform, inclined upwards, of the length of the separated part of the stamens; *Stigma* simple, downy, nearly as long as the style, deciduous; *Pericarpium*, a legumen, or its modification, a *lomentum*; *Seeds* round, or kidney-shaped, attached to the upper suture of the pod by an umbilicus. The orders of this class are four, namely,

Order I.—*Pentandria.*—Diadelphous flowers having five stamens. This order is constituted by one genus only, *monnieria trifolia*, a small South American annual, described by Aublet.

Order II.—Diadelphous flowers having *six* stamens. This is a small order containing only six genera, all of which are herbaceous. Corydales and fumaria are two of the principal: three species of the latter, and three of the former genera are British plants.

Order III. — *Octandria.* — Diadelphous flowers having *eight* stamens. This order contains four genera, the chief and best known of which is the polygala, or milk-wort. Of which genus the generic character is—*Calyx* of five unequal sepals, two of them winged and persisting; *Petals* from three to five, joined to the tube of the stamens, vexillum above, the keel crested; *Stamens* united in two sets, anthers one-celled; *Style* thickened at top, incurved; *Stigma* tubular; *Capsula*, inversely heart-shaped, two-celled, two-seeded. To assist the student, we give a figure of the common milk-wort (*Polygala vulgaris*), *Pl.* 18; *a*, a flower magnified; *b*, the beard, or crest, laid open to show the stamens; *c*, ovary and style, (1 and 2, the stigma).

There is only one species of polygala indigenous in Britain, and which has either blue or white flowers, and is frequently found on dry chalky banks. Some of the shrubby species from the Cape of Good Hope are very handsome.

Order IV. — *Decandria*. — Diadelphous flowers having *ten* stamens: that is nine in one brotherhood, and the tenth solitary. This is one of the largest orders in the Linnæan system; embracing all those plants, whose flowers are *papilionaceous*, or butterfly-shaped.

Here we find the useful pea, bean, trefoil, and many others bearing similar flowers. Some of the most magnificent flowering trees are also here, as the robinia, sutherlandia, æschynomena, wistaria, erythrina, dalbergia, &c. Nor is their beauty the only recommendations; many are alimentary, or medical, or economical.

CLASS XVIII.—POLYADELPHIA.

Bisexual flowers furnished with more than two sets of united stamens. This class contains two orders, namely,

ORDER I.—*Decandria.*—This order comprises all polydelphous flowers having *ten* stamens. There are only four genera described of which theobroma and abroma are chief. The first yield the famous chocolate-nut, which is manufactured into a favourite article of diet.

ORDER II.—*Polyandria.*— Flowers having many stamens, arranged in *many* brotherhoods.

A principal part of the genera of this order are New Holland plants; such are melaleuca, tristania, calothamnuses, and beaufortia. But the most important genus is the citrus, productive of the most ornamental trees, and a variety of the finest sanative fruits. But the most familiar genus is the St. John's wort (*hypericum*), nine species of which are natives of Britain. To give an idea of the generic characters, we add that the *Calyx* is in five parts, and persisting, that is, it remains entire after the petals and stamens have faded; *Petals* five; *Stamens* not in distinct bundles, nor any glands at the base; *Styles* from three to five; *Capsula* of five valves, valves bent inwards: placenta of each cell united at the centre; *Seeds* small and numerous.—*Sprengel.*

At *Pl.* 19, we have figured a flower of the tutsan (*androsæmum officinale*, formerly, *hypericum androsæmum*); *a*, a bundle of stamens, as they separate, cohering at the base. The androsæmum differs from hypericum in having three styles and a one-celled capsula; though both genera are in the same natural order. It is necessary to explain that, though the stamens do not appear to grow in bundles, they are shed in tufts as represented.

CLASS XIX.—SYNGENESIA.

Composite flowers. This class contains a natural order of plants distinct from all others in the vegetable kingdom: hence also the mode of their arrangement in the Linnæan system is peculiar. The number of the stamens and pistils are useless here, as the same number is found in all the genera. Other characters are therefore had recourse to, on which to found the basis of subdivision.

The polygamy or intermixture of the sexes in the florets has been chosen for this purpose; which, although it may not be readily understood by a learner at first view, a little acquaintance with the different orders will soon develop the Linnæan plan of arrangement.

The term syngenesia signifies to generate together: hence the union of the anthers, which are attached side to side, and form a cylinder round the style, is the character which justifies the title, and at the same time is the essential character of the class. The flower being composite, that is, formed of many florets, some of the parts must necessarily be common. These parts are the calyx or involucrum, now called *anthodium*, and the receptacle. These two organs are common, because the latter has all the florets seated upon it, and the former includes them in its embrace, acting as a defence before flowering, and afterward as a protection to the seeds. The anthodium is generally imbricated and sometimes armed with prickles; when the corollets of the florets are fallen, it converges inwards and incloses the seeds, and opens again to permit their escape.

The common disk or receptacle of the flower, as already stated, supports all the florets on its surface, which is either concave, plane, rounded, or conical; and is either smooth, except small cavities where the bases of the seeds are inserted, or *paleaceous*, that is, set with chaffy scales which separate the florets, or it is villose.

The florets are either male or female, bisexual or neuter, and admit of a great variety of character. The character of a bisexual floret may be thus described — *Calyx*, if present, is a small superior perianthium, persisting, and becoming the crown of the seed; *Corollet*, superior, if tubulose, the limb bell shaped, and divided into five segments, the segments revolute; if *ligulate*, that is, if the corollet, instead of being tubular, is narrowed into a tongue, or strap-shaped expansion, it is always stretched divergingly; *Stamens* five in number, like hairs, inserted into the tube of the floret, anthers five, erect, united by their margins, surrounding the style in all the bisexual florets; *Pistillum* inferior, being a naked seed, crowned with the other parts of the floret; *Style* filiform, erect; *Stigma*, of two parts, each part revolute, and divergent; *Seed* a single one, at the base of the bisexual or female floret, naked as in the sunflower, crowned with the perianthium, as in aster, or with a pappus, as in groundsel. This class is divided into five orders, namely,

Order I.—*Æqualis.*—This order consists of composite flowers having *all* the florets bisexual, each being perfect. A vast number of genera are ranked here, and many of them have numerous species. We can only mention a few of the most common, in order that the student may have recourse to the flowers themselves, to prove and profit by the descriptions: namely, dandelion, sowthistle, and lettuce; these have all ligulate florets. Carduus, cynara, and cnicus have globose flowers; the artichoke (*Cynara Scolymus*) is a good example of the class and order.

Order II.—*Superflua.*— Flowers belonging to this order have the florets of the disk bisexual, and those of the radicus female: these last however being impregnated by the pollen form the disk. There are many fine flowering plants in this section; the gnaphaliums, metalasias, elichrysums, &c., are all universally admired, and so are the asters, cinerarias, and dahlias: of the varieties of which there is now no end. The chrysanthemums are also great favourites. *Pl.* 20 represents a flower of the French marigold (*Tagetes patula*) ; *a*, a floret of the disk ; *b*, a floret of the ray ; 1, the seeds.

ORDER III.—*Frustranea.*—Ineffectual polygamy ; the florets of disk bisexual, and of the radius or margin neuter. This order contains many well known plants ; for instance, the sunflower, rudbeckia, coreopsis, calliopsis, the large genus centaurea, &c.

ORDER IV.—*Necessaria.*—In this order the florets of the disk are male, and those of the margin female ; this circumstance giving the title to the order ; calendula, arctotis, osteospermum, and othonna, are the principal genera, some of the species of which bear splendid flowers.

ORDER V.—*Segregata.* — Separate polygamy ; that is, the florets in which the character of the class is exhibited, have either each its proper calyx besides the anthodium : or they are contained, several together, in a proper calyx, or calyculus as it is called by Botanists. This order includes about thirteen genera, all exotic plants, the elephant's foot, and the globe thistle, being two of the principal genera.

CLASS XX.—GYNANDRIA.

The Linnæan character of this remarkable class is, that both the male and female parts are seated together on the pistillum or central column of the flower. It contains three orders, namely,

ORDER I.—*Monandria.*—Gynandrous flowers having *one* anther. A great many very curious, as well as beautiful, tuberous perennial herbs are ranged in this order. Nearly forty species are indigenous in Britain, and constitute a tribe of the most interesting objects in our meadows and woods. The platanthera, gymnadenia, orchis, ophrys, neottia, &c., are among those which are British, and many very splendid flowering species are the produce of foreign countries.

ORDER II.—*Diandria.*—Gynandrous flowers having *two* anthers attached to the column. This order comprises only two genera, namely, the stylidium from New-Holland, and the cypripedium, one species of which is the most remarkable of British plants, and admired by every one for its elegant slipper-like form.

ORDER III.—*Hexandria.*—Gynandrous flowers having *six* anthers growing on the pistillum. This order contains but one genus, but that a very curious one, namely, the aristolochia or birthwort. The generic character is:—*Calyx* corolla-like, swollen at the base, limb varied; *Corolla* none; *Anthers* two-celled, cut-in, at the sides of the stigma; *Capsule* below, six-celled, many-seeded; *Seeds* compressed, scaled, and often winged. We give a figure of the snake-root (*Aristolochia serpentaria*), *Pl.* 21; *a*, a section of the flower showing the column and stamens.

CLASS XXI.—MONŒCIA.

This class contains all plants having male and female flowers separate on the same root; not connected with the same *calyx*, as in the eighteen first classes, or within the same *anthodium*, as in the nineteenth, or within the same *sepals*, as in the twentieth; but quite apart on different stations of the plant. The orders in this class are ten, namely,

ORDER I.—*Monandria.*—This order contains five genera, the male flowers of which have only one anther. The most interesting genus is the artocarpus, the famous bread fruit of travellers. One plant is only found belonging to this order in Britain, and that is the pond-weed (*Zannichellia palustris*). The other genera are foreign.

ORDER II.—*Diandria.*—Monœcious flowers, the males having two stamens. This order contains four genera, one of which is a well known British aquatic plant—the duck-weed (*Lemna*), so commonly seen floating on stagnant pools, and of which there are four species. The other genera are foreign.

ORDER III.—*Triandria.*—Monœcious flowers, the males having *three* stamens. The comptonia and hernandia are two of the principal genera in the order ; but that which have the greatest number of species are the bur reed (*Sparganium*), and carex, both aquatics, chiefly British. The latter is divided into thirteen sections, but are all uncultivated worthless plants.

ORDER IV, — *Tetrandria*, — Associates all monœcious flowers, of which the males have *four* stamens. Here are some useful timber trees, as the box, birch, and alder ; two fruits, the mulberry, and osage orange ; several shrubs, among which is the aucuba, and among many weeds the odious nettle.

ORDER V. — *Pentandria*. — Contains all monœcious flowers, the males having five stamens. This order consists chiefly of annual plants ; among others, the showy amaranthus is universally cultivated as a flower garden annual. Some Botanists place the amaranthus in the fifth class, and describe the flower as follows :— *Flowers* monœcious ; *Calyx*, of from three to five sepals ; *Stamens*, three or five, distinct ; *Styles*, deeply divided into two or three parts, seed-vessel a *utriculus* cut round, one seeded ; *Seeds* covered with an *arillas*. We add a figure of the flower of love-lies-bleeding (*Amarantus caudatus*), *Pl.* 22 ; *a*, a flower having a pistil ; *b*, a flower having stamens, both surrounded by bracts inclosed in a calyx.

ORDER VI.—*Hexandria*.—Includes all monœcious flowers, the males having six stamens.

Except two genera, which are grasses, and one fine genus of trees, namely, the guettarda, all the remainder are palms, including sagus, cocos, elate, bactris, acrocomia, &c. These palms have been placed here since the time of Linnæus.

ORDER VII.—*Octandria.*—Monœcious flowers, the males having *eight* stamens. This order has only one genus, duvaua, of which two species have been described under the name of schinus.

ORDER VIII. — *Icosandria.* — Monœcious flowers having more than *twenty* stamens inserted *into the calyx.* This order contains but one genus, the atherosperma moschata, a New Holland tree introduced in 1824.

ORDER IX. — *Polyandria.* — Including all plants with monœcious flowers, the males having many stamens seated on the receptacle. This is an important order, as containing a great portion of our most useful timber trees; such as the hornbeam, beech, walnut, oak, plane, and four or five palms; together with a good many curious herbaceous plants.

ORDER X. — *Monadelphia.* — Monœcious flowers, the males being united in *one* brotherhood. This is also an important order, as containing the numerous genus pinus, with its natural allies, the cedars, cypresses, arbor vitæ, &c. Here are also the fruits-bearing herbs, cucumber, melon, gourd, &c., and many curious shrubs, as the phyllanthus, xylophylla, &c. The begonia is a good type of this order.

CLASS XXII.—DIŒCIA.

This class contains all plants that are unisexual; that is, the male flowers being on one plant, and the females on another. Consequently, both are barren, unless the male and female plants grow near together. The class is divided into thirteen orders.

ORDER I.—*Monandria.*—Diœcious flowers the males having *one* stamen. This order contains only two genera, namely, the pandanus or screw pine, and the triclocladus, an African shrub. The former is remarkable for the regular screw-like position of its long sword-shaped leaves, and appearing like an enormous pine-apple plant on a lofty stem.

ORDER II.—*Diandria.*—Diœcious flowers, those on the male plants having *two* stamens. This order contains only four genera; one of which is the extensive genus salix, the willow, a great majority of which are British natives; the species showing every grade of lofty trees, shrubs, and dwarfs resembling herbs, indeed one species is called *salix herbacea*.

ORDER III.—*Triandria.*—Diœcious plants, the male individuals bearing flowers having *three* stamens. The principal genus in this order is the date-palm (*Phœnix dactylifera*), a highly useful fruit tree, indigenous to northern

Africa, Syria, and Persia, where the fruit is a necessary of life, and an important article of commerce. The only British plant in this order is the crow-berry (*Empetrum nigrum*), a small shrub, found on moist heaths in the north.

ORDER IV.—*Tetrandria.*—In this order the male plants bear flowers having *four* stamens. The most extensive genus in this order is the leucadendron or white-tree, a native of the Cape of Good Hope, of which there are nearly forty species. The sweet gale (*myrica*), or candleberry myrtle, a native of Britain, also belongs here. But the most familiar type of this order is the remarkable mistletoe (*Viscum album*), of which we have given a figure, *Pl.* 23. The flowers are described thus:—*Calyx*, scarcely visible; *Corolla*, of four petals; *Anthers*, nearly sitting, and pressed to the petals; *Stigma*, sitting and roundish; *Fruit*, a berry of one seed, which one has often several embryos.

ORDER V.—*Pentandria.*—Male plants having flowers with *five* stamens. The pistachia nut (*Pistacea officinarum*), is one of the most conspicuous genera of this order, and which produces nuts useful for various purposes. Here is also the toothache tree of Jamaica (*zanthoxylon*); and the antidesma of the East Indies, the bark of which is used for making ropes. Also our common culinary spinach, and as common hop and hemp. The male plants of these last three are easily detected among the females, when seen growing together; and it may be satisfactory to the student to attend to this circumstance when an opportunity offers.

Order VI.—*Hexandria.*—Male plants producing flowers having *six* stamens. Here are xerotes a herbaceous genus from New Holland; six different sorts of palms, the climbing smilax, and tamus (or black bryony, common in English hedges), and the dioscorea or yam, so useful in India.

Order VII.—*Octandria.*—Male plants furnished with flowers or catkins, having *eight* stamens. This order contains only one genus of hardy trees, namely, the poplar. Of this, there are twenty-four species, four of which are natives of Britain, and abound on the banks of rivers or ponds.

Order VIII.—*Enneandria.*—In this order, the male plants bear flowers having *nine* stamens. It contains only three genera—mercurealis, triplaris, and hydrocharis. Two species of the first, and the last, the frog-bit, are natives of this country in hedges and ditches.

Order IX.—*Decandria.*—Male plants having flowers with *ten* stamens. This is also a small order, comprising only five genera, all exotics. The gymnocladus is a hardy deciduous tree, introduced into this country in

1748, and belongs to the natural order leguiminosæ. The carica or papaw is an East Indian fruit, like a melon, but much inferior.

ORDER X. — *Dodecandria.* — Male plants having flowers furnished with *twelve* stamens. This order is constituted of six genera, all herbs and shrubs. The moon-seed, menispermum, a climbing shrub, is one of the principal genera; one only is British, the water-soldier (*Stratiotes aloides*), an aquatic plant.

ORDER XI.—*Icosandria.*—Male plants bearing flowers having above *twenty* stamens seated *on the calyx.* This order contains three genera, all tropical plants, and of no particular interest.

ORDER XII.—In this order, the male flowers have many stamens seated *on the receptacle.* Here the two curious genera of cycas and zamia, dwarf palm-looking plants are placed, together with flacourtia, an important tropical fruit-bearing genus of shrubs and trees, and the cliffortia, a Cape family of evergreen shrubs, frequent in our greenhouse collections.

ORDER XIII. — *Monadelphia.* — Diœcious plants, the male flowers of which have their stamens connected in one brotherhood. This last order of the class Diœcia contains some majestic genera, as the araucaria and altingia, belonging to the abietiniæ section of the coniferæ, growing to the height of from one hundred to one hundred and fifty feet; there is also the latania, a fine palm, the juniper, yew, the valuable nutmeg, and the curious nepenthes, &c.

CLASS XXIII.—POLYGAMIA.

The title of this class signifies many marriages; indicating that there are unisexual, or bisexual, flowers on the same, or on different roots. The class is divided into two orders, namely,

ORDER I. — *Monœcia.* — Contains plants, which have unisexual and bisexual flowers on the same plant. This order comprises many estimable plants; such are the mimosa, acacia, with its numerous species; the useful cereal sorghum, the maple, celtis, ailantus, clusia, and that excellent fruit, the mango, besides several palms and grassses.

We figure on *Pl.* 24, the wall pellitory (*Parietaria officionalis*); *a*, a fertile flower; *b*, the calyx of a sterile flower; *c*, perfect flower laid open. The generic character of this genus is: *Flowers* involucrated; *Involucrum* more or less divided. Bisexual flowers; *Calyx* four-cleft; *Corolla,* none; *Stamens,* four filaments, elastic; *Anthers,* two-celled; *Germen* crowned by a bearded stigma. Male and female flowers have a tubular four-toothed calyx; *Style,* very simple; *Stigma,* bearded; *Seed,* included in the calyx.

ORDER II.—*Diœcia.*—Contains plants which have male, female, and male and female united on two distinct roots. It was supposed by Linnæus, that these mixed marriages existed on three separate roots; but this has not been confirmed by subsequent observation.

This order comprises the fan palm, gleditschia, the carib-tree, and date-plum, the ash, a timber tree, anacardium, a fruit, and the large genus ficus, of which the cultivated fig is the principal species.

CLASS XXIV.—CRYPTOGAMIA.

The meaning of this title is *hidden* marriages, by which the author only meant, that the plants had no visible flowers. But, arguing by analogy, Linnæus concluded that all plants must have flowers, although they could not be seen. He was cognizant, however, that the plants in this class were reproducible by atoms discharged from certain parts of themselves; but which he did not consider as perfect seeds, but a kind of viviparous progeny, which are developed into perfect form, wherever they find a suitable bed. These vital particles he called *propagines*, or, as they are now called, *sporules*, and whatever their real structure may be, they possess the same principle as that of perfect seed.

This class contains nine orders, namely,

ORDER I.—*Filices.*—Ferns are a very peculiar tribe of herbaceous plants. They have generally creeping underground stems, frequently branched; from the points of these, the foliar expansions are annually produced. These expansions are called *fronds,* and bear the fructification on the back, either in dots along the margin or nerves, or in lines variously disposed. Sometimes the fructification is borne on a loose and separate spike ; and sometimes small spikes are appended to the apices of the divisions of the fronds. A few of the tropical species have a tree-like port, and vie in stature with some of the palms, to which, except in their fructification, they are nearly allied. This order is divided into five tribes, namely, polypodiaceæ, osmundaceæ, gleichenicæ, poropterides, and aphioglosseæ, merely for facilitating the study of this, to some Botanists, most interesting genus of plants.

The general arrangement of the ferns is according to the modifications of the spots or lines of the fructification, and the absence, presence, and manner of opening of the conceptacles.

Order II.—*Equisetaceæ.*—This order contains one genus only, of which there are *ten* species ; of these, seven are natives of England, where they are called horse-tail, or frog-pipes. They are mostly found growing in pools, or on damp clayey ground, and are of a regular pyramidal figure ; stems jointed with whirls of linear leaves at each joint; the fructification forming a spike on the summit of the stem.

