PART I.

THE ORGANS OF VEGETATION.

ROOTS.

THE *Radix*, or *Root*, is the lower part of the vegetable, which, from being generally attached to the earth, derives from thence various nutritious principles, which it conveys to every part of the plant; it also performs the important office of retaining the plant in a fixed position.

The principal divisions of the root are those denominated *Caudex* and *Radiculæ*. By the term caudex, Linnæus means the main body of the root; and by radiculæ, the stringy or fibrous parts, which, in the greater number of vegetables, terminate the main root, and are especially concerned in absorbing nourishment from the earth. The caudex consists of two parts: the *Caudex descendens*, or descending caudex, which strikes downward, and throws out radicles, or small fibres; the *Caudex ascendens*, or ascending caudex, which is that part of the root raising itself above the ground and ultimately becoming the stem.

The minute extensions, termed *Radiculæ*, may also be called *Fibrillæ;* and, on the authority of Professor Link, the young roots of mosses and lichens may be termed *rhizina* and *rhizula.*

FORM.

Roots in respect of their form are:—the *Radix fibrosa; Radix fusiformis; Radix tuberosa; Radix præmorsa; Radix granulata;* and the *Radix bulbosa.*

The *Radix fibrosa*, or fibrous root, consists principally of a number of fibrous radicles, each of which is more slender than the base of the trunk or stem to which it is attached.

The *Radix fusiformis*, or spindle shaped, otherwise tap root, is a species of root tapering to a point; the radicles, or fibres, are generally disposed over the whole surface of the principal root.

The *Radix tuberosa*, or knobbed root, is a hard and fleshy root, and generally thicker than the base of the stem to which it is attached. It consists either of one knob or of several, formed by filaments into a bunch: such tuberous roots as throw out their radicles at the top from a knob formed between the stem and the root, are called *Radices comosæ*,* from the fibres resembling a tuft of hair.

* *Coma*, a bush or head of hair.

The *Radix præmorsa* is a species of root which does not taper, but ends abruptly. Hence, it is not improperly called the bitten root.

The *Radix granulata,* or granulate root, consists of several little tubers, or fleshy knobs, which resemble grains of corn.

The *Radix bulbosa,* or bulbous root, has given rise to much dispute, and it is important to attend to the structure of it, as it frequently affords the only means of distinguishing one species of plant from another of the same genus. Thus, the different species of the genus *Scilla*, or squill, can hardly be distinguished from each other, except by the character of their bulbs, which are coated, deemed solid, and scaly.

This form of root is, perhaps, more properly speaking, a large bud, situated under ground; it encloses and protects the future plant, several generations of which lie enveloped in it, until they are unfolded by the action of water or other alimentary stimulus To illustrate this view of the subject it may be proper to observe, that Linnæus does not consider the bulbus as a part of the root, but as the Hybernaculum, or winter quarters of the plant. From the lower part of the bulb extend the fibrous appendage by which the plant is attached to the earth in which it grows, and which are so many absorbing vessels, through which the necessary alimentary matters

are conveyed. These *Radiculæ* Linnæus regards as forming the true root. From this opinion there are, however, many dissensions, and amongst them was the Marquis de St. Simon, who, in his work on Hyacinths, printed at Amsterdam, 1768, asserts that the radicles, or cylindrical fibres, of certain bulbus-rooted plants, such as the Hyacinth, were by no means necessary to their full growth and perfection; he deduced this conclusion from certain observations which shewed that the radicles exercised an exhaling, rather than an absorbing action. Without determining between the Marquis and Linnæus, the student may be safely recommended to examine for himself the five different kinds of bulbs, as described by Linnæus, viz. *Bulbus squamosus; Bulbus solidus; Bulbus tunicatus; Bulbus articulatus;* and the *Bulbus duplicatus.*

The *Bulbus squamosus,* or scaly bulb, consists of a number of imbricated lamellæ, or thin plates, which are laid over each other somewhat in the manner of scales on a fish.

Many species of Lilies furnish us with examples of this beautiful kind of bulb.—EXAMPLE, Fig. 6, Plate 1.

The *Bulbus solidus,* or solid bulb, apparently consists of one solid and fleshy substance, and Linnæus offers the Tulip as an exhibition of this kind of bulb; but, on a minute examination,

it evidently is a truecoated bulb. Professor Ludwig has adduced the common *Crocus* as an example of the solid bulb; but even this, upon a careful inspection, appears to consist of a number of tunics or coats, the exterior ones of which spontaneously separate from one another; and the internal ones, though thicker, are easily divided. It is, therefore, a matter of question, whether a true solid bulb, in Linnæus's sense of the word, exists.

The *Bulbus tunicatus,* or coated bulb, consists of a number of tunics, or coats, which are regularly laid over each other. The common onion, the amaryllis, and very many other plants, furnish instances of this species of bulb, the coats of which are frequently so thick and succulent that they are sufficient to make the plants vegetate, without the aid of mould or water. Instances often occur when the officinal squill, as it lies in the shops of the druggists, may be seen protruding both vigorous stems and flowers.—EXAMPLE, Fig. 1, Plate 1.

The *Bulbus articulatus*, or jointed bulb, consists of lamellæ, which are linked or chained together, as in the Lathræa squamaria, or toothwort; the Adoxa moschatellina, or Tuberous Moschatel; the Dentaria bulbifera of the British Flora, and the Martynia perennis, a native of South America.

The *Bulbus duplicatus,* is a name applied to certain roots which have two bulbs connected together. Some species of Orchides furnish us with the best examples of this kind of root.

Where two bulbs are thus united, it is commonly observed, that one of them is light, empty, and swims on the surface of the water; whilst the other, which is partially solid, sinks by reason of its weight. From the former, the plant of the present year has proceeded: the latter contains the bud of the future year.—EXAMPLE, Fig. iv., plate 1.

DIRECTION AND MANNER OF GROWTH.

The *Radix perpendicularis*, or perpendicular root, descends in one strait fibre, and gradually tapers from above downwards.

The *Radix horizontalis,* or horizontal root, extends itself under the surface of the ground, nearly in a horizontal direction. The English Iris pseudacorus (common Flower de Luce), the Humulus lupulus (Hop), and the North-American May Apple (Podophyllum peltatum), furnish us with examples of this direction of the root. Some of the horizontal roots run very near the surface, such as the woodbine and the wild anemone; others run lower, as the Friticum repens (couch grass).

The *Radix repens*, or creeping root, is distinguished from the horizontal root, to which, however, it is nearly allied: while the latter species of root is extended under the earth, in a transverse direction, the former is observed to creep horizontally in every direction, putting forth fibres as it proceeds. The Mentha, or mint, furnishes examples of this kind of root.

The *Radix ramosissima*, is a root which is greatly subdivided, or which branches to a considerable degree.

The *Radix ramosa* is an ordinary branched root.

The *Radix simplex*, or simple root, will require no explanation.

Some roots have a two-fold direction; thus, in the Primula (primrose,) the main root runs level, and the radicles and fibres strike perpendicularly into the earth.

EXPLANATION OF PLATE 1.

Fig. 1. The bulb (bulbus, Radix bulbosa,) of the beautiful Atamasco lily (Amaryllis atamasco.) A. The bulb. B,B. Two off-sets or suckers, from the lower end of the bulb. C. The radicle (radicula) or fibrillæ.

Fig. 2. A transverse section of Fig. 1, to show its tunicated structure, a, b. Two eyes, or places from whence proceed the flowers. c. The radicle or fibrillæ.

Fig. 3. The root of the Fumaria cucullaria. A,A. Two bulbs. b, b. Small succulent scales, protecting the lower parts of the bulbs, each of which is capable of becoming a perfect plant.

Fig. 4. The ophrys hyemalis. A,B. The two principal bulbs, constituting the Bulbus duplicatus. C,C. The fibrous portions of the root. D. The radicle or fibrillæ. E. The plicated or folded leaf (Folium plicatum.)

Fig. 5. The root and a portion of the stem of the beautiful Limodorum tuberosum of Linnæus, (Cymbidium pulchellum of Swartz.) A,A. The radicle or fibrillæ. B,C. Two small suckers.

Fig. 6. The scaly bulb (Bulbus squamosus) of the Lilium superbum. A. The radicle or fibrillæ. B. The scaly portion.


Fig 7
B
Fig 8
A
Fig 9
A

EXPLANATION OF PLATE 2.

Fig. 7. The root, &c., of the Veratrum luteum of Linnæus. It is a good exhibition of the premorse root (Radix præmorsa.) A. The extremity of the root, which appears as if it had been bitten off. B. The radicles or fibrillæ. C. Portions of the leaves, which are all radical (Folia radicalia) in this plant.

Fig. 8. The fusiform root (Radix fusiformis) of the wild carrot (Daucus carota.) A,A. The main body of the root, or the descending caudex. B,B. Mark the commencement of the ascending caudex or stem.

Fig. 9. The root of the Tuberus Moschatel (Adoxa Moschatellina.) A. A shoot proceeding from the root. B. Continuation of the same, but detached.

Fig. 10. Creeping Crowfoot (Ranunculus repens.) A,A. The stem. B,B. Radicle or fibrillæ, proceeding from the bosom of the leaves.

Fig. 11. The horizontal root (Radix horizontalis,) of the May apple (Podophyllum peltatum). A. The ascending caudex, or a portion of the stem. B,B. b,b. The main body of the root, as it creeps or spreads in a horizontal direction under the ground. C,C,C. Fibres proceeding from the main root.

THE STEM.

The Stem has been called *Caudex ascendens, Caudex intermedius, Culmus truncus, Truncus ascendens*, and by many other names. It is invariably composed of a bundle of vascular and woody tissues, embedded in cellular substance in various ways, and the whole covered by a cuticle.

In the true sense of Linnæus, the stem is to be considered as only a part of the herb (herba), and which he defines to be that part of the vegetable which arises from the root, is terminated by the organs of fructification, and comprehends the Trunk, the Leaves, the Fulcres, and the Hybernacle.

The Trunk (truncus) is the body or main stem of the vegetable, whether it be a tree, a shrub, or an herbaceous plant. It supports the leaves and the fruit, and, according to circumstances, marks the character of the plant; for example: when a trunk bears permanent or perennial branches, the plant is termed a Tree;* when permanent branches arise, not from a trunk, but from the root, the plant is termed a Shrub;†

* Latin, *Arbor*. † *Frutex* or *Arbustum*.

when the branches are small and numerous, a Copse Shrub;* when a plant is furnished with woody branches that are not permanent, as in tree mignonette, it is termed an Under Shrub;† and when the stem is not woody, and dies down every year as far as the crown of the root, the plant is called a Herb;‡ and when a trunk is formed, like the underground stems of the iris, of the hardened bases of leaves which have withered and fallen, and is not tapered, but of a uniform thickness, giving off no branches, as in the date and cocoa, the plant is termed a Palm.||

Linnæus enumerates seven species of trunk, viz.: the *caulis, culmus, scapus, petiolus, pedunculus, frons, and stipes.*

The Caulis stem or stalk is, as has been already observed, the body of any herb or tree supporting branches, leaves, and fruit. Dr. Milne says that the caulis is an universal trunk; that is, it proceeds immediately from the root, whilst the foot-stalks of the flower and leaf, which Linnæus likewise denominates Trunks, are partial; proceeding as they frequently do from the universal trunk, or its branches.

