The *Historia Plantarum Generalis* of John Ray: Book I - a translation and commentary.

In three volumes

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BOOK ONE OF *THE HISTORY OF PLANTS* WHICH IS ABOUT PLANTS IN GENERAL.

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Chapter One:

The definition of a plant.

A plant (φυτὸν) according to Jung's definition is:

> a living body, not sentient, in a fixed place, or planted in a certain place, which can be nourished, grow and finally propagate itself.

Definition of Life

Life is a union or conjunction of spirit with a body. I call the vital spirit that internal element, whatever on earth it may be, whether substance or attribute, from which are derived the peculiar functions of vegetables, whether nutrition, growth or the production of seed; for so long as that element remains inherent within the body, so long the plant may be said to live.

"Not sentient" is added to the definition to exclude animals, which no less than plants live and flourish.

Someone may object that some plants, called ***Æschynomena*** or ***Pudica*** by the ancients, ***Viva, Sensitiva*** and ***Mimosa*** by more recent writers, produce clear indications of feeling. For their leaves, when touched by hand or finger and pressed a little even at the height of midday when the sun is shining, as a result contract themselves and, as it were, shrink, a phenomenon which they also suffer as a result of a draught of cold air.

I grant indeed that it is very difficult to give any mechanical reason for this occurrence, if we deny all feeling and spontaneous movement to plants.

It is confirmed by experience that the leaves and tops of herbs, torn away or broken off, quickly go flaccid and collapse. The reason for this phenomenon is clear; it is obviously because of the flight and evaporation of the sap, which usually fills and distends their veins and pores, since new sap does not come to replace it. For just as the lungs of animals, when filled with inspired air, are distended and lifted, so likewise are the leaves of plants, with breaths and vapours flowing through their 'nerves'; conversely, just as again the lungs when empty fall in and collapse, because the air is breathed out or has

slipped out through the pores, so likewise leaves are emptied, when the sap has evaporated. Why, you will ask, does the sap flow out from leaves that are plucked but does not do so in leaves adhering to the mother? The point is that it does flow out in both, for the humid parts of all plants are in perpetual flux and infinitely evaporate through their pores, but in those adhering to the mother, fresh sap is constantly supplied from the root to replace what has been lost, but it is not the same in plants, which have been torn away or plucked off, as a result of which the latter become flaccid, but the former even yet remain extended. So it can happen that, so long as the hand of someone touching, by compressing the nerves, impedes and retards the flow of vaporous sap, from which came what was filling the nerves and vessels, by exhaling the leaves will necessarily contract and collapse.

Moreover parts of some plants [leaves, branches, ears/awns] also contract through dryness and sometimes roll up, and then expand and stretch out with moisture; this is most clearly seen in ears of oats and in that plant falsely called ***Rosa Hierichuntina.*** For, after it has clearly dried up completely, indeed after it has been put aside dry for many years with its branches coalescing into a ball, if it is immersed as far as the root in warm water, this plant will, as a result, unfold itself and expand its branches into a circle afresh, obviously because the moisture infiltrates itself into the pores of the branches and extends them. It is even to be noted that the leaves as well as the branches of plants contract and curl upwards or inwards. The reason for this seems to be that the internal or supine parts, when exposed to the rays of the sun and when the moisture has been drawn off, are dried sooner and to a greater extent, as a result of which the contraction is necessarily in this direction. We see the same thing in tablets or wooden stakes or even in the covers or pages of books, which, if they are exposed to the rays of the sun or fire, curl and bend in the section which is facing the sun. But the contraction, which results from dryness, I think, does not have a place here.

Yet another contraction occurs from cold, which stops the motion of bodily fluids especially those vaporized into steam and compresses

them into a narrow space. And that contraction in the leaves of ***Mimosa*** plants, about which we raise questions, seems to be of this kind. For the cold either of the finger or the atmosphere restricts the expansive motion of the sap in the nerves and for the most part stops its flow, whence the fibres automatically contract themselves and draw the lobes of the leaves together. In a not dissimilar way the cold of our bodies usually contracts and corrugates the skin of our body, just as conversely heat usually relaxes it. But the lobes of leaves contract inwardly upon each other, perhaps because the upper little fibres in the nerves are drier and for this reason contract more promptly and swiftly, and the lower ones are more pliable and therefore more easily yield and expand.

That this contraction of leaves may be a result of cold is indicated by the similar contraction at night of almost all legumes, whether they have lobed or pinnate leaves, and the expansion of their leaves in the daytime. Likewise, the compression of some flowers, closing themselves up at night, as for example, those of ***Calendula, Cichorium, Convolvulus*** etc.. For, as in the experiment of Jacob Cornutus, the ***Anemone*** flower, which is of this kind, when plucked off and hidden in a very warm place, such as a small casket faithfully sealed, opens up there after a time if its base is simply immersed in warm water.

But in assigning causes for this phenomenon, I do not satisfy even myself. I would not at all concede that there are valvules, which some people contrive to be found in the ducts of plants.

A plant is said to grow, which restores more of its substance than is dissipated. But a plant not only becomes greater in all dimensions throughout all of its immature parts but also continuously grows new parts for itself: leaves, flowers and fruits. In this it differs from an animal, which never loses any parts nor grows new ones except for hairs and feathers, unless you discount hairs and feathers as parts, which continually drop away as new ones grow to replace them. Here the deer family must be excepted, in which yearly the antlers fall off and regenerate. For the antlers can be considered equally, if not more so, to be parts of animals than are the leaves of plants. It is no

argument against this that they lack the facility to feel, since bones too, when denuded of the periosteum, become lacking in feeling. However, they are nevertheless held to be parts of animals by everyone. Fruits, which in plants are usually thought to be parts, no less in animals than in plants, fall from the parent. But whether new ones are generated in animals in the same way as in plants, I have reason to doubt. But since the eggs of animals correspond so exactly to the fruits of plants and germinate in almost the same way from the ovary as the fruit of plants from the seeds and racemes, I see no reason why the term "part" should be denied to the former but conceded to the latter.

Perennial plants differ from animals in respect of growth, because those parts which are perennial, as long as the plant is alive, go on increasing, as is clearly seen in trees, however old, in which a new circle of wood is added each year. But animals, when they have reached their full size, cease to grow.

In the definition it is added "in a fixed place" or "planted in a certain place", yet this does not fit all plants universally nor all individuals. Not all, since indeed the plant called ***Stratiotes*** by the ancients (cf Dioscorides), "lives swimming on top of the waters without a root, although it has a leaf like ***Aizoos*** but larger". Prosper Alpino confirms this in part declaring:

Instead of roots a sort of thin and tiny woolly substance hangs down;

and the most learned Vesling adds:

> The whole plant sits upon a low base in the Nile, swimming in the waters without a root, although in the place of roots very thin filaments of fibres support it, which, as it were, grow down towards the earth.

But these thin filaments, which stretch out towards the earth, do not reach the earth and do not seem to be able to stabilise the plant or stop it from floating hither and thither and changing its location. A restriction to be fixed in the earth or other position is not confined only to plants; the fact is that it occurs also in some animals and not only those which are imperfect or of doubtful nature, which we usually call *Zoophytes*, but also in more perfect ones, for there are

some examples of species of shellfish, which are fixed in one place, such as are called by Aristotle μόνιμα or *Stabilia* for this very reason; and this is a result not of some accident but of their own nature. For I have seen for myself the species of *Mytili*, which is fixed to rocks by a little cord emerging from the shell. And indeed, those *Balani*, which are usually called *Conchae Anatiferæ* stick to the keels and other planks of ships, which are floating for a long time in the sea, by a certain pipe, which is a leathery, wrinkled and prolonged offshoot. But in truth, to adhere to the earth or another position in this way, in such a way that it draws sustenance from it, or sucks from it, is peculiar to a plant, and does not fit any animal that I know, for I consider the traditions about *The Scythian Lamb* to be false and fabulous.

Chapter Two:

On the parts of plants in general.

Before I begin a break-down of the parts of plants, it will not be inconvenient to discuss for a little while that well-known distinction of the parts into *similares* (tissues) and *organicæ* (organs), and to set out in a few words what I understand by *similares* and what by *organicæ*.

A tissue [literally 'a uniform part'], (the words are those of Sennertus), as indeed the Greek word 'ὁμοιομερὴs itself indicates, is of some simple and single nature, and does not consist of parts which are naturally different, and furthermore is properly opposed to one that is not uniform; of this type are bones, cartilages, flesh, membranes, nerves, veins etc.. Thus to this extent a tissue is uniform and has no obvious function, but does at least obtain its own nutrition. An organ is a part, which, apart from feeding itself, has some other function, by which it serves other parts or the whole body. Hence it is clear that a tissue is not properly opposed to an organ, but to a part that is not uniform, as I have just said, for the same part can be both uniform and organic in different respects. For example, uniform in respect of texture and constitution, organic in respect of shape and conformation, and to this extent organic in respect of use and function in the body. Thus a vein is indeed by its own nature a uniform part, but as far as it is shaped in such a way that it may be a fitting channel for the distribution of blood flowing back to the heart, it is called organic. So the *tibia* bone is by its nature simple but, in so far as it has its own peculiar shape and size, it is called *tibia*.