ORDER III.—*Lycopoduceæ*,—Contains only two genera, namely, lycopodium, the club-moss, and psilotum; of the latter, there is only one species yet described; and eighteen of the former, of which six are found in Britain, usually in boggy pools.

ORDER IV.—*Marsileaceæ*.—This order contains four genera, namely, isoetes, quillwort, pilularia, pillwort, salvinia, and marsilea. The two first are British. The quillwort is an aquatic; but both are small inconspicuous plants, with fructification near the root.

ORDER V.—*Musci*.—The mosses are numerous, and differ in bulk from mere atoms to branched plants two feet in length. The fructification of the mosses is much more distinctly visible than some other orders in this class. Dillenius detected both male and female flowers; the anthers covered with a *calyptra*, or veil, and under this another covering called by Linnæus an *aperculum*. The seeds are little naked bodies without coat or cotyledons.

ORDER VI.—*Hepaticæ*.—This order contains six genera. The most extensive genus is jungermannia, of which there are a great many species. The leaves are of various forms—some entire, others more or less divided. Some have stipules, others none; but all growing in loose or dense tufts or patches, on walls, or bark of trees, on rocks or on bogs; many affect moist places, and a few are floaters. *Pl.* 25 is a figure of Jungermannia (*J. Pinguis*).

ORDER VII.—*Algæ.*—This is a very large order of cryptogamic plants, comprehending all the sea-weeds, and many others found in rivers, pools, and low damp places. Their forms are as various as the species; some are like minute spots, or tufts of silky hair; others foliacious, and have petioles or stems many feet in length.

ORDER VIII.—*Lichenes.*—This is also a very large order, comprising thousands of small organised bodies, attached to the bark of both living and dead trees; on the bare earth, on stones, and rocks of different descriptions; in short, on the surface of every kind of stationary matter. Some of them are eaten by animals, a few medicinal, and several are economical.

ORDER IX.—*Fungi.*—Of all the cryptogamic orders this is certainly the most extensive, and it may be added, without exaggeration, that there are, perhaps, as many nondescripts as there are species already described; although these amount to nearly twelve hundred! Besides the division called mushrooms (*agaricus*), there are many unheeded genera, which are produced on live and dead vegetables, and particularly on animal and vegetable substances which are in a state of decay. Fruits and grain, and the young shoots of living trees, are the prey of fungi, and some of them have even the power of decomposing the hardest timber.

To these twenty-four classes, Linnæus added an appendix, in which he included all the palms that were then known—ten in number; but since his time, these remarkable plants have been described, and transferred to the class and orders to which they respectively belong in his system.

In taking a retrospective view of the Sexual System of Linnæus, it appears to be one of the best defined artificial methods that ever was invented; not only because it is consistently derived from one simple principle, but also because the author of it, by means of new nomenclature, has given to his terms the greatest distinctness of meaning. Hence the student with but a small degree of attention, and a very little labour, can soon comprehend the principle, and acquire the terms. When this is accomplished, he finds little or no difficulty in referring every flower that falls in his way to its proper class and order; especially those belonging to any of the first eighteen classes. The remaining classes certainly require more study, but a little perseverance, and by frequently comparing the characters of the classes and orders with the flowers themselves, a facility of classification will soon be gained: and this to the young Botanist will be a constant source of pleasure, and innocent amusement.

Every newly blown flower of the season, and every strange blossom which accident presents to notice, is an inviting and fresh subject for examination and mental exercise; and when the class and order is ascertained, and the proper name discovered by this easy process of investigation, the result is always exceedingly gratifying to the juvenile Botanist. Every successful step, and every new acquisition made in this way is an advance towards gaining such a competent knowledge of the science, as will be for ever afterwards a constant source of unalloyed delight and satisfaction.

While thus engaged in the pursuit of a knowledge of Linnæan Botany, years of pleasurable exercise and rational amusement may roll away before the student will discover that the system is only an artificial dictionary of the names of plants, in which he may neither find nor suspect any thing like incongruous associations; but that it is not free from incongruities is perfectly obvious, and many were detected, even during the lifetime of Linnæus himself, who well knew its defects, and whose candour admitted, and whose penetration foresaw, that there was yet another system in the womb of futurity, and within the bounds of practicability, that would be more consonant with nature, and a more valuable acquisition to human knowledge.

Linnæus bequeathed to his posterity "fragments," of a natural system; and this circumstance is a complete exculpation of the temerity of his successors who have set aside nearly the whole of his celebrated sexual system. They have only done what he himself would have done had his life been prolonged. On the broad principle of consistent philosophy, systematists are bound to adhere as closely as possible to the grand features of affinity and verisimilitude which nature herself has so visibly marked. And, according to this principle, the late eminent Botanist, Jussieu, has founded what is now called the NATURAL SYSTEM.

That celebrated Botanist, possessing a most extensive knowledge of plants, has, with immense labour and study, drawn out the *grand outlines* of a system which is likely in time to supersede all others. Its details he left imperfect; but his followers are every day making improvements and alterations, with a view of perfecting what Jussieu so worthily began. The outlines and principal characteristics of his system are chosen with great judgment, because they are naturally *invariable;* but the details carried out according to the rules he has laid down, extend and are extending to a frightful length. Some of the orders are founded on such trifling differences of structure, that there appears to be no boundary or limit to the orders, so long as botanical research is prosecuted with glasses of high magnifying powers only.

So much is this diffusiveness of the natural system complained of by practical, as well as by literary Botanists, that it is a "consummation devoutly to be wished," that some influential MASTER, or band of masters, would undertake the task of circumscribing the natural system; and invent some scheme of amalgamating the scattered orders into manageable groups, so that the system might be more inviting to the student than it is at present.

In proceeding to give the necessary details of the Jussieuan system for the information of the young Botanist, we shall endeavour to make the path along which we propose to lead our pupil as smooth and agreeable as possible; because as the approaches to a science, whatever that science may be, are usually rendered rugged by its terminology, care must be taken that the progress of the tyro be not impeded by the unnecessary use of hard or learned terms.

It has been made a question in describing or teaching the science of Botany, whether the pupil should commence his studies at the highest or lowest grade of vegetation. In other matters of human concern, whether of mental improvement, or manual dexterity, the elementary parts are always first presented to the attention. But it is said, that in the case of Botany the reverse should be adopted; merely for this reason, that the lowest grade of vegetables are microscopic objects, and consequently make less impression on the mind than such as are palpable and visible, and of course easier demonstrable. To the demonstrator, it is certainly much more agreeable and much more easy also, to illustrate his lecture by pointing to the different parts of a plant on his table, than by attempting to show the parts of a fungus devouring the point of a peach-tree shoot. Notwithstanding this, we think that rising from small to greater, from the lowest to the highest, is a more natural way of proceeding than the reverse; and therefore in the succeeding pages we shall proceed on this principle.

THE

NATURAL SYSTEM OF BOTANY.

It appears that the author of this system, possessing, as he did, a thorough knowledge of all that had been written and discovered before his own time, was enabled to take a comprehensive view of the vegetable kingdom, and of all that had been published concerning it. While on the one hand he saw the defects of all previous systems, he could not be ignorant that the attempts of Tournefort had been so far successful as to have brought together, unintentionally or accidentally, perhaps, several of the truly natural orders.

He was also acquainted with the sentiments of the great Linnæus on the subject of natural classification; and, availing himself of the hints bequeathed by that enlightened natural philosopher, he became impressed with the idea that the arrangement of a natural system was fairly within the bounds of practicability.

In the pursuit of this grand object, Jussieu found it necessary, in the first place, to divest himself entirely of all previous schemes of classification, and have recourse to other distinctions among plants than those which had been before employed in systematic Botany. He naturally turned to the physical components and structure of vegetables, where he soon found distinctions which were permanent, invariable, and at the same time easily discernible. These were the *cellular* and *vascular* apparatus of plants, already described in the former sections of this work.

These distinctions, so evident and truly natural, served at once to divide vegetation into two plain and easily definable parts. This was the first, and a most important step; and the second step or discovery was not less so. He also found that the cellular plants were not only distinguishable by their internal structure, but also by the remarkable circumstance that their sporules or seeds germinated without the usual appendages of cotyledons, or seed-leaves.

Thus the first or lowest division of plants he called *cellulares*, because composed entirely of cellular tissue, or *acotyledones*, because the plants are destitute of seed leaves, or cotyledons; these together constituting one grand division of the vegetable kingdom, which he afterward subdivided, as will be shown presently.

The other grand division he called *vasculares*, from their varied and more complex physical structure, otherwise *cotyledones*, from the circumstance of their seedlings germinating with the appendages of seed-leaves. On a further examination of this grand division, Jussieu found that it was divisible into two classes:—certain plants rising with *one* cotyledon, and others with *two*; hence the first he called *monocotyledones*, and the second he termed *dicotyledones*. In this last, which comprehends by far the greater number of the most useful and beautiful plants, he found it necessary, for the more easy arrangement of the numerous genera and species, to have recourse to certain parts of the flowers which were the least variable, to typify other divisions, which he called subdivisions, two in number, and which are again separated into sub classes.

A scheme of the natural system may be sketched thus:

There are *two grand divisions*:—first, the CELLULARES, which contains two classes, *Aphyllæ* and *Foliaceæ*:—and, secondly, the VASCULARES, which also contains two classes, *Monocotyledoneæ* and *Dicotyledoneæ*.

The two classes of Cellulares are again subdivided into orders containing one or more genera, having titles derived from the names of some one of the genera that is typical of the order.

The second class of the Vasculares is divided into *Monochlamydeæ* and *Dichlamydeæ.* The subdivision Dichlamydeæ, is again divided into three sub-classes. The second grand division comprises every kind of flowering plant, all bearing the general title of *phanerogamia.*

The first class monocotyledoneæ, the subdivisions monochlamydeæ and dichlamydeæ, are also divided into genera on the same principle as those of the grand division Cellulares.

These particulars will be more fully explained in the succeeding review of this ingenious system, when we shall study to make the whole as plain as possible.

Returning then, to begin with the lowest order of plants, we cannot resist quoting from a late writer what he has offered as an apology for extreme plainness in botanical dissertations. "Much of the arrangement," says he, "seems very natural, and most of the terms highly expressive: and why should not English names be as carefully defined as those of Greek and Latin? for although not all so classically elegant as some of our botanical nomenclature is, they are equally intelligible, and far more euphonous, than many semi-barbarous technicalities: sufficient is it for our present purpose, that they are generally known, as we merely propose to use the most familiar terms; because, although many persons are well versed in botanical language, to many it may be otherwise and obscure. Who is there who has not, at some time, felt the galling yoke of technicalities? Who is there that has not found, that to learn a science, and at the same time to be obliged to learn a language, is indeed to have the tale of bricks demanded, while the straw to make them is denied. We shall, therefore, in order to lessen this evil, in conjunction with the scientific names employ the common English synonymes, whenever such exist."—Bur.

ACOTYLEDONES.

CLASS I.—APHYLLÆ.

FUNGI.

In descending to the lowest point of vegetable life, we are stopped at that barrier beyond which our ocular powers cease to serve us. That many genera of the fungi are inconceivably minute, we are well aware of; many indeed so small, as to be only known by their effects; their presence being indicated only by a discolouration of the body or surface on which they grow. Individually they are invisible; but as they appear in legions they come into view.

Such are the rust on corn, the moulds on stale bread or cheese, on cloth, or other matter. Indeed there is no kind of decayed or decaying animal or vegetable substances but attract and become the prey of one species of fungus or other. On this account they have been well called and considered as the *scavengers* of nature; for no sooner does any animal or vegetable matter become useless or poisonous to animals, than it becomes a bait for the *fungi*, which devour and decompose the noxious matter, and thereby render it wholesome food for the vegetation of the following season.

But how, it has been asked, are such myriads of *fungi* disseminated? The answer is, by the vapour-like and wandering habits of their *sporules* which float about in the atmosphere in countless numbers, only waiting for the presence of a fitting soil on which to alight and grow. It is supposed that *fungi* never fix upon any substance which is healthy. That some pre-existing disease or disorganisation must invite the attack; and it is a most wonderful provision of nature, that the vast hosts of *fungi* do not appear till that period of the year, when vegetation is on the wane, shedding its leafy honours, and flowers, and fruit; and when many of the insect tribes have danced away their fleeting life in the solar beams, lie down to die on the cold and humid earth, that the *fungi* come forth to seize and clear away those noxious exuvia of recent life, lest accumulated corruption should taint the vital air, or render sterile the fruitful bosom of the earth.

The peculiarity of their agency, says Lyell, consists in their power of suddenly multiplying their numbers, to a degree which could only be accomplished in a considerable lapse of time in any larger beings, and then as instantaneously relapsing, without the intervention of any violent disturbing cause, into their former insignificance. Our admiration is strongly excited when we contemplate the powers of insect and fungus life, in the creation of which nature as been so prodigal. A scanty number of minute individuals, only to be detected by careful research, and often not detectable at all, are ready in a few days or weeks to give birth to myriads, which may repress or remove the deleterious matter. But no sooner has the commission been executed, than the gigantic power becomes dormant ; each of the mighty host soon reaches the term of its transient existence ; and when the fitting food or offal lessens in quantity, then fewer of the spores find soil in which to germinate : and when the whole has been consumed, the legions before so active, all return to their dormant inactive state.

But it may be asked, how is it in the case of *rubigo*, the red rust, or blight on wheat, to be accounted for ? On one day, the whole field looks healthy and promising, the straw of a bright golden glossy appearance, and the ears nearly filled; in a few days afterwards, the golden hue is changed to a dead white; instead of the bright gloss, ranks of black lines soil the surface and change it to a dingy shade; the magnifying glass applied shows thousands of little mushrooms, ranged in lines or bursting out in tufts, checking and exhausting the current of the sap, and robbing the grain of half its bulk. What is it that invites the attack in this case? Practical experience has taught us to answer this question. The plants have received a sudden check from a night frost, or from a day or two's prevalence of clouded skies, and a humid stagnant atmosphere; the sap is arrested in its ascent, becomes tainted or corrupt in quality, and consequently a favourite bed for the support and encouragement of the *fungi*. This is a case, however, in which we cannot reconcile ourselves to contemplate with gratitude the general good performed by these minute plants; because in this, their interference is apparently a misfortune. But here, we must not mistake the effect for the cause. The corrupted sap might be as prejudicial to the grain as its extraction by the *Uredo*.

This and other species of *fungi* are very peculiar in their aspect and character. They are destitute of external organs; they have neither flowers nor leaves, nor any members which show the slightest resemblance to them, and even their stem, when present, is unlike the stem of other plants. In their colouring they are remarkable; nature, having withheld from them those flowers which form the chief beauty of the higher orders of plants, and even the leaves with which they are clothed, has profusely scattered her colours over the whole surface of the mushroom; ornamenting the cap with one colour, the gills with a second, and the stem with a third, and often blending in stripes, or shading two or three tints into each other, as in *Agaricus psittacinus*. Many, indeed, of the fungi rival in symmetry and splendour the tulip and the lily.

But they are a degraded and neglected family of plants; for so long as they are only known by the names of blight, blasts, brands, rusts, moulds, puff-balls, toad's-stools, mildews, &c., no high opinion is entertained of them; and very few are interested in becoming acquainted with the products of corruption. Some of the moulds are even poisonous; and very afflicting accounts are on record of whole families being poisoned by eating mouldy provisions. Here however, we should pause, and not attribute to the fungi what is really occasioned by the half-putrified and unwholesome state of the viands. The presence of the fungi should rather be esteemed as a providential sign of the deleterious quality of the body they grow on, to warn the consumer to be on his guard against its use.

One of these fungi, under the name of smut, destroys the nutritious flour of the wheat and other grain ; and when ground with the sound grain renders both flour and bread unpalatable and unwholesome. This is very different from the rust which affects the straw; for this last only lessens the quantity, but hurts not the quality of the grain.

The smaller species of fungi are so very numerous, that, it is not in our power to add their names, save as we have already done, under their vulgar or provincial English names. But as the species increase in size, they become more familiar, especially as some few of them are dietetic.

The mushroom (*agaricus campestris*), the morel (*morchella esculenta*), and the truffle (*tuber cibarium*), are universally known as articles of diet in one shape or other. The first is extensively cultivated, and though there are many species of the mushroom which are eatable, they are all more or less dangerous, especially if produced on damp ground. Indeed, too much caution cannot be taken in gathering mushrooms for use, as there are several unwholesome species which resemble the true one. The truffle and morel are only used in high cookery, and are not yet in cultivation in this country.

We may mention one other fungus, which has some interest attached to it, in consequence of its value as a medicine. We mean the ergot of rye (*Secale cornutum*). This fungus takes possession of the grain, while in its milky state, and causes it to swell much beyond its usual size, in shape like a horn. The meal is changed to a grey powder, and remains within the unbroken husk. The ergot appears sometimes in this country, but it is very common in Spain, and in the south of France, where it is collected for the supply of European druggists. Where rye is employed as a bread-corn, the ergot is a dangerous ingredient: for when in excess, it is a fearful poison.

Three of the principal orders among the fungi are *boletales*, or mushrooms, the *tuberales*, or puff-balls, and the *mucedinales*, or mildews. Some of the puff-balls grow to the amazing size of three feet in diameter. The mildews are frequent on the leaves of many plants, and on the points of the young shoots of peach, and other fruit trees. Some of the mushrooms grow to a very large size, but they are dangerous kinds. The external organs of the mushroom are the *volva*, or wrapper ; the *stipes*, or stalk ; the *veil*, which becomes an annulus round the stem ; the *hymenium*, or gills, which contain the *asci*, or spore cases, and the *pileus*, or cap. See *Pl.* 26, *f.* 2 ; *a*, a section of the pileus.

ALGÆ AND LICHENES.

The algæ or flags are many of them sea-weeds, and hence their vulgar name, because, on the retiring of the tide, they flag down upon the rocks or sand on which they grow. On land, and especially on uncultivated ground, they clothe the surface, climb up on rocks, and inhabit the trunks of old trees. They are usually shapeless masses of leather-like expansions clinging close to the bodies on which they grow.

As a class, the flags are divided into orders, sections, and genera; and among these are found some of the most curious living structures which are as yet known. Here are protophytes, just emerging from lifelessness to life, and beings which, almost animals, are yet most certainly real vegetables. Some of these flags are so simple and diminutive, that it is difficult to say whether or not they are flags or fungi; some of them, as the slimy matter seen on rocks and stones, on gravel walks, and on the glass of windows, however, diminutive, consist of curious and most admirable vegetable structures. The green coating on trees and palings is composed of an infinite number of small plants of an exceedingly curious formation.

Among the lowly flags is the "red snow," often seen on northern mountains, and which is found to be a small plant, called "*proto-coccus.*" This, as well as the gory dew (*Palmalla cruenta*), bloody rain (*Hepraria kermasina*), and many other sudden appearances on the earth, or in stagnant water, are only aggregations of minute flags, which occasionally come into view, and as suddenly disappear. These are in the very lowest grade of this order, and, when magnified, appear only like an association of transparent globules.

The sea-weeds (*fucales*), the lavers (*ulvinæ*), and the kelpware (*fucinæ*), are generally water plants. The lichens, on the contrary, are universally aerial, and found, as already observed, on rocks and trees. The history of the fuci, as yielding iodine and kelp, two such valuable articles in medicine and commerce, affords an instructive lesson to those persons who hastily and presumptuously condemn all things as useless, the use of which they know not; for that very weed confers great benefits on man; that flag, the gathering of which for years enriched both peer and peasant on our northern coasts, the very flag that now "affords the iodine, which really does relieve that evil which the boasted royal touch so long has failed to cure."—*Bur.*

The decompositiou of the algæ on the rocky surface forms in time a layer of mould, in which useful herbs, and ultimately stately trees, are raised to clothe the earth; many of the flags are medicinal, and one or two are fodder for the rein-deer. Of the algæ we have figured *Oscillatoria urbica, Pl.* 26, *f.* 1; *a*, the natural size; *b*, powerfully magnified.

The *algæ, lichens*, and *fungi* form together the second class of Jussieu's second grand division of plants, namely, Cellulares, which he divides, as we have stated, into, first, *foliaceæ*, being leafy, and secondly, *aphyllæ*, leafless; both classes being entirely cellular, and springing up from their spori or seeds, destitute of seed-leaves; hence they are also called *acotyledoneæ*. Of the Lichens we have given an illustration, *Pl.* 26, *f.* 3, the Easter Stereocaulon (*S. paschale*).

The leafless class we have already noticed in the preceding pages, and now proceed to remark on the six orders of the class foliaceæ.

CLASS II.—FOLIACEÆ.

HEPATICÆ.