The Caulis is either simple, simply branched, or compound: simple, when undivided to the

* *Dumus.*
† *Subfrutex.*
‡ *Herba.*
|| *Palma.*

summit; simply branching, when not divided from the crown of the root; and compound, when subdivided into *ramuli*, or small branches, diminishing as they ascend, so as frequently to lose the appearance of a stem.

Linnæus enumerates the following varieties of the Caulix simplex, or simple stem.

Caulis nudus, a stem without leaves or hair.

Caulis foliatus, a stem covered with leaves.

Caulis flexuosus, a stem which takes a different direction at every joint.

Caulis volubilis, a stem which ascends in a spiral direction, or round the branch, stem or prop of some other plant.

Caulis reclinatus, a stem reclining in an arch towards the ground.

Caulis procumbens, a stem lying along the ground, but not putting forth roots.

Caulis repens, a stem running along the ground, and throwing roots at certain distances.

Caulis sarmentosus, a slender stem having leaves in branches only at the joints where it strikes root.

Caulis parasiticus, a stem which does not grow immediately from the ground, but depends for its support upon some other plant.

Caulis teres, a columnar stem, or stem without angles.

Caulis anceps, a two-edged stem, compressed, and forming two opposite angles.

Caulis triqueter, a stem having three plane or flat sides.

Caulis trigonus, a stem having three angles, with the sides concave or convex.

Caulis sulcatus, a furrowed, grooved, or fluted stem.

Caulis striatus, a stem marked throughout its whole length, with superficial or slight grooves or channels.

Caulis glaber, a smooth stem.

Caulis scaber, a rugged stem.

Caulis villosus, a stem covered with down.

Caulis hispidus, a stem covered with bristles or minute prickles.

Of simply branching stems, there are the following kinds:

Caulis ascendens, a stem, the branches of which grow at first in a horizontal direction, and then gradually curve upwards.

Caulis diffusus, a stem furnished with spreading branches.

Caulis distichus, a stem with the branches horizontal, and produced in two rows.

Caulis brachiatus, a stem having branches,

stretched out like arms, in pairs, each of which are at right angles with the next.

Caulis ramosissimus, a stem very much branched, and having the branches disposed without any regular order.

Caulis fulcratus, a stem supported by the branches, which descend to the root; as in the Fig-tree and the Rhizophora, or sea mangrove.

Caulis prolifer, a stem which puts forth branches only from the centre of the summit; as in the Pine, Fir, and Cedar.

Caulis simplicissimus, a stem of the most simple growth, having very few branches, and which proceed in a straight line to the top, as in the Lathræa, Squamaria, or Tooth-wort.

Of the *Compound Stem*, or *Caulis compositus*, Linnæus mentions three species, viz.—

Caulis dichotomus, a stem which is regularly divided by pairs, from the top to the bottom; as in the Viscum or Misletoe.

Caulis subdivisus, a stem divided into branches irregularly and without order.

Caulis articulatus, a jointed stem, having joints or knobs at regular distances.

Culmus, which may be very properly rendered culm, straw, or haulm, is defined by Linnæus to

be the proper trunk of grasses, which support the leaves and fruit; Professor Martyn prefers the term *culm* generally; the term straw, can perhaps only be properly applied to the dry stalks of corn. There is a general feature in this species of stem; it is usually tubular, or hollow, and sometimes triangular, and has very frequently knots or joints at regular intervals.

When jointed, it is called *Culmus articulatus;* when free from joints or knobs, *Culmus enodis.* The interval or space between each two joints of a jointed culm, is termed an internode, agreeably to Professor Martyn.

In the greater number of grasses, the culm is furnished with leaves, as in wheat, rye, Indian corn, &c.; in some, the culm is entirely leafless, as in certain sheaves of cypress grass.

The Scapus,* or scape, is a species of stem or trunk which supports the fruit but not the leaves; and, like the caulis, is an universal stem; in this respect it differs from the pedunculus or peduncle. The scape proceeds immediately from the root, whereas the peduncle issues always from the stem, or branches of the stem. The scape likewise differs from the *Caulis aphyllus*, or leafless stem, in having radical or bottom leaves.

Examples of the scape are to be seen in the

* Latin, the shaft of a column.

cowslip, narcissus, pyrola or winter green, convallaria majalis, or lily of the valley, hyacinth, dionæa muscipula, sarracenia purpurea, hypoxis erecta, and the sagittaria folia.*

The *Petiolus* or *petiole*, is the *leaf-stalk* or *foot-stalk;* it is also called a *fulcre*, from the support it gives to the leaf; and it is, of course, *the part connecting* the leaf with the main stem. *In the* generality of plants it is nearly of the same colour as the leaf to which it belongs; indeed it has the appearance of the leaf in a compressed state, its upper surface being flattened, the under round or convex. It consists of one or more bundles of fibrovascular tissue, surrounded by cellular tissue; its figure is generally half-cylindrical, frequently channelled on the surface; in most monocotyledonous plants it is perfectly cylindrical.

At the base of the petiole, where it joins the main stem, there is generally produced a protuberance, which, by RUELLIUS and LINK is called the *pulvinus*, but the term *coussinet*, given it by M. de CANDOLE, is preferable.

At the opposite extremity of the petiole, where it is connected with the leaf or lamina, a similar increase is often visible, as in *Sterculia, Mimosa sensitiva,* and others; this is termed *Struma,*

* For example, see Plate 16, class 22.

and by De Candole and other French botanists, *Bourrelet*. The petiole is generally straight, but in some cases rigid and twisted, so that the plant can climb by it. Occasionally it embraces the branch from whence it springs, and it is then said to be a sheath, as in the grasses. When the lower part only of the petiole is sheathed, as in Umbelliferæ, that part is with propriety called the pericladium. This division of the plant sometimes supplies us with very elegant marks for discriminating the different species of a genus: the *Petiolus alatus*, or winged petiole, is a species of leaf-footstalk, which has a thin membrane or border on each side of it; this little characteristic distinguishes the *orange (Citrus aurantium,)* from the *lemon (Citrus medica)*.

In the latter species the petiole is linear; that is, it is nearly of the same breadth its whole length.

In the greater number of vegetables, the leaves and fruit are supported by distinct foot-stalks, but in a few cases, the same foot-stalk supports alike the leaf, and the flower or fruit; this is the case in *Turnera ulmifolia*, and in *Hibiscus moscheutos*.

The PEDUNCULUS, or peduncle, is that part of the stem supporting the fruit without the leaves. The term is only practically used to denote the immediate support of a single flower, and is therefore confined to that part of the

inflorescence which first proceeds from the stem; it may, however, with propriety be applied to all parts bearing flowers without leaves, that is, not producing perfect leaves, for the peduncle is distinguished from every other kind of stem by producing the *bractæ*,* an imperfect leaf both as to size and figure.

Various species of the peduncle are enumerated by Linnæus; the principal of which are subdivided in the following manner:

The *Peduncle*, as to its place of *origin*, is called

Caulinus, proceeding from the stem.

Rameus, proceeding from a branch.

Petiolaris, proceeding from the petiole.

Cirrhiferus, proceeding from a tendril.

Terminalis, terminating, or proceeding from the top of the stem.

Axillaris, proceeding from the axil, or angle made by the leaf and the stem, or by the branch and the stem.

Oppositifolius, opposite to a leaf.

Lateriflorus, having the flower on the side of it.

Interfoliaceus, among the leaves.

Intrafoliaceus, within the leaf.

Extrafoliaceus, without or on the outside of the leaf.

* See Bractæ, under the head of Fulcres.

Suprafoliaceus, inserted into the stem, higher than the leaf.

In respect to their *situation,* Peduncles may be

Oppositi, opposite to each other.

Alterni, alternate.

Sparsi, scattered, without any regular order, and

Verticillati, in whorls.

As to their *number* they may be either *Solitarii,* single, or *Geminati,* double, in pairs.

The *peduncle,* according to the *number of flowers* it bears, is called

Uniflorus, one-flowered.

Biflorus, two-flowered.

Triflorus, three-flowered.

Multiflorus, many-flowered.

In regard to its *direction,* a Peduncle may be

Appressus, pressed close to the stem.

Erectus, upright.

Patens, spreading.

Cernuus, drooping, or pointing to the ground.

Resupinatus, upside down.

Declinatus, bowed, or curved downwards.

Natans, nodding.

Adscendens, rising gradually.

Flaccidus, weak or feeble, bending with the weight of the flower it supports.

Pendulous, loose, tending downwards with the leaf.

Strictus, stiff and straight.

Flexuosus, bending readily, in different directions.
Retrofractus, bent backwards, as if broken.

With respect to its *length*, it is

Brevis, short.
Brevissimus, very short.
Longus, long.
Longissimus, very long.

As to its *structure*, it is

Teres, round, cylindrical, or columnar.
Triqueter, three-sided.
Tetragonus, four-cornered.
Filiformis, like a thread, or of the same thickness in all the parts.
Attenuatus, tapering gradually towards the top.
Incrassatus, growing gradually thicker towards the top.
Clavatus, club shaped.
Nudus, without bractes.
Squamosus, scaly.
Bracteatus, furnished with bractes.
Articulatus, jointed.
Geniculatus, bent at the joints.

The *Frons*, or frond, is the sixth species of trunk recognised by Linnæus. He defines it to be a kind of stem, which has the branch united with the leaf, and frequently with the fruit.

The *Stipes*, or stipe, is, by Linnæus, said to be the base of the frond.

Both the Frons and the Stipes, (the former particularly,) belong to the ferns and palms, and as these do not strictly come within the plan of this work, all that is necessary to be said of them will be found to follow the illustrations of the 24th Class, Plate 18.

The term stipe, however, is by Linnæus partially applied to the foot-stalk, which, in many of the compound flowers belonging to the class of Syngenesia, is a species of trunk, elevating the feather-like crown, (called Pappus,) with which the seeds are furnished, and which connects it with the seed. This is sufficiently conspicuous in the *common Lettuce*, the *Leontodon Taraxacum*, (Dandelion,) the *Tussilago*, (Colts-foot,) and many other plants.