An organ is sometimes simple and at other times compound. A simple one is that which consists of parts of the very same nature and temperament, but needs some peculiar shape and conformation for exercising a common function, that is, either for the use of the whole body or other parts. Of this sort are the mouth, veins, nerves etc.. A compound organ is one which consists of many parts of diverse nature and constitution, which nevertheless come together at one and the same time for the same function, and, accepted in

this sense, an organ is opposed to a tissue. Thus, for example, the eye is an organ composed of various layers and humours of diverse texture and constitution, which nevertheless conspire together for sight. Functions of this sort, which are discharged by organs composed of many parts and ones of diverse nature, Galen calls perfect.

Having said all of this by way of preface towards the understanding of this distinction, I divide the parts of plants into simple and compound.

Simple are those which consist of parts of the same texture and constitution.

Compound are those which are made up of parts of a diverse nature.

Simple are those which either are containers or vessels, or contents or sap.

For it is very likely that all simple parts whatsoever, making up the body in plants at least if not also in animals, are either vessels, or saps or liquids contained in vessels.

All contained parts seem to be similar, for however much they can be reduced by chemical analysis into other still more simple parts, they are nevertheless such, however much they are divided and commingled, that, whatever observable part is made up equally of all these more simple parts, it is thus of the same nature as the remaining observable parts.

The containing parts can be considered in two ways. Either they should be considered in respect of their substance and of their uniform texture, which define them as tissues, and as which they do not have any function other than their own nutrition; or they should be considered in respect of shape and conformation designed for discharging some use and duty in the body, and to this extent may be called organs.

Compound parts are those which consist of many simple parts, which are also (as I have said) of diverse nature; these too are also called organs, because these simple parts together contribute to a particular function.

The compound parts, into which a plant is usually divided, are

root, stalk, leaves, flower and fruit, concerning each of which I will deal individually.

There are also other less important parts, as, for example, tendrils, little hooks, hairs, thorns etc..

Chapter Three:

On the roots of plants.

A root (according to Jung's definition) is:

> the lower part of a plant, intended for the absorption of food, which is hidden away within a more solid body, which itself provides the situation for the plant (whether that may be earth, as is generally the case, or rock, or limestone, or sand, or wood, or whatever else).

Roots can be divided into those which are fibrous and those which are thicker. I call fibrous those which consist of more than one fibre or filament coming separately out of the bottom of the plant.

I call thicker those which are of a rather thick form in the manner of a plant, either divided into branches or producing fibres. These are either fleshy and swelling out to the side, or extended lengthwise and generally rather solid and woody.

Roots, which are fleshy and swell to the side, are either bulbous or tuberous.

I call bulbs those which consist of a single tuber or head, which is either scaly or layered and which puts out many fibres from its lowest point or base.

Thus bulbous roots, strictly speaking, are either layered, that is, composed of many skins built up into a ball, such as those of ***Cepa, Allium, Hyacinthus, Tulipa*** etc., or scaly, that is, composed of many scales arranged almost like tiles, such as those of ***Lilium*** and ***Martagon.***

But it must be noted that bulbous plants, to use the correct term, are more rightly to be reckoned among those with fibrous roots. For fibres coming out of the bottom of a bulb are correctly, to that extent, roots; the bulb itself seems to be nothing other than a rather large, subterranean bud, as is rightly stated by that most learned and ingenious man Dr. Nehemiah Grew, M.D., deservedly most celebrated for his famous discoveries and observations in *The Anatomy of Plants* and in the rest of his history of the same.

Tuberous roots are those which consist of solid and continuous flesh, and are either in the form of a simple tuber as in ***Rapa, Crocus*** etc., or of a multiple tuber as in ***Asphodel, Pæonia*** etc..

Note. Some plants are endowed with roots of two sorts, tuberous and fibrous, like the ***Orchis.***

Roots extended lengthwise, which are generally stiffer and more wood-like, either produce long runners and progress transversely or creep along, such as those of ***Glycyrrhiza, Carduus viarum, Acetosa ovilla*** etc., or they are stalk-like and descend deeply.

But it must be noted that offshoots creeping in many directions under the earth seem to be subterranean stalks rather than roots, since they are bent at angles in the form of joints and put out fibres from these joints, such as in ***Gramen caninum Offic., Mentha, Pilosella aurea, Ptarmica*** etc..

Stalk-like roots and ones descending deeply are either rather simple, only putting out fibres from their sides, or branched. But the latter are branched in the manner of stalks either immediately from the point of origin, or they descend so far in a simple stem and then develop into branches. The branches are spread out into shoots and fibres. Some plants even put out many trunks of roots from their bases.

There may be still other differences of roots to be defined from colours, taste, smell and usages, which it is not my plan to pursue in this place. Perhaps elsewhere I will give catalogues of them.

It has been observed by previous botanists that some bulbous roots, as for example those of the ***Tulipa,*** descend into the earth each year. Dr. Grew recently observed the same thing in many other roots and indeed in the roots of different types of plant, as for example those of the ***Arum, Valeriana, Scrophularia, Helleborus niger, Tanacetum, Lychnis, Crithmum, Primula, Caryophyllata, Acetosella, Iris*** etc., in all of which the same scholar observes that the root is yearly renewed from the trunk or from the stalk itself, or rather is repaired piecemeal. The base or lower part of the stalk, gradually descending below ground level and hiding itself in it, is

changed into the nature of a genuine root and takes its place and performs its function. However, concerning this movement of the stem, only a single root descends, and depending on how durable it is, it extends either more or less, and its older and lower part rots away by the same amount as the upper part grows from the descending and transformed stem. Thus in the ***Scrophularia,*** for example, but especially in the ***Succisa,*** which appears bitten off at the root, as the lower part of the stem subsides until it is immersed in the earth, it is obstructed by the upper part of the root, but by continuous descent in the following year, the lower part of the same moves on and in the next year rots and disappears. A new growth clearly is made every year from the root as the lower and older parts rot and are broken down. Thus equally in the ***Dracontium, Crocus, Gladiolus*** etc., where the bulb is double, upper and lower, the bottom of the stem in the succeeding year becomes the upper root, in the next year the lower root, and in the third year perishes and is broken down.

A descent and transformation of a stalk of this kind into a root is more evidently seen and more clearly shown in some plants than in others, as in the transverse and tuber-like roots of the ***Primula*** and the ***Acetosella.*** For when the leaves of these plants have successively decayed and disappeared, their bases, nourished by more copious sap, swell into the same number of thicker nodules. The same thing can be inferred in some others from a similar position of vessels and woody parts in the trunk and in the root, as for example in ***Helleborastrum***, but especially in the tuberous ***Iris***, in which, although the leaves right next to the surface of the stem fall away, nevertheless, after the stem has descended and swelled into a root, the positions or remains of the leaves, which have fallen off, are clearly visible along with the ends of the vessels serving them, the root visibly variegated by certain rings and dotted marks, the rings demonstrating the positions of the leaves, the dots the openings of the vessels.

The proximate cause and visible or manifest signs of this descent are fibrous roots, which stems of this sort put out, for those descending straight into the earth drag the trunk after them as though they were so many little ropes.

Hence the shape of some roots is like an inverted plant. For while most of them spread out below into a certain number of branches like so many legs, some divide above it into many necks, as it were, or horns [the botanists call them 'heads'] as is seen in the ***Dens leonis*** and in some others. For these roots put out many buds from the top of their head, which develop into the same number of stems. These buds or new growths successively putting out new leaves discard the old ones, and so gradually and continuously descending, at length develop into the same number of necks, three, four, five or even more inches long.

Hence it is may be understood how some roots seem bitten off, as in the ***Succisa***, and perennially disappear, obviously with a successive regeneration of new portions in place of those, which every year decay and perish, as in the plants about which I have dealt, repairing their annual losses from the descending part of the trunk each year; and in the ***Orchis, Battata, Napellus, Chelidonium minus*** and other tuberous plants, in which, when the older roots and tubers wither away, new ones are regenerated in their place. Even ***Tulipæ*** and other bulbous roots are of the same type as these; for the layers, of which the bulbs chiefly consist, every year completely dry up and wither into thin membranes or skins, while new leaves and cortices continuously grow afresh in the middle. In the same way their fibrous roots annually succeed one another, whence after some years, although the same bulb seems to continue to exist, it is in reality something entirely different with no particle of the original remaining.

The parts of the root as of the stem are cortex, wood, or in herbaceous plants the part corresponding to the wood, and the pith.

The Cortex

The cortex is composed of skin and inner substance.

The Skin

The skin appears to derive its origin from the cortex and to be nothing more than old cortex completely dried up and contracted, a new one having been born in its place each year; so in the same way the skin of a snake,

which it sloughs off each year, is just the dried skin of the same creature. The skin in a root seems to be composed of the same parts as in a stem, that is, *utriculi* or vesicles as in the parenchyma, with some woody vessels or pipe-shaped fibres intermingled, which although they are barely visible even with a microscope, Dr Grew nevertheless concluded to be present from the fact that the cuticle is split or torn apart cross-wise with much more difficulty than along its length and from other arguments, for which see his work.