The hepaticæ are the first remove above the leafless cellulares, and are small creeping plants, with leaves arranged like scales. They differ from lichens in structure, colour, and in fruit, and from mosses in the opening of their capsules. They are the connecting link between the flags and mosses. There are six genera and nearly one hundred species. The genus Jungermannia is one of the most extensive, one of which *J. Pinguis*, we have figured at *Pl.* 25.

These plants are mostly furnished with fructiferous *theca*, sometimes imbedded in the frond, or raised on stalks, or pedicels. They are mostly obscure plants, growing in damp situations, or on moist rocks or trees. None of them are poisonous; their taste is mild; some few are fragrant, but not possessed of any very sensible qualities, nor have they been applied to any useful purpose economically. The marchantia, another genus, is more especially called liverworts; hence the *signature* physicians attributed wonderful curative powers to these plants, especially to the *M. polymorpha;* the lobulated fronds of which species, from a fancied resemblance to the liver, caused it to be esteemed as a specific in jaundice, and other hepatic complaints. Though neglected as a medicine in this country, it is still used in others; it appearing to possess considerable virtues. The riccia and targionia are two other curious genera belonging to this order.

MUSCI OR MOSSES.

This order contains thirty-seven genera, and above three hundred species. They are very common lowly plants, mostly growing in the cold season, and in cold countries. They are easily distinguished from the liverworts, by the possession of an *operculum*, or lid, which covers the *urn*, or theca, in which are contained the seeds or sporules. The mosses are distributed into three sections, which are distinguished by the different manner of the dehiscence of the urns. The generic or essential character of the mosses is in having the bottom of the axis prolonged into a fibrous root; the ascending axis is called a *surculus*. The regular divisions of the surculus are called branches, and the foliaceous appendages are the leaves. Under the leaves there are little expansions called stipules. The urns or theca, borne by these plants are closed by a lid, and covered by a veil, or *calyptra*. This last opens in different ways by long or short clefts, or not opening, remains to be broken up by decomposition. One of the most minute mosses is the genus phascum of which there are thirteen species described, and though small are all very beautiful. The sphagnum is a rank growing genus, and with the hypnum triquetrum,are the kinds so much used for packing. Both this and the bryum are known by their deciduous operculum. Mattresses and brushes are made of the prepared stems of the polytrichum commune, and in Lapland this moss serves the inhabitants for both bed and bedding. They choose the starry headed plants; out of the tufts of which they cut either beds or bolsters, separating the moss in flakes from the earth, and of which whole beds and bolsters, and even coverlets, are made ; these natural fabrics, being elastic, are most agreeable couches, and are perfectly free from every kind of vermin.

Among the mosses we find the curious genus chara. They are leafless plants, but have whirled branches, and are remarkable for the counter currents of their sap observable in their jointed stems, and which exhibit a constant circulation, not from the bottom to the top of the stem and back again, but only to and fro between the nodes or joints of the stems. The chara are also remarkable for their power of depositing upon themselves the carbonate of lime, with which they become completely incrusted; hence they are called *stoneworts.*

A remarkable property of the mosses is their tenacity of life. They may be kept in a dry cabinet for scores of years, and if afterwards laid in a damp place, and moistened with water, they will quickly revive, and grow again as well as ever.

MARSILEACEÆ.

The marsileaceæ is another order belonging to the foliaceous cellulares, containing four genera, of which there are one species of each in British lists. The genus *isoetes,* or quillwort, is a native of Britain, and grows in marshy ground. Its stem is a kind of tuber, out of which long quill-like leaves proceed, having conceptacles of the seeds within the base of each. *Pilularia*, or pillwort, is also a British plant affecting damp ground, and differs from the preceding in having free or exposed conceptacles like pills in the axils of the leaves. *Marsilea*, or pepperwort, is an Italian plant, and resembles its congeners above, only it has but four leaves, or rather four leaflets on a stalk.

LYCOPODIACEÆ.

This order comprehends only two well marked genera, namely, *lycopodium* the club-moss, and *psilotum*, the wolf-claw-wort. In these genera the stem is elongated and trailing, throwing up slender branches, the apices being forked. The sporules are in the axils of bractea. Some of the species are useful as dyes, and others in medicine.

EQUISETACEÆ.

Of this order there is only one genus, of which there are ten species described. They are aquatic plants, or live only on moist ground. Many of the species are British, where they are provincially known as jointed ferns, or horse-tail. The structure of their stems, or *stipitella*, is elegant, being regularly jointed, with whirls of leaflets or branches arranged like a cone. The fructification is seated on spikes at the tops of the stipitella. The stems are hollow between the joints; and the interior surface is regularly decked with a deposit of flint, arranged in lines so closely set, that they take and retain the form of the stem, when the vegetable matter of the stem is removed.

The next step we take in our advance towards the higher tribes of vegetation is to give a brief notice of that curious rustic genus of plants,

FILICES.

The ferns, it will be observed, are placed ot the head of the cellular plants. They stand midway between the simplest and the more complex forms of vegetation. Though flowerless, and rising without cotyledons, chiefly cellular, they are much more highly organized than the orders already noticed, and much less so than the orders that are to follow. There are in the last published lists nearly three-score genera, and very near four hundred species, described. The stem is perennial, and creeping either under or upon the surface of the ground. In tropical countries some of the species are arborescent, and rise to the height of many feet. But whether tropical or extra-tropical, their foliage or fronds are all elegant in form, and curious in the manner of their evolution. In æstivation (that is, while enclosed in the bud) the points of the fronds, as well as those of the divisions and subdivisions of the same, are rolled inwards upon their bases respectively; and their expansion is effected by unrolling in a very beautiful manner. The fronds, though mostly pinnatified, are sometimes entire, with reticulated veins. The capsules are usually round, brown spots variously disposed on the under surface of the fronds, and sometimes compound on separate spikes.

Ferns are natives of every region of the world, and particularly of waste or uncultivated land. Nearly fifty of the species are natives of Britain. The adder's tongue (*ophioglossum*) is a small plant, and frequently found on clayey pastures. The largest of the British species is the osmunda regalis, or flowering fern; its root being used medicinally. The trichomanes and hymenophyllum are beautiful plants, but only flourish in a wild state. One species of onoclea has fronds as delicately divided as the plumes of the ostrich, and has been specifically named *sensibilis*, shrinking as it is said, from the approach of the evil doer. The brakes or frondose ferns are only useful for litter, or for covering tender plants: one species, the aspidium filix mas, is medicinal. The fabled Tartarian lamb is an aspidium, of which most wonderful tales have been told. A lively imagination can make any thing of a grotesque looking plant, especially a shaggy fern. The Medico-Botanical Society of London possess a beautiful specimen of this fern; and, though a very curious production, it is no more like a lamb than it is like a young bear; but when the fronds are cut off, the *rhizoma*, or horizontal stem, being shaggy, has some distant resemblance to the body of a fur or wool-covered animal.

The common eagle-brake (*Pteris aquilina*) is one of the most common on our commons, and forms one of the finest covers for game; and their ashes, from the alkali they contain, are much used in the manufacture of soap and glass. The wall-fern, or polypody of the oak (*polypodium vulgare*), is used for the same purposes. See *f.* 4, *Pl.* 26, showing a portion of the extremity of a frond.

The ferns are arranged by cryptogamists into five tribes, namely, polypodiaceæ, gleichenicæ, osmundaceæ, ophioglosseæ, and poropterides; which tribes are distinguished from each other by the forms and manner of opening of the conceptacles, or of the fructification being or not being compound.

Quitting the cellular grand division, we enter next on the simplest forms of the *cotyledoneæ;* that is, those plants which are partly vascular, and which rise from perfect seeds, with one or more cotyledons. Those plants which we are about to allude to rise with *one* seed leaf; hence the class in which they stand is called *monocotyledoneæ.*

MONOCOTYLEDONES.

The germination of the monocotyledons is exhibited thus: a spur-like process bursts through the coat or *testa* of the seed, and after being more or less lengthened, turns downward into the soil, and emits a fringe of root-fibres. In the mean time a bud appears upon the spur-like process, either close to the seed, as in the cocoa-nut, or nearer the fibrous end, as in pancratium and mistletoe, which soon bursts and displays a *single leaf,* showing its classical character. From the bosom of this single leaf other leaves, and the point of the *plumula,* or young stem are evolved; the part behind the bud and empty testa rotting away, leaving the young plantlet free and independent.

This mode of germination is the circumstance on which Jussieu founded the class *monocotyledoneæ;* and which is certainly a very natural mark of distinction, and designates all plants belonging to it with great accuracy.

GRAMINEÆ.

The grasses are one of the most common, and in their structure most simple, of all plants; but at the same time certainly the most universally useful. One hundred and fifty-eight genera, and above one thousand species, have been described. Here are lofty trees, as the bamboo, and the most lowly of herbs; the richest extracts, as sugar; the most fiery spirits, as alcohol; and the most nutritious meal, as that of wheat and other cereals. Equally important is the green carpet of the earth, formed by this social tribe of plants, which keeps our steeds, and fills our stalls as well as our garners. The grasses are too well known to require further description. See *Pl.* 28, sweet-scented grass (*Anthoxanthum odoratum*), which imparts that grateful odour emitted by new-mown grass. Next to the grasses are placed the

CYPERACEÆ.

The sedges are somewhat similar in point of structure, but altogether different in point of value, being mostly worthless plants, inhabiting barren ground. There are above twenty genera, and nearly three hundred species. Some of them are useful to the mat and chair-makers. The papyrus, or paper of the ancient Egyptians, was manufactured from the stems of *papyrus* *antiquorum*, a common plant in the Nile. Some of the roots are fragrant; but they are a neglected, and by no means a favourite tribe of plants. Next to these come the

RESTIACEÆ,

Partaking the character of the cyperaceæ, being rough inelegant plants found mostly in the southern parts of the globe. There are nine genera, none of which deserve particular notice.

GILLIESIEÆ,

An order containing only one genus, instituted by Dr. Lindley, and which, he says, is a small grassy looking plant, a native of Chili:—its flowers are greenish yellow.

JUNCEÆ.

The rushes are the next order of monocotyledoneæ. They present us with the first approach to a regular perianthium, as we ascend in the scale of vegetation. There are seven genera, and above seventy species. Most of them are worthless weeds, though some of them, as the xyris and narthecium, have pretty yellow flowers. Xerotes resembles a low palm.

FLUVIALES.

This order is a further advance towards

complicated structure. They are chiefly, as indicated by their title, aquatics; and have separate flowers, one-seeded carpels, and intra-foliaceous vaginæ. The potamogeton, ruppia, &c., are British plants, and common in rivers and ditches; and so are the lemna, or duck's-meat, which mantle every stagnant pool. Next to these we find the

AROIDEÆ.

The plants associated here give evidence of a further progressive change in organization. Among them we find pothos, dracontium, acorus, caladium, &c.; also the well-known wake-robin or cuckoo-pint (*Arum vulgare*), See *Pl.* 27; *a*, the spadix surrounded by its spathe; *b*, stamens borne by the spadix on its higher part; *c*, ovaries inserted into the lower part of the same spadix; *d*, a berry; *e*, a divided seed, in which is seen the cyliudrical embryo, in the middle of the fleshy perisperm. The roots of many of the arums are eatable after baking or boiling: those of the wake-robin are prepared and sold under the name of Portland sago; and the leaves of the caladium esculentum are used as greens in India. The above figure gives a good idea of the flowers of many of the genera.

TYPHINÆ.

This order contains only two genera, namely, the reed-mace (*typha*), and the bur-reed (*sparganium*), which form together a type closely allied to the cyperales; for in the stamineous flowers the scales of the perianth are irregular, but in the pistilline ones the sepals are verticillate. The flowers are triandrous, single superior ovary, and pendulous solitary ovule. The typhas are not known to possess any properties different from the ordinary sedges, and are always found in company: it is the reed that painters usually figure in our Saviour's hand. The bur-reed is also found in pools, and is a rigid useless plant. The next family of plants we meet with in our ascent is the

PANDANEÆ.

The screw-pines, which are natives of the alluvial lands of Malacca, and other parts of the East, are, when full grown, magnificent objects. Their dense whirls of long narrow leaves, elevated on compound stems, give them all the port of palms. Their flowers are highly fragrant, and a valuable perfume is manufactured from them. Their fruit is eatable, but inferior, and only used on occasions of necessity. The leaves are applied to many economical purposes, as basket-making and thatching, and the soft spongy roots are used for corks. There is one other genus (*phytel-phas*), united with pandanus, but it is a less useful plant.

PALMÆ.

This splendid order of exotic plants were called by Linnæus the "princes of vegetation," and certainly they well deserve the title. Whether we consider their altitude, their noble crown of fronds, their valuable fruits and useful timber, or whether we consider them as forming the finest feature in tropical scenery, they are in every respect admirable. The palms were always considered as a distinct order of plants, and distinguished by a peculiar name which they have always retained. They are arborescent, and, like the rest of their class, rise from the seed with but one cotyledon, as has already been explained. In general they have simple cylindrical stems, and rarely branched. The stem is formed of the bases of the leaves, these being permanent, while the points wither and consecutively drop off. New fronds are ever rising from the centre of the trunk, and therefore the latter is truly endogenous. The enflorescence is in large clusters or racemes, bractiated and often involved in a spatha. Each flower has a kind of calyx and corolla; the stamens frequently six, rarely three; the styles are three, often connate; stigma simple; germen superior, three celled, two or one of these cells often abortive; cells one-seeded.

Palms differ, and are distinguished from arboreous ferns by their flowers, and from cycadaceæ by their endogenous structure and covered seeds. Forty genera, and one hundred and thirty species are already described in our recently published lists; and one traveller imagines that there are several hundreds in South America yet to be described.

The date palm (*Phœnix dactylifera*) is one of the most valuable as a fruit tree; as all over Syria, Arabia, Persia, and the neighbouring countries, it is a chief article of native subsistence both for man and beast, the camels being fed with bruised seeds. The cocoa-nut (*coccus nucifera*) is also extremely useful to the inhabitants of the countries where cultivated or growing naturally, which it does in many places of the East. Its nuts yield kernel, milk, and cream, as the different states of the hardening kernel are called; the shells serve for making small drinking vessels; a refreshing beverage (after fermentation) is supplied by the sap, which distils from the point of the excised racemes, called toddy; and from which an ardent spirit is procured by distillation. A valuable oil is expressed from the kernels; and the stem, from its great length and rectilinear form, is useful for edifices of any kind, the timber, though of very coarse grain, being very durable.

The *Calamus scipionum*, and *C. rotany* yield the canes called rattans. The cable-cane (*Ca-*

lamus rudentum) exceeds in length all other palms, or perhaps, any other vegetable; some have been met with five hundred feet in length. Like other reed palms they are applied to many useful purposes. Sago is manufactured from a pithy substance procurable from the stems of several palms, particularly from that of the *Sagus Rumphii*. The *Raphia vinifera* yields, when wounded, sap which when fermented is an intoxicating liquor. The doum-palm of Upper-Egypt is remarkable for its twice-divided stem, which is a rare characteristic in this tribe of plants. The doum-palm (*Cucifera thebaica*) also yields an useful fruit. One of the handsomest palms, the *borassus flabelliformis*, bears a very large fruit, and affords an abundant flow of sap by tapping, and from which sugar is obtained, or fermented into wine.

The talipot palm (*Corypha umbraculifera*) has already been described: but there is another, *C. Taliera*, in Northern India, which is almost as useful as the talipot of Ceylon. The *areca catechu* affords the betel-nut, which is so much used as a masticatory or quid in India. A slice of betel wrapped in a leaf of the betel-pepper, enclosing a little *chunam* (red lime), is kept in the mouth for exhilirating the spirits, and for allaying hunger. *Areca oleracia* is the cabbage palm of the West Indies, the young heart leaves being used like coleworts. It is




the tallest of all their palms, often rising two hundred feet high. Besides the above, there are many other species which are of the greatest importance to man, as furnishing him with so many dietetic and medicinal extracts, and materials for his convenience.

COMMELINACEÆ.

The next order above the palms is commelinaceæ, an humble tribe, but superior to the palms in organization. Eight genera are associated here, of which there are seventy species. They are mostly natives of America; and some of them, particularly dechorezandra and tradescantia, are fine flowering plants. As a type of the order, we give a figure of the flower of the common spiderwort (*Tradescantia virginica*), *Pl.* 29; *a*, summit of the stem; *b*, the calyx, stamens and pistils; *c*, the pistil only; *d*, the fruit surrounded by the persistent calyx.

PONTEDEREÆ,

A small association of aquatics, natives of America. Pontederia, heteranthera, and leptanthus are the genera, of which there are ten species. They are elegant in form, with cordate leaves, and central spikes or racemes of blue flowers.

BROMELIACEÆ.

This order comprises several well known

genera out of the twelve which compose the group. They are almost all rigid looking plants, with long sword-shaped, jagged, lepor-ous-coloured leaves, with minute white scales. The American aloe (*Agave Americana*) is a universally known green-house ornament, having been long cultivated in this country, where they occasionally flower, and are exhibited as a rarity. As to the old error of these plants requiring one hundred years to perfect their flowers, it needs no contradiction; because in their native country they arrive at a flowering state in about four years, and in this country they might be made to flower in as short a time, provided the necessary temperature were applied. In tropical countries very efficient hedges are made of them; although a gap is made by every flowering individual dying down with the stem, leaving only a small sucker or two to succeed. But the most celebrated plant in this order is the cultivated pine-apple (*Ananas sativa*), which is now brought to so great perfection in this country by artificial means; to a perfection both in weight and flavour, far superior to any raised naturally in tropical gardens. The pine-plant is very fertile in progeny, multiplying itself by seeds, crowns, and suckers; and presenting the curious fact that its stem may be infinitely extended; there being no pause at the place where the flowers and fruit are produced, as is the case with the agave, and many other plants. It is a practice in Mexico to scoop out the central leaves of the agave to form a basin, into which the sap collects, to be ladled out as it is wanted for the labourers' drink. When this liquor is fermented, it is inebriating, and is called *pulque*, of which great quantities are made for sale. The Pitcairnia and Buonapartea, plants of no beauty, belong to this order.

MELANTHACEÆ,

An order of herbaceous plants with inconspicuous flowers, many of them possessing qualities of very suspicious character; though these qualities are often found useful to the pharmacopeist; for instance, the veratrum and colchicum; the bulbs of the latter forming the base of the eau medicinale so celebrated for relieving the tortures of the gout. The veratrum is said to have been the hellebore of the ancients. Some of the genera have ornamental flowers, as the uvnlaria and bulbocodium; but the generality are of little or no account.

TULIPACEÆ.

Of this gaudy order there are eight genera and as many as one hundred and twelve species described. The stately yucca or Adam's needle, with racemes thickly hung with pale yellow bells; the branched lilies; the scandent gloriosa, the varied tulip, and the modest erythronium, are all denizens of the flower garden, and all favourite objects of the florist's care. They all are so much domesticated and so well known, that no particular description is required of them, especially as a type of the order has been shown on *Pl. 7*.

ASPHODELEÆ.

This is an order containing above fifty genera, of which there are above five hundred species, chiefly natives of temperate latitudes. Many of the genera are nearly allied to the order hemerocallideæ, and a considerable portion bear some affinity to the tulipaceæ or liliaceæ. The species are all pretty, and many are handsome; some with bulbous, others with tuberous or fibrous roots. The hyacinth, scilla, and gagea, are among the beauties: the allium (onion), and asparagus, and phornium, the lily-flax, are among the most useful. They are mostly hexandrous.

SMILACEÆ.

The plants in this order are verging near upon the asphodeleæ as well in station as in organization. The genera are all curious; some exceedingly fragrant, as the lily-of-the-valley; and others are elegant, as the trillium. The roots of several species form the sarsaparilla of the shops.

TAMEÆ.

A solitary genus of two species constitutes this order, showing it to be of so peculiar a conformation that it cannot be associated with any other order. The *Tamus communis* is the black bryony of English Botany; a common hedge plant with climbing stems, and large tuberous roots.

DIOSCOREÆ.

This is also a small order containing only three genera, of which there are thirty-seven species. They have all climbing stems, with broad heart-shaped leaves and large fleshy roots. The yam is the type of the order, one of the most useful of tropical esculents. The tuber is irregularly round, and as large as a child's head; the skin is rough and dark coloured, but the interior, when dressed, is mealy and beautifully white. Yams grow naturally in Ceylon and in Sumatra, and other oriental islands; but are cultivated in many parts of India. Another curious genus belongs here, namely, the elephant's foot (*Testudinaria elephantipes*). The roots of this plant are slender fibres, proceeding from the tuber which lies on the surface of the ground. It is of a woody consistence and annually enlarged, the outer bark being regularly split into square lozenges, which every year become more projecting from the surface. Every year's growth is so visibly marked on the sides of the lozenges, that the age of the plant is as truly marked as if written with a pen. By this means, some of the old wild plants at the Cape of Good Hope have been calculated at two hundred years old. The stems are slender and flexible, bearing heart-shaped leaves with racemes of small flowers in the axils.