OF THE LEAVES.

A knowledge of the leaves of plants is an important part of the study of Botany. Nature appears to have taken delight in giving to them forms almost innumerable. It is from the leaves that some of the most eminent Botanists, particularly RAY, LINNÆUS, and VAN ROYEN, have taken the greater number of their specific characters of plants; and Linnæus lays it down as

an axiom, that the leaves exhibit the most elegant natural differences. This opinion, however, must be received with some qualification, for we find a variation of soil, or climate, or situation, to change considerably the aspect of the leaves of plants. Linnæus, too, has denominated the leaves the lungs of vegetables. We have, however, since his time made but little advance in the knowledge of their functions, and it is to be lamented that both LINNÆUS and HALLER were removed from their labours in this life* soon after PRIESTLEY, and other illustrious men, had turned their attention to the relations which subsist between vegetables and the atmosphere.

DR. ERASMUS DARWIN took much pains to prove, that the leaves are the lungs of vegetables, and that their offices nearly correspond with those of the lungs in man, and many of the lower animals. This opinion has been adopted by almost every botanist of eminence, and even by Professor LINDLEY. "Leaves," he says, "are at once organs of respiration, digestion, and nutrition; they elaborate the crude sap impelled into them from the stem, parting with its water, adding to its carbon, and exposing the whole to the action of air; and while they supply the

* Haller died 1777, and Linnæus in January 1778.

necessary food to the young fibres that pass downwards from them, and from the buds in the form of alburnum and liber, they also furnish nutriment to all the other parts immediately above and beneath them." He adds that there are many experiments to show that such is the purpose of the leaves. "If a number of rings of bark are separated by spaces without the bark, those which have leaves upon them will live much longer than those which are destitute of leaves. If leaves are stripped off a plant before the fruit has commenced ripening, the fruit will fall off and not ripen. If a branch be deprived of leaves for a whole summer, it will either die or not increase in size perceptibly." To these convincing experiments may be added one, made by the nephew of the late Dr. Darwin, and related in his *Principia Botanica*. He says, "If the spiracula of the leaves are stopped, by covering the upper surface with oil, death ensues."

OF THE ANATOMICAL STRUCTURE OF LEAVES.

The anatomical structure of Leaves is the subject which next claims attention.

The expansion of the vessels of the stem or stalk, forming several ramifications like network, are extended in length and breadth in a deter-

minate manner, having the interstices filled up with a tender pulpy substance, called the *Parenchyma.* The external covering is considered to be a continuation and expansion of the scarf-skin, or bark of the stem or stalk.

When a leaf is torn in a horizontal direction, we observe an exterior membrane, which is generally thin, and almost pellucid; this membrane is the bark of the leaf. It does not adhere to the subjacent parts with equal firmness in all plants; nor even on the two surfaces of the leaves in the same plant. It possesses the singular property, when first torn off, of quickly folding itself inwards; but when dry, of twisting in a contrary direction.

The bark of the leaf appears to be composed of an epidermis, properly so called, and a thicker substance, which may be denominated a cuticle; the bark is also furnished with a number of glandular bodies, which are of different sizes and forms; these glands are surrounded by fibres or small vessels; under this bark we find a beautiful network of vessels, connected with the cortical glands, and their circumambient vessels, which, whether they be arteries, veins, or absorbing lymphatics, are evidently a continuation of the vessels common to the stem and petiole; this network is known by the name of the cortical net of the leaf; and it is composed of a great number

of vessels, more or less minute, which, by crossing each other, forms its appearance. The forms of the spaces, or areæ, between these thread-like vessels composing the net, are very different in different vegetables; and, indeed, in various parts of the same plant there is a perceptible variation in the form; they are more regular upon the upper than upon the under side of the leaf, and they are narrower and longer towards the petiole or foot-stem, than towards the middle and anterior part.

This beautiful, delicate, and regular net, is either single, double, or triple. These variations are exhibited in the following plants:

In the leaves of the Maple, the cortical net is single.

In the leaves of the Holly, it is double.

In the leaves of the Orange, it is treble.

Under the Cortical net, and in the areal interstices between the vascular fibres, we meet with another substance, which, as before said, has received the name of the *Parenchyma*, the pulp, or pith of the leaf: this substance is of a tender and cellular nature, but is by no means inorganic, or destitute of vessels; on the contrary, it distinctly appears to contain larger vessels than those which compose the cortical net; the areal interstices are larger also than those in the net (cortical). It is this pulpy substance which is so frequently

consumed by the myriads of insects which spread their ravages through our gardens, fields, and forests; leaving entirely, or in a very great measure, untouched, the cortical network. By allowing the leaves of plants to remain some days in water for the purpose of reducing the parenchymatous part to a more tender pulp, and afterwards pressing it out, we form those beautiful preparations of leaves which are so well calculated to exhibit the fabric of the cortical net.

Between the upper and under surface of the leaf there is a very essential difference. In the greater number of leaves, the veins and arteries are much more in relief upon the under than upon the upper surface; and, in general, the upper surface is of a deeper green. The entire surface of a leaf is called by Linnæus, *Discus*, or disk. In contradistinction, the upper surface is called *Discus supinus*, the under, *Discus pronus*. They are also termed *Pagina superior*, and *Pagina inferior*. The *apex* is the tip or end of the leaf, the most remote from the base; and the point where the base of the upper side of a leaf joins the stem, is called the *axilla;* any thing which arises out of that point, is said to be *axillary*. If a branch proceeds from above the *axilla*, it is called *Supra-axillary;* if from below it, *Infra-axillary*.

Ludwig, and some other writers, have distin-

guished leaves into primary and accessary. The primary are those which have been described; the accessary, those termed by Linnæus *Stipulæ* and *Bractæ*, and which will be considered under the head of *Fulcres*.

OF THE NOMENCLATURE OF LEAVES.

Leaves considered in respect to their nomenclature may be treated under the three following heads, viz.

Simple leaves, *Compound leaves*, and *leaves according to their Determination.*

The *Folium simplex*, or simple leaf, is that species of leaf which consists of one undivided substance, situated upon a petiole, or foot-stalk. In other words, the simple leaf is one of which the petiole is terminated by a single expansion, and the divisions of which, however deep, do not reach to the middle rib. "To understand this, let it be observed, that the middle rib of every leaf is the principal prolongation of the foot-stalk; which, to form the membranous expansion, called the leaf, runs out into a number of ramifications, which, inosculating and crossing each other, jointly form the cortical net" of the leaf. "When these ramifications of the foot-stalk are so connected as to form one entire expansion,

the leaf is said to be simple; but when the middle rib becomes, in fact, a foot-stalk, and several expansions, instead of one, proceed from the common foot-stalk, the leaf is called compound." The middle rib of a leaf, whether it be simple or compound, is denominated by Linnæus, costa.

The forms of the simple leaf are almost innumerable. The majority of those enumerated by Linnæus in his *Philosophia Botanica* will be noticed; but it is impossible within the limits of an elementary work to attempt any thing like a full description of all. Among the most important to be noticed are the—

Folium orbiculatum, an orbicular or circular leaf.
— *subrotundum*, a leaf partially round.
— *ovatum*, an ovate, or egg-shaped leaf.
— *ovale*, an oval leaf.
— *parabolicum*, a parabolic leaf.
— *spatulatum*, a spatulate, or spatula-shaped leaf.
— *cuneiforme*, a wedge-shaped leaf.
— *oblongum*, an oblong leaf.
— *lanceolatum*, a lanceolate leaf.
— *lineare*, a linear leaf, as in the leaves of grasses.
— *acerosum*, an acerose leaf, or a leaf which is permanent, as in the Pine, Yew, and many other ever-green trees.

Folium subulatum, a subulate leaf; linear at the bottom, but gradually tapering to the end.

— *triangulare,* a triangular leaf.

— *qradrangulare,* a quadrangular leaf.

— *quinquangular,* a five-cornered leaf.

— *deltoides,* a deltoid leaf.

— *rotundum,* a round leaf.

— *reniforme,* a kidney-shaped leaf.

— *cordatum,* a heart-shaped leaf.

— *lunulatum,* a crescent-shaped leaf.

— *sagittatum,* a sagittate leaf, one shaped like the head of an arrow.

— *hastatum,* a hastate leaf, or one resembling the head of a halbert.

— *panduræforme,* a guitar-shaped leaf.

— *fissum,* a cleft-leaf, a leaf divided by linear sinuses, with straight margins; according to the number of which divisions, the leaf is called bifid, trifid, quadrifid, quinquefid, multifid.

— *lobatum,* a lobate or lobed leaf.

— *palmatum,* a hand-shaped leaf.

— *pinnatifidum,* a pinnatifid leaf.

— *lyratum,* a lyre-shaped leaf.

— *laciniatum,* a laciniate, or jagged leaf; a leaf divided almost down to the base. According to the number of the divisions, this parted leaf is called *bipartitum,* bi-

partite; *tripartitum*, tripartite; *quadripartitum*, quadripartite; *quinquepartitum*, quinquepartite; and *multipartitum*; or numerously parted.

Folium integrum, an entire leaf.

— *truncatum*, a truncate leaf; or a leaf ending in a transverse line, so that it seems as if the tip had been cut off.

— *præmorsum*, a leaf ending very obtusely, with unequal notches.

— *emarginatum*, a leaf notched at the end.

— *obtusum*, an obtuse or blunt leaf.

— *acutum*, an acute leaf, ending in an acute angle.

— *acuminatum*, an acuminate or sharp pointed leaf, ending in a subulabe or awl-shaped point.

— *cirrhosum*, a cirrhose leaf, terminating in a tendril.

— *spinosum*, a spiny or thorny leaf.

— *dentatum*, a toothed leaf.

— *serratum*, a serrate leaf, toothed like a saw.

— *crenatum*, a crenate leaf, having the edge cut with angular or circular incisures, but not inclining towards either extremity.

— *repandum*, a repand leaf, having its rim terminated by angles, with sinuses between them.

Folium cartilagineum, a cartilaginous leaf.
— *ciliatum*, a ciliate leaf, having the edge guarded by parallel bristles, longitudinally, similar to the human eyelashes.
— *lacerum*, a lacerated leaf, with the edge variously cut, as if it were torn.
— *erosum*, an erose, or gnawed leaf, as if gnawed by insects.
— *integerrimum*, absolutely entire, the margin or edge not being in the least cut or notched.
— *viscidum*, a viscid leaf, covered with a tenacious juice.
— *tomentosum*, a tomentose leaf, downy or cottony.
— *lanatum*, a woolly leaf, or covered with a substance resembling a spider's web.
— *pilosum*, a hairy leaf, having the surface covered with long and distinct hairs.
— *hispidum*, a hisped leaf, or covered with minute prickles.
— *scabrum*, a rugged leaf, resembling shagreen.
— *aculiatum*, a prickly leaf.
— *striatum*, a striated or streaked leaf.
— *papillosum*, a papillose leaf, having the surface covered with fleshy dots.
— *punctatum*, a dotted leaf.
— *nitidum*, a glittering or glossy leaf.