The internal substance of the cortex generally varies in thickness, for in some roots as in ***Flos solis pyramidalis, Tragopogon,*** and in a number of trees it is very thin, in others quite thick, constituting by far the largest part of the root as in the fibres of ***Asparagus.*** Indeed the cortex of the root in many plants takes up a far greater proportion of the wood than it does in the stem; and in this respect the root differs notably from the stem, that is, in the thickness of the cortex.

The cortex in the root is composed of almost the same parts as in the stem, that is:

1. Of *utriculi* or vesicles or parenchyma generally spherical but sometimes oblong, very little permeable and open only one to another, but closed on all sides and pellucid like drops of water to such an extent that the parenchyma of the cortex, as far as its composition is concerned, calls to mind most nearly the froth of beer or beaten eggs or the middle of a properly fermented loaf. These vesicles are so small that they are poorly visible even with a microscope; however, they differ in size sometimes within the same cortex but especially in roots of different kinds. They are often arranged in straight lines in a series as much along the length of the roots as across the width. They are always distended with clear or pellucid liquid, which insinuates itself through the pores of the same membranes, for it is not given a wider door by which to enter. Dr Malpighi believes the *utriculi* to be mutually open and permeable.

Dr Grew has observed that these *utriculi* are of two types in some plants; for, apart from those that have been described, others appear whiter and not transparent, even drier and not fluid-filled, whence rightly he

thinks that they are solid. You will find a fuller description of these in this much praised author's book *On the Anatomy of Roots.*

2. Apart from *utriculi*, the woody fibres too or sap-bearing vessels more or less complete the composition of the cortex, as is clear from the easier tearing apart of the cortex along its length than transversely; this is clear from the visible direction of these same fibres along its length, with the appearance of thin filaments, and from the rising of the sap when the cortex is transversely cut in those places where these same filaments terminate.

These fibres form net-like plaits in the same manner as in the cortex of stalks. But, however much they twine among themselves and are turned back again, absolutely no anastomosis occurs among them (according to Grew's observations) but every single filament is a single and simple vessel right from its bottom to its top with no branches and an equal cavity from its bottom to its top. Nor are they wound around one with another or otherwise entwined, but are simply contiguous to each other. These plaits differ in number and shape in different plants, in some more sparse, in others more dense. However it must be noted that they are single filaments not single vessels, that each is a parcel or mass of parallel vessels, which nevertheless are neither mutually permeable nor are rolled together in the same bundle or otherwise entwined, as we have said about the filaments. The same things may be said about the *tracheæ* or vessels bringing air down, which occur in the woody part. There is, however, reason why I suspect that anastomosis does in fact occur in vessels of this sort. Moreover, I do not altogether agree with Dr. Grew's opinion, especially as concerns woody fibres; partly by analogy with the veins and arteries in animals, of which the offshoots are clearly mutually permeable and inosculate in a net-like way: partly from the structure of the leaves, which are extensions of the wood, in which the fibres, which join up with each other, seem to be inosculate and entwined in a net-like fashion: and partly, finally, from the experiment propounded below concerning the movement of sap downwards in a transverse section.

The colour of roots in many plants is white, in some yellow, in a

few red or dark red as in the ***Anchusa, Erythrodanum*** and ***Pastinaca tenuifolia.***

Dr Grew (whom you should consult) concludes that these vessels are of different sorts from the diversity of the liquids which they contain; for some contain water, others milky sap, others in some plants dew or vapour. But I think that these vessels are analogous to those, which are observed in the cortex of stalks and bring down saps of the same kind, and for this reason I refrain from saying more about them.

The Wood

The woody part of the root consists of almost the same parts and is made up in the same way as the stem, that is:-

1. of parenchyma or *utriculi* disposed in diametric rays stretching from the circumference to the centre as is clear in a transverse section.
2. of woody fibres or sap-bearing vessels, which are of two kinds just as in the cortex, that is, either carrying water, or milky sap, or something else peculiar to the plant, or, as it is called, specific.
3. of tubes or *tracheæ* designed for receiving and drawing off air, concerning the texture and composition of which I shall speak below. Concerning their size, number and position, which differ in different kinds of plants, see Grew's book on *The Anatomy of Roots* - Chapter 4. But Malpighi notes in addition that these tubes are generally bigger in roots and more evident than in the trunk and the branches.

Pith is not common to the roots of all plants, for some, as for example ***Nicotiana, Stramonium*** etc., lack it. Some, although they have none in the lower part, nevertheless possess it quite clearly in the upper parts. It is composed of *utriculi* as in the stalk and these likewise differ in size and shape, among which some sap-bearing vessels are mixed from time to time.

It must be noted, however, that the *utriculi* or those vesicles, from which the pith is composed, are not mere and random membranes, but composed from many ranks or series of extremely thin fibres or filaments placed close together from the bottom to the top of the vesicles and running

down from vesicle to vesicle transversely (as in the weft from thread to thread of the warp). As a result the pith is nothing more than a sort of marvellous net, or an infinite number of the most minute fibres woven in a marvellous arrangement. However, these are not simple fibres but are composed of many joined together, indeed woven out of little cross fibres, (which seem to be simple).

How nourishment enters the roots from below still escapes my perception (says Malpighi) but may probably be conjectured. They absorb the dissolved salts of drops of water and other minerals dispersed through the earth and turn them into fluids, and the heterogeneous body of this kind, arriving at the roots of plants, as if passed through a sieve, is squeezed into the woody tubes, or enters through the orifices of the hairs, which grow in abundance around delicate roots, or percolate through the surrounding skin, and so are gradually introduced into the *utriculi*, and flow from these to the adjoining tubes, or are taken in through the outer orifices of the tubes and served by the same transverse *utriculi*. Thus this probably happens in the tiniest roots, which are called fibres, in which the tubes are stretched out as far as their extremities, transverse *utriculi* growing infrequently here.

Chapter Four:

On the stems of plants and their constituent parts from the writings of the most famous authors Malpighi and Grew.

A stem, according to Jung's definition, is the upper part of a plant, extended upwards in such a way that the anterior parts do not differ from the posterior or the right from the left. The stem is called trunk [stipe, bole] in trees and fruit trees; in pipe-like plants it is called a reed and in corn a culm.

The stem is either simple or branched.

A shaft-like stem is part of a branched stem, which extends from the bottom to the very top in a sort of single line, to which the branches are attached on all sides.

The parts of a stem are the cortex, the wood, or in herbaceous plants the part corresponding to wood, and the *medulla* (pith).

The Cortex is that which clothes the stem and the branches on all sides. It is moreover composed of cuticle and internal substance.

The Cuticle

The cuticle is composed of *utriculi* or little sacs located in such a way that in a horizontal plane a ring is formed. The *utriculi* in time are depleted by rigidity and by fault of age, and collapsing in upon themselves sometimes make a dry outer layer as observed by Malpighi in the ***Betula***, the ***Cerasus*** and especially in the ***Pomus***.

Concerning the Cortex

The interior substance of the cortex consists of:-

1. many envelopes of woody fibres, woven into net-like plaits, the exterior going round the interior like the skins of a ***Cèpa***.

Then:

2. of *utriculi*, or little sacs, more or less round, but sometimes oval or angular, filling the holes or spaces of the network just mentioned, directed horizontally towards the wood like radii.

3. finally of peculiar vessels, containing the sap belonging to the plant and specific to it.

Dr. Grew first differentiated the interior substance of the cortex into vessels andparenchyma. He calls parenchyma the *utriculi* just mentioned, which correspond to the parenchyma of the guts in animals. He divides the vessels into those which carry lymph, which he defines as being of two kinds, for he is of the opinion that the exterior ones and those nearest to the skin bring down a sap different in kind from those that are interior and near to the wood; these vessels are those which I have defined as woody fibres and which contain sap proper to the plant and specific to it, as for example in ***Abies*** and ***Pinus*** they are resin-bearing, in ***Prunus*** and ***Cerasus*** gum-bearing and in ***Tithymalus*** milk-bearing. Concerning these three parts I will treat more explicitly in a little while.

Woody vessels or Vessels carrying lymph

1) Woody fibres, according to the description of the most distinguished Malpighi, are tubular bodies, permeable to liquids rising from below, and their structure consists of square bodies [sometimes differing in shape], hollow and alternately opening. These vessels are not arranged straight nor parallel and in general are glued together into bundles. Some of these again inclined and separated [from their bundles] make a net, whence the net-like plaits, which I have talked about, by which the wood is surrounded. Dr. Grew calls these fibres lymph ducts or lymph-bearing vessels, because of course they contain watery liquid, clear and almost tasteless. These net-like plaits of fibres, woven out of digressing parts of bundles and those which are stretching out to the ones nearest to them and uniting with them and bent back again, can clearly be seen in the root of ***Rapa caulescens***, especially when it is cooked, and indeed can be spread out with the fingers.

Utriculi or the Parenchyma of the Cortex

2) What are called *utriculi* are vesicles or little bottles distended with fluid, which they receive from the woody fibres, generally placed horizontally in straight lines or radii running from the skin to the wood and are

like the parenchyma of the cortex, as I said above. [Dr. Grew says that the *utriculi* of the cortex are distributed more rarely in diametral radii, in which respect they differ from the parenchyma of a root cortex.] Horizontal lines of *utriculi* hang down and erupt from pipe-like woody fibres (the words are Malpighi's). For when the pipes of the still tender cortex are torn away by force the continuous appendices of the *utriculi* follow. So a liquid-like juice is discharged, ascending into these transverse *utriculi,* and after suffering a rather long delay there, and after being intimately mingled with more mature sap and fermented, is then exalted into the nature of food. A very copious sap is purified in the horizontal appendices of a cortex of this kind and is distributed to the wood and other parts of plants; from which it is not surprising that the cortex provides a more abundant and stronger nourishment for the fire than other parts of plants.