HEMEROCALLIDEÆ.

The hemerocallis, or day-lily, gives a title to this order; and as they may be met with in every garden, specimens of the flowers may be applied to for the character of the order. The type has many fine plants in its train; the agapanthus, polianthus, blandfordia, aletris, &c., are all choice flowering plants; then there is the numerous family of aloes, that are so curious in form, so gay in blossoms, and so valuable in medicine. The next order in our ascent, is one of the most splendid in the class, namely, the

AMARYLLIDACEÆ.

The genus which gives a title to the order is of itself so truly conspicuous and attractive, that it sheds a lustre over all its congeners. The amaryllis so significantly, in the language of Scripture, called "The Lilies of the Field," together with the narcissus, so rich in species, the universal favourite, the snow-drop, the magnificent doryanthes and pancratium, crinum, cyrtanthus and hæmanthus are all splendid plants. They are almost all bulbous, and their foliage is all very similar except in size. The colours of their flowers vary from white to the deepest scarlet, and many of them are sweetly scented. They are natives of every climate; and of all other tribes are easiest of cultivation. A few of the narcissi are medicinal, and the juice of Brunsvigia is poisonous.

HYPOXIDEÆ.

The plants in this order were formerly associated with the asphodeleæ, but withdrawn on account of the inferior ovary of hypoxis. There are only three genera herein included, namely, curculigo, molineria, and hypoxis. The first and last, and their very few allies at present known, are natives of New Holland, India, and the Cape of Good Hope. They are plants of little beauty, *hypoxis stellata* excepted, and not sufficiently known, so that their value has never been ascertained.

HÆMODORACEÆ

Are perennial herbaceous plants, with bundled and fibrous roots. The leaves alternate, sword-shaped, and equitant, that is, riding on the backs of each other, like those of the iris. They are chiefly stemless, though some have dichotomus (twice divided) stems. This order stands between iris and amaryllis, having some of the characters of both, without entirely belonging to either. Many of the species are showy; the roots of several, as hæmodorum, wachendorfia, and dilatris tinctoria, yield a red dye, but they are not of much importance.

IRIDACEÆ.

The iris or flowering-flag is a well known and beautiful family of plants, which are inhabitants of every quarter of the world. The crocus, gladiolus, tigridia, and numerous other allied genera, are highly interesting, easy of cultivation, and have a place in every flower-garden. In the genus iris, the whole of the six pieces of the perianth are highly coloured, the three outer, which are reflexed and form the calyx, most so; the three inner pieces are erect, answering to the corolla; within which there are three stamens covered by three petal-like pistils, which thus mark the transition of those organs into each other. Dr. Lindley says, their medicinal properties are trifling. Iris florentina and germanica have roots, which when dry smell like violets, and are slightly stimulant, acting as sternutatories or purgatives, according as they are employed. The stigmas of the crocus-sativus form the well-known saffron for which this species is cultivated. The ixias, watsonias, sparaxis, ferrarias, antholyzas, &c., are the sparkling ornaments of the South African meadows; and several beautiful irises are natives of Siberia.

MUSACEÆ.

The gigantic fruit-bearing herb called *musa paradisaica* gives title to this order, and with which only three other genera are united, namely, urania, strelitzia, and heliconia. They are all magnificent plants, both in flowers and foliage; and the musa, otherwise called the plantain or banana, is perhaps, one of the most valuable plants which can be cultivated near the residence of man in tropical countries. The fruit, of which great quantities are produced, are eatable, whether green, for baking or boiling, or when ripe as nourishing food. A plantain-walk is indispensable to every planter, and indeed to every house or hut in the West Indies; as there are always some of the plants in fruit, and when the whole *vast bunch* of ripe fruit is cut, the succulent stem, which never flowers but once, is cut down, and sliced into chaff or fodder for cattle. There are many varieties of the cultivated musa, that called the plantain being the most robust grower, but the banana is said to have the finest flavoured fruit.

Although the plantain has been long in our stove collections, their cultivation as a horticultural luxury has been but sparingly followed, because of the great altitude of the plants requiring such lofty hot-houses. But this bar to their culture is now obviated, by the introduction, lately, of a very *dwarf* species or variety, called *musa Cavendishia*, in honour of the Duke of Devonshire, in whose garden at Chatsworth, the plaut was first fruited; and whose gardener, Mr. Paxton, is now cultivating the sort as a table fruit, with entire success.

The stem of the plantain when full grown is from four to eight inches in diameter, and rises from eight to fourteen feet high. The leaves are six or seven feet long, and two feet wide; very fragile in texture, and easily torn by wind. In a gale, the noise of a plantain walk is astounding: the foliage is shattered to ribbons, so it is seldom we see a handsome or perfect plant in the open air.

The Strelitzias, named in honour of the late Queen Charlotte of England, have rigid, smooth, spoon-shaped leaves; and their flowers of orange, and scarlet and white, are very brilliant. The fruits of some species of the heliconia and urania are eatable, but not so much esteemed as the banana.

CANNEÆ.

This order occupies the first class and order of Linnæan Botany, and contains five genera, and above four-score species. The canna, or Indian-shot, is a well known stove or green-house exotic, bearing spikes of scarlet coloured, irregular formed flowers, in which the filaments, instead of being generally like threads, are what Botanists term *petaloid*, that is, resembling the petals of the corolla. The maranta arundinacia belongs to this order, and is the plant which contains so much nutritious fæcula in its root-stock, and from which the celebrated arrow-root is manufactured.

SICTAMINACEÆ.

An order of reed-looking plants, some of which are valuable for their fine aromatic properties. There are eleven genera, and above one hundred and twenty species. Some of the hedychiums, alpinias, globbas, &c., are highly ornamental plants, and the most useful ones are those yielding ginger, galangale, costus, zedoary, and turmeric. The last is useful for dying yellow; and is also a principal ingredient, along with ginger, cardamoms, and similar spices, in compounding the famous currie-powder of the East Indies. They are all cultivated in our stove collections, or by artificial heat.

ORCHIDACEÆ.

This is a very distinct and remarkable tribe of herbaceous plants. There are above one hundred genera, and four hundred species already described. Some of them have tuberous stems, seated, and increasing themselves in the earth ; many are epiphytes and grow on trees ; and a few, if they by accident are suspended in the air, continue to grow and flower without assistance from the earth, or other substance. The leaves are simple, entire, alternate, either sheathing or articulated, with nervo-striated venation, and occasionally degenerating into scales. The sepals of the calyx are in general similar, the odd one uppermost ; the petals of the corolla vary in form, the upper petal, which by the twisting of the seed-vessel becomes apparently the lower, is called the *lip*, as the two lower sepals, which become from the same cause uppermost, are named the *helmet*. The lip, or labellum, which is often lobed, and assumes a great variety of forms likened to flies, bees, men, monkies, was called in the Linnæan school the nectary. The stamens are three, becoming by abortion two or one, united with the pistil, forming a fleshy column which surmounts the ovary. On the apex of the column there is found a two-celled anther, and on either side an eminence marking the abortion of the other two. This is a distinction of one section of the orchidaceæ; another distinction is, when those which are abortive become developed, and others remain inactive. The pollen contained in the anthers is sometimes powdery and free, but more frequently waxy or granular, with the grains cohering in masses, and these have often prolongations called caudicula, or tails by which they are attached to a viscid gland. The formation of the flowers of all the orchidaceæ is so singular, and the mode of action of the organs upon each other is often so obscure, that much attention is required in the study of them so as to ascertain the tribes and genera to which they belong.

The orchidaceæ are no less remarkable for their forms than they are admired for the elegance and rich beauty of their blossoms. Out of the most grotesque habit, flowers of matchless brilliancy of colouring are produced. The cattleya is as vividly coloured as any other flower whatever; while some others are as hideously marbled with dull and lurid hues as can well be conceived. Almost all the South American species are remarkable, either for their modes of growth, distorted figure, or beauty of flowers. As a sample of elegance and beauty of our indigenous orchidaceæ, we have only to instance the lady's-slipper (*cypripedium calceolus*), a much admired plant; so much admired, indeed, even by the shepherd boys, that it is almost extinct, except in gardens where it is carefully protected. The orchis, of which there are so many species in our moist meadows, are very interesting plants, and seldom escape the notice of any lover of flowers.

We present a figure of *Epidendrum guttatum*, *Pl.* 30 ; *a*, fragment of a stem ; *b*, the pistil and stamen ; *c*, the pollen. Vanilla is the produce of the old *E. vanilla*, it is used for flavouring chocolate, and also for perfuming snuff.

Orders JUNCAGINEÆ, and BUTOMEÆ, and ALISMACEÆ are three orders of aquatic plants. The first contains two genera of insignificant bog plants, with slender leaves, and central racemes of greenish flowers. The second contains also two genera ; one of which is the *butomus*, or flowering rush of English Botany, considered one of the most handsome of British plants. The third order contains three genera, namely, *sagittaria*, *alisma*, and *actinocarpus*. Some species of all three are frequently met with in ditches.

HYDROCHARIDACEÆ.

This is another order of aquatic plants, comprising four genera, and of which there are only five species. Two of the genera, namely, hydrocharis, the frog-bit, the water-soldier (*Stratiotis*), are British. The other two are foreign; but one of them vallisneria, an Italian plant, has something so curious in its history as to deserve remark. The plant grows in rivers, and roots in the mud; the female flowers have long spiral peduncles, which can shrink or elongate themselves according to the depth of the water. The male flowers have no footstalk, but are seated on the crown of the roots. When the female flowers are ready to open, they mount to the surface to enjoy the light and heat of the sun, and there expand. About the same time, the male flowers quit their hold below, rise to the surface, and floating loosely, are blown about by the wind among the female flowers, and where the necessary contact can hardly fail to take place. Dr. Darwin in his "loves of the plants," has the following beautiful allusion to this circumstance:—

"As dash the waves on India's breezy strand,
Her flush'd cheek press'd upon her lily hand,
Valisner sits, upturns her tearful eyes,
Calls her lost lover, and upbraids the skies;
For him she breathes the silent sigh, forlorn
Each setting day; for him each rising morn,—
Bright orbs, that light yon high ethereal plain,
Or bathe your radiant tresses in the main;
Pale moon, that silver'st o'er night's sable brow;—
For ye were witness to his parting vow!
Ye shelving rocks, dark waves, and sounding shore,
Ye echoed sweet the tender words he swore!—
Can stars or seas the sails of love retain?
O guide my wanderer to my arms again!"

When the contact has taken place, the female flower withers, and gradually sinks to the bottom, there to ripen and shed the seeds. It was the opinion of the late Mr. Sweet, F.L.S., that this plant might be kept in a hot-house cistern, if roots or seeds could be had from Italy.

CYCADACEÆ.

This order contains only two genera, but they are very peculiarly formed plants. They can neither be called trees, nor shrubs, nor herbs. For though they have the appearance of dwarf-palms, the interior fabric of their stems is totally different; showing them to be a connecting link between the dicotyledonous or exogenous, and monocotyledonous or endogenous structure. On this account they are placed among the most perfect orders of the class MONOCOTYLEDONEÆ, in conformity with common usage; though there are well-founded doubts, whether or not cycadaceæ should not have been placed among the lowest orders of the DICOTYLEDONEÆ.

The genus cycas is a native of India, and of which there are several species. They have pectinated fronds expanded in the manner of some of the ferns; are very rigid and durable, and all evolved from the collet of the roots. The other genus, zamia, is fonnd at the Cape of Good Hope, and is an uncommon looking plant, throwing up consecutively, perhaps periodically, sets of harsh, pinnated leaves from the centre of a thick squat stem, shaggy with the remains of former leaves. The fructification is lateral, and diœcious, the flowers on both the male and female plants being borne on a spadix. These plants are in every stove collection, and kept more for the oddity of their forms than for their flowers, which are only interesting to the Botanist.

Having finished our review of the class monocotyledoneæ, it may not be amiss to reiterate the chief characteristics of the class, and the orders it contains. The grand and principal distinction is, that all the different plants rise from the seed developing *one cotyledon* only; or if there be two, the first is below the second; as sometimes, if not always, appears in the germination of the grasses. The second distinction is, that the growth is *endogenous*, all proceeding from the centre of the plant, or from the centre of each division of a compound plant. If the growth of a tulip, narcissus, an aloe, an orchis, or of the larger genera, the palms, or bananas, be observed, every new addition to the general bulk will be seen to proceed from the centre, and without, in many cases, any discernible lateral expansion. Another circumstance identifying the plants of this class is the *venation*, that is, the manner in which the petiole, if present, is divided and disposed through or along the web of the leaf. Throughout the class we have just been examining, the main veins are seen to run parallel with each other from the base to the apex of the leaves; and this circumstance is often sufficient to indicate to the Botanist what class a given plant belongs to. The leaves of dicotyledoneæ have always a principal midrib or costa, whence the veins diverge laterally, and very different from the parallel veined leaves of monocotyledoneæ. There is also in the latter a greater proportion of cellular matter employed in their structure than is found in the generality of the dicotyledoneæ.

We now enter on a brief examination, or rather an enumeration, of the orders contained in the first class of Jussieuan Botany, namely dicotyledoneæ, or plants having a vascular organization, and rising from the seed with *two* or more cotyledons or seed-leaves; and, agreeably to our plan, shall begin at the rear of the orders as they have been heretofore enranked. Not that those which we shall first have occasion to mention are more simple in their structure than those which we mean to notice last; but only for the purpose of winding up our review, where so many other writers have begun. We consider ourselves at liberty to do this, because we do not consider it essential to the use of the natural system to study it in that series in which it was first sketched by Jussieu himself, or as it now stands, as arranged by his followers; because there is no very apparent connecting chain so indicative of affinity that confines, or should confine us, to the same orders as they are placed before us in books.

DICOTYLEDONES.

This class consists of two subdivisions; the second of which is again divided into three sub-classes, which shall be explained as we arrive at them; and first, of the

SUBDIVISION MONOCHLAMYDEÆ.

The title monochlamydeæ is a Greek compound, signifying *one bed or coat,* alluding to the circumstance of the two outer coats of the flower, namely, the calyx and corolla, being united in *one.* This is a good and easily discovered distinction, and very useful in a systematic arrangement of plants. It is not subject to variation, except among highly cultivated plants; which cultivation very soon deranges the normal or natural forms of vegetation, a fact which is perfectly obvious in respect of many of the old denizens of our gardens.

The first we meet with, is the

EMPETREÆ.

This order contains only three genera of dwarf heath-like plants, with minute flowers and berries. The crowberry (*Empetrum nigrum*) is a British plant, and common on the hills of the north. The white crow-berry is a native of Portugal.

CONIFERÆ.

If the preceding order is one of the smallest of shrubs, the present is one containing some of the most majestic and useful of our forest trees. The coniferæ, including the pines, firs, cedars, &c., seem to be peculiarly adapted as a clothing for cold northern countries, yielding necessary shelter for both man and beast. The North American species arrive at vast stature, some of them to above two hundred feet high. The spruce firs of the north of Europe are also very lofty; but the araucarias, altingias, and Cunninghamias of Australia, it is said, excel all in height and magnitude of their trunks. The Scotch fir (*pinus sylvestris*) is one of the hardiest and most useful to the builder, as it furnishes all our yellow deal, which is at once easily converted and very durable, in consequence of the great quantity of resinous sap with which the cellular and vascular members of the timber are filled. We have now, in our public nurseries and *pinetums,* a vast variety of species belonging to this order; and though many of them are heavy sombrous-looking trees, some of them are highly ornamental, notwithstanding their formal outline. The deciduous cypress (*Taxodium disticha*) is perhaps one of the most truly beautiful of hardy trees; and in its native country arrives at the greatest magnitude, and the greatest age, even hundreds of years.

The coniferæ are all monœcious, bearing catkins of male flowers, and female cones containing naked seeds. When the male flowers are ripe, a puff of wind raises a cloud of the pollen, which may be seen in bright sunshine, flying at a great distance from the trees. The products of the coniferæ, besides timber, are pitch, turpentine, Venice turpentine, gum sandarach, &c.; and a few yield eatable seeds.

As an illustration of this order we have chosen the common yew, *Pl.* 44, (*Taxus baccatus*); *a*, male catkin, scaly peltated anther; *b*, female catkin, magnified, and the same cut vertically; *c*, the outer scale; *d*, the capsule; *e*, the ovary; *f*, the stigma; *g*, glandulous tubers, surrounding the base of the cup; *h*, the capsula uncovered; *i*, the berry, cut vertically to show the pericarp; *k*, the grain.

HAMAMELIDEÆ.

A small order of hardy shrubs, natives of America, allied to the order amentaceæ. The genera are hamamelis and fothergilla. The first has some medical properties in its bark; and both are common in our shrubberies.

AMENTACEÆ.

This is a well defined natural order, the male flowers being all contained in aments or catkins. It is one of the most important of the class, from the number of useful species it contains; indeed, we may observe, that all which it comprises render, more or less, services to man. To this order belong all the lofty trees of our forests, and some of the small members of our shrubberies. We are consequently indebted to it for much of our timber, useful for building, and in the arts.

Their flowers, always unisexual, are without a perigone, and contain, in the male flowers, a very variable number of stamens, disposed in catkins, as in the chesnut. The ovary of the female flowers is protected only by a loose scaly envelope: their alternate leaves are sometimes entire, and sometimes dentate.

These members of the vegetable kingdom seem to dread the intense heat of a tropical sun, as but a small number are found in those regions, while they form dense and extensive forests in northern or temperate countries of the two continents: it is there where they attain to their greatest altitude, and acquire that substance and strength which renders them so useful for house and ship building. Their age it is difficult to determine; of some individuals their origin is lost in the ages of antiquity.

From its extent and importance, and, above all, from the difference of their botanical characters, the order has been divided into five sub-orders, namely, *saliceæ*, containing the willows and poplars; *betulinæ*, containing the alder, birch, hornbeam, hop-hornbeam and hazel; *cuperlifereæ*, containing the oak, beech, and sweet chesnut; *plataneæ*, containing platanus and liquid-amber; and lastly *myriceæ*, comprising the sweet gale, comptonia, and casuarina.

The above list of genera shows the vast importance of this order to the comfort, convenience, and protection of man; and, moreover, the fruits of some of them have been heretofore considered necessaries of life; and even now, especially in the south of Europe, chesnuts, acorns, filbert-nuts, and beech-mast, are still used as part of the labourer's fare, and in the desserts of the opulent. See *Pl.* 43, hazel-nut (*Corylus avellana*); *a*, fertile flowers; *b*, sterile flowers; *c*, a sterile flower magnified; *d*, a stamen magnified; *e*, a fertile flower separate; *f*, a group of nuts; *g*, one naked.

IUGLANDEÆ

Include two genera of American trees,

namely, iuglans, the walnut, and carya, the hiccory-nut. The nuts of the hiccory, as well as those of the well known walnut, are edible; and every where eaten as a dessert. These genera are separated from amentaceæ, because they belong to different orders of monœcia.

PEPERACÆ

Contain three genera, namely, piper nigra or black pepper, so valuable in commerce; but which are very common looking climbing shrubs with inconspicuous flowers; and piperomia, herbaceous plants of no beauty. The pungent qualities of these berries, so useful as spice, especially in the warm countries, where these plants are natives, constitute their value. The black pepper is extensively cultivated in India and the neighbouring islands, and forms a principal branch of their trade. Saururus, the lizard's-tail, is the third genus, and a native of temperate latitudes, but in qualities has nothing in common with the other two.

ULMACEÆ,

Or the elm family, are known by their definite perigynous stamens all fertile, a superior two-celled germen, and solitary pendulous seeds, foliaceous cotyledons, with simple alternate, serrate, and stipulate leaves. The order contains only three genera, namely, celtis, planera, and ulmus. Of the last there are above twenty species, the chief of which are timber trees. The celtis or nettle-tree also yields timber when full grown; though there are but few such in this country. The planera is a deciduous shrub of neither much value or use.

URTICEÆ.

This, as an order of the natural system, has been more carped at by its opposers than any other; because of the genera associated in it being so decidedly different in their appearance and products. It is the character and forms of their flowers, however, which brings these dissimilar genera together. Their enflorescence is somewhat amentacious, with definite stamens; germen superior, one-celled, and mostly one-seeded; leaves alternate and stipulate; not lactescent, except in some few instances. The greater part of the plants in this order are only weeds, having none of the loveliness of vegetation in their composition; but this defect is abundantly compensated for by a few associates of very great value, such as the fig, the mulberry, and the bread-fruit (*artocarpus incisa*), as useful fruits; and the hop and hemp equally valuable for other purposes of man. The loathed stinging nettle, which is the type of the order, throws discredit over the whole assemblage.