Folium plicatum, a plaited leaf, or folded like a fan.

— *undulatum,* a waved leaf, or having the surface resembling waves.

— *crispum,* a curled leaf.

— *rugosum,* a wrinkled leaf.

— *concavum,* a concave leaf, with its edges standing above the disk.

— *venosum,* a veined leaf; the vessels of which branch or variously divide over the surface. Where a leaf has no perceptible vessels, it is called—

— *avenium,* a veinless leaf.

— *coloratum,* a coloured leaf, applied to a leaf of any other colour than green.

— *glabrum,* a smooth leaf.

— *teres,* a columnar leaf, a leaf without angles.

— *tubulosum,* a tubulous or hollow leaf, as in the onion; and most singularly in the *Sarracenia purpurea.*

— *Carnosum,* a fleshy leaf, full of pulp within.

— *compressum,* a compressed or flatted leaf.

— *planum,* a plane or flat leaf, having the two surfaces parallel.

— *gibbum,* a gibbous leaf, having both surfaces convex.

Folium convexum, a convex leaf, with the edge more contracted than the disk.

— *depressum,* a depressed leaf, hollowed in the middle, by having the disk more depressed than the sides.

— *canaliculatum,* a channelled leaf, hollowed above with a deep longitudinal groove, and convex underneath.

— *ensiforme,* a sword-shaped leaf, tapering from the base to the point.

— *acinaciforme,* an acinaciform leaf, fleshy, and compressed, and resembling a sabre, faulchion, or scimitar.

— *dolabriforme,* a dolabriform leaf, resembling an axe, or hatchet.

— *linguiforme,* a tongue-shaped leaf, linear and fleshy, blunt at the end, convex underneath, and having usually a cartilaginous border.

— *anceps,* an ancipital leaf, having two prominent longitudinal angles, with a convex disk.

— *triquetrum,* a three-sided leaf.

— *sulcatum,* a furrowed, grooved, or fluted leaf.

— *carinatum,* a carinated leaf, having upon the back a longitudinal prominency, like the keel of a vessel.

— *membranaceum,* a membranaceous leaf, hav-

ing no perceptible pulpy matter between the two surfaces.

COMPOUND LEAVES, are those whose foot-stalks are terminated by several expansions; in other words, whose divisions extend to the common foot-stalk, which, not running into the membranaceous part of the leaf, supports the several lobes, or lesser vessels, called *foliola*, and of which the compound leaf consists.

The foliolæ, or leaflets, as Dr. Martyn renders the word, are true simple leaves, the forms of which, like those of the simple leaves already treated off, are very diversified. These leaflets are sometimes furnished with particular foot-stalks; sometimes they are destitute of such foot-stalks, but are seated upon the middle rib of the compound leaf. The former leaflet is called *foliolum petiolatum*, a petioled leaflet; the latter *foliolum sessile*, a sessile leaflet.

In these Compound Leaves, the central longitudinal fibre, or part to which the leaflets are attached is, as already observed, called the costa, or rib. This part of the leaf is, by some botanists, called a nerve; but this term ought not to be admitted into botanical language, since there is no reason to believe that any peculiar sensibility, the attribute of nervous matter, resides in the central or any other fibre. It has also been

called a vein; to this term there seems no objection, since it is now well known that a fluid circulates through every part of the leaf along the course of the middle rib, and of the branches which it sends out.

Compound leaves are distinguished by Linnæus into three classes, viz.:

Once compounded; twice compounded; and more than twice compounded.

First.—The *folium compositum*, or leaf only once compounded, admits of the following species or varieties, viz.:

Folium articulatum, a jointed leaf; when one leaflet grows from the top of another.

— *digitatum*, a digitate leaf; when a simple or undivided foot-stalk connects several distinct leaflets at the end of it, as in different species of *Æsculus*, (horse chesnut.)

— *binatum*, a binate leaf, having a simple petiole connecting two leaflets on the top of it.

— *ternatum*, a ternate leaf, having three leaflets on one petiole. as in Trefoil, Strawberry, &c.

— *quinatum*, a quinate leaf, having five leaflets on one petiole.

— *pinnatum*, a pinnate leaf, composed of a

number of leaflets, arranged like wings, along both sides of the middle rib.

Examples of this beautiful leaf are found in the different species of ***Robinia, Cassia, Pea, Vetch,*** &c. &c. Under the general head of the pinnate leaf, Linnæus refers to various varieties, such as the following:

Folium pinnatum cum impari, unequally pinnate, when the wings composed of leaflets, are terminated by a single leaflet, as in *Robinia viscosa.*

— *cirrhosum,* cirrhosely pinnate; terminated by a tendril.

— *abruptum,* abruptly pinnate, neither terminating by a leaflet nor by a tendril.

— *opposite,* oppositely pinnate; having the leaflets placed opposite to each other, in pairs, as in *Cassia marilandica.*

— *pinnatum alternatim,* alternately pinnate; the leaflet ranged alternately along the common petiole.

— *interrupte,* interruptedly pinnate; having smaller leaflets interposed between the principal ones.

— *articulate,* jointedly pinnate; when the common foot-stalk is articulated or jointed.

Folium decursive, decursively pinnate; when the leaflets run into one another, along the common petiole.

— *conjugatum*, a conjugate leaf, having only one pair of leaflets.

Secondly.—The *Folium compositum decompositum*, or decompound leaf. This is formed when the primary petiole is so divided that each part forms a compound leaf; that is, the foot-stalk, instead of supporting small lobes, or leaflets, on the top, or on each side, bears partial foot-stalks, from which proceed the leaflets on both sides. Of this kind there are the following varieties:

Folium bigeminatum, or bigeminate leaf; having a dichotomous or forked petiole, with several leaflets at the extremity of each division.

— *biternatum*, a biternate or doubly-ternate leaf; when the petiole has three ternate leaflets, as in *Epimedium*.

— *bipinnatum*, a doubly-winged leaf, or frond; when the common petiole has on each side of it pinnate leaves, as in *Athamanta libanotis*, and many ferns.

— *pedatum*, a pedate leaf; when a bifid or forked petiole connects several leaflets on the inside only; as in the Arum, &c.

Thirdly and *lastly.*—The *Folium compositum supra decompositum*, supra decompound leaf, or a leaf which is more than twice compounded. This is a species of compound leaf, in which the petiole, being several times divided, connects many leaflets, each part forming a decompound leaf; as in *Pimpinella glauca, Ranunculus rutæfolius,* and others; of this there are the following species, viz.

Folium triternatum, a triternate or triply-threefold leaf; is when the petiole has three biternate leaves.

— *tripinnatum*, a tripinnate, or three times pinnate-leaf; when the petiole has bipinnate leaves ranged on each side of it; as in the *Peteris aquilina,* and other ferns.

— *tergeminum*, a tergeminate or thrice-doubled leaf, and which arises, as Professor Martyn says—"When a forked petiole is subdivided, having two leaflets at the extremity of each subdivision; and also two other leaflets at the division of the common petiole."

DETERMINATION.

The *determination* or *disposition* of leaves, whether they be simple or compound, comprehends the following particulars, viz.

The *Locus*, or place of the leaf.

The *Situs*, or situation.
The *Insertio*, or insertion; and
The *Directio*, or direction.

By the term LOCUS, or place of the leaf, Linnæus means the particular part where it is attached to the plant; and under this head he enumerates the following varieties, viz.

Folium primo, the seed-leaf, or the primary leaf of the plant, being the cotyledons or lobes of a seed expanded, and in a vegetating state.

— *radicale*, a root-leaf, proceeding immediately from the root, and not adhering to the stem.

— *caulinum*, a cauline leaf; growing immediately on the stem, without the intervention of branches.

— *rameum*, a branch leaf, growing on or proceeding from a branch.

— *axillare*, an axillary leaf; growing at the angle which is formed by the branch with the stem.

— *florale*, a floral leaf; immediately attending the flower, and never appearing but with it. This, however, must not be confounded with the *bractæ* or *bracte*.

The SITUS, or *situation* of leaves, respects

their position in regard to themselves; and in this subdivision there are the following varieties.

Folia stellato, or stellato leaves; when more than two leaves surround the stem in a whorl, or radiate like the spokes of a wheel; of this there are examples in *Rubia* (Madder) *Asperula odorata* (sweet Woodruff), &c. &c., such leavesare also called *Verticillate; terna, quaterna, quina, sena,* &c., or three-fold, four-fold, five-fold, and six-fold leaves; these, of course, are to be understood as different varieties of stellate leaves, when the leaves grow in a whorl, three, four, five, or six together.

— *opposita,* opposite leaves, growing in pairs, each pair decussated, or crossing that above or below it.

— *alterna,* alternate leaves, coming out one after or above another, in a regular succession or gradation, as in *Ludvigia alternifolia;* the term alternate is opposed to the opposite.

— *sparsa,* scattered leaves; neither opposite nor alternate, nor in any regular order; as in several species of the Lily.

— *conferta,* crowded or clustered leaves; leaves so copious as to occupy the whole of the

branches, hardly having any space between, as in the *Antirrhinum linaria.*

Folia imbricata, imbricate leaves; lying over each other like the scales on a fish.

— *fasciculata,* fascicled leaves; growing in bundles or bunches from the same point, as in the Larch-tree.

— *disticha,* two ranked leaves; leaves, respecting only two sides of the branch, though inserted on all parts of it, as in the Fir and others.

INSERTIO.

By the term *Insertio,* or *insertion* of the leaves, is meant the manner in which they are attached to the plant; in this view they are recognised as follows, viz.

Folium peltatum, a peltate or target-shaped leaf; having the foot-stalk inserted into the disk of the leaf, instead of the edge or base, which is the more common mode of insertion; as in different species of *Nelumbium;* the *Tropæolum* (Nasturtium), and others.

— *petiolatum,* a petiolate or petioled leaf; growing on a petiole or foot-stalk, which

is usually inserted into its base, as in the greater number of leaves; (the term is opposed to sessile.)

Folium sessile, a sessile leaf; a leaf which is immediately connected with the stem or branch, without the intervention of a footstalk, as in *Rhexia virginica*, and *Veronica chamædrys*.

— *decurrens*, a decurrent leaf; this is a sessile leaf, with its base extending downwards along the trunk, or stem; as in *Symphytum* (Comfrey), *Cordus* (Thistle), and others.