Sap-bearing Vessels

3) The vessels carrying their own specific sap around the plant contain different sap in various plants, as for example the resin of the ***Abies***, and the milk of ***Tithymalus*** and ***Lactuca***. Sap of this kind, when extracted from the vessels by evaporation of the watery liquid, generally solidifies into gum resin or other thick substance.

The nature of this sap (says Malpighi) is various. Frequently it flows out as a watery and diaphanous liquid, sometimes like milk, often tinged with a yellow colour, and sometimes when semi-solid it acquires viscosity, to such an extent that there are as many peculiar saps found as species of plants existing. He goes on:

> This sap carried to individual parts is poured out like dew and by solidifying increases them and brings them to their due size.

Thus it appears to correspond to the blood of animals, although (to confess the truth) I do not entirely agree with Dr. Malpighi's opinion, that is, that this sap is the final and specific food of the plant. I do not deny that it is the quintessence (as they say) of the whole plant, and that which gives it both its smell and taste and contains the plant's powers, as it were, concentrated within itself.

No vessels bringing air are observed in the cortex and certainly, if they are present, they are inconspicuous up to now, nor do they discharge their function as happens in animals enclosed in the womb, and only by the conversion of the cortex into its woody nature do they become manifest and clear as Malpighi says.

Concerning the Wood

The wood is composed of the same parts as the cortex and is connected in the same way, that is:

1. of pipe-like woody fibres collected in bundles and woven together in net-like plaits.
2. of *utriculi* filling the holes and spaces in the network.
3. of vessels bearing specific sap.
4. and, in addition, of a peculiar kind of vessel designed for drawing air and corresponding to the throat and lungs of animals.

1. The woody fibres are of the same nature as those composing the cortex. For they are composed (to use Malpighi's words) of the same tiny and empty little discs opening in turns and they give out a similar sap. However there is this difference between the fibres of the cortex and the wood, that the former, when the trunk is cut transversely, all leak out sap spontaneously, but of the latter none do it every time and generally they never do it. The latter fibres account for the greater firmness and strength of transverse *utriculi* in their rows, to such an extent that from their twining about each other a certain kind of mat is produced; moreover the chief and better part of the trunk or stem consists of these woody pipes. These differ in various kinds of plants in size, number and position, as is easy to show: see Malpighi and also Grew's *The Anatomy of Plants and Trunks.*

Malpighi in his *Anatomy of Plants*, page 11, proves that anastomosis occurs between woody fibres, exactly as in animals, between the branches of veins.

2. The *utriculi* running between the fibres and vessels are disposed in diametral radii extending from the cortex to the medulla. However they do

not all reach the latter, but sometimes disappear towards the centre of the wood, when new rings have developed in the inner parts of the wood; but they are clear when a branch or stem is cut transversely. In fruit trees (according to Malpighi's observations) and in those which do not have a very thick woody body and in which a considerable account of pith is embedded, appendices of *utriculi* run down from the cortex to the medulla and are extended to it. As a result the same nature is found in both [in the *utriculi* of the cortex and of the medulla]. Indeed the same characteristics too, which are met with in the *utriculi* of the cortex sometimes occur in the medulla. But the rows of *utriculi* are made up of oval bodies, alternately opening, whence too they swell with the sap that they contain, in some plants diaphanous, in others coloured; but individual *utriculi* consist of a thin pellucid and diaphanous membrane. In different kinds of plants they vary greatly in number, size, texture, extent etc..

3. Vessels containing sap, which is specific and essential for a plant, are arranged in as many rings as there are skins or wrappers of annual growth from medulla to cortex. For they are identical to the inner parts of the cortex, which yearly leave the cortex and fasten themselves to the wood, sometimes made thinner by the pressure of the woody fibres surrounding them on all sides.

The Tracheæ

4. The vessels intended for acquiring air and distributing it, which Malpighi calls 'spiral pipes' and '*tracheæ*', are composed of a silvery plate twisted in a spiral so that by tearing they easily resolve into an oblong and continuous band. This plate, if it is examined more carefully with a microscope, is found to be composed of scaly particles. [This plate (according to Grew's observations) consists of many rounded fibres placed collaterally on the same plane like the threads of a ribbon or bandage and of lesser transverse fibres woven together like a weft.] The larger spiral pipes frequently contain lung-like vesicles of the substance of *tracheæ:* sometimes they open alternately: sometimes they are oval in form, and occasionally they are closed at the other end so that they appear very different from the lung vesicles of insects. Dr.

Malpighi is of the opinion that nature has fabricated in insects and plants a spiral plate composed of scaly little pieces instead of a *trachea*, so that constriction and dilatation can be experienced in the violent bendings and twistings of trees and in the elastic movement of the enclosed air. Woody fibres very often support these *tracheæ* and encompass them on every side and sometimes press them together, as a result of which, when the wood is cut transversely, their orifices appear frequently oval, or round, sometimes angular. But the *tracheæ*, not deviating much from a straight line, are dispersed upwards from the roots to trunk, stem and branches, but in leaves are curved and woven in a net. These vessels are by far the biggest of all with the exception of the proper sap-bearing vessels of the cortex; they occur very frequently throughout the whole substance of the wood but none are observed in the cortex.

There is so much necessity for and use of respiration that nature has prepared different but analogous instruments in each order of living creatures, which we call lungs, with this difference, that those creatures which we consider more perfect rejoice in less elaborate lungs, as the inestimable Malpighi shows in discussing *Quadrupeds, Birds, Fishes, Bloodless Sea Creatures* and *Insects*. However, he says that in plants, which rank below the lowest order of animals, it is right that such abundance and production of *tracheæ* exists, that the smallest parts of plants are irrigated through these in addition to the cortex.

It is a question by which part the air enters these vessels, whether, that is, through the pores of the root or those of the trunk, leaves and other superficial parts. Dr. Malpighi writes that he long and anxiously questioned whether in the leaves and cortex there are orifices open to the air, and he could never detect these. But he observed that the roots were made up of so many and such large *tracheæ*, that in certain plants and trees these far outnumbered the mass of the rest. For this reason (as may be conjectured) the vapour or respiratory sap, separated from the earth, which is mixed with water and air, on entering the *tracheæ* fills and distends them. But the woody fibres or the rows of horizontal *utriculi* receive a separate part of the exhalation from

the skins of the *tracheæ*, or sap instead of respiration, since woody fibres like those of the ***Hedera*** twine around the *tracheæ*. Dr. Grew was of the opinion that air entered the pores of all parts, as much the ones above the surface as those below the ground, but these latter most copiously. For in the trunks of some plants there are so many pores that they are patent to even the naked, unassisted eye; of this kind are ***Canna indica***, which we use for sticks and staffs. Indeed even in the leaves of ***Pinus*** [pores] are seen dispersed in an elegant line through the whole length of the leaves; therefore it is very likely that some particle of air insinuates itself through them. However, the most important, and, as it were, royal roads, by which air enters, are the orifices of the root, into which mixed with sap it betakes itself. For the root in plants corresponds to the mouths of animals. Then, if air only enters through the pores of superficial parts, before it can be mingled with the sap of the root, it must necessarily descend against the movement of the sap, which perpetually rises, and thus air and sap colliding with each other would act as an impediment, which does not seem likely. This can be shown further by the paucity and smallness of the diametral sections [of *utriculi*] in the trunk compared with that in the root, which nature seems to have designated there for air, by separating it from the sap with which it is taken in. Thus far Dr. Grew, in whose work see further.

The Medulla

The medulla, once believed to be analogous to heart and brain, consists of a multiple rank of globules placed lengthwise. The globules I have mentioned are *utriculi* consisting of membranes or vesicles, which in most plants indeed are round but in some are angular, these being either cubic or with five or six sides. Although the medulla has a different name from the parenchyma of wood and cortex [this is what I call the diametral *utriculi* filling the spaces between fibres], nevertheless in nature and substance it corresponds to it, as both texture and continuity show; continuity, I say, for the rows of *utriculi* coming out from the cortex (to use Dr. Malpighi's words) have their position defined by being extended throughout the woody fibres into the

medulla, as a result of which the same nature is found in both [in the cortical and medullar *utriculi*]. *Utriculi* do not differ among themselves except in size: medullar, which are the largest of all: cortical, which are of intermediate size, and those of the wood, which are smallest.

The size of the medulla is different in different plants: most ample in ***Absinthium***, for example, and in ***Rhoe, Ficus*** and ***Oxacanthus***, (according to Dr. Grew's observations): smaller or almost twice as narrow in ***Pinus, Fraxinus, Agrifolium*** and ***Juglans:*** still smaller in ***Quercus, Malus, Pyrus*** and ***Corylus***, and in ***Ulmus*** smallest of all.