ANTIDESMEÆ.

A small order of Indian trees, consisting of two genera, namely, antidesma and stilago. They are small trees or shrubs; the flowers in spikes; calyx, variously parted; corolla, absent; fruit, drupaceous, hanging in clusters, eatable, but very acid, like berberries. The bark of antidesma is made into ropes, and also used medicinally.

EUPHORBIACEÆ.

A large order, containing forty-seven genera, and nearly four hundred and fifty species. Their flowers, which are inconspicuous, are separate; germen, free, mostly three-celled; pendulous seeds with rough testæ; sap, with few exceptions, lactescent. The genera brought together here are exceedingly various in aspect; some are lofty trees, others shrubs, of which the common box (*buxus sempervirens*) is a familiar example; those of northern latitudes are undershrubs or herbaceous. Although their milky juices are generally dangerous, many potent and excellent drugs are extracted from one or other of the species. The poison found in many of the euphorbias is dissipable by fire; the iatropha manihot, than which there scarcely exists a more dangerous poison, when submitted to the action of fire, becomes innocuous, and forms a nutritious food called *cassava*, and which is sold and used in London for making puddings. Some species are called wart-worts, from the acrid juices being used to destroy warts. The seeds of the *ricinus* or palma Christi, yields the valuable castor-oil ; and many other drugs are extracted from the different genera. In Africa and in India the leafless euphorbias are often planted as hedges ; and from their prickles and irritating juices are impenetrable to both man and beast. Many of the European species are called *spurges*.

CYTINEÆ.

This order contains only the curious, but unsociable genus *nepenthes*, the Chinese pitcher plant. The enflorescence is in interminal spikes or racemes ; the diœcious, the perianth, inferior, and four sepaled ; stamens definite sixteen ; united filaments, and two-celled anthers. Nepenthes is a name of classic celebrity. Every one who has read Homer's Odyssey must remember the passages in which nepenthes is mentioned as a charm for sorrow, or as an exhilirating or intoxicating drink for assuaging pain. Whatever Homer meant by his nepenthes is now of little moment, but the plant is admired by every lover of plants for the curious form of its leaves.

ASARINÆ.

This is also a small order, embracing only two genera, of which there are thirty-six species. Asarum and aristolochia compose the order which is known by the definite stamens, variable in exsertion ; a many-celled ovary, numerous ovules, subcentral placentæ, and an included embryo. The species are mostly half shrubby plants, with simple, often kidney-shaped, leaves: mottled grotesque flowers, usually brownish purple. Arislochia sipho is the common birthwort, a large leaved climber met with in every garden. The A. clematitis is a British herbaceous plant found in woods.

ELÆAGNEÆ.

An order of four genera and thirteen species. The genera have scaly leaves, the perianth scaly without, and persistent, covering the fruit when ripe, and the ovules and embryo both erect. They are mostly hardy shrubs or small trees ; the flowers are inconspicuous but fragrant. The berries of hippophæ, one of the genera, are used as a condiment in Sweden.

SANTALACEÆ.

An order containing seven genera and above twenty species. They are trees, shrubs, and herbs with unattractive flowers, chiefly natives of Southern Africa, New Holland, and India. The wood of Santalum album, of the flower of which we annex a figure, *Pl.* 31 ; *b*, a single flower ; *c*, the calyx laid open ; *d*, the pistil ; *e*, the fruit ; *f*, the fruit cut vertically ; has a sweet aromatic flavour, and a slightly bitter taste ; it is chiefly known as a perfume.

THYMELEÆ.

An order of eleven genera, nearly all shrubby plants, found in all parts of the world. They differ from the preceding in having smooth leaves, the perianth coloured within and without, and not covering the fruit, the ovules pendulous, and the embryo inverted. The spurge laurel and mezereon (*daphne laureola* and *mezereum*), the lace bark (*lazetta*), and the leather wood (*dirca*), are the chief types of this order. They are all remarkable for their acrid, or rather caustic juices, so that their leaves and bark may be used as vesicatories. The inner barks of the lagetta lintearia is the vegetable-lace, or Jamaica lace-bark ; it consists of the annual layers of liber, and which are easily separated from each other, and may be made into any light ornament of dress. We are told that of this natural fabric, our Charles II. had a cravat, frill, and ruffles, presented to him by a Governor of Jamaica.

To give a better idea of these monochlamydous flowers, we refer our fair readers to *Pl.* 32, which contains a figure of part of a branch of the mezereon (*D. Mezereum*), showing first, *b*, a flower laid open; *c*, the same, showing the manner in which the stamens are inserted; *d*, the berry covered by the perigone, in which it is entirely enclosed; *e*, the same uncovered; *f*, the berry divided transversely, leaving the seed half uncovered.

PROTEACEÆ.

Protea, so named on account of the varied forms of foliage prevailing among the numerous species, is the normal genus of the type, which is intermediate between the thymeleaceæ and santalaceæ, having like the former the germen free, and agreeing with the latter in the valvate æstivation of the perianth.

The proteas are all exotic trees or shrubs, and almost all natives of the Cape of Good Hope, and New Holland. The leaves are without stipules and alternate, opposite or whirled; usually undivided, but sometimes toothed, rarely compound. The enflorescence is variable, sometimes in spikes, panicles, or corymbs, or congested heads. Perianth four-leaved leathery, coloured; stamina, four, opposite the lobes of the calyx; filaments short, anthers, adnate, and two-celled; germen free, formed of a single carpel; the style simple, and the ovules one or many.

There are above thirty other genera associated with the protea, many of which are commemorative of eminent Botanists; as Banksia, Dryandra, Knightea, Lambertia, Grevillea, &c. The telopea, one of the most splendid flowering plants of New Holland is also here. Their properties are but little known.

MYRISTICEÆ.

The plants composing this order are all tropical; of the several species of myristica, the common nutmeg (*M. moschata*) is the most valuable. The flowers are diœcious, axillary, or terminal, collected in tufts or panicles; the stamens are monadelphous; anthers, two-celled. The female flowers have a deciduous calyx; the germen, free, formed of a single carpellum; the style, short; and the stigma, slightly lobed. The fruit is fleshy; the seed nut-like, and covered by a many-cleft *arillus*, which is the mace when separated from the nutmeg.

The nutmeg trees are indigenous to almost all the islands in the eastern archipelago, both wild and cultivated. The wild ones are of a longer shape, and are often fraudulently mixed with the true sort in the markets of Batavia, and elsewhere. The monopoly of the Dutch in nutmegs and other spices is now completely at an end; not only by the loss of their eastern colonies, but that the different plants have been introduced into every other colony where they will grow.

Hernandia, the other genus associated with the myristica, differs from it by its exalbuminous seeds; its species are arboreous plants, with simple, entire, alternate leaves, of a coriaceous texture. They are found both in tropical America and India; and some of them are medicinal. The juice of the leaves of hernauda sonora is found to be an advantageous and effectual depilatory, destroying hair wherever applied, and that without pain. The colonists call it "Jack in a Box," and Botanists the specific epithet of *sonora,* in consequence of the whistling noise made by the wind blowing through its persistent involucels.

LAURINEÆ.

This very important and highly ornamental order of trees and shrubs is not very far removed from myristica. Both produce the finest spices, and resemble each other in general aspect; but the flowers of laurus are bisexual, while those of the myristica are diœcious. The laurineæ are all aromatic and uniform in their properties, they contain an essential oil, which gives them a warm and pleasant taste. The old genus laurus has been divided into three genera or groups, called laurus, persea, and cinnamomum. The first includes the bay and other laurels, with two celled anthers and naked fruit. The second the alligator pear; and the third, the cassia, the true cinnamon, and the camphor.

The laurus nobilis, sweet bay, is the only European species belonging to the type; and is still used in cookery for giving flavor to certain dishes, though almost superseded by its exotic congeners. The red bay, L. Borbonia, yields the isobella wood. L. chloroxylon and L. Indica are both much valued for their timber. The sassafras of medicine is the wood of the *L. Sassafras*, a Chinese forest tree; and, in fact, there is not one of the species but yields something useful to man.

POLYGONACEÆ.

An order of herbaceous, or half shrubby many jointed plants, mostly natives of the northern hemisphere. There are fourteen genera, and of which there are nearly two hundred species. Many of the last are worthless weeds; some are ornamental; but the most valuable are those which are medicinal or dietetic. For these purposes, the rhubarb (*rheum*) is the chief, and equally prized by the sickly as by the gourmand. The polygonum fagopyrum is agricultural. In Russia and other northern parts of Europe it is esteemed as a bread-corn; in France and England it is cultivated for cattle and poultry; and a strong spirit is obtained from the grain (called buck or beech-wheat) by distillation, and from which much of our ardent gin, rum, and brandies, is rectified and compounded.

BEGONIACEÆ

Are semisucculent herbaceous plants, with juices not milky. Most of the species of this single genus are pretty, some very handsome, and, as they are mostly tropical plants, delight in warmth and moisture. The greater part of them are tuberous, with jointed round stems, alternate, simple obliquely formed leaves, with free deciduous stipules; the flowers are monœcious, disposed in twice-divided, axillary cymes, the central ones male, and those in the circumference female; the bractea are coloured like the perianth, the two inner sepals being smallest; the stamens many, the anthers two-celled; the ovarium inferior, winged, and three-celled; styles three, very short, and the stigmas lobed; fruit capsular, crowned with the faded perianth; seeds many and small.

As the begonias are what may be called genteel looking plants, and often chosen for the embellishment of sitting-rooms, we would propose to the young Botanist the study of the enflorescence of this genus, as a most conspicuous example of monœcious flowers.

CHENOPODACEÆ.

An order embracing above twenty genera,

and above one hundred species. From the shape of the leaves, this tribe of herbs are called chenopodium or goosefoot. They are generally weedy, mean looking plants, and as the wild ones are mostly seen on dunghills, this station adds nothing to their character. Though nearly allied to amaranthaceæ, the goosefoot is denied such brilliant colours, and therefore overlooked. Still the order has some redeeming characters; they are all innocuous; and several of them are valuable, as decoctions of their leaves, or powdered seeds, or expressed oil, are all useful anthelmintics. Besides there is the invaluable cattle-plant, the beet, the bland culinary spinach, and the South American quinoa, or "petty rice," which proves a most nutritious food, are all of importance more or less; and moreover, there are many of the wild and neglected species which serve poor people for greens when garden sorts are scarce. To give an idea of the flowers of this order, we have figured *Pl.* 33, a portion of the stem of water starwort (*Blitum virgatum*), which is an European annual; *b*, a flower; *c*, the calyx; *d*, the fruit, all magnified; *e*, the fruit cut vertically.

PHYTOLACEÆ.

An order of insignificant herbaceous plants, possessing some medicinal properties, but of no special interest.

AMARANTHACEÆ.

An order of sixteen genera, and one hundred and forty species, described in Botanical works. Many of them are cultivated for their deep crimson coloured flowers. The high coloured species are called *amarants*, or "undying ones" from the persistent calices retaining their colours long after the plants are dead. The prince's feather, love lies bleeding, the beautiful globe, and splendid cock's-comb, are all flower garden favourites. Several are used as pot herbs in India, but they are inferior to spinach.

NYCTAGINEÆ.

With the exception, says Dr. Lindley, of Mirabilis, the marvel of Peru, in which the coloured calyx has a showy effect, all the order consists only of weeds. Occasionally they have tuberous root-stocks and knotted stems. Their leaves are without stipules, opposite, rarely alternate, and almost always unequal. It is remarked of the marvel of Peru, that it opens its flowers at four o'clock in the afternoon; hence it is called "the four o'clock flower," in the West Indies. The abronias, another genus of this order, are delicate and beautiful plants, but of no known use. *Pl.* 34 shows dissections of the flower of the marvel of Peru (*Mirabilis jalapa*); *a*, a perpendicular section of a flower, showing four of the five stamens, with the style and stigma; *b*, a perpendicular section of the thick base of the calyx; *c*, the nut, or hardened base of the calyx, containing one ovule; 1, the orifice where the coloured portion of the calyx is seated; 2, the involucre.

PLANTAGINEÆ.

This is the last order of the sub-division MONOCHLAMYDEÆ. It contains only three genera, namely, plantago, littorella, and glaux. The plantains in general are considered as troublesome weeds, especially in turf, their broad radical leaves growing flat on the ground, prevents the growth of better herbage. One species, the (*p. lanceolata*), ribgrass, is sown on sheep pasture, as it retains its verdure in dry summers, when grass is withered up. The (*p. major*), way-bred, so called from its prevalence on way-sides, is called the "Englishman's foot," in foreign countries; for wherever it is found there our countrymen have trod. Glaux is the black saltwort of English Botany, and is common on the sea-shore. It is said, that great quantities of the seeds of plantago arenaria are imported from France, for the purpose of forming an infusion in which muslins are washed.

We now enter upon an enumeration of the orders contained in the second subdivision of the second class, dicotyledoneæ, of the natural system. The plants in this subdivision present what is considered to be the highest degree of vegetable development: their organization is more complex; and their structure is more diversified.

We have already reviewed the simple forms of the division cellulares, and pointed out the homogeniety of their membranes. We next mounted a second step, to the monocotyledons, to show that their organization was superior, not only by a vascular apparatus being conjoined with the cellular, but by possessing certain foliar expansions which the cellulares have not; and which is signified by the terms acotyledons and monocotyledons. We, at a third step, entered upon the lowest subdivision of the dicotyledons, distinguished by their flowers having a single perianthium; and we now proceed to review the higher sub-classes of dicotyledoneæ, in which we shall have to notice the highest grades of the vegetable kingdom.

To prevent repetition, we may in the first place observe, that all the plants now before us are *Vascular;* that is, they are composed of cellular tissue, spiral and other vessels, and bundles of longitudinal fibres. They rise from the seed furnished with *two* cotyledons, or seed-leaves; and their growth is *exogenous,* that is, the new accretions are formed on the exterior of the axis.

SUBDIVISION DICHLAMYDEÆ.

The first class in this subdivision is distinguished from the other two classes by having the stamens of all the plants referable to it fixed on the corolla; which corolla is said to be monopetalous, and not attached to the calyx.

CLASS I.—COROLLIFLORÆ.

PLUMBAGINEÆ.

This is an order containing only three genera, but of which there are a great many species. Dr. Lindley says, that it is properly placed on the confines of the monochlamydeæ and dichlamydeæ, because many Botanists consider it as referable to either. The different species of plumbago are remarkable for the acridity of their juices; and, as such, are used medicinally. *Statice*, the sea-lavender, and *armeria*, the thrift, are many of them ornamental; and several species of both are British.

GLOBULARIÆ.

A solitary genus constitutes this order; but there are ten species, and they are all pretty alpine plants; a few of them are under-shrubs; and though they are in the fourth class and first order of Linnæan Botany, they are not associable with any other order.

PRIMULACEÆ.

The genera of this order, amounting to seventeen in number, are almost all favourites. They are valued as much for their early advent as for intrinsic and modest beauty. The primrose, cowslip, and auricula; the androsaces, aretias, and soldenellas, are all inhabitants of mountains and meadows in all the temperate regions of the northern hemisphere. Huttonia is a streamlet plant, and keeps in flower for several months, garnishing the sedge and grass among which it grows with its rosy blossoms. The cyclamen and dedecatheon belong to this order, enhancing the value of the whole by their presence. The tubers of the former being eaten by swine in Sicily, caused it to be called sow-bread by the ancients. They are almost all spring-flowering plants, and easily cultivated.

LENTIBULARIÆ.

This small order contains two genera, namely, penguicula and utricularia; are herbaceous, aquatic, or marshy plants, with a round stem, and alternate or whirled leaves; and it is remarkable that those which are under water are compound, while those which are emersed are simple. The economy of the utricularia, in raising and sinking itself in the water, by means of its utricules or bladders being filled with water or with air, is exceedingly curious, and is one of those manifold proofs of design on the part of the Omnipotent Creator which we find continually exemplified in the most obscure and lowly members of vegetable life.

OROBANCHEÆ.

A curious order of two parasite genera, both British plants, namely, the *orobanche*, or broom rape, and the *lathræa*, or tooth-wort. The first is found either on the roots of common broom, or on those of the common broad or red clover. The orobanche seldom makes its appearance on clover until about the end of August, or September; when, in some seasons, it rises in such abundance, as to very much lessen the second crop of clover. The stem and didynamous flowers rise like those of a hyacinth, though some of the species are branched, with narrow leaves, or bractea; colour of both flowers and bractea, a dull purple, succeeded by capsules of many seeds.

The lathrœa is found in woods, growing among decayed leaves, and attached to the roots of trees, on or by which it supports itself. This has also didynamous flowers.

ACANTHACEÆ.

These are herbs, under-shrubs, or shrubs chiefly tropical; the leaves opposite, simple, undivided, rarely sublobed, entire, or serrate. The enflorescence is terminal or axillary; bractea large and leafy, which enclose a diminished calyx; the flowers irregular and united; the calyx is free; corolla below the germen and bearing the stamens; style one, and stigma two lobed; the fruit is superior, and mostly capsular and two-celled, spontaneously separating into two plates. The genus acanthus possesses some classical celebrity, from the legend, that its growing accidentally round a basket gave the original idea of the Corinthian capital in architecture. Thunbergia is a fine flowering genus, and also a climber suitable for ornamenting columns in greenhouses. All the acanthaceæ are known by the elastic valves of their capsules.

MYOPORINÆ.

An order containing four genera and eighteen species of South Sea and New Holland plants, remarkable for the smoothness of the stems and leaves. Their leaves are simple, petiolate; flowers without bractea; a dry unopened two or four-celled fruit, with one or two seeds. The flowers are scarlet, white, or blue, and axillæary. The geuera of this order are very near Verbenaceæ. Stenochillus is a handsome genus; and Avicennia tomentosa is the white mangrove of Brazil.

VERBENACEÆ.

This order contains some very fine flowering herbs, shrubs, and trees. There are twenty-nine genera, and nearly two hundred and twenty species. One of the largest forest trees known, namely, the teak (*Tectona Indica*) belongs to this order; as well as the Clerodendrons and Volkamerias of the same warm latitudes. The fine scented aloysia, and the humble verbenas of our gardens are universally admired.

LABIATÆ.

Labiatæ or lipped flowers, as some of those in Diandria Monogynia, and all the Didynamia Gymnospermia of Linnæus, are included in this very large order. The genera amount to seventy-eight, and the species to above eight hundred and fifty. They are known by their four stamens being fixed on the corolla, with four naked seeds, single style, and irregular corolla. The order is divided into seven tribes for the convenience of studying and arranging the genera. The type of the whole is the well known mint (*Mentha*), hence the order has been called by some Botanists *Menthaceæ*. The rosemary, thyme, hyssop, lavender, &c., are all common well known genera needing no description.

SCROPHULARINÆ.

This is another large order embracing almost all the plants in Didynamia Angiospermia of Linnæus. The fruit being capsular, and the didynamous stamens sufficiently characterise the genera of this order. They are chiefly herbaceous, and common in all parts of the world. Some of them are ornamental, as the Foxglove and Calceolaria; some are fragrant, as mimulus moschatus; and several are medicinal in small doses; and others, as the Digitalis purpurea, are dangerous. A great majority are weeds. The order has two sections, one having four, and the other, by abortion, two stamens only.

SOLANEÆ.

An important order in several respects. Here we meet beauty and deformity: sanative vegetables and frightful poisons. The Petunia, Salphiglossis, Datura, and Brugmansia, &c., are admired as ornamental. The Atropa, Mandragora, Stramonium, &c., are dreaded; while the invaluable potatoe (*Solanum tuberosum*) is cherished, and the nauseous tobacco (*Nicotiana*) is delighted in and relished as a spurious and deceptive necessary of life! The history of this last would fill a volume. Many tracts have been written against the use of it; even one of our sovereigns, James I., brandished his sarcastic pen against smokers, in his "*counterblast*," in which he denounces every ill upon the consumers of that deleterious weed. "Now," says his Majesty, "to the corrupted baseness of the first use of this tobacco, doeth very well agree the foolish and groundless first entry thereof into this kingdome. It was neither brought in by king or great conqueror, nor learned doctour of physicke; with the reporte of a great discovery for a conqueste, some two or three savage men were brought in, together with this savage custom. But the pitie is, the poor wild barbarous men died, but that vile barbarous custom is yet alive, yea in fresh vigour;" and he adds, "surely smoke becomes a kitchen farre better than a dining chamber; and yet it makes a kitchen oftentimes in the inward parts of men, soyling and infecting them with an unctuous and oyly kind of soote, as hath been found in some great tobacco-takers that after their death were opened." Had his Majesty reigned at this time of our history, it is probable he would have found his own Chancellor of the Exchequer as much opposed to the *disuse* of tobacco as the monarch was opposed to its consumption.