— *amplexicaule*, a stem-clasping leaf, embracing or surrounding the stem by its base: some leaves only go half round the stem; these are denominated,—

— *semiamplexicacelia*, or half-stem-clasping leaves.

— *perfoliatum*, a perfoliate or perforated leaf, having the base of the leaf entirely surrounding the stem transversely, so that the stem appears to have been driven through the middle of the leaf, as in *Bupleurum rotundifolium* (Thoroughwax), *Eupatorium perfoliatum* (Thoroughwort), and others.

— *connatum*, a connate leaf; when two opposite leaves are so united at their bases as to

appear as though they were one leaf; examples of which are seen in the *Garden honey-suckle*, &c.

Folium tubulosum, a tubular leaf; investing the stem or branches by its base, in form of a tube; as in many *grasses*, *Liliaceous* plants, and others.

DIRECTIO.

With respect to their direction, leaves are distinguished as follows:

— *adversum*, an adverse leaf; when the upper side is turned to the south, as in *Amomum*.

— *obliquum*, an oblique leaf, having the base directed towards the sky; and the apex, or point, towards the horizon; as in *Protea* and *Fritillaria*.

— *inflexum*, an inflex or inflected leaf; bent upwards at the end, towards the stem.

— *adpressum*, an appressed leaf; when the disk approaches so near to the stem as to seem as if it were pressed to it with violence.

— *erectum*, an erect or upright leaf; when it makes with the stem an angle so acute as to appear to be close to it.

— *patens*, a spreading leaf, forming an acute angle with the stem or branch upon

which it is placed, between the erect and horizontal position.

— *horizontale*, a horizontal leaf; making a right angle with the stem, the upper disk being turned towards the sky.

— *reclinatum*, a reclined leaf, bent downwards, so that the point of the leaf is lower than the base.

— *revolutum*, a revolute leaf, having the edges rolled back, or towards the lower surface; as in *Rosemary*, *Kalmia glauca*, *Vaccinium oxycoccos*, *and Vitis* Idæa, (Cranberry and Cow Berry.)

— *dependens*, a leaf hanging down, or pointing directly to the ground.

— *radicans*, a rooting leaf, a leaf shooting forth radicles, or roots; as in some aquatic plants: this term is also applied to those leaves which, being planted in the ground, there strike root and vegetate; such are the properties of the succulent leaves of several of the *Liliaceous* plants, the *Aloe*, the *Squill*, the *Orange*, and many others.

— *natans*, a floating leaf; a leaf which lies or floats upon the surface of the water; as in *Nymphæa* (Water lily), *Potamogeton natans*, *Trapa natans*, &c. &c.

— *demersum*, a demersed leaf, called also a drowned or sunk leaf; a leaf which grows

below the surface of the water. Examples of this species are found in *Vallisneria spiralis,* in *Hottonia palustris* (Water violet), *Potamogeton* (Pond weed), and in many other aquatic plants. Some plants are constantly placed below the surface of the water, whilst others, from the coldness of the air, are contracted; they are consequently withdrawn from the surface, and by which they escape the rigours of the winter months; this is particularly the case with the *Callitriche* (Water-starwort), and the *Stratiotes aloides* (Fresh-water soldier, or more properly sailor).

OF THE FULCRA.

The fulcra are agents for the support of those parts of the plant proceeding from the main stem, which are to bear the flowers, or, in the absence of flowers, the leaves, as in the Ivy. The number and character of these fulcra, Linnæus has, in different parts of his writings, treated somewhat inconsistently. This indecision has given rise to much variety of opinion. Professor Lindley argues that the fulcra of Linnæus are in general to be considered as nothing more than curious transformations and elongations of the

petiole, &c. This opinion, however, is not maintainable, though at the same time it is probable that the nomenclature of botany would lose little of its value by the entire rejection of the term *fulcra*.

Under this head, Linnæus enumerates the following:

The *Petiole*, *Peduncle*, *Spina*, *Aculeus*, *Glandula*, *Pilus*, *Cirrus*, *Stipula*, *and Bractæ*.

The first two may be rejected on the authority of Linnæus himself, who having determined them to be (partial) stems, they cannot be regarded as anything else, nor as belonging to any other part of the plant.* It is equally certain that the four which follow them cannot, with any degree of propriety, be considered as props or supports, no circumstances appearing to warrant our investing the *Spina, Aculeus, Glandula, and Pilus*, with such capabilities. These four subdivisions may, therefore, be rejected in this place, and considered under the separate head of *Absorbents* and *Exhalents*. Cirrus, Bractæ, and Stipula, are more properly termed fulcra, supporters, or props, and they only have any claim to the appellation.

* See pages 16 and 17, *petiole*.

FULCRA.

The Fulcra, more properly so called, are the

CIRRUS, STIPULA, AND BRACTÆ.

First.—The *Cirrus* (a curl,) is translated a *Tendril*, it is also called a *clasper*. It is a fine spiral string, or fibre, proceeding from different parts of the plant, by means of which it fastens itself to some other plant or body. Various species of tendrils are mentioned by Linnæus, but they may be all resolved into two divisions, viz., according to their place of origin or situation, and according to their form, or the number of leaves which they support.

First.—According to their place of origin: when the tendril proceeds from the axil, or angle, formed by the branch with the stem, or by the leaf with a branch, it is called *Cirrus axillaris.*

When the tendril proceeds from the leaf, as in the *Pisum ochrus*, or winged pea, it is called *Cirrus foliaris.*

When proceeding from the petiole or foot-stalk of the leaf, it is called *Cirrus petiolaris.*

When proceeding from the peduncle, it is called *Cirrus peduncularis.*

Second.—According to their form: this mode of division affords the following classification.

Cirrus simplex, a simple or undivided tendril.

Cirrus trifidus, a three-cleft tendril, or a tendril divided into three parts.

— *multifidus,* many cleft, or often divided.

— *diphyllus,* a two-leaved tendril, or a tendril supporting two leaves.

— *tetraphyllus,* a tendril supporting four leaves.

— *polyphyllus,* a tendril supporting many leaves.

— *convolutus,* a convoluted tendril, or a tendril twisted into rings or spirals.

— *revolutus,* a revolute tendril, it is so called when a spire of the spiral, having made half a revolution, turns back in a contrary direction; this species of tendril is seen in the *Passiflora,* plate 14, in this work.

Tendrils are very important parts in many plants. The *Bignonia radicans,* called *Trumpet flower,* as well as the *Ivy,* throw out tendrils (erroneously taken for roots,) on each side of the stem, by which it is enabled to climb up any surface tolerably uneven, such as a wall, thatch, or an old tree. In consequence of its being rarely seen on a young tree, on whose smooth bark it finds a difficulty to climb, it has been supposed to attack only sickly ones, and to expedite their decay. One of our poets, otherwise most happy in his descriptions of nature, has unfortunately rendered this opinion all but impossible

to eradicate; but the fact is, that the Ivy derives all its nourishment from its own root, leaves, &c. This will become apparent by observing, that the ivy on a dead wall is as vigorous as that upon a living tree.

In the Cucumber, and cucurbitaceous plants, the tendrils serve alike for sustentation, support, and shade. By their means, the trunks of the plants are bound as it were together, and prevented from being at the mercy of the winds; while, at the same time, an artificial arbour is made by their own leaves under which the tender fruits lie, and are protected from the fiercer rays of the sun.

BRACTÆ.

The *Bracta*, Bracte, or floral leaf, is a leaf which, in the majority of plants, differs from the true leaves both in shape and in colour; it is commonly situated on the peduncle between the true leaves and the calyx, and often so near to the corolla as to be mistaken for the calyx. This approximation is evident in the *Helebore*, *Nigella*, *Bartsia*, *Peganum*, and other plants. The following, among many, furnish us with remarkable instances of the bractæ.

The *Tilia* or *Lime-tree*, *Melampyrum*, *Bartsia coccinea*,* some species of *Fumaria*, the *Monarda*

* See Plate 10.

didyma or *Oswego-tea, Polygala* or *Milkwort, Ononis* or *Rest-harrow, Anthyllis* or *Lady's finger, Glycine frutescens,* &c.

In general, the bractæ are of the same duration as the common or true leaves of the plant; this circumstance is worthy of attention, as it will, in some instances, enable us to distinguish the bracta from the perianth or flower-cup, which last almost always withers when the fruit has ripened, if not, indeed, before. By neglecting this intimation, the young and inexperienced botanist may fall into serious mistakes, in ascertaining the genera of certain plants; such as *Hellebore, Fennel-flower, Passion-flower,* and others, which are furnished with bractes, but are destitute of calyx.

The BRACTE is *virides* or green, as in the *Hypoxis erecta* and *Coloratæ;* or coloured, as in *Bartsia coccinea.**

In point of duration, it is either

Deciduæ or *deciduous.*
Caducæ or *caducous,*
Persistentes or *permanent.*

In point of number, *bractes* are either—*Una,* one; *duæ,* two; *plures,* more than two.

* See Plate 10.

The following, among many other plants, have, in general, but one bracte, viz.

Chondrilla juncea, Aristolochia pistolochia, and *Erica dabœcia.*

The following plants have two bractes, viz. *Campanula alpina, Commelina zanonia, Rosa canina, Roy na villosa, Ruellia ringens, Cineraria sibirica,* and *Hypoxis erecta.*

The *Erica calycina,* and *Atractylis cancellata,* have three bractes.

The *Corymbium scabrum,* has four or five.

The *Cunila pulegioides, Stipa spinefex, Bartsia coccinea,** and many others, have several bractes.

In respect to size and height, bractes may be shorter than the calyx, as in *Justicia hyssopifolia,* and *Ruellia ringens;* longer than the calyx, as in *Salvia sclarea, Ruellia repens,* and *Stipa spinifex;* larger than the calyx, and placed under it, as in *Royena villosa;* shorter than the flower, as in *Salvia sylvestris, Fumaria nobilis,* and *Minuartia campestris;* of equal length with the flower, in *Fumaria bulbosa, Hypoxis erecta,* and *Ornithogalum comosum;* longer than the flower, as in *Ribes alpina,* and *Minuartia montana.* The *Cunila pulegioides,* besides a number of smaller bractes, has two that are larger than the flower, placed on each side of the foot-stalk.

* See Plate 10.

In some plants, such as the *Crown-imperial, Lavender,* some species of *Sage, Bartsia coccinea,** and a few others; the stem is terminated by a number of very large and conspicuous bractes, which are called Coma (*Bracteæ comosæ*), from their resembling a head of human hair.