Grasses and shrubs generally have a larger medulla than trees in proportion to their size, as is apparent in ***Rhoe, Ficus*** and ***Oxyacanthus.*** The medulla is composed of vessels and *utriculi*:; the vessels are sited at the edge of the medulla and surround it in a circle; they contain the essential and specific sap of the plant.

The medullar *utriculi* of the pith, although they are said to be larger compared to the other *utriculi* of the same plant, nevertheless differ significantly in size in different plants. For in some, as for example in the most common ***Carduus***, they are a hundred times larger than in others, as for example in the ***Quercus.***

It must also be noted that the size of the *utriculi* does not correspond to the size of the medulla; since in the medulla of the ***Sambucus***, which is much larger than the medulla of the ***Oxyacanthus*** the *utriculi* composing it are twice as small as those of the latter.

It is agreed that there is succulence in the first year medulla and in that alone, for after the first year the medulla dries up and never afterwards admits sap; which is why only loose, soft skin remains - Grew.

In the *utriculi* of the medulla, sometimes among the transverse ones, little vessels occur surrounding the *utriculi* in a net-like fashion, whence it may be conjectured that the rows, both of the medulla and of the transverse little sacs, are irrigated by the interwoven vessels.

Chapter Five:

Concerning the parts contained in the stems and the movement of sap.

Partly from the writings of the most famous Malpighi and Grew, and partly from my own observation.

There are as many differences of contained parts as there are kinds of vessels in trunks and roots. Here I exclude *utriculi* from the number of vessels and I ascribe them to parenchyma, although these too are really vessels. Thus the contained parts are:-

1. Lymph, or clear and watery sap in lymph-ducts or pipe-like woody fibres.
2. The essential or specific sap of the plant contained in special sap-bearing vessels.
3. Air carried in spiral pipes, which, however, does not seem to be called part of the plant.

Dr. Grew concludes from the structure and position of the lymph-ducts that the limpid sap in some plants is of two kinds.

The *utriculi* (as I have said) are, as it were, the parenchyma of the trunk, and do not contain sap which is different from the kinds mentioned above, but they lie between the vessels and either serve for concocting cruder sap, as Dr. Malpighi would have it, or serve in addition for taking air from the spiral pipes and drawing it off into sap-bearing vessels, in almost the same way as in animals, the vesicles of the lungs impart air received from the *bronchii* of the *trachea* to the arteries, as Dr. Grew thinks.

Lymph

The limpid sap or lymph, when it first begins to flow out, does not differ much from ordinary water either in taste or consistency. It ascends in such abundance in spring-time that in some trees it flows out abundantly from a wound, which has been inflicted. But the vessels, through which it is

transported, according to Dr. Grew, are spiral pipes or what are called *tracheæ* by Dr. Malpighi. The explanation or reason (he says) for its ascent through these pipes at the beginning of spring is that the lymph-ducts of the cortex or the vessels, through which it is borne during the whole summer, are then just beginning to be formed; when, therefore, it cannot find its way through these passages, it digresses into the air vessels. But as soon as the aforementioned lymph-ducts reach their due consistency and extent, the sap returns to its own route from the diversion and takes itself into these as into its own proper receptacle, abandoning the *tracheæ*. This is what Dr. Grew says, but he does not satisfy me in every respect; for although it may be a sufficient reason why the sap first flows into the *tracheæ*, nevertheless, since those vessels are larger and more accessible than the newly extruded lymph-ducts and since there is no reason why it should not continue its course, I do not see the reason why, leaving these as it were by choice, it should remove itself to new channels. Meanwhile, however, I do not at all deny that in spring-time the sap is borne upwards through air vessels and, when the trunk is damaged, flows out through their orifices.

What I have learned by experiment concerning the spring movement of sap in the ***Betula, Vitis, Acer majus*** and ***minus, Juglans, Carpinum*** and ***Salix*** (for I have observed that only these trees weep in this sort of way in my own region) I will state below.

1. Through whatever vessels the sap at length ascends, experiments show convincingly that it ascends through the whole thickness of the wood. If the trunk, branch or root is perforated, the deeper the hole that is made, the more copiously the sap drips out and indeed does so in proportion to the depth, thus from a doubly deep hole an almost double quantity of sap comes out in the same period of time.

   Next in order that I may first cut short all opportunity for doubting even from the most scrupulous, I cut into a rather large branch of ***Betula*** by drawing a saw backwards and forwards almost to the pith, and having left a space of six inches beside it, I made a groove or

incision in this same part of equal depth; then after taking away the intervening section, I made sawings in the wood, and, after boring a hole in the middle of the area of wood planed, I put down into it an edge of cloth or filter, being careful meanwhile that no liquid flowed down into the filter from above. After doing all of this, I discovered that sap nevertheless dripped copiously from the hole.

2. It is agreed that sap moves upwards as freely as downwards in the vessels. For a stick of ***Salix*** or other tree swells with sap when it is cut back and, when suspended in a perpendicular position, sometimes dropped out a tear from the lower wider end. Indeed, if you apply and stick a wax pipe to the upper extremity of a stick or rod of ***Salix*** or ***Acer***, cut back at both ends in such a way that it forms a small vessel, of which the sides are made by the circumference of the tube and the bottom by the flat part of the cut back stick, and if you pour water into it when it is erected perpendicularly, you will see in a short time that the water, after passing through the wood, gradually drips out from the other extremity of the stick, and does not stop before the aforementioned vessel has been drained. The same thing is seen in the ***Tithymalus*** and other milk-producing plants, which when cut back at both ends, pour out milky sap equally from the upper as from the lower end. From this it is clear that no valves exist in the vessels of plants. What is also confirmed from this is that, if a stick or twig is planted upside down, with without doubt its upper extremity put down into the earth, it will nevertheless take root and will germinate however much the direction of the sap has been changed, as I have experienced in the case of the ***Salix***. However it always happens (as Malpighi warns) that twigs planted in such a way do less well.

3. The sap-bearing vessels communicate among themselves along their length through mutual anastomosis, as I shall prove by an experiment of this sort. After sawing deeply across the trunk of a rather old ***Betula***, and then after leaving a space beyond that same part of the trunk, I made

a saw cut to the same depth as well as we could calculate, and the trunk wept not only from the lower cut but even from the upper and indeed in equal quantity, and not only when the first saw cuts or furrows were made but even after some days, and even after it had ceased, it sometimes flowed again afresh. But vessels which have been cut across could not receive sap from elsewhere than from whole and intact vessels climbing on the other side of the trunk, with which they were conjoined in the upper part of the tree through anastomosis. But here it is proper to warn in passing that a transverse circular section of the cortex does not always destroy the whole tree as is commonly believed. Indeed from my own observation in the case of an ***Agrifolium,*** after a ring of the cortex almost a palm in width had been removed and the wood had been bared, the tree nevertheless lived for several years. However, Dr. Malpighi made a horizontal section in the cortex in various twigs of different trees and in the branches of the ***Opulus*** and also of the ***Prunus, Malus Cydonia, Quercus, Salix, Populus*** and ***Avellana***, a ring-shaped portion of bark being removed from each; when this had been done, the upper part of the twig or trunk, growing just above the section, so increased in size that it became swollen for a long way. For the cortex, in the ***Quercus*** particularly, and in the ***Prunus*** and the ***Malus Cydonia***, so elongates the horizontal rows of *utriculi* that frequently extra growths are produced, by which a denuded portion of wood is covered; and after a mutual anastomosis has been made afresh with the lower lip of the cut cortex, the cortex becomes again continuous. The portion of the branch beyond the section also bulges out very thickly in a woody encircling and covering outgrowth. But the denuded woody portion remains slender with no increase in growth, because it is in continuity with the rest of the shoot below the section. From this it is clear that:-

Sap not only creeps upwards through the cortex and wood but even ascends in vessels situated in the very substance of the wood.

Sometimes I have doubted (says Dr. Malpighi) and I also with him, whether an evident swelling, induced beyond the circular section in the upper parts of the branches, can be occasioned by the impetus of the sap being propelled upwards. After ascending in the cut cortex through the woody tubes alone as if in a narrow and confined space, nourishment, finding a more spacious area of cortex beyond the cut, can expand in another direction; as a result of coming to a standstill it is able to provide nourishment for the neighbouring parts. However, since in new shoots, especially of the ***Quercus***, when a cut is made in the cortex, if a small portion only of the branch survives beyond the circular section, that is, when the end of the branch has been amputated, almost no swelling grows in its place; also in the case of trees, in which a horizontal section has equally been made but in such a way that a portion of that same cortex remains still intact, equalling the breadth of the smallest finger nail, the cortex thus being continuous, it is certain that an increase of nutrition follows in this remaining part of the cortex and in the upper portion. Therefore, from these facts, I have conjectured that it is more probable that the movement of the nutritional sap progresses from the upper even to the lower parts. Thus far Malpighi, with whom I also concur; indeed I think that the descent of the sap is definitely deduced and demonstrated from the experiment given above, and also from the weeping of a root cut on either side, as much the side which is attached to the trunk as that which remains in the earth, and so I think that the sprouting and growth of the branch above the ring, where the cortex has been removed, is due to the sap descending, which, when it is unable to continue its movement further towards the lower parts because the cortex has been interrupted, is discharged into a new wrapping of cortex and wood.