Besides the cultivated varieties of the *N. tabacum*, there are many other species of this genus, some of which are more ornamental than useful, and perennial instead of annual, as the great majority are. Stramonium is as powerful a narcotic as tobacco, and is used extensively in medicine. Several other genera of this order are used for similar purposes as tobacco: the qualities of the majority being very much alike.

HYDROPHYLLEÆ.

Five genera are associated here, all very pretty plants with opposite or alternate leaves, a two scaled nectary at the base of each lobe of the corolla, and a one-celled germen. They have pentandrous flowers, either blue or pink, and are admitted into every flower garden.

CORDIACEÆ.

An order containing five genera of tropical trees or shrubs, the properties of which are not much known. Cordia is the principal genus of the order; some of the species of which, as C. sebestina and C. myxa, bear edible fruit. So are some of the ehretias fruitful, but their fruit is inferior, and in no estimation.

BORAGINEÆ.

Contains twenty-six genera, of which there are above two hundred and seventy species. They are all innocuous plants, chiefly characterised by their mucilaginous properties, and the occasional presence of colouring matter; hence some are used as demulcents, and some as dyes. The flowers are pentandrous, as may be seen by examining any of the well-known plants arranged in this order. The common borage, which is found wild in England, is also in every garden. This and pulmonaria, and several others, were considered by the old herbalists as sovereign remedies for many of the ailments of mankind. These plants contain a considerable quantity of nitre in their composition; to which is owing their cooling effects in potations. The lithospermums (stone-seeds) are remarkable for their hard pericarps, which have the glossiness and brittleness of glass. The symphytums and cynoglossum were also accounted medicinal. The boragineæ are found in every quarter of the world; the tournefortias and heliotropiums, being tropical; but the greater number are found in northern latitudes.

CONVOLVULACEÆ.

A large order of twining plants, having mostly fine showy flowers. The greater part are herbaceous annuals, several are perennial, and a few are shrubs. Several useful drugs are found in this order; as scammony, jalap, &c., and also some articles of human food, as the sweet potatoe of America, ipomæa batatas, and the ipomæa edulis of the south of Europe. The convolvulus is so well-known, and so commonly met with in gardens, fields, and on waste ground, that they need no farther description than what is presented on our *Pl. 35*, field convolvulus (*C. arvensis*); *a*, the base of the corolla, laid open to show the number and position of the stamens; *b*, 1, ovary, 2, style, and 3, stigma; *c*, a perpendicular section of the ovary, showing the attachment of the ovules.

HYDROLEACEÆ.

A single genus constitutes this order; there are only two species, but interesting, as, though they grow near water, their leaves appear as if smeared with oil. They are distinguished from convolvulaceæ by their flowers having two styles, and two-valved capsules.

POLEMONIACEÆ.

This order contains nine genera, and above sixty species. They are herbaceous plants with showy blue, red, or white flowers, and often with winged leaves. Many of them are flower garden favourites, as the phlox, the gillia, ipomopsis, &c. Of these the enflorescence is in panicles, corymbiform, or somewhat capitate, and the pentandrous flowers are regular and united. They are all very hardy, and easily cultivated plants.

SESAMEÆ.

An order of tropical annuals, with trumpet-shaped didynamous flowers, and simple leaves. The sesamum is called the "oily-grain," and is cultivated in India, and other warm countries. The oil is as sweet and tasteless as that of olives or almonds, and is expressed for domestic use. Herodotus mentions the esteem in which it was held in his time by the Babylonians; and Dioscorides says, sesame oil was highly valued by the Egyptians, who used it both to eat and burn, and their females as a cosmetic.

BIGNONIACEÆ, COBÆACEÆ, AND PEDALINEÆ.

These three orders were united by Jussieu, but the two last have been separated from the first, and from each other, by modern Botanists. Bignonia or trumpet flower, and its allies, are trees or shrubs, with twining or climbing stems, opposite compound leaves, destitute of stipules, but often with tendrils. It is a large order, and is divided into seven sections, founded on the difference in the forms of their leaves. The tecoma radicans is often met with in gardens, and much admired for the beauty of its flowers and pinnated foliage. The jacarandas, eccrimocarpus, and most of the other genera, are tropical, and though many of them have fine flowers and foliage, their uses are few.

COBEACEÆ

Contains only one genus, namely, cobea scandens, separated from bignoniaceæ, is a climbing genus with large purple flowers, and pinnated tendriled leaves, remarkable for the rapidity of the growth of its shoots, sometimes extending above a hundred feet in a summer.

PEDALINEÆ.

Another order containing a single genus, namely, pedalium murex, the caltrops-fruited pedalium, also separated from bignoniaceæ, in consequence of the small number of seeds in each cell of the fruit.

GENTIANACEÆ.

The gentians are mostly dwarf herbaceous plants, with deep blue flowers. They are all interesting, and some exceedingly beautiful; innocuous, but remarkable for their bitterness, which renders them, as medicines, tonic and stomachic. Erythræa, vohiria, chironia, spigelia, are all favourite plants. Villarsia and menyanthus are aquatics, and well worth a place in the flower garden.

ASCLEPIADACEÆ.

This order contains forty-four genera, and above two hundred and sixty species. They are remarkable for the peculiar structure of their flowers; for, instead of the five stamens being free, they are united into a kind of fleshy canopy, or crown, subtending the germen. The pollen, instead of being pulverescent, is disposed in masses, like wax, as is observable in the orchidaceæ. Periploca is the only hardy shrubby genus of this order in our collections; all the others are foreign, though some of the herbaceous species are placed in our flower borders. One of the most curious genera is the stapelia, chiefly natives of southern Africa. They are leafless plants, and are composed of a congeries of short rugged green stems, from among the bases of which the single flowers are produced on footstalks of various lengths. The flowers are of the most symmetrical forms, and of the oddest colours, and some of them evolve such an abominable stench as even to attract the flesh-flies. On the other hand, the hoya, another genus, distils honey so copiously that, it is said, wasps and bees, desert the sweetest ripe fruit to feast on the honey of the hoya. Pergularia, cynanchum, calotropis, and gymnema, are some of the other genera, and are all very similar in the structure of their flowers. The qualities of the order in general, if not actually poisonous, are at least suspicious. Many of them, however, yield useful drugs, both emetics and purgatives.

APOCYNEÆ.

This is a large order, there being thirty-six genera, and above one hundred and forty species. Many of them are highly ornamental, and it may be said of them, that they are much more attractive in habit than amiable in qualities. Under the most gorgeous flowers, and foliage, there often lurk dangerous powers, hurtful to animal life. One of their most striking characteristics in form is the twisted position of their petals, which lie obliquely over each other, both before and after expansion. By looking at the flowers of the periwinkle (*vinca*), or at those of the lovely oleander (*nerium*), a perfect idea may be had of this obliquity of petals which identify every genus of the order. Here we have the strychnos nux vomica, or poison nut of Hindostan, so well known to the rat-catchers. Here are also cerbera, wrightia, echites, apocynum, and urceola, all more or less handsome plants; but all suspicious characters. We find here, notwithstanding, like all other dispensations and arrangements of Providence, a blessing amid those productions where danger might be apprehended. The nut of the strychnos potatorum is the cleansing-nut of India, and which has the rare and valuable property of purifying foul water so frequently met with in the tanks of that thirsty land. By rubbing the inside of a vessel with one of the nuts for a minute or two before the water is put in, however foul and muddy it may be, it is instantly cleared by the precipitation of the earthy matters to the bottom, leaving the water above transparent and wholesome. This is such a common practice in India, that the nuts are sold in every market for the purpose, and always used by the officers of the army, when campaigning in that country.

The seeds of the cerberæ (ominous name), and their milky sap, are so potent a poison, that a single seed given, or distributed in powder, is enough to poison twenty men. The apocyneæ are also dangerous plants; and from some of them caoutchouc is obtained; but this substance is chiefly obtained from vahea gummifera and urceola elastica, for the European market. The vinca major, and the other species of periwinkle, are astringent; V. minor was the favourite flower of Jean Jacques Rousseau. Ophioxylon serpentinum is one of the snake-woods, affirmed to be antidotes to the venom of serpents. Wrightia tinctoria yields a valuable blue dye. The beautiful allamanda cathartica is medicinal, as well as both the plumeiera, alba and rubra. The strychnos, alluded to above, has been removed to an order to which it gives a title, namely,

STRYCHNERÆ,

Containing, besides the type, fagæa and theophrasta, fine tropical trees, nearly allied to apocyneæ, and, like them, possessing dangerous properties.

JASMINEÆ.

An order containing only two genera, but both favourites, wherever known, for their exquisitely fine scent. The jasmine is seen on almost every old cottage ; and the nyctanthes is equally valued in every climate suitable to its growth. They are both natives of India, though jasminum officionale is quite hardy with us, retaining its Arabic name of *yasmyn*, nearly. The *sambac* of India (nyctanthes sambac) is sweetly scented, evolving its fragrance most powerfully during night ; hence its generic name. This is a stove plant.

OLEINÆ.

This order receives its title from the useful olive, a fruit tree of much importance in the south of Europe. Here there are eleven genera associated, of which there are about one hundred species or more. Besides the olive, we find several of our most common shrubs and trees, namely, the privet (*ligustrum*) ; the lilac (*syringa*) ; the ash (*fraxinus*) ; phillyrea, &c. The ash is hardly congenerous, as it has no corolla, and its fruit is a *samara*, that is, a closed, winged, one or two-seeded capsule, commonly called *keys* of the ash. In the privet the leaves are simple, and the fruit is drupaceous or baccate. A kind of wax exudes from the Chinese privet (*Ligustrum lucidum*), which is used economically in that country. The olea fragrans has very sweet-smelling leaves and flowers, both used by the Chinese in the manufacture of their teas. Ornus Europæa is the manna-ash, distinguished from fraxinus by its four-petaled corolla. This, and other species, yield that peculiar sweet cathartic, known in medicine under the name of manna. It is a product of the south of Italy, where the trees are plentiful. Chionanthus, the fringe-tree, is from North America, and makes a fine shrubbery plant. The above Oleineæ are all in diandria monagynia of Linnæus.

BREXIEÆ.

A solitary genus, of which there are three species, constitutes this order; they are lofty forest trees, natives of Madagascar, of which we have very good specimens in our stoves.

EBENACEÆ.

A genus consisting of four genera, and nearly forty species; some of which are hardy trees and shrubs, with deciduous leaves and white flowers, natives of North America, Europe, and New Holland; others are tropical ever-greens. Of the latter, many of the diospyruses produce eatable fruit, when fully ripe; they are commonly known as date-plums, and are in China preserved aud used as sweetmeats. The wood of the black ebony (*Diospyrus ebenum*) is the most prized; but there are ebonies of other colours, as red, green, and yellow. The true black sort is a native of Madagascar, Mauritius, and Ceylon, whence our supplies are brought.

SAPOTACEÆ

Are mostly shrubs, and trees, and ever-green natives of warm climates. They are chiefly valuable for their fruit; those of the inocarpus, achras, chrysophyllum, memusops, &c., are all eatable. The first is the Tahite chesnut; the different species of chrysophyllum are the star-apples and medlars of Europeans; achras sapota yields the sapodilla plum and naseberry; and much of the palm oil of commerce is believed to be yielded by the bassica, and other sapotaceæ.

MYRSINEÆ.

This order, which contains eight genera of showy shrubs, with ever-green entire leaves, and cymes of white or red flowers, are all tropical. The ardisias are regarded for the beauty of their foliage; and the jacquinias are so ornamental, that the twigs of some of them are worn as garlands.

STYRACINEÆ.

An order of two genera only, styrax and halesia. Of these there are seven species, all elegant trees, with white flowers. The styrax is an Italian tree; the halesia North American. They are both hardy enough for this country, into which they have been long introduced. The first is a richly-scented and beautiful tree; the second, for its snowdrop-like flowers, is always seen in dressed grounds.

SYMPLOCINEÆ.

A single genus, of which there are only two species of ever-green shrubs, with serrated leaves, and small white flowers. The leaves of the symplocos tinctoria are used in America for dying yellow.

EPACRIDACEÆ.

An order of elegant shrubs natives of New Holland, which from their dry prickly habit and general appearance have been called the "Australian heaths;" as they are only distinguishable from the true heaths by being destitute of horns, or awns, on their anthers. There are eighteen genera, and seventy-one species.

Their properties are scarcely known, but they are all very neat greenhouse plants with tubular flowers. Our notice of this order, finishes our review of the sub-class, COROLLIFLORÆ, which, as before stated, is distinguished by the insertion of the stamens into the *corolla*. We next enter upon the sub-class CALYCIORÆ, which contains all the dicotyledonous plants which have the stamens seated on, or inserted into the *calyx*. This is the principal mark of distinction.

CLASS II.—CALYCIORÆ.

PENEACEÆ,

Containing eight species of beautiful shrubs, natives of the Cape of Good Hope. This genus is distantly allied to the Proteaceæ, and is distinguished from Epacrideæ in the calyx being of two leaves, and in the stigma being four-cornered, as well as in the fruit being four-valved. The rezined gum called sarcocol, is the produce of the Penæa sarcocolla and other species natives of Ethiopia.

ERICACEÆ.

This, collectively considered, is a very extensive order, and has so many alliances that it was very unweildy until rearranged by Professor Don. It embraces all the heaths, kalmias, rhododendrons, arbutus, gaultheria, &c.,

amounting to twenty-eight genera, and near one thousand species, with varieties out of number. A monograph of this single order would be a portly tome; so that our notice of it must be brief. But if we only allude to the varied beauty and elegance of the African heaths, and to the grandeur of the European, American, and Asiatic rhododendrons, azaleas, kalmias, &c., which are associated in this order, our readers will readily agree with us, that there is no other order in the vegetable kingdom which can be compared with this for varied beauty and splendour.

The only drawback against this fine order is that the honey exuded by the flowers of kalmia, rhododendron, &c., and collected by bees, is unwholesome, especially to children, to whom it is administered as a medicine. This has often been noticed in America, where these plants abound. On the other hand, the honey collected on our British heaths is said to be the best in the market.

The heaths, strawberry-tree, with andromeda and menziesia, are sufficient illustrations of the order Ericaceæ. But as pictorial illustration is always satisfactory, we add a figure, *Pl.* 36, of *Menziesia polifolia*; *a*, a flower divided longitudinally; *b*, a single stamen; *c*, the pistil, surrounded by the calyx; *d*, the berry cut transversely.

VACCINEÆ.

Pretty little shrubs found in the northern parts of Asia, Europe, and America. The oxycoccus macrocarpus produce the American cranberries ; and the oxycoccus palustris those of Europe. Vaccinium myrtillus yields the wortleberry. The order is distinguished by its inferior berry. The barks of these plants are esteemed as tonic medicines.

GESNERIEÆ

Is an herbaceous order, mostly found in woods in tropical America. They have large radical leaves and flowers, either blue or purple. The gloxinea is one of the most conspicuous genera ; and is a good type of the order.

CAMPANULACEÆ.

This order is chiefly herbaceous, nearly two hundred species being hardy. All the genera, of which there are eleven, are pretty, and some, especially the campanulas, are highly ornamental. Their anthers are mostly distinct, their fruit many-seeded, and some of them exude a milky juice. The rampion (*Campanula rapunculus*) is a culinary vegetable, the roots being esteemed a delicacy. We give a representation, *Pl.* 37, of the Throat-

wort (*Campanula trachelium*) ; *a*, position of the stamens at the base of the corolla ; *b*, a stamen magnified ; *c*, the pistil ; *d*, the fruit ; *e*, the fruit cut transversely.

GOODENOVIÆ.

Consist of New Holland herbs or under-shrubs, nearly allied to the curious order Stylideæ. They are all interesting little plants and worth cultivation. The flowers are pentandrous.

STYLIDEÆ.

This order comprises only one genus, but it is a very remarkable one. The flowers are gynandrous, the stamens and style being united. They have pink-coloured flowers covered with glittering glands ; and such is the unusual form of the organs, that Botanists have been led into error. The pistil is so concealed by the stamens, that by Labilliardiere and L. C. Richard it was wholly overlooked. The irritability of the stigma is physiologically curious ; if the stigma be touched by a pin it instantly starts from its place with great elasticity.

LOBELIACEÆ.

This order was distinguished by Linnæus, under the title *Monogamia*, because its single (not composite) flowers had the anthers united in a cylinder, like those of the florets of the class Syngenesia. Modern Botanists have erected it into an order of the natural system with much propriety, because no mistake can be made in identifying the genera. They are all fine ornamental plants, with blue, white, or scarlet flowers. The lobelias are universal favourites, although the qualities of some of them are deleterious.

COMPOSITÆ.

This large natural order includes all the syngenesious plants of Linnæus. There are no less than two hundred and ninety-six genera, and two thousand seven hundred and seventy-one species enrolled in recently pub'ished lists. All gradations, from the ample sunflower down to the minute daisy, are met with here. It is a conspicuous natural order, which Tourneforte arranged in his *radiati,* Linnæus in his class *syngenesia*, and Jussieu in the present order *compositæ*. It is divided into nine sub-orders, with appropriate titles, and these again into numerous tribes. Without such a classification, the order, being so unwieldy, would be difficnlt to study and arrange. Yellow is the predominating colour of the flowers; and, from the circumstance of many of them being so common in the northern hemisphere, in meadows and pastures, they attract but little notice. But a few foreigners are highly prized, as the dahlia, the Chinese chrysanthemums, the marigold, coreopsis, and caliopsis, &c. We give a figure of a very handsome Chilian genus (*Madia elegans*), on *Pl.* 38; *a*, a floret of the ray; 1, a portion of the involucre attached to the base of the ovary, 2; 3, the tube of the corollet; 4, the lip or limb of the same; 5, the style, bearing two stigmas; *b*, a floret of the disk; 1, pappas; 2, the tube of corollet, divided into five equal segments; 4, cylinder of anthers; and 5, the pistil.

The DIPSACEÆ and CALYCEREÆ are two orders containing together nine genera and one hundred and nine species, nearly akin to compositæ, of which they have a similar habit. All are herbaceous, with flowers growing on heads. The genus scabiosus is a good representative of the order; and, as they are in every garden, may be easily referred to.

VALERIANACEÆ.

Small herbaceous plants, without attraction in the eye of the florist. They are, however, neat, and some of them are useful as salad plants. They are annuals or perennials, and they have been long extolled for their medicinal properties. The roots of the perennial sorts, especially those which grow in dry situations, are aromatic and highly stimulating, and are used freely in hysterical cases.

RUBIACEÆ.

Rubia, the generic name of the madder, so useful to the dyer, gives a title to this order, one of the most important in the natural system. The genera are known by their opposite entire leaves with intervening stipules, a monopetalous superior corolla, a definite number of stamens (four), and a two-celled ovarium. The order includes humble weeds and lofty trees, medicinal qualities, and flowers of gayest colours. The order is divided into nine sections, but they are chiefly artificial. The plants of beauty and value are innumerable: of the former, the ixora, bouvardia, catesbœa, Portlandia, &c., are examples: to the latter every genus has a contribution of one kind or other. Many are dye-stuffs; and, among medicines, the cinchona, or Jesuit's-bark, is invaluable; so is the ipecacuanha; and last, not least, the excellent coffea Arabica. The rubia and galium are the representatives of the order in Britain.

CLORANTHEÆ and LORANTHEÆ are two small orders: the first are inconspicuous shrubs, with terminal spikes of green flowers of no interest. The second contains two genera of parasitic plants; namely, loranthus, the foreign, and viscum, the English mistletoe. The latter are of no great beauty; but the tropical lorantheæ are scarlet flowering plants of the greatest splendour. The loranthus is not in our collections; though it is supposed they were once natives, but disappeared with the Druids.

CAPRIFOLIACEÆ.

So called because some of the species climb like goats; for instance, the honeysuckle (caprifolium). This order contains eleven genera and above one hundred species. The honeysuckles, of which there are numerous species, need no description, being not only in every hedge but on every house. The cornus, elder, guelder rose, &c., are all common in our woods. The lonicera are exotic shrubs, some of them having handsome flowers. But the most celebrated genus, though it has neither bulk nor beauty to boast of, is the *Linnæa*, an insignificant memorial of one of the greatest naturalists that ever lived, *Carl von Linné*. That this plant may be better known, we have added a representation of parts of the *Linnæa borealis* on *Pl.* 39; *a*, a flower cut transversely; *b*, a stamen magnified; *c*, the ovary surmounted by the calyx, also magnified.

ARALIACEÆ.