It might appear presumptuous to reject the authority of *Professor Lindley, Jussieu,* and many other eminent botanists, did they not practically follow in their illustrations that arrangement which they theoretically undervalue, and therefore it may safely be submitted, taking into consideration the mechanical support the bractæ render, as well as the succour the efflorescence receives from it, that the office of this organ is of the very highest importance.

So satisfied was the late Dr. Darwin of the truth of this, that he writes thus, "All the different kinds of bractes serve the office of lungs, for the purpose of exposing the vegetable fluid to the influence of the air, and of preparing it for the proper nourishment of the reproducing portions of the plant."

ON THE STIPULA, OR STIPULE.

This is the third and last species of *Fulcra.* It is defined by Linnæus to be a scale, or small

* See Plate 10.

leaf, situated on each side of the base of the petiole and peduncle, or foot-stalks of the leaves and flowers, at their first appearance, and designed for the purpose of sustentation and support.

The presence or absence of stipulæ is a characteristic of the same importance as is the insertion of leaves: generally, stipulæ cannot be absent and present in different varieties of the same *natural* order; there are exceptions, but they are so few as not to invalidate the rule.

Stipulæ are very conspicuous in the *Tamarind,* the *Rose,* the *Cassia,* the *Melianthus* or *Honey-flower,* the *Apricot,* the *Peach,* the *Bird-cherry,* the *Magnolia,* and many species of *Pea-bloom-flowers,* &c.

Perhaps in no plant are they more beautifully conspicuous than in the *Liriodendron* or *Tulip-tree.* In this, and in many other vegetables, stipulæ are conspicuously fulcra or supporters; for they enclose, support, protect, and cherish the young leaves, until they have acquired a larger growth and greater strength. For these offices they are admirably calculated, being either membraneous, succulent, or spiny.

In the greater number of plants which are furnished with stipulæ, there are two of these scales or leaves attached to the stem, one on

each side; in this case they are called *Stipulæ geminæ,* or stipulæ in pairs.

In the *African Melianthus,* and in the *Ruscus* or *Butcher's broom,* there is only a single stipule, which, in the first-mentioned plant, is placed on the inside, and, in the latter, on the outside of the stalk; such as these are called, by Linnæus, *Solitariæ*, solitary.

In some plants the stipulæ grow upon, or are inserted into the sides; these are termed *Stipulæ laterales*, or *Lateral stipules.*

Stipulæ extrafoliaceæ, or extrafoliaceous stipules, are those which grow on the outside of the leaves, or below them, as in *Betula,* (the Beech,) *Tilia,* (the Lime,) and many of the *Diadelphous,* or *Pea-bloom* flowers. The term *extrafoliaceous*, is used in opposition to *Stipulæ intrafoliaceæ,* or intrafoliaceous stipules; stipules which grow above, or *within* the leaves, as in *Prunus padus.*

Stipulæ oppositifolæ, or oppositifolious stipules, are such as are placed opposite to the leaf.

When a stipule surrounds the stem of a plant it becomes, according to Professor *Willdenow*, an *Ochrea;* in this case, the anterior and posterior margins are united by cohesion, a property which they possess in common with all modifications of leaves, and of which different instances

may be pointed out, as in Magnoliaceæ, where the back margins only cohere; in certain *Cinchonaceæ*, where the anterior margins of the stipulæ of opposite leaves are united; and in a multitude of other plants.

In point of duration, some stipules fall off before the leaves; these are the *stipulæ caducæ*, or caducous stipules; examples of these are seen in the *common Cherry*, the *Almond, Poplar, Elm, Oak, Beech, Horn-beam, Birch, Alder, Fig, Mulberry*, and many others.

Stipulæ deciduæ, or deciduous stipules are those which fall off with the flower, and which is the characteristic of the majority of stipules, but in the Rose, Raspberry, Cinquefoil, Tormentil, Avens, Pea-bloom Flowers, and some others, the stipule remains till after the fall of the leaves, and in such cases, it is called *Stipulæ persistentes*, or permanent stipules.

The terms sessile, adnate, decurrent, sheathing, subulate, lanceolate, sagittate, lunate, erect, speading, reflex, serrate, ciliate, toothed, cleft, &c., are applied to stipules as well as to leaves. For the explanation of these various terms, the reader is referred to the nomenclature of leaves at page 27.

Although there is sufficient reason to regard the *Stipulæ* as Fulcra, according to the Linnæan

system, it must be admitted that in several plants they appear to have nothing to do in the way of support, but these evidences are, however, partial, and not sufficient to warrant the rejection of the opinion of Linnæus, and the adoption of that of his opponents.

We will now consider the SPINA, ACULUS, PILUS, and GLANDULA; as ABSORBENTS or EXHALENTS.

First.—The SPINA, SPINE, or THORN, is a sharp substance, varying in form, and issuing out of the ligneous or woody part of the plant. These parts have been called *Arma,* (arms,) the defensive weapons of plants, but as their natural enemy has never been satisfactorily pointed out, the term seems misapplied.

Instances of the *Thorn* are seen in the *Prunus spinosa,* (sloe or black Thorn,) *cratægus oxyacantha,* (Hawthorn,) &c.

To acquire a knowledge of their various situations, attention should be directed to the *Buck Thorn,* and *Orange Tree,* where the thorns issue from the stem and branches.

Robinia Pseudacacia, where they issue from the petioles.

Agave Americana, (American aloe.) *Yecca filamentosa,* (Adam's needle.) *Ilex aquifolium,*

(Holly.) *Hippomane mancinella,* (Manchineel.) *Ruscus,* (Butcher's Broom,) &c.

In each of which they issue from the leaves.

In several species of night-shade, they proceed from the ribs of the leaves.

In the Thistle, from the calyx.

In the *Datura Stramonium,* (Thorn-apple,) and many others, from the pericarp, or seed vessel.

The nomenclature of thorns originates from, and is to be referred to their situation, for example:

Spina terminalis, is a thorn situated at the apex or edges of a leaf, or forming the end of a branch.

It will here be necessary to bring before the reader some facts to illustrate the difference between the *Thorn* and the *Aculeus* or *Prickle.* The Spines of a leaf are formed either by an elongation of the woody tissue of the veins, or by a contraction of the parenchyma of the leaf: in the former case they project beyond the surface or margin, as in the Holly; in the latter they are veins themselves becoming indurated, as in the palmated spines of the *Berberis vulgaris.* The spiny petiole of many Leguminous plants is of this nature, and so strong is the tendency in some plants to assume a spiny state, that in a specimen of *Prosopis* from *Chili,* which was in

the possession of Professor LINDLEY, half the leaflets of its bipinnated leaves had the upper part converted into spines: but the most striking difference between the *Spine* or *Thorn*, and the *Aculous* or *Prickle*, is seen in the point issuing from the end of a branch; and this is generally produced by the branch being imperfectly formed, whereby it loses its power of extension and elongation, becoming unusually hard, and acquiring a sharp termination. Another characteristic of the Spina is, that it occasionally bears leaves, an instance of which is seen in the White-thorn.

Of these organs it is unnecessary to enter very minutely into the nomenclature, since it has been already stated that it is derived from their situation; but it will be proper to explain that the *Spina axillaris* is a Spine or Thorn, issuing out of an angle formed by a branch or leaf with a stem.

Thorns are considered as simple, double, triple, &c.

Simple, as in the majority of *Thorny* plants;

Double, as in the *Horned Acacia*; and

Triple, as in the *Gleditsia triacanthos*, (Honey-locust.) It must not, however, be taken as a general rule, that the number of thorns growing together in the same species, is always the same; for in the *Gleditsia*, although the number is usually three, there is sometimes only one, sometimes two, and sometimes five or six.

The *Aculeus,* (from Acus, a needle,) or prickle, is, like the thorn, a sharp substance, but proceeds from the bark only, and not from the wood: in this respect it differs essentially from the *Spina* or *Thorn,* which is a prolongation of the woody part of the vegetable to which it belongs. The difference of origin is apparent from the facility with which the *Prickle* is detached, the bark only coming away with it; whereas the *Spina* or *Thorn* is not removed without, at the same time, removing a portion of the wood. In point of general features, the *prickles* (aculei) are less rigid than the thorns, but they are equally opaque; they are conical and formed of masses of cellular tissue, terminating in an acute point, and it is believed that they invariably point downwards; they are found on all parts of a plant, except the stipulæ and stamens, though very rarely on the corolla, as in *Solanum Hystrix.* The most usual situation of the prickle is upon the stem, as in the *Rose,* the *Raspberry,* the *Berberry,* the *Aralia spinosa,* (Angelica-tree), the *Gooseberry,* and other bushes, &c.

Hook, in describing the *prickles* of the *stinging nettle,* says, "They are tubular, and arise from bulbs, containing an acrid fluid, which, upon the prickle being pressed down, is forced up and discharged through minute pores at the tips of

each, in a similar way to the poison discharged through the sting of wasps."

In form and appearance, *Prickles* are *erecti*, straight, as in the Solanum indicum.

Incurvi, bent downwards, as in Mimosa cineraria.

Recurvi, recurved, or bent outwards.

Tomentosi, downy, or covered with a silver white woolly appearance, as in Solanum sanctum.

Acerosi, chaffy, as in Solanum tomentosum.

Geninati, double, or two growing together, as in Euphorbia canariensis, and Euphorbia officinarum.

PRICKLES, when divided, are called *furcæ*, or forked; and are termed bifid, trifid, &c., from the number of their divisions.

The Pilus or *Hair of Plants*, has next to be considered. This term comprehends every kind of substance of a villous character, which covers the vegetable, however partially.

According to Professors Du Hamel and De Candolle, this substance, (like the Human Hair,) arises from small bulbs, either within the rind, or in the first layer of the inner bark; they are not found on roots, except at the time of germina-

tion, or on parts that grow under water. In some cases, they are like simple threads, in others like cells, stretched out lengthwise, threaded on each other, having frequently, instead of a sharp point at the tip, a minute vesicle, which gives out an oily fluid, somewhat glutinous, and sometimes coloured. Examples of this may be found in the *Moss-rose,* the *Sun-dew,* and others.

This substance originates either directly from the cutile, or from the cellular substance beneath it, and never has any communication with the vascular or ligneous system; it varies extremely in length, density, rigidity, and other particulars. The following species are enumerated by Linnæus and others.

Pili, hairs, long, soft, and erect.

Lana, wool, closely curled.

Tomentum, interwoven, or entangled, closely pressed to the stem, and scarcely perceivable.

Strigæ, stiffish, flat hairs.

Setæ, bristles, or stiff and roundish hairs.

Hami, hooks, sharp points curved back.

Glochides, barbs, forked at the apex, and both divisions of the fork hooked.

Villus villosus, very long, very soft, erect, and straight.