4. Sap does not creep upwards only between the cortex and the wood, as was once commonly believed, nor only in the annual rings or layers of wood, but also in the vessels situated in the substance of the wood

itself, as I have just shown.

5. Some trees begin to weep more swiftly than others of the same kind and age; the older and larger generally more swiftly than the smaller and younger, and also more copiously from an incision of the same depth.

6. Any tree will weep when the sap begins to ascend from an incision made before the ascent of the sap.

7. When any particular root is cut into, sap will drip out from either part, as I have just intimated, that is, as much from the part which remains united to the trunk as from that which is separated from it; from this also it is established that sap moves both up and down into either part.

8. Sap dripping down from a wound inflicted in a certain place will gradually precipitate a sort of gelatine or white coagulum, and more copiously when the tree begins to unfold its leaves. This coagulum seems to be the material of the wood.

9. There is a great difference in the movement and outflowing of sap in trees of different kinds. ***Acer majus*** drips out sap even in autumn, the moment after the leaves have fallen, and then throughout the whole winter, if it has been wounded at a suitable time; I say at a suitable time, that is, when the temperature of the air is cold and slightly frosty. Whether cut or bored, when the sun shines after a frost at night, provided that the cold is not too harsh, ***Acer majus, Juglans*** etc. drip sap abundantly, not indeed at night or very early in the morning, but in the two or three hours after the rising of the sun and especially around midday. After a harsher and longer frost, when the cold begins to slacken off, sap flows out in the greatest quantity of all, even from wounds made previously, and in those trees which scarcely ever respond to wounding of another sort. This is so true that if frost happens to fall when spring has got under way, when the sap has already stopped dripping, it begins to flow again, and it drips at least during the hours of morning. Thus, provided that the frost is not very harsh, it promotes the movement of sap and indeed reanimates it when it

is already ceasing to flow. For I have seen liquid from wounds inflicted on the ***Acer majus*** and the ***Juglans*** flowing at night and for a long time, although immediately after it emerged it coalesced and condensed into icicles by the force of the cold. It must also be noted that in a harsh frost, when the surface of the ground is covered with snow, a root of the ***Acer majus***, which has been cut, wept most copiously from the part sticking to the earth and more abundantly than at any other time, although, however, because of the force of the cold, the sap, which was either congealed on the trunk or reduced to a much more sluggish motion, would not flow out when a wound was inflicted. Whence it is clear that the frost was the cause of this abundant outflow. Is it because the compacted surface of the soil prevents the usual ascent of the vapours and drives them back, and do they rush into the pores of the root, when they have made an attack, and do not find an exit and are packed together a little below the surface of the earth? However, (to confess the truth) I do not even satisfy myself in giving a reason for this phenomenon. However, there is no doubt how great an abundance of living fountains there is in a very harsh frost, as happened last winter.

The particular and specific saps of plants generally coalesce either into gum or into resin or into a sort of material between gum and resin.

Definition of Gum

Gum is a solid sap which dissolves easily in water, does not liquefy in fire, nor catch fire, but sometimes crackles. Of this kind are ***Gummum Arabicum, Gummum Cerasum*** and so on. This kind [Dr. Grew says] is nothing other than dried mucilage, of which the substance contains little or no oil.

Definition of Resin

Resin is a heavy oleagenous fluid, more often flowing from the tree of its own accord, sometimes when it has been wounded; moreover, it is twofold by virtue of its consistency - liquid and dry. C.B. When it contains little water and a lot of oil, it does not dissolve in water, but sometimes does so

in oil. Of this kind are ***Terebinthina, Mastiche*** etc..

Thickened sap of the intermediate kind has a lot of water mixed with its oily parts, and so can be dissolved equally well in water and in oil like ***Galbanum, Sagapenum, Amoniacum*** etc. But these are nothing more to begin with than milky, thickened saps. The properly dried out sap of any kind of milk-producing plant easily catches light, and the plant pours it out both translucently and continuously in exactly the same way as ***Terebinthina*** or ***Pix Liquida.***

The origin of the milky colour in saps

Moreover the milky colour in the saps of plants arises from a mixture, which contains more oil than water. And the origin and cause of milk (as Dr. Grew rightly says) is the same in both vegetables and animals, that is, the aforementioned mixture of oily with watery parts in the minutest portions, as they call them. Hence the watery and oily parts of milk, when separated from each other, both turn out to be transparent. Hence, for example, in the distillation of the water of ***Anisum*** or ***Cinnamomum***, the first spirit to leave is limpid and transparent, but when the greater part of the spirit has been exhausted, and the particles of water, which carry the oily particles upwards with them, ascend with the remainder, a turbid and white liquid emerges, which is as though it has been suffused with milk.

Chapter Six:

On the annual increase of the trunk.

The trunks of trees and bushes and the branches that grow out from them are increased by new woody wrappings added every year. For every year a new ring of fibres grows onto the internal wood, and, divided eventually into two, goes off in different directions. The exterior part is joined to the bark; the interior, gradually hardening before the end of autumn, acquires the hardness and solidity of wood and, growing away from the bark, is cemented to the wood. Thus the trunk is increased in the way that Dr. Malpighi noted:

> frequently there is a long and continuous fibre, presently joined to the wood just below the bark but still keeping its identity, whence [he says] it is not surprising that in the trunk and branches of trees from which a small portion of the bark has been removed, the woody part lying below never experiences growth once the bark has been stripped away.

Since, therefore, trunks and branches are increased solely in this way, it was once believed that the nutritional sap only ascends between the bark and the wood; I have shown above that this view is erroneous.

These rings or woody layers in trees growing in the tropics are all equidistant from each other and form the medulla as their true centre, as Gassendi observed in the wood of the ***Brasilianum Acanthinum***. But in other regions, situated either to the south or the north of the tropics, they are spread out towards the meridian and are contracted in the part facing the pole, in such a way that the *medullæ*, when examined, are always found to be eccentric. Hence many people have taught how to find the south from this placing of the rings; and the more experienced agriculturalists advise, in the case of trees about to be transplanted, that, when replanted, they keep the same positioning of parts in respect of the quarters of the sky, which they had in their previous position.

The age of the trunk or branch is ascertained from the number of rings of wood, since indeed the number of rings equals the number of years which it has lived.

The inner rings are narrower than the outer, because, when the plant is stronger, it attracts more copious nourishment and forms thicker rings, and because the inner rings are pressed and constricted by the outer rings, and finally because the wood in time dries and contracts. So much for growing trees and ones which have not yet reached their proper stature and size. For the matter is different in mature trees and in those which have attained their full size.

The inner rings, as they are contracted by the years and dryness, press together and constrict the spongy medulla more and more, until in some cases it is entirely concealed and vanishes.

The wood of the inner rings is harder than that of the outer ones and generally tinged with a stronger colour, certainly never paler. Hence the exterior part of the wood is called '*sap-wood*' after its colour by Pliny, and by us The Sap of the Tree. Dr. Malpighi thinks that a peculiar sap is secreted from the fibres and transverse rows of *utriculi*, by which the wood is bound together, whose structure and varied solidification produce the firmness and hardness in the wood. However, he says, a long time is required for the same degree of solidity to be established in new wood as is found in the older wood. As a result of which, the new woody additions, which develop, do not achieve a sufficient hardness for the insects living beneath not to eat them, and, moreover, they are particularly vulnerable to the woodworm. I have seen eight rings and layers constituting the '*sap-wood*' in the ***Quercus***, and for this reason, when they fall as a result of injuries inflicted by wind and water, they are thrown away by carpenters as useless.

Trees and branches, which grow tall over many years, show fewer rings in their upper part than in their lower, the outer rings being common to both but not the interior. For the exterior ones are formed on top of the interior ones each year, as a result of which, too, the interior rings, which do

not reach the top, always end in a point, and each makes, as it were, a hollow cone, as can clearly be seen in planks of the ***Abies*** cut lengthwise.

From the comparison of these rings in various trees the diversity of annual increment becaomes apparent, however many one compares. Thus, for example, the three year increment of a ***Quercus*** equals in thickness the five year increment of an ***Ulmus***. In addition from the comparison of the rings of annual increment in a particular tree, which are not always equal but usually differ in thickness, apparently according to the annual variation of climate, it can be understood what sort of weather each year is most suitable for the increase in girth of any tree.

Chapter Seven:

On the differences of stems, from Joachim Jung's "Isagoge Phytoscopica", with some additions and changes.

Stems differ in many ways:-

The differences of stems in respect of leaves.

1. In respect of leaves a stem is either clothed in leaves or is entirely destitute of them, that is naked. The stems of plants are generally clothed in leaves. A naked stem is either absolutely naked or virtually naked. I call absolutely naked one which is given absolutely no rudiments of leaves, such as ***Taraxacum, Plantago, Bellis*** etc.; virtually naked is one, which is clad in very scanty leaves, which are not very distinct from the stem, such as in ***Tussilago, Petasites, Dentaria aphylla*** etc..

A stem which is clothed in leaves is either leafy in a regular or irregular way. Regularly leaved is one, which only puts out leaves from a definite position; from one position as in ***Anemone, Pulsatilla, Herba Paridis*** and ***Aconitum hyemale***; from two positions in ***Phthora, Unifolium*** and any other ***Cotyledon.*** The rest are irregularly leaved.