The plants in this order might be mistaken for a branch of the umbelliferæ, with which they nearly agree in habit, except in being usually shrubby, as well as being distinguished by their five-celled fruit. Their flowers have no beauty, but their foliage is fine. The most familiar type of araliaceæ is our common ivy. Some of them yield an aromatic gum resin; and the famous Ginseng is produced from *Panax-quinquifolia*, of which we give a figure, *Pl.* 40; *a*, an hermaphrodite flower magnified; *b*, a male flower magnified; *c*, a stamen magnified; *d*, the calyx and pistil; *e*, the same cut transversely; *f*, the fruit cut transversely.

CUNONIACEÆ.

This order was formerly associated with the saxifrage till separated by Dr. Brown. They are shrubs with pinnated leaves and white or red flowers. Two of the genera, callicoma and bauera, having simple leaves, are estimable greenhouse plants.

SAXIFRAGEÆ.

The break-stones are humble herbaceous plants usually found on rocks, old walls, or ruins of buildings. They are inhabitants of temperate or northern climates. Their flowers are decandrous, and have two styles; very symmetrical in form, but seldom highly coloured. There are ten genera in the order, and one hundred and forty-two species; the latter chiefly saxifrages. The well known hydrangea is here, but, it is said, misplaced.

GROSSULARIEÆ and ESCALLONIÆ are two orders with each a single genus. The first engrosses the genus ribes, the well known gooseberry and currants; the other a South American shrub somewhat similar to vacciniæ.

CACTEÆ OR OPUNTIACEÆ.

A remarkable order of succulent plants, destitute of leaves, but many of them having flattened stems or a profusion of spines, which probably answer the same purpose. Many attain a considerable height, assuming most fantastic shapes, and are called torch-thistles. Some of the cacteæ, as the cereus for instance, have most magnificent flowers, equal to any other flower whatever. The opuntia cochinillifera is the plant on which the coccus, that is, the cochineal insect, is bred, and from which this valuable colouring substance is collected. The melocactus and mammalaria have curious depressed stems, regularly covered with rigid spines. Some of them yield eatable fruit, which are eaten more for their refreshing coolness than for any other excellence.

FICOIDEÆ.

These are called fig-marigolds from the shape of their stems, and form of their flowers. The mesembryanthemums are a very numerous family of succulent plants; the leaves are fleshy, and of every imaginable shape. Their flowers though not so large as those of the cereus are equally rich in colour ; some of them presenting the richest metallic brilliancy under bright sunshine. They are mostly dry stove plants. Tetragona expansa, a hardy annual, is eaten like spinach.

CRASSULACEÆ.

Another very extensive order of half succulent under shrubs. They have beautiful scarlet, orange, yellow, or white flowers, and are natives of every quarter of the globe. This order is distinguished from ficoideæ in the embryo being straight, not curved. The leaves of some of these plants are physiologically remarkable ; the upper leaves or bractea of the echeveria, if laid on the surface of the earth, strike root and become new plants ; and the leaves of bryophyllum bear viviparous progeny on the edges, whence they drop off and take root in the ground.

PORTULACEÆ.

An order of ten genera, and above fifty species. Except talinum and calandrinia, and a few species of claytonia, the majority are worthless weeds. The portulacea sativa is the common purslane, the only useful herb in the order.

PARONYCHIEÆ

Is an order, which only differs from portulaceæ by the stamens being opposite the lobes of the calyx, not alternate with them. Corrigiola, telephium the orpine, and some species of lahaya, are the principal genera.

LOASEÆ AND TURNERACEÆ.

Two small orders of plants, natives of tropical America. The first contains five genera of succulent cut-leaved plants generally covered with stinging hairs. Some of them are climbers and mostly annuals. Turneraceæ has one genus of annuals and undershrubs. It differs from loaseæ, in the stamens being equal in number with the petals, and inserted at the bottom of the calyx, not in the throat of the tube as in the first order.

PASSIFLOREÆ.

The singular form and arrangement of the flowers of this order, their gaudy colours, and their symbolic character and history, make them universally regarded. There are five other genera associated with the passion-flower; all being climbers, and natives of the tropics. Some of the passion-flowers yield eatable fruit. P. malaformis is the sweet calabash of the West Indies, and is a good dessert fruit. Many of the species flower freely in our hothouses, and sometimes ripen fruit.

CUCURBITACEÆ.

This is the order which includes all the gourd, melon, and cucumber tribe. They are climbing plants having tendrils by which they attach themselves to other plants for support. Their flowers are monœcious, and they are decidedly herbaceous except one, the carica papaya, which has the port of a tree rising from ten to fifteen feet high, bearing large fruit like melons, but not half so good. All the eatable species are most useful in tropical countries, where every kind of juicy wholesome vegetable is valued. But they are not all wholesome; the coloquintida gourd, the squirting cucumber, and the tricosanthis amara, are all possessed of violent purgative qualities. It is observed of these last named plants, that though the pulp is disagreeable, the seeds are sweet and palatable. Bryony is a British genus, but it is useless, having only some obscure medicinal properties.

MYRTACEÆ.

The common myrtle is the type of this beautiful and useful order. It includes thirty-seven genera, and very near three hundred species. The myrtaceæ are known by their dotted leaves with marginal ribs, an inferior ovarium, and single style. They are all evergreen trees or shrubs with white flowers, and some of them bear pleasant fruit. The order is divided into five tribes and two sub-tribes. The allspice and the clove are valuable spices. The euginia, jambosa, and gauvas are excellent fruits. Most of the genera yield a fine aromatic oil; that of the melaleuca leucodendron is the famous cajeputi. A similar rich oil is procured from the clove; indeed the whole order is of primary importance.

PHILADELPHEÆ

Is a small order separated from myrtaceæ by Professor Don. It contains philadelphus coronarius, the mock orange of our shrubberies, of which there are several species; and decumaria, an American climber of no beauty.

ALANGIEÆ

Is another order separated from myrtaceæ, because its petals are more numerous, its anthers adnate, and its fruit being one-celled. It is a native of India, where the fruit is considered good and wholesome.

MELASTOMACEÆ.

An order containing twelve genera, and near eighty species of beautiful trees and shrubs, with large white or purple flowers, and leaves with several, generally three, costa. The fruit of the melastoma is a fleshy insipid berry; eatable, but stains the teeth and mouth black; hence its generic name. The beautiful little rhexias, herbaceous pretty plants from Carolina, belong to this order. This order is only removed from myrtaceæ because of their want of essential oil, and of the dot-like reservoirs of the leaves and other parts which contain it.

LYTHRARICÆ, OR SALICARIÆ.

Genera eleven, species sixty-one. Most of these, says Dr. Lindley, are very showy plants, particularly lythrum and lagerstrœmia, which are the representatives of the order. The lythrum salicaria is an English plant, found on the banks of rivers, bearing long spikes of purple flowers. The lagerstrœmia is one of the most beautiful Indian shrubs. Peplis (the water purslane) is British. Lawsonia is used by the Turkish women to stain their nails; and several of the species are medicinal.

CERATOPHYLLEÆ.

An order formed for the purpose of comprising a single genus of two species of British plants, namely, the hornworts, ceratophyllum, demersum et submersum; common in ditches every where.

ONAGRARIÆ.

A pretty extensive order, containing fourteen genera, and nearly one hundred and fifty species. It is well defined and known by its pollen cohering by slender threads; by an inferior polyspermous ovarium; a four-sepaled calyx; and four-petaled flower, with a definite number (eight) of stamens, and a single style. Most of the genera are handsome. The epilobium, œnothera, Clarkia, and fuchsia, are all eminently ornamental in our flower borders; trapanutans yields an eatable nut, of much service to the poor where the plants are wild; trapa bicornis is a common culinary vegetable in China. The œnothera biennis is the evening primrose; and which has many new and beautiful congeners.

HALORAGEÆ

Is an order of seven genera, nearly allied to onagrariæ, and only distinguishable by its naked and solitary ovule. The genus calitriche is British, and found in ponds and ditches frequent.

TAMARISCINEÆ.

An order which differs from onagrariæ in the ovary being free, and in the imbricate æstivation of the calyx; and from lythraricæ, in the petals being inserted at the bottom of the calyx. The tamarisks are shrubs with twiggy branches, small scale-like leaves, and white or rose-coloured flowers, disposed in branched spikes; common in our shrubberies.

COMBRETACEÆ.

This order contains seven genera, and nearly forty species. It is divided into two tribes, namely, terminaliæ and combreteæ. The juice of terminalia vernix is a Chinese varnish; the bark of buceda is used for tanning leather in Guiana; and the woods in that country are festooned with the deep-coloured flowers of those fine climbers, the quisqualis and combreteæ.

VOCHYSIACEÆ.

A single plant, agrees with combretaceæ, in having convolute cotyledons and inverted seeds; and with onagrariæ, in the flowers being monandrous; or if triandrous, two of the anthers are always sterile.

RHIZOPHOREÆ

Is a genus, the growth of which has already been alluded to.

GRANATEÆ

Contains only one unsociable genus, namely, the well-known pomegranate (*punica granatum*), so called from its resemblance to an apple full of grain. This fruit tree is a native of the north of Africa, where it yields abundantly; but though esteemed by the Turks and other inhabitants, it is certainly inferior to the orange; the flowers are scarlet, and very ornamental in this country, when planted in favourable situations.

MEMECYLEÆ

Is a doubtful order, of three genera, natives of the tropics; the fruit is said to be useful, though very acid. Memecylon, mouririn, and scutula are the genera; all of which are distantly related to granateæ, melastomaceæ, as well as in some particulars to myrtaceæ.

CALYCANTHACEÆ.

Beautiful hardy early-flowering shrubs, natives of North America and eastern Asia, with sweet-scented yellow or dull purple flowers. They differ from rosaceæ, in the form of the embryo; and from granate in the embricate æstivation of the calyx; from both, in the absence of petals, and in the numerous divisions of the calyx.

ROSACEÆ.

This very large, and, in many respects, most important order, consists of forty-six genera, and no less than seven hundred and eighty-three species in our modern lists, besides a more than equal number of varieties. The admirable rose is the type of the whole; which on examination will be found to have petals inserted into the calyx; which last is five-sepaled, the fifth, or odd sepal, being axial, or posterior; the fruit a drupe, pome, or akenium; the seeds exalbuminous; and the embryo straight. Beauty of flowers is one characteristic of the order;

but it is not for the charms of scent, or blossom, or foliage, that this order has gained for itself the estimation of mankind. It also includes all the most valuable fruits of the temperate regions of the earth. It may only be necessary to mention the almond, apple, pear, plum, apricot, cherry, peach and nectarine, loquat (a Chinese fruit), medlar and quince, together with the humble but luscious strawberry, besides many other fruits in tropical countries.

LEGUMINOSÆ.

This legume, or pod-bearing order, is one of the largest in the natural system. It contains, in our lately published lists, two hundred and forty-four genera, and two thousand six hundred and twenty-six species. Collectively they have been called leguminosæ, from the shape of their fruit; and, by the earlier Botanists, papilionaceæ, from the form of their flowers resembling a butterfly. These characteristics are familiar to everybody, and facilitate the arrangement, as no notice is taken of the number or position of the stamens, &c., as is done in Linnæan Botany. The loftiest trees, the densest shrubs, and the humblest herbs, are found in this order; and, notwithstanding their diversity of stature, their flowers are all very similar. The order is divided into two divisions, namely, *curviubriæ* (crooked pods), and *rectembriæ*, straight pods. These are


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again subdivided into sub-orders, sub-tribes, and tribes. These sub-divisions, though somewhat distracting to the student by the multiplicity of distinctions, render the study of the whole in groups easier in the end than if no sub-divisions were designated. They are like the marginal lines of counties on a national map; and, by apportioning the attention, make the exertion less irksome.

It is needless to point to the great number of magnificent plants which are found in this order, for whether we view the open uncultivated commons, or look into the arable fields or pastures, or into the flower or pleasure gardens, we are sure to encounter some plant or other belonging to leguminosæ. We give a figure, *Pl.* 42, of the field-pea (*Pisum arvense*); *a*, the calyx; *b*, a detached corolla; *c*, the standard or vexillum; *d*, the alæ or wings; *e*, pistils and stamens in their natural positions, that is diadelphous—nine united by their filaments, and one free, the pistil between the two series; *f*, the legume or pod, one portion removed to show the seed.

TEREBINTHACEÆ.

An order not yet definitively arranged, for want of full information as to the various genera, of which there are twenty-seven. They are all shrubs or trees, with alternate exstipulate leaves, inconspicuous flowers, and abound in a balsamiferous rezin, which is chiefly present in the leaves and bark. Some are valuable as medicines, and others for their fruit. The cashew and pistacea nuts are well known in European markets. The hog-plum (*Spondias*) and the mango are favourite tropical fruits. The balsam of Mecca, the balm of Acouchi, the gum of Amyris, the mastich, and Venetian turpentine are all products from the plants of this order. Besides, the frankincense of India and many of the best varnishes are procured from one or other of the genera.

CHAILLETIACEÆ AND AQUILARINEÆ.

The first agrees with the Terebinthaceæ, in being furnished with a calyx and corolla ; fruit furnished with a dry covering, including a two or three-celled nut. The leaves are entire, alternate, and stipulate, with axillary or terminal racemes of small white pentandrous flowers. The nuts are poisonous, and employed to kill rats. The aquilarineæ include only one genus, which is an evergreen shrub or tree found in Malayo.

BRUNIACEÆ, SAMYDEÆ, AND HOMALINEÆ.

Three small orders containing together about a dozen genera. The first are small heath-like plants, and very neat both in flower and foliage. Samydeæ are small shrubs or trees, with leaves covered with shining dots, and with small axilliary decandrous flowers. The Homalineæ have polyandrous flowers, and are handsome evergreen shrubs with alternate leaves and deciduous stipulæ. Blackwellia, one of the genera, has fine bunches of white and fragrant dodecandrous flowers. Aristotelia is not uncommon in our shrubberries, and bears eatable berries, about the size of peas, of a very dark purple colour, and of an agreeable acid flavour. In Chili they are called *Macqui*, and it is the plant which Dombey used with so much success against the plague, in Chili, in the year 1782.

RHAMNEÆ AND CELASTRINEÆ.

These two orders are somewhat alike in habit; but the first differs from the second in having the stamens alternate with the petals; the sepals imbricated in æstivation; and the ovarium wholly superior. Celastrus, the staff-tree; ilex, the holly; and rhamnus, the buckthorn; are the normal genera of these orders. They are all shrubs or small trees, and some of them are common in our gardens, as the staphylea, the celastrus, the ilex, and the euonymus or spindle tree with its curious fruit. The fruit and inner bark of the rhamnus catharticus are purgative and emetic. Some, as zizyphus, jujuba, yield a wholesome and agreeable fruit; and the Z. Lotus, of the African shores of the Mediterranean, is celebrated to the skies for its usefulness :—

The trees around them all their food produce:
Lotus, the name divine, nectareous juice,
Thence called Lotophagi, which, whoso tastes,
Insatiate riots in their sweet repasts.

HOMER.

The leaves of rhamnus theezans are used by the lower order of people in China instead of tea; and the leaves of many of the genera are used medicinally.

With these two orders we finish our remarks on the sub-class CALYCEFLORÆ, which comprises all plants having their petals *separate, and inserted into the calyx;* this circumstance being the character of the second sub-class of the second sub-division, *Dichlamydeæ.*

CLASS III.—THALAMIFLORÆ.

We now enter upon an enumeration of the orders contained in the third sub-class, *Thalamifloræ,* the chief character of which is, *insertion of the stamens under the pistillum.* This sub-class contains all the polyandrous plants of Linnæus, as the sub-class calycifloræ, which we have just left, contained all the icosandrous plants of the same Botanist.

This sub-class is divided into four sections, namely, *First,* fruit inserted into a fleshy receptacle, with which the style is continuous. *Second,* ovarium solitary, placenta central. *Third,* carpella solitary or connate, placentæ pariental. *Fourth,* carpella numerous, or stamens opposite the petals. The first order of the first section which we have now to notice is

CORIARIEÆ.

Consists of a single genus; the species are astringent, and their leaves, especially those of C. myrtifolia, have been employed by dyers to strike a black colour. Their succulent fruits are, if eaten in any quantity, poisonous. Sauvages witnessed death ensue in half an hour after some were eaten. Accidents have happened from the leaves of this plant being fraudulently substituted for senna.

OCHNACEÆ.

An order containing four genera, and fifteen species. They are yellow-flowered, fragrant tropical shrubs with shining leaves, and fruit, which though not very agreeable, is wholesome. The flowers are polyandrous.

These two orders are all that are contained in the first section of this sub-class.

SIMARUBACEÆ.

This small order of three genera is found in the warmest parts of America. They are trees or shrubs, with an intensely bitter bark, a milky juice, and pinnated leaves. Simaruba and quassia are the two most important genera included in this order; both are valued for their excessive bitterness, which is pure and simple, and free from astringency and scent. The flowers are decandrous.

RUTACEÆ.

A rather extensive order of herbs, shrubs, and trees, found in all parts of the globe. The rue, and its allies, are bitter stimulating plants, with a strong and rather unpleasant scent, and a hot bitter taste. Rue was much esteemed in ancient medicine, and strongly recommended by Hippocrates, and in a later age by Boerhaave. The African rutaceæ have regular flowers, and are known as diosmas, the European genera, dictamnus, ruta, &c., have irregular, and more showy blossoms.

ZYGOPHYLLEÆ.

This order consists of seven genera, and above thirty species, of which guaiacum is one of the most prized, as well for its medicinal properties, as for its wood, which is known in commerce and in the arts as lignum vitæ.

OXALIDEÆ.

An order of only three genera, but a vast number of species. Oxalis, the wood sorrel, is the type, and a beautiful family of herbs they are. Their properties are well known; all having a slightly acid taste. In some of the American species oxalic acid exists in great abundance. Averhoa, another genus, are East India fruit trees, and the other, and last genus, is the byophytum, very nearly allied to oxalis.

BALSAMINEÆ.

An order containing two genera, namely, balsamina, and impatiens; the last so named because of the elastic force with which the seeds are scattered, if the ripe capsula be ever so gently touched by the fingers. Both orders consist of annuals; the balsam is a well-known garden ornament, and one of the impatiens is the noli-me-tangere, a British plant. Some Botanists are of opinion, that the three last mentioned might be all thrown into one.

TROPÆOLEÆ.

This order contains only the genus tropæolum commonly called the Indian cress or nasturtion. They differ from geraniacæ by their stamens being separate, and not agreeing in number with the petals, by their axillary flowers, and fleshy closed fruit.

GERANIACEÆ.

This order includes the geraniums (crane's-bill), and pelargoniums (stork's-bill), both well-known genera, and which have been long known under the general name of geraniums; together with the erodium (heron's-bill), and two other nearly allied genera, namely, sarcocaulon and monsonia. They are all herbs or undershrubs, with sometimes tuberous roots. The leaves are mostly simple, the lower ones opposite, the upper ones alternate, their fellows being supplanted by peduncles as in vines, but these never become tendrils. The facility with which the pelargoniums can be varied in their forms and colours by cross impregnation has multiplied, and is still multiplying varieties without end. Above three hundred varieties are already catalogued.

AMPELIDACEÆ.

This order includes four genera, namely, cissus, ampelopsis, leea, and vitis. This last, the invaluable grape-vine, is the type of the order, and the only one which yields useful fruit. The ampelopsis (virginia creeper) is seen in every court-yard, and the leea and cissus are hot-house plants of no beauty.

MELIACEÆ.

This order is particularly distinguished by the stamens being united into a tube bearing the anthers. They have mostly pinnated leaves, and are natives of the tropics, being either trees or shrubs. Among other fine trees in this order the mahogany (*Swietenia*) may be mentioned as giving dignity to the whole.

SAPINDACEÆ.

A large order of genera, there being nineteen, and of these, there are eighty-eight species. One of the distinctive peculiarities of this order, or what is sometimes called the essential character, consists in the petals having an additional lobe in the inside, or a tuft of hairs instead. Nearly all have compound leaves and bunches of white flowers. Euphoria nephelium, and dimocarpus, both bear fine fruit, and so do melicocca; and the arillus of blighia sapida are excellent as desserts. There is only one of the genera which succeeds in the open air with us, namely, the kölreuteria, a deciduous native of China.

RHIZOBOLEÆ.

An order containing only a single genus, namely, the caryocar nuciferum, of which there are three species, called by the colonists the butter-nut. In our fruit shops, these fruits are called suwarrow-nuts, from the native name Saour.

HIPPOCASTANEÆ.

This order embraces only the horse-chesnut and pavia; the first is a well-known ornamental tree; the second is not so frequently seen, but is equally ornamental, having its fine spikes of scarlet flowers.