Velumen, velvet, short, very dense and soft, yet rigid, forming a surface like velvet.

Ciliæ-ciliatus, long, and forming a fringe to a margin, like an eye-lash.

Stings, stiff and pungent, giving out an acrid juice, if touched, as in the nettle.

Pili Capitali, glandular hairs, tipped with a glandular exudation, as in *Primula sinsis.*

Sericeus, silky, long, very fine, and pressed closely to the surface, so as to present a sublucid and silky appearance.

Arachnoid, very long, and loosely entangled, so as to resemble a cobweb.

Barbatus, bearded, the hairs long, and placed in tufts.

Asper, rough, the surface clothed with hairs, the lower joint of which resembles a little bulb, and the upper a short, rigid bristle.

To this catalogue it may be added, that the hairs which are distributed over the surface of vegetables, assume a considerable variety of forms. Thus, in the *Leguminous* plants, they are generally cylindrical; in the *Malvaceous* plants, they terminate in a point; in the *Agrimonia,* they are shaped like a fish hook; in the *Nettle,* they are subulate or awl-shaped, and jointed; and in some of the *Syngenesious* plants, that are furnished with hollow or funnel-shaped florets, they terminate in two obtuse joints.

The limits of an elementary work, render it impossible to enter upon more than a brief in-

vestigation of the history and appearances of all these varieties of capillaceous substances. The subject, however, is too important in the study of plants to be dismissed without some further notice.

It is not to be concluded that any plants are destitute of some substance resembling hair, because, to the naked eye, the leaves, or other parts of them appear to be absolutely smooth. The microscope discovers, in all cases, numerous minute hairs, and that, too, generally of an uniform character and disposition; and it is upon the young stems of plants, that this delicate covering is more especially discoverable. From this uniformity of character, and more particularly of disposition, the learned and judicious GUETTARD has observed, that they constitute good generic, but not specific characters.

Had Linnæus lived a few years longer, he would doubtless have ceased to regard any one of the three divisions last under our consideration as Fulcra; they are all essentially exhaling and absorbent lymphatic vessels. The Pilus may, however, under particular and local circumstances, afford protection,—*First,* in saving that part of the plant on which they are seated, from friction:—*Secondly,* in protecting it from cold, when growing in the Alpine or other cold districts;

and *Thirdly,*—in preventing a too rapid evaporation in such plants growing in hot climates.

In discussing this much disputed subject, the writer commenced by presuming to differ from the great Linnæus; a course adopted with much hesitation, and adhered to only from a firm conviction that in this instance, many eminent men have fallen into error, from their not having taken notice of the indecision which Linnæus displayed in his various writings. Reasons have been given to support the opinion advanced, and it may now be asked, whether the *Spina,* the *Aculus,* or the *Pilus,* can, by possibility, be regarded as Fulcra, in the mechanical sense meant by Linnæus, when he wrote of the bractes Cirrus and Stipulæ. It is clear that the Glandula is totally out of the question. That the *Spina,* &c., cannot be fulcra or supports, is evident from their positions; and that the Pilus is composed of absorbing and exhaling vessels is certain. That the *Aculus* is of the same nature is probable, but of this we have not the same proof as we have of the *Spina.* There are instances of the latter bearing leaves, as in the White-thorn. This circumstance shews it to be both an absorbent and an exhalent organ. If the advocates of the terms adopted by Linnæus, as applicable to the organs now under our consideration,

should still be unconvinced, they may be asked in conclusion, how it is that in the *Apple* and *Pear*, in their wild varieties, being spiny, and producing unprofitably, should, under domestic management, not only produce profitably, but, at the same period, cease to produce the spines; when by the increase of their fruit, both as to size, quality, and quantity, it is but natural to conclude they would require increased means of support. Nature always proportions means to ends, and in this case we may find additional reasons for concluding that these parts of the plants were never intended for supports.

Pruning is of the most salutary processes of the modern domestic system, and its operation may be explained, in reference to the opinions which have been advanced. By its application the absorbing and secretory powers are brought more immediately into the neighbourhood of the fructifying or s. to the great increase of the powers of the plant, as is apparent from the vast augmentation of produce consequent upon the practice.

OF THE GLANDULA, GLANDULE, OR GLAND.

This is the last organ of vegetation which Linnæus has thought entitled to be considered as one of the Fulcra. That it has no pretensions to the name has been already mentioned, and it is to be lamented that Linnæus should have so

termed it, in his *Delineatio Plantæ*, when we find he abandoned this opinion at another period, as appears in his *Philosophia Botanica*. In that work, his definition of a Gland conveys the notion of a *papilla*, whose office it is to exhale some substance in a gaseous form, or to relieve the plant of some redundant fluid or humour. This is more rational, for there appears to be a serious objection both to the former term and its definition. There is, most assuredly, little resemblance between the properties and functions of this organ and the animal glands to which the name would lead us to suppose it bore an affinity; but sanctioned as the term has been, it is believed, by every botanist of eminence, it would be extremely difficult to procure its abolition, although a name much more appropriate might readily be found.

The characteristics of this organ as exhibited in different plants, will now be explained.

According to Professor Link, Glands are simple or compound elevations in the stratum of the parenchyma, lying immediately below the cuticle. They are simple when consisting of one single cell, or when placed upon a hair, acting as a conduit or reservoir, and occasionally interrupted by divisions. In this situation, compound organs are never found. They are compound, in the general sense, when consisting of various cells, and seated upon the stalk, containing several

conduits, formed by rows of cellular tissue. They are common, in the Rose and the Bramble; in which they become very rigid, and from this cause they have frequently been taken for *Aculi*. In some species they abound on the calyx and corolla, not giving out any exudation; they contain, however, a deep red juice within their cells, but which is only discoverable by the microscope. In some they are much branched, in others they form curious humid appendages at the apex of the stamens. But the most common exhibit to the unassisted eye a form resembling a blister, as is seen in St. John's-wort. In the following plants the Glandulus is visible without the aid of the microscope.

In many *Ferns*, they are like a number of small scales.

In many *Fir-trees*, they are not unlike the Millet seed.

In the *Apricot-tree*, they resemble a small cup.

That they perform an important function is inferred from their being found to be frequently furnished with a proper footstalk; although, when situated upon the leaves of plants, they are without a footstalk. In the following plants they are placed on the petioles or footstalks of the leaves, viz.

Ricinus communis, *Cassava*, *Passion-flower*; many species of *Cassia* and *Robinia*.

In the *Willow-tree* they are situated on the indented edges of the leaves.

In the *Almond-tree, Gourd, Gelder-rose*, and *Bird-cherry*, they proceed from the base of the leaf.

In the *Urena, Tamarisk, Ricinus*, and others, they spring from the back of the leaf; whilst in the *Butter-wort* and *Sun-dew*, they are seated on its upper surface.

In some plants, as in *Bauhinia aculeata*, (*Mountain ebony,*) and the *Apricot-tree*, the Glands are situated upon the tender stipules or scales, which surround the young footstalks of the flower and the leaves; such as these are, by *Linnæus*, called *Glandulæ stipulares*, or stipular Glands.

To the general head of Glands, Linnæus seems also to refer the following, viz.

Folliculi, follicles; vessels distended with air, such as are observable at the roots of the *Utricularia*, or *Water-milfoil;* and on the leaves of the *Aldrovanda* vesiculosa.*

Utriculi, utricles; vessels, said to be filled with a secreted liquor; the notion of this secretory power, however, is not tenable, a point upon which the majority of botanists now agree.

* Two natives of the marshes of India and of Italy.

It is adverted to here, only for the purpose of noticing the most remarkable examples of what Linnæus calls the *Utriculus;* the *Nepenthes destillatoria,* a native of *Ceylon,* furnishes us with the first example;—the extremity of the leaf of this plant terminates in a filiform process; and this, again, in a cylinder, which is closed at the end by an opercle, or lid, so as to be able to retain water. The second are afforded by *different species of the genus* SARRACENIA; these have hollow leaves, which can retain, for a considerable time, the water which has been received by them from the rains or dew.

The structure of these plants is quite sufficient to overthrow the opinion of Linnæus, on this point, who evidently mistook a casual capability for an universal organ of sustentation.

Whatever may be the general uses of these organs, or the opinions of botanists on the subject, they are obviously of great importance in discriminating the species of certain genera of plants; for instance, the *Almond* and the *Peach* are two distinct species of one genus, the *Amygdalus;* but it is hardly possible to distinguish the two species without calling in the aid of what we are obliged to call the Glands; in the *Almond,* these are situated at the base of the leaves, upon the serratures; the *Peach* is destitute of the glandular structure.

OF THE HYBERNACULUM, OR WINTER QUARTERS OF THE PLANT.

This is the last part of the plant which can be considered as an organ of vegetation, and which Professor Martyn calls the *Hybernacle.*

The Hybernaculum is defined, by Linnæus, to be a part of a plant which encloses the embryo herb, protecting it from external injuries of all kinds, and, in his language, it is either a *bulbus,* or a *gemma.*

Of the bulbi or bulbs, mention has been already made,* and the propriety of considering them as roots, in the strict sense of the word, has been questioned, although their approximating to the nature of roots is not denied. It will be unnecessary here to resume the argument, and we may, therefore, proceed at once to the consideration of the *Gemma,* or bud. Previously, however, to doing this, it will be proper to give some account of the *Bulbus Caulinus,* and other similar productions.

The *Bulbus Caulinus,* or *stem bulb,* is a small species of bulb, or hybernacle, which is situated immediately upon the stem or stalk of some plants, and having no immediate connexion

See page 3.

with the root. In the *Dentaria bulbifera*, (Tooth-wort,) and *Saxifraga cernua*, as well as the *Lilium bulbiferum*, or bulbiferous lily, we find small bulbs in the wings of the leaves, that is, at the place where the leaf is united to the stem. If, after the stalks have decayed, these bulbs be taken off and planted, they will soon take root and vegetate; it is evident, therefore, that these productions are the repositories of an embryo plant, and consequently they may, with strict propriety, be considered as a species of hybernacle.

In some alliaceous plants, such as those of the onion kind, bulbs, very similar to those which have just been mentioned, are produced at the origin of the umbel of the flowers, between the peduncles or foot-stalks. Such alliaceous plants are frequently called bulbiferous plants. The individual bulbs are well known by gardeners, and, in common language, by the name of cloves: thus, the structure of these cauline and umbel-bulbs, appears to be very similar to that of the true root-bulbs, of which an account has already been given.

Bulbous granules, or productions, are very common in many species of *Lichen*, belonging to the 24th Class; but in these *Lichens*, the bulbs are situated without the axils of the leaves.

In many plants we observe appearances, which, from their general affinity to that of the true bulbous granules, deserve to be mentioned in this place.