The differences of stems in respect of branches.

2. In respect of branches and petioles, a stem is either simple or divided into branches; simple as in ***Taraxacum, Bellis, Plantago, Pulsatilla, Anemone, Nymphaea, Bistorta, Vincetoxicum, Pyrola vulgaris*** etc.: branched as in the majority.

Falling between the simple and the branched is a stem spread into an umbel as in ***Primula veris*** and ***Auricula ursi.*** But in these the stem is divided into pedicels rather than little branches.

The differences of leaves in respect of position.

3. In respect of the position of flowers, a stem is either regular or irregular.

A regular stem produces flowers and seeds at the extremities or

tops of the flower stalk and thus ends either in a capitulum [lit. 'little head'], or in a spike or thyrse, or in a panicle, or in an umbel, or in a corymb.

Definition of a Capitulum.

A capitulum consists of many little flowers and seeds packed closely together into a spherical, circular or disc-shaped form, as in ***Cyanus, Scabiosa, Jacea, Carduus*** etc. and also in ***Bellis, Chrysanthemum*** etc..

Definition of a Spike.

A spike is thickly composed of flowers and seeds in such a way that an upright but oblong or very sharp cone develops thence, as in ***Lysimachia purpurea, Verbascum, Plantago, Luteola, Reseda, Bistorta, Secale, Hordeum*** etc..

Definition of a Panicle.

A panicle, which is like a mane, is a loosely spread spike, particularly with pedicels hanging downwards as in the case of ***Milium.***

Definition of an Umbel.

An umbel is the extremity of a stem divided into many rather long pedicels, which radiate in broad fashion around it, and which are themselves sub-divided into lesser pedicels carrying flowers again radiating in a circle. It is so-called from its similarity to the parasol, with which ladies protect their faces from the sun.

Definition of a Corymb.

A corymb is the extremity of a stem, so sub-divided and laden with flowers or fruits, that a spherical shape arises from it, as in ***Hedera arborea, Sambucus aquatica, Cepa*** and ***Porrum.*** Sometimes a corymb is pendulous as in ***Sambucus aquatica*** or ***Sambucus rosea.***

The term corymb is used more widely and in general means 'a top of any sort'. For the first mention of it is τοῦ κορύμβου in the chapter on the old Attic people for the 'piled up hair' or 'the top of the pile of hair' according to the writer Scaliger. But among writers on plants the racemes of ***Hedera*** are properly called *corymbi.* Pliny, Book 16, chapter 34, says in his

description of ***Hedera***, "the racemes arranged in a circle, which are called *corymbi*". Dioscorides in his chapter on ***Hippophae*** says "Flowers like the *corymbi* of ***Hedera*** are like racemes sticking together".

Alternative definition of a Corymb.

The corymb is also assumed among more recent botanists to be a flower formed in a disc-like way, which does not resolve into a tuft.

Definition of an Irregular Stem.

An irregular stem is one which bears flowers and seed on petioles projecting from the side of the stem.

And thus there is no end to its growth except that which the winter's cold imposes.

The differences of stems in respect of shape.

4. In respect of shape a stem is either angular or rounded, and both are either solid or hollow.

An angular stem can be:

Three-sided, such as that of ***Cyperus*** and ***Gramen cyperoides, Papyrus*** etc.. A stem, which is distinguished by three projections of leaves, especially thorny ones, can also be classed as triangular, such as that of ***Carduus chrysanthemus.***

Or four-sided, such as that of ***Salvia, Mentha, Lamium, Marrubium, Rubia*** and six hundred others.

Or five-sided, such as that of ***Campanula*** and ***Polycantha vulgaris.***

Or six-sided, such as that of the three-leaved purple ***Lysimachia.***

Between the angled and the round stems come striated ones, such as that of ***Siciliana.***

The stem is smooth or rounded in ***Anagallis aquatica, Nummularia*** and an infinite number of others, especially in bulbous plants.

A hollow stem is either hollow throughout, or linked by nodes or little joints, such as that of ***Arundo, Frumentum, Gramen,***

Foeniculum, Gentiana etc..

The differences of stems in respect of position.

5. Finally, in respect of its position, a stem is either upright or creeping. An upright one either sustains itself by its own strength or it requires supports around which either it entwines itself by twisting like ***Lupulus*** and ***Convolvulus***: or to which it ties itself with tendrils like ***Vitis, Bryonia alba*** and most legumes: or it attaches itself with the petioles of its leaves like ***Nasturtium Indicum*** and ***Fumaria***: or it sticks to its support with tufts of hair like ***Hedera.***

A creeping stem is one which extends horizontally and puts out leaves and forms roots at intervals, such as that of ***Fragaria, Pentaphyllum*** and ***Ranunculus***. Jung calls plants in which the stems are of this kind "plants of many foundations". But most plants of this kind put out stems of two types, one erect, the other creeping, as is seen in ***Fragaria, Bugula*** and ***Ranunculus.***

Chapter Eight:

On buds, especially what is written by the most illustrious Malpighi and Grew.

The new embryos of trees and shrubs are called buds. They give birth to them each year in the summer or autumn, wrapped in scaly coverings like afterbirths, in which they lie dormant throughout the whole winter, and at last when the spring comes afresh they begin to unfold into shoots. These (says Malpighi) "burst out in our regions about the month of June from the tender little shoot, which lies within the axil of the leaf" [later amongst us in England]. For in each individual year new parts emerge from absolutely every little branch, and not only is the material of seeds distilled and derived from these but also the seed forming organs. For the same womb does not remain active for ever to serve the rest of the vegetable body to which it is attached as it does in animals, but each single branch, in the year in which it enjoys the light of day, rejoices in its own seed organs, is fertile for a short time only, and then passes the rest of its life infertile.

Not only the shoots of trees and bushes, but also the new sown roots of herbs produce buds in the autumn.

A bud is both the abbreviation of a shoot, and is itself the tender young shoot enclosed as it were in miniature with the beginnings of its future leaves. It is composed of the same parts as are the branches. For the middle and deep substance is very soft wood ringed around with its own cortex, woven with woody fibres and medullary *utriculi* and very frequently interspersed with white hairs. From these the leaves burst out placed like scales, of which the outer parts, which serve to protect the bud, are either temporary and fall away, or they degenerate into another form as Dr. Malpighi shows with many examples. But these (as he reasons) not only produce a protection for their interior, confined parts, but also the sap, which they and others contain, is purified in their own special *utriculi*, and is stored in that long period of quiet [through the winter] until raised by that spermatic spirit, by the

power of the air flowing around, it is carried back into the shell of the bud, that is, into the new shoot in order to produce further growth of leaves. As a result bud leaves of this kind do not only possess one midrib stretched along the centre, as I almost always observe in permanent leaves, but multiple bundles rising from the base, which end in their own appended *utriculi*. These little bud leaves finally waste away until they are attached in pairs to one permanent leaf, the refined liquid, which they produced, having by now been exhausted, and at last they fall off, or are altered by narrowing down into the form of a petiole.

Moreover, there is not one single constant method in nature for the development of the leaves of buds, so that the deciduous leaves are the ones which break out first, followed soon afterwards by the permanent ones and then, when the latter have finally developed, the former gradually waste away and fall off, but here and there in many trees, the leaves of buds, especially those which form the bud's base, when they have lost their sheath-like shape, as a result of new changes, finally turn into permanent leaves, by which the shoot is decorated on all sides.

Nature's method of producing permanent leaves is equally wonderful. For first a little rib or petiole appears like a keel, swelling with liquid and with little fibres hanging from it, from which probably small membranes of little sacs or transverse *utriculi* hang down, as is observed in the primitive delineation of animals. Moreover, they appear to receive fresh nourishment, because the complicated mass of sacs swells with the sap entering from below and thus provides for the widening and expansion of the leaf.

The position of permanent leaves within the confines of the bud is equally wonderful, for their parts are so twisted and folded, that, fitted together, they are kept safe and occupy less space.

Thus, for example, in ***Lapathum, Acetosa, Bistorta*** etc. single leaves are wrapped up in a sac, which is formed of a thin membrane; equally the two halves of leaves, rolled together towards the exterior part, produce a place for the smaller leaf, contained within its own sac above the rib which runs outwards. This equally experiences the same change in its parts

within its own protective envelope, and on a still smaller scale protects the little leaf surrounded by its sac above the rib, and thus right down to the smallest parts; or if we start from the smallest, these are enclosed in their own covering or wrapping and are always enclosed in a covering common to both, each within the next larger size of leaf. Then each of these leaves protected by their coverings are similarly covered, along with the next larger size of leaf in a wrapping common to all, and thus by progression right up to the largest. But there is, says Dr. Grew, a general rule, which nature observes in buds, when the petioles of leaves are too long for the leaves to be wrapped up together in an advantageous way and no other special protection is provided, that from the base of the petioles broad membranes extend like a shroud for the protection of the leaves, sometimes double, sometimes single.

However, for the various ways in which nature enfolds new young leaves, so that they may be confined within the restrictions of the bud in the most definitely advantageous way for the shape and composition of each, see in Grew's works, in his book *On the Anatomy of Plants*, Chapter 4, and likewise Book 4, Chapter 1, of *On the Anatomy of Leaves*.