ACERINEÆ

Includes the maples, of which there are nearly thirty species. They are natives of the northern hemisphere, and particularly abundant in America, where great quantities of sugar is manufactured from the sap of the sugar maple (*Acer saccharinum*), and the ash leaved species, *Negundium fraxinifolium*.

MALPIGHIACEÆ.

An order of tropical trees and shrubs, some of them climbers. They are known by the stinging hairs by which their leaves are defended, by the undulated corolla, the petals thereof being without claws. The fruit is eatable under the name of the Barbadoes cherry, that of M. glabra is much esteemed in the British West Indies, and on the American continent. The timber of the malpighiaceæ is of a deep red colour, and their bark is a febrifuge.

ERYTHROXYLEÆ.

An order containing only two genera, and four species. Erythroxylon, as its name implies, is remarkable for the redness of its wood, a character likewise occurring in some of the malpighias; but from these they are distinguished, not only by their peculiar habit, but by their appendiculate petals, each having a little claw at their base. They are shrubs or trees, with alternate leaves, furnished with axillary stipules.

HIPPOCRATEACEÆ.

An obscure order in which five genera have been arranged, of which there are thirteen species named in books. They are tropical arborescent or climbing shrubs. The enflorescence is axillary, and in fascicles; the flowers small and regular.

MARCGRAVIACEÆ.

Very curious half climbing shrubs, natives of the tropics. The flowers are very large and showy, and some of the species are remarkable for their curious pitcher-shaped bracteæ somewhat resembling the vessels formed on the leaves and leaf-stalks of cephalotus and nepenthes; and on the same plan as the extraordinary trap appendages of Dionæa and Drosera.

GUTTIFERÆ.

Trees or shrubs found in the hottest parts of the world. The leaves are opposite, leathery, entire, with short petioles, a strong mid-rib, and often parallel lateral costulæ extending to the margin, stipules none. Among the genera we find the garcinia mangostana, or mangostien, which by universal consent is esteemed the most delicious fruit in the world. It is as large as a full sized orange crowned with the persistent stigma. The central placenta is less visible than that of an orange, the pulp is beautifully transparent, and the flavour exquisitely rich and refreshing, combining the flavour of the grape and strawberry. The African and American mammeæ both yield pleasant and useful fruits and good timber, garcinea gambogia yields the well known and valuable gum-resin callcd gamboge so much employed in medicine, and as a pigment. This tree also yields good fruit, which is considered an excellent provocative of the appetite.

HYPERICINEÆ.

An order of seven genera and ninety species. The native and hardy exotic sorts which bear the open air in this country are well known; and there is a general resemblance, especially in their leaves being dotted with black, even upon the yellow petals. The petals have also a singular obliquity, which is not visible in their outline, but by the arrangement of their veins. A small part of the order is tropical, but its most common habitat is in the shady groves and thickets in the cooler parts of Europe.

AURANTIACEÆ.

The orange, lemon, citron, shaddock, and lime family. They are plants of the greatest beauty and utility. They are, without exception, innocuous plants, and although formerly exotic rarities, are now, from the excellent, portable, and keeping qualities of the fruit, as plentiful, and often cheaper than some of our native fruit.

OLACINEA.

An obscure order of four genera and six species of trees or shrubs, mostly tropical. They have alternate, simple, entire leaves; enflorescence axillary, the flowers small, unsymmetrical or by abortion polygamous. The place of this order in the natural system is not yet established.

CAMELLIACEÆ.

The Chinese Camellias, and their congener thea or tea, are so well known as to need no description. The first is one of the most beautiful, the last, one of the most useful plants in the world. The seeds of several of the camellias yield a fine oil; though none have fragrant flowers. Some Botanists think these belong to

TERNSTROMIACEÆ.

A small order of trees or shrubs bearing white or yellowish flowers. Nothing is known of their properties, except from what may be suspected of them as allies of the tea. As ornamental plants they are desirable ; and several of them, as the gordonia, stuartia, &c., are in our shrubberies.

CHLENACEÆ.

An order of one genus, the species of which are shrubs or trees, with simple alternate leaves ; natives of Madagascar.

ELÆOCARPEÆ.

This is an order of four genera and six species. They differ in nothing from tiliaceæ, except their lobed petals and anthers opening by two pores at the apex. The flowers of elæocarpus are fragrant, and some of the species bear eatable fruit. The *Perim-kara* of Malabar is one of the species, which bears palatable fruit, the stones of which have rough and apparently sculptured surfaces, and are often brought to this country, and set in gold for necklaces.

TILIACEÆ.

The linden or lime tree is the type of this order. They are trees or shrubs, seldom herbaceous plants, with simple alternate leaves, and deciduous stipules. The enflorescence axillary or terminal, racemose or paniculate, seldom solitary, and the flowers are regular and united. The inner bark of most of these plants is tough and strong, and of which Russian mats are made. Honey made in the neighbourhood of Lime forests is always considered superior to any other.

BYTTERIACEÆ.

This is an extensive order consisting of twenty-eight genera, and above one hundred and fifty species. They consist of lofty umbrageous trees, fine shrubs, and flowering herbs. The seeds of the sterculia and chicha are large and eatable. The astrapæa of Madagascar is one of the most beautiful of trees. Guazuma ulmifolia has its fruit filled with a pleasant mucilage which is sweet and very agreeable. Several of the genera have properties which are variously useful.

BOMBACEÆ.

This order comprises a very grand assemblage of trees, with large showy flowers, mostly natives of the tropics. The adansonia is supposed to be the largest vegetable production in the world. The bombax (the silk-cotton tree) is most splendid when covered, early in spring, with a mantle of rich scarlet blossoms. This order is, in many particulars, allied to

MALVACEÆ.

An extensive order, containing twenty-two genera, and nearly four hundred species. It includes the well-known mallow (altheæ), to which the hollyhock belongs; the hibiscus, pavonia, lavatera, malvaviscus, &c. The greater part of the order is clothed with stellate pubescence ; and a kidney-shaped one-celled anther is common to the whole. These two peculiarities, together with the alternate stipulate leaves, distinguish malvaceæ from all the rest of dichlamydeæ. The invaluable cotton shrub (*gossypium*) belongs to this order, and other useful and ornamental plants.

LINEÆ.

So entitled, from its containing the linum usitatissimum (the common lint or flax), which is of so much importance to the comfort and cleanliness of mankind. This genus is also desirable, as an ornament in the flower garden ; the sparkling blue or white flowers of the species are always attractive.

CARYOPHYLLEÆ.

A very extensive order, embracing twenty-six genera, and above five hundred and thirty species, found in all parts of the world. A great proportion are weeds ; but the sweet and lovely dianthus is the valued gem of the order; and from the richest of the dianthus family, the clove, the title of the order is derived.

FRANKENIACEÆ.

Is an order of one genus, namely, frankenia, allied to caryophylleæ, but distinguished from it by the fruit not having a central separate placenta, but bearing the seeds on the inner margin of the valves. Besides the genus here named, two others have been added by M. De Candolle.

PITTOSPOREÆ.

Small shrubs and trees natives of New Holland and Asiatic islands. The order is distinguished by the imbricate æstivation of the sepals and petals; which last, as well as the stamens, are five, and hypogynous; and by its minute embryo.

TREMANDREÆ

Contains only one genus, namely, tetratheca; of which there are several species of neat little heath-like plants, natives of New Holland. The flowers are octandrous.

POLYGALACEÆ.

This order of milkwort, and its allies, are herbaceous or shrubby plants, sometimes with milky juices, and simple entire exstipulate leaves. They are mostly ornamental, and some are possessed of considerable beauty. Their stamens are united in a single body; and their irregular bearded petals are very striking.

DROSERACEÆ.

An order of five genera, and sixteen species of herbaceous plants, inhabitants of marshes in all temperate climates. The sundews are remarkable for the great number of glandular hairs with which all parts of their leaves are covered. The young leaves are circinnate in vernation, and have the property of curdling milk.

VIOLARIEÆ.

If no other genus than the one which is the type of this order were included in it, the lover of beauty and fragrance could not fail to be partial to the whole. Many are remarkable for their perfume, others for their brilliant colours, and all for their neatness. One of the genera, called alsodia, from its leafyness, is a shrubby violet, a native of Madagascar, which has not yet been introduced into British collections. The viola tricolor (*pansies*) now vie in beauty and variety with the finest productions of the florist.

CISTINEÆ.

The rock-rose family consists of four genera, and one hundred and eighty-seven species. Some species of cistus, or helianthemum, may be seen in every garden, either of which will give a good idea of the general character. The C. ladaniferus (gum cistus) is a general favourite; and is remarkable for the beauty and ephemeral character of its flowers.

BIXINEÆ.

This is a small order, and the genera are neither remarkable for beauty or use. The bixa orellana is chiefly known for producing the seeds called in the shops arnotta, used in dairies for colouring cheese. The species are nearly all tropical.

FLACOURTIANEÆ.

An order of only three genera, namely, ryania, flacourtia, and kiggelaria. The order is remarkable on account of the structure of the fruit, to the inner lining of which the seeds are attached upon a branched placenta. Their properties, if useful, are unknown; they are all small tropical shrubs or trees. Some of the flacourtias yield eatable fruit; they are called the Madagascar plum.

CAPPARIDEÆ.

Capparis, cleome, and their allies, are herbs, shrubs, or small trees, with aqueous juices; alternate, simple, or palmate leaves, with stipules absent or spinescent. Cratæva religiosa is pura-ta-rura of Tahiti: it is there planted in the burial-grounds, and it is supposed to be held sacred to their idols by the natives. From the scent of the fruits of this order, they have been called garlic-pears. Capparis spinosa (the common caper) is well known, from the agreeable condiment which its pickled flower-buds afford. It is cultivated on a great scale in the south of France and Italy, and, when pickled, exported in large quantities.

RESEDACEÆ.

This order, of one genus, has a good many worthless species; there being only two in cultivation; the R. luteola, or woad, used for dying yellow, and the matchless scented mignonette. This genus is separated from cruciferæ, on account of its capsules being one-celled, and the stamens being indefinite. Another order, *datisceæ*, differs from the preceding, in having an inferior ovarium, and in the seeds being furnished with albumen. These datisceæ are strong, coarse, hardy perennials, sometimes seen in our shrubberies.

CRUCIFERÆ.

The cruciferæ includes all those plants which have the four petals of their corolla disposed in the form of a cross. It is a most extensive order, containing eighty-eight genera, and seven hundred and sixty-one species. It is divided into five sub-orders, founded on the manner in which the radical and the cotyledons are applied to each other, that is, how they are disposed with respect to each other within the testa of the seed; and these are again subdivided into many tribes. This circumstance may be a constant and very proper mark for apportioning this large cumbrous order into districts, but the signs can only be found by dissecting the seeds, which requires considerable tact.

The different genera of this order are of the greatest importance to mankind, directly and indirectly, as human and as cattle food. As proof we need only mention the single genus brassica, with its numerous species, varieties, and sub-varieties, supplying our tables and our stalls with the most wholesome animal and vegetable food in every month of the year. Nor is this order wanting in either beauty, or in fragrance; the stocks (mathiola), and the wall flower, though old, are still favourites, and many other handsome, as well as useful plants are found here. The general medicinal property of the order is antiscorbutic.

FUMARIACEÆ.

The greater part of the Fumariaceæ are delicate annuals, found in all temperate climates. Several of the genera, corydalis and fumaria, are indigenous in Britain, and several of the same, which are perennials, appear in the flower garden.

PAPAVERACEÆ.

The poppies and their allies are well known, their splendid scarlet colours making them as conspicuous in the field and garden as their narcotic powers are known in the apothecary's shop. The flowers are mostly large, and are white and yellow, as well as scarlet. Opium is obtained from P. somniferum, and some other species; it is a necessary of life in Turkey, and among the rich Chinese. Even in England the custom of swallowing it as a cordial is much more general than is publicly known. While the juices of the poppy are powerfully soporific, it is absent from the seeds, which have a nutty flavour; and in some countries are put into soups. The orders which remain to be noticed are in the fourth section of thalamiflora.

SARACENIÆ.

Here there is one genus only; the side-saddle flower, so called, from its resemblance to that article of female equestrianism. The species are four, and have flowers of various colours. They are found in the swamps of North America, and have been long in our collections.

NYMPHÆACEÆ

Are the water-lilies of this and other countries. There are four genera, namely, Nelumbium, euryali, nymphæa, nuphar, and to which may be added, Victoria regina, a newly discovered genus in Mexico. They are all foreigners, except one of the nymphæas, and one of the nuphars, which are British.

The exotic species are magnificent plants, both in their floating foliage, and large rose-shaped red or crimson coloured flowers. These fine plants are frequently flowered in our stoves in cisterns of water, as they are all aquatics. The roots of these plants are tubers as large as kidney potatoes, and are a good substitute for them at table. The sacred Egyptian bean of antiquity was no other than the seeds of the Nelumbium speciosum. The new genus Victoria exceeds all others of the order in size of leaves and flowers, and is an object of great interest at present among collectors.

PODOPHYLLACEÆ AND HYDROPELTIDEÆ.

Two small orders of North American aquatic herbs. The first is nearly related to nymphæaceæ on the one hand, and to the herbaceous genera of berberideæ on the other. The second order differs from nymphæaceæ in having a definite number of seeds. There are two genera with a single species of each. Both are small floating plants, the properties of which are unknown.

BERBERIDACEÆ.

An order containing seven genera and nearly forty species. Berberis is a fine genus, and contains several very ornamental plants. Except nandina, which is a pretty Japanese shrub, the others are small and of no great beauty. Mahonia has pinnated leaves, and the flowers though small are elegant. The common barberry is wild all over Europe and North America; and it is said that there are several very fine species in Chili not yet introduced into this country. The fruit of the barberry, as is well-known, are acid and astringent, and are used as a pickle.

We give on *Pl.* 41, dissections of the flower and fruit of the common barberry (*Berberis vulgaris*); *a*, the calyx; *b*, the corolla; *c*, a stamen inserted at the base of a petal; *d*, the pistil; *e*, the fruit; *f*, a berry cut vertically to show the position of the seed.

MENISPERMACEÆ.

The genera associated here are climbing

shrubs, or perennial herbaceous plants, with alternate, petiolate, and, in general, cordate leaves and small flowers. With the exception of schizandra coccinea, none of them are worth cultivating as ornaments. Cissampelos is one of the principal genera; the berries of several of the species are useful drugs; the poisonous cocculus Indicus is the fruit of C. suberosus, and though a dangerous fruit, it has been found useful in restoring lost power to palsied limbs. They are all tropical plants.

ANNONACEÆ.

This is rather an important order, from several of the species yielding very fine fruit, spices, &c. They are distinguished from magnoliaceæ by the absence of stipulæ, and by the structure of their anthers and seeds. The fruit of the annona is in many species highly esteemed, especially that of the cherimoyer, which is said to be the finest fruit in the world next to the mangosteen. A. muricata is the sour-sop; A. squamosa is the sweet-sop; and other species are the custard apples. Asminia triloba (formerly anona triloba) is sour, and has a fœtid scent, but is hardy enough to bear the cold of this country. The dry fruit of annona aromatica and Æthiopica, which latter is the piper Æthiopica of commerce. Xylopea frutescens has an aromatic fruit with the flavour of pepper.

MAGNOLIACEÆ

Consists of five genera, and of which there are thirty-seven species. The magnolias are highly esteemed ornamental trees and shrubs. The hardy species are natives of North America and the more tender ones natives of China and other parts of Eastern Asia. *Tulip-tree* is a very significant cognomen for this genus, and their foliage is equally interesting. The bark of M. glauca is said to be as valuable a medicine as cinchona or Jesuit's bark. Michelia champaca, or tsiampaca of the Malays, who are fond of ornamenting their heads with its orange-coloured flowers, belongs to this order, and also the aniseed-tree, illicium floridanum of the Chinese. Liriodendron, or saddle-leaved-tulip tree of our pleasure-grounds, also belongs to this fine order.

DILLENIACEÆ.

This order comprises twelve genera and about thirty species. The type of the order is the dillenia speciosa, a native of India, resplendent with yellow blossoms, rivalling those of magnolia. The genera of this order are closely allied both to the annonaceæ and magnoliaceæ, from both of which they are however distinguished by the exstipulate leaves and the quinory arrangement of the floral organs. They are also allied (except for their habit and persistent sepals) to ranunculaceæ, which accounts for their proximity in the system.

RANUNCULACEÆ.

The frogwort, or crowfoot, and its allies, are herbaceous, seldom shrubby plants, with aqueous juices, and round or irregularly angled stems, alternate petiolate leaves, without stipules, but with dilated footstalks, more or less amplexicaul. The butter-cups in our meadows, the anemones in our woods, the adonis in our fields, are all as attractive as they are common. In the garden, the lowly hepatica, the glittering ranunculus, the graceful clematis, and the gorgeous peony, are conspicuous. Twenty-nine genera and above six hundred species are already described in the lately published genera, and species plantarum. The genera are distributed over every part of the globe, and wherever they are seen they are admired. And yet amid their gaudy colours dangerous qualities lurk. Some of the crowfoots, the South American anemones, the aconites, hellebores, are all acrid, and more or less poisonons. The clematis, atrageni, and xanthorhiza are the only genera which are shrubby, and these are embowering climbers, and often employed in covering garden-seats or alcoves.

The ranunculaceæ are the last order of the last section of the sub-class thalamifloræ of our arrangement; and from this pre-eminence it would appear that Jussieu and his followers consider this order as one in which vegetation is most perfectly developed, and as presenting the greatest variety of vegetable organization. The characters of this section are carpella numerous, or stamens opposite the petals.

Having ended our review and enumeration of the divisions, classes, subdivisions, and orders of the natural system, it may not be amiss to append a few general inferences deducible from the whole.

And first we may presume that when the student takes a backward glance at the vast array of two hundred and ten orders of vascular plants, and nine orders of those which are cellular, he may well be appalled at the difficulty he will have in attaining even a very moderate knowledge of them. And, as one genus can only be distinguished from another by a close comparison, a large share of practical information is in the first place necessary, before he could be competent to assign to any given plant its proper place or order in the system, so as to arrive at its name and botanical character. But the study of Botany, like that of every other science, appears much more difficult and perplexing to the beginner than it afterwards proves to be when the first step has been surmounted.

Let us suppose that a tyro is about to commence the study of the natural system, who, after having well considered the scheme, picks up by accident any morsel of vegetable matter, whether alive or dead. By examining the structure, he may easily determine whether it be cellular or vascular. If the first, he will see it perfectly uniform, as if formed of atoms of equal size and consistence. If the latter, he will observe that the structure is far from uniform, but is varied by different sized tubes, by fibrous bundles, and by zones of porous or denser substance. Hence he refers the latter to the second division, vasculares, and the former to the first division, cellulares.

If, again, he has opportunity of seeing a number of young plants just risen from the seeds, some with one seed leaf, or cotyledon, and others with two or more; he may be assured that the first belongs to the first class, monocotyledoneæ, and the last to the second, dicotyledoneæ. But, supposing he has no opportunity of seeing seedlings rise, he may examine the perfect leaves, for they will furnish him with as much information as though he had seen the seedlings. If perfect leaves have a principal midrib or costa extending from the base to the apex of the leaf, with lateral branches or nerves, the student may be certain that the plant belongs to dicotyledoneæ, *f.* 91.

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And besides this, if he observes that the lateral growth or expansion is added to the exterior of the axis, he may be equally assured that the plant is dicotyledonous.

But if, in examining a perfect leaf, he finds, instead of a principal midrib, this member divided at the base into several ribs, which rise towards the apex, or to the margin, in nearly parallel or slightly diverging lines, he may be convinced that the plant is monocotyledonous, *f.* 92; and more especially if it be observable that the additions to the bulk arise from the centre, and are not laid upon the outside of the axis.

Here are two very material points gained; and he then proceeds (as there are no subclasses in monocotyledoneæ) to find out, by actual practice, the characteristics of the subclasses of the third subdivision of dicotyledoneæ; that is to say, whether a flower under investigation has got the calyx and corolla distinct, showing the *two coats* of dichlamydeæ; or, when these members are united, to show that they have only one coat, which refers to monochlamydeæ. Next he observes, whether the stamens be seated under the pistillum ; in which case the flower is thalamiflorous ; or calciflorus, seated on the calyx ; or corolliflorus, seated on the corolla.

Ascertaining these points by practice is a great advance in acquiring a scientific knowledge of plants ; and what many will be quite satisfied to attain, even should they be for ever incapable of assigning plants to their orders respectively. But such a ground work will enable the possessor to gain a knowledge of the orders almost intuitively ; and for generic and specific names a master must be applied to who can point out the practical road to a thorough knowledge of this fascinating science.

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