The *Polygonum viviparum*, (Alpine bistort,) of the Scotch and Cumberland mountains, some species of Poa and other grasses, shoot out, from their flowers, bulbouslike processes, which, falling to the ground, there take root and vegetate into plants, similar to the parent: such plants are called viviparous. In the Tangekolli, a plant of Senegal, which is particularly mentioned by Mr. Adanson, the seeds are said to germinate in the fruit, or capsule; forming bulbs, even before the fruit has arrived at maturity. The Agave Vivipara, of East Florida, exhibits a very similar appearance; after the flowers of this fine vegetable have fallen off, the seeds often vegetate, and even arrive to a pretty considerable size, their leaves being sometimes three or four inches long, whilst yet attached to the parent tree. The branches of the Agave frequently appear covered with the young plants; which, falling to the ground, there take root, grow, and flower. To this vegetable, the celebrated Professor Paul Hermann, gave the very appropriate name of *Sobolifera*.

Under this head of *Stem bulbs*, we may with propriety class the succulent leaves of various species of plants, particularly those of the lila-

ceous order, such as the *Aloe*, the *Squill*, and also those of some species of *Arum*, or Cuckoo-pint. These, if they are carefully planted, will, in due time, throw out radicles, or fibres, and vegetate. Hence, it is evident, that there would be some propriety in denominating such leaves hybernacles.

The bulbous granules, whether they be situated in the wings of the leaves, or on parts of the stalk, furnish the Botanist with excellent marks for the discrimination of different species of plants; in the genera Ornithogalum, Dentaria, Polygonum, Saxifraga, Lilium, Allium, &c. &c., it is particularly the case, and the different species of these genera receive their specific names, *bulbifera*, *bulbiferum*, vivipara, viviparum, &c. &c., from the bulbs which are found upon them.

THE GEMMA, OR BUD.

The Hybernacle, in the strictest sense, and that which most particularly claims attention, is the Gemma, or Bud: this is defined by Linnæus to be an organ seated upon the ascending Caudex (stem,) and branches, and composed of stipules, petioles, the rudiments of leaves, or the cortical scales. In fact, every bud is to be considered as an epitome, or compendium of one or more plants, similar to the parent plant, or in the

words of Lofling, it is nothing else than the plant or vegetable straitened, from a defect in the powers of vegetation; but the term hybernaculum, as given by Linnæus, to designate the bud, is most happily conceived and applied.

Mr. Ray is said to have been the first person who gave to the bud now spoken of, the name of Gemma.

Before the time of that illustrious Professor, of whom England has reason to be proud, the bud, we are told, had been denominated german; it is admitted, indeed, that the term gemma was used before Ray's time, to signify a particular species of bud; namely, that which contains a flower; and some of the ancient authors, (Pliny in particular,) appear to have carefully distinguished it from the germin, or bud, which contained leaves and wood.

Experience shews that buds assume different forms in different vegetables. In general, they may be said to be small and rounded, or conical bodies, and sometimes ending in a point. But the form of the bud is often so different in the different species of the same genus, as to afford to the botanist a good mark of distinction in the winter season, when the leaves and other parts, upon which the specific characters are more generally founded, cannot be seen; thus, in many species of Willow, and in Rhamnus, or Buckthorn,

the specific characters are often taken from the form of the buds.

In general, buds are placed at the extremity of the young and tender vegetable shoots, and along the course of the branches; they are fixed by a short footstalk, upon a species of brackets, which are the remainder of the leaves, in the axils of which the buds of the present were formed in the preceding year. Sometimes, we observe only one bud in a place; sometimes two, and these are either opposite or alternate; whilst, sometimes they are collected in greater numbers, and in whorls, or rings.

The construction of buds is at once beautiful and intricate. On the exterior surface of these vegetable cradles, we observe a number of scales, which are more or less hard, hollowed like a spoon, and laid over each other in the manner of scales on a fish; these scales are often surrounded with a kind of hair, and are fixed into the inner plates of the bark of the stems and branches, from which they seem to proceed. No one can be at a loss to determine the use of these bud-scales, they serve to defend from cold, and other causes of injury, the tender and delicate embryo plants contained within the bud; the scales are connected with each other, and with the embryon within, by means of a thick, clammy juice, which, in the buds of many vegetables,

such as the Populus balsumifera, or Tacamahaca-tree, is of a resinous nature, and highly odoriferous. It is considered probable that, in some plants, this viscous matter may operate in preventing an excess of perspiration from the bud; and it generally follows, that, when the internal parts of the bud have expanded and unfolded, the scales, being no longer useful, fall off.

The following observations of Ledermuller, an ingenious German naturalist, are well calculated to show the delicate and careful structure of the bud. In the winter season, he separated from a *Horse-chesnut* (*Æsculus hippocastanum*), a bud not exceeding in size a common pea; he found the bud to be covered externally with seventeen scales, anointed with a viscid fluid. Having carefully separated these scales, the whole bud, covered completely with down, was brought into view; on removing the down, Ledermuller found the bud surrounded with four branch leaves, and covering a spike of flowers; in this spike he very distinctly counted sixty-eight flowers; and, by the aid of a powerful microscope, even the pollen of the stamens was observable; some of it was opaque, and some transparent.

The different species of buds enumerated by [illegible], are three, viz.

1. *Gemma floralis*, a bud containing a flower.
2. *Ditto, foliaris*, a leaf-bud, or a bud containing a leaf or leaves; by *Du Petit Thouars* this has been called a *fixed embryo.*
3. *Ditto communis*, a bud containing both flowers and leaves.

These three different species have received different terms from other botanists, viz.

The 1st has been called *Gemma florifera.*
-- 2d. *Gemma foliifera.*
— 3d. *Gemma foliifera-florifera.*

The superior simplicity of the terms employed by Linnæus may well justify their adoption, especially in an elementary work.

The *Gemma flo·alis*, or *flower-bud*, is that which contains the rudiments of one or many flowers, without leaves, and surrounded with scales. To this species of bud, the French have given the name of "*Bouton à fleur; ou, au fruit.*" It is often found at the extremity of the small branches of certain trees, which branches are shorter, more rough, and less furnished with leaves than the rest. It is also observable that this flower-bud is, in general, thicker, shorter, more square, or less pointed than either of the other kind of buds; it commonly terminates obtusely.

The *Gemma foliaris*, is the bud containing the rudiments of several leaves without flowers; this kind of bud is commonly more pointed than the *Gemma floralis;* in some vegetables, however, as in the Hazel, it is nearly round; and in the *Æsculus hippocastanum*, or Horse-chesnut, it is very thick.

The *Gemma communis;* is a species of bud, producing both flowers and leaves, and it is the most common; in general, it is smaller than either of the two preceding kinds; and a remarkable fact is, that the flowers, which are mixed with the leaves, are not always of the same kind. Sometimes the bud protrudes male-flowers with leaves, as in the Pine and Fir-tree. Sometimes it throws out female flowers with leaves, as in the Hazel and Carpinus, or Horn-beam; at other times, androgynos flowers, with leaves, are its offspring, examples of which are seen in the Elm, Cornus, or Cornel-tree, Daphne or Mezereon, and the Almond-tree.

Those buds which are evolved into leaves only, are termed unproductive buds; those which contain both leaves and flowers, are denominated fertile. These terms are very properly applied, and it is to be observed, that the size or bulk of the bud, before its expansion, foretells whether it contains leaves only, or flowers and leaves together.

The use of buds is sufficiently obvious; they are the protecting domes,—the cradles, of the tender embryons, which, in due time, burst from their enclosures, and expose themselves to the eye. Professor Lindley has very justly said, "The leaf-bud perpetuates the individual, the embryo continues the species."

This view of the subject, the soundness of which may be tested by every individual, is utterly at variance with the theories of certain writers of the present day, who have represented the scales of buds as abortive or imperfect leaves. Such persons forget that in creation there is nothing organically imperfect, that all is harmony and beauty; nothing is redundant, though we may be unable to explain its use.

From what has been advanced, the reader will not be surprised to learn that the greater number of the trees and shrubs of cold climates are bountifully supplied with buds, while they are seldom found upon the vegetables of climates where an intensely cold winter is unknown.

Professor Lofling furnishes the following list of plants, which, in their native soils, are destitute of buds. It will of course be understood, that they constitute only part of a larger number.

The *Citron, Orange, Lemon, Cassava, Mock-orange, Blad-apple, Shrubby Swallow-wort,*

the Shrubby Geraniums, viz: Geranium fulgidum, G. inquinans, G. papilionaceum, G. betulinum, G. scabrum, G. cucullatum, G. gibbosum, G. carnosum, G. peltatum, G. acetosum, G. zonale, and G. vitifolium; the Berry-bearing Alder, Christ's Thorn, Syrian Mallow, Adansonia or Baobab, Justicia, Wild Senna, the Acacias, and Mimosas, Coral Tree, Trefoil, Oleander, Tamarisk, Heath, Barbadoes Cherry, Tree Mallow, the Shrubby Nightshades, viz.: Solanum verbascifolium, S. guineense, S. pseudocapsicum, S. diphyllum, S. bonariense, S. pimpinellifolium, S. sanctum, S. tomentosum, and the Solanum bahamense; the Guinea Henweed, Cypress, Lignum Vitæ, and Savine. Some of the Vegetables in this list are large trees, such as the *Adansonia*, and several of the *Mimosæ;* whilst others are smaller, but furnished with ligneous or woody stems, and belong to the family of shrubs and under-shrubs.

True or complete buds are never produced upon the annual plants, that is, upon those the roots and stems of which perish after the term of a year; such plants are perpetuated by their seed; from which circumstance, GLEDITSCH has compared the annual plants with insects; the one, like the other, having undergone various changes, arrives at maturity, performs its offices, and then dies

Mr. RAY, and SIGNOR PONTEDERA, an Italian Botanist of great research, have, at their several periods, instituted a division of vegetables into herbaceous plants and trees, founding the distinction upon the absence or presence of the gemmæ or buds; this division, however, is certainly erroneous, and is calculated to introduce much confusion. It might not be improper, indeed, to adopt such a distinction in the history of the plants of one country not very extensive, and not exhibiting any marked difference of climates; but it is out of place when applied to the plants of the whole world, since, as has been already shewn, the absence or presence of buds, or the scaly appearance essentially appertaining to them, is governed by the climate in which the plant grows.

With respect to the origin of buds, the most probable seems to be that they are derived from the medulla or pith of the vegetable; it is certain that the pith is essentially necessary to their existence and growth; but, as this subject would necessarily lead to a discussion on the anatomical structure of vegetables, it is not within the pale of our present enquiries, nor is its introduction necessary in a work of this nature.