There are two kinds of bud: one only contains leaves within it and unfolds into leaf-bearing shoots: the other is also pregnant with flowers and is easily distinguished from the former by its size at the beginning of spring.

But all flowers (according to Grew's observation) are perfectly formed in exactly the same way as shoots in absolutely all their parts for three or four months, and sometimes for half a year or even more, before they come out into the light and into view. The result is that flowers of perennial herbs and of all kinds of trees and bushes, which are counted as of that particular year, are really not of that year but came into existence long before, having obviously reached the complete form and disposition of all their parts in the preceding year, as will be clear by dissecting the buds of individual plants. Thus the flower of ***Mezereum***, for example, which sometimes opens in January, was completely formed about the middle of August of the preceding year. At this time, if the green leaves of the bud are carefully removed, the

petals of the flower and its anthers surrounding the receptacle of the seed become clearly and distinctly visible even to a mediocre sight. The esteemed author lists other examples, for which see his work. But he is surprised that the time, at which the flower is born or formed, had never been observed by anyone before him. However, I find, in the case of the lesser ***Lunaria***, that this time was noticed by the most observant F. Colonna. He says:

> In this kind of flower all the plants have a kind of little sac above the root at the bottom of the petiole, tiny like the flower of an ***Arum***, in which I have seen a tiny little plant existing like a huddled up fœtus within a litttle sac, which takes the whole place of the uterus, the part, which was devoid of a raceme but containing a leaf, only coming after a year, and the part, which contained a raceme, was wrapped up within its own tiny but whole raceme.

And this is a wonderful arrangement of nature. I have noticed other plants retain their uterus within the ground in a similar way and bring forth progeny in due time, but not for a whole year and sometimes not for half a year, in fact from a new swelling of the root itself, as in the case of some bulbs, in which I have observed within the bulb itself a spiky little stem coming forth in its own due time.

Chapter Nine:

On the leaves of plants according to Joachim Jung and other writers.

A leaf, according to Jung's definition, is that part which extends in length and breadth in such a way from the base, to which it adheres, that the limits of the three dimensions differ from each other, that is, the internal face of the leaf from the external. The internal face of the leaf, which is also called upper or supine, is that which looks back at the stalk, and so either makes something of a cavity or at least is less convex than the other external, inferior or prone face.

One type of leaf is simple, another composite.

Definition of a Composite Leaf.

A composite leaf is one, which consists of a petiole or nerve or rib and lobes or leaflets [rather than, as Jung wishes, simple leaves]. For the whole of the former, as Theophrastus taught us, which usually falls with the petiole, ought to be called a leaf as in the case of ***Juglans, Fraxinus, Sorbus*** etc.. But those parts, which in many plants seem to be distinct leaves, are lobes and leaflets not individual leaves.

Definition of a petiole.

The petiole or pedicel is the part of the leaf extended lengthwise, which supports the leaf and joins it to the stalk.

The petiole, strictly speaking, is understood as being from the stalk to the beginning of the leaf; that which is within the leaf is more often called the nerve or rib.

A composite leaf, according to Jung's classification, is either digitate, or pinnate, or triangulate.

A digitate leaf is where several flaps [or several simple leaves, according to Jung] are, as it were, fitted to one point or terminus of a petiole, as in the case of ***Trifolium*** and ***Pentaphyllum, Fragaria, Lupinus, Cannabis, Vitis*** etc..

A pinnate leaf is one in which two lobes [leaves according to Jung] are directly opposite to each other at the same point, as it were, of the rib or at the same division of the rib. *[The lobes are not always directly opposite to each other in leaves of this kind as we have observed in many kinds of ferns and other plants.]* Leaves of this kind are either equally or unequally pinnate. Equally pinnate as in ***Faba, Vicia, Piso*** etc.. [One tree, ***Lentiscus***, has equally pinnate leaves.] Unequally pinnate when the very end of the rib ends in a single leaf, which yields an unequal number of lobes, as in ***Rosa, Juglans, Fraxinus, Potentilla, Sorbus*** etc.. Furthermore a pinnate leaf is either uniform or diform. Uniform, if the lobes distributed around the same rib are almost equal in size. Diform, if smaller lobes are interposed between bigger ones, as in ***Ulmaria, Agrimonia, Filipendula.***

A triangulate leaf is one in which the rib is so branched that two branches primarily opposed to each other separate from the same point of division into as many branches as there are in the remaining exterior portion of the primary rib; it is also called a leafy wing or branched leaf. These details are from Jung. But with the most observant and sharp-eyed F. Colonna I prefer to divide the composite leaf into:

1. digitate or round in circumference and incised as far as the pedicel.
2. pinnate or τεταρσωμένον; and
3. multi-sided or πολυσχιδὲς, that is, divided into many lobes or leaflets. But in this type those leaves, which have broad lobes or leaflets, are called πλατυπολυσχιδῆ like ***Apium, Cicuta, Angelica, Sphondylium*** and the like; but those, which are divided into narrower lobes or segments, can be called λεπτοπολυσχιδῆ like ***Ligusticum, Thapsia, Ruta*** etc.. Finally those, which are divided entirely into hair-like leaflets, are properly called τριχοσχιδῆ like ***Ferulacea, Ammum, Millefolium, Fœniculum*** and similar.

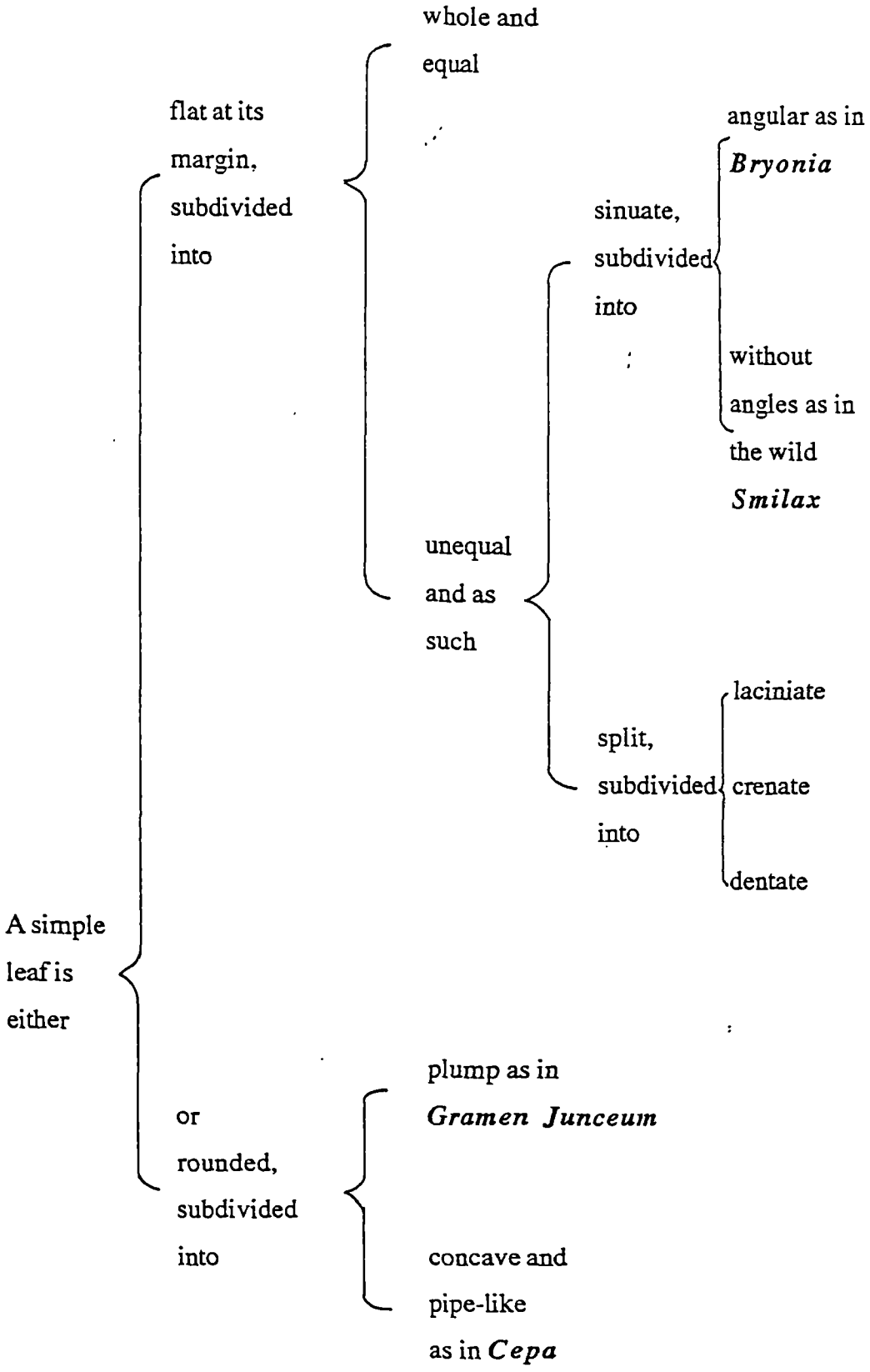
A simple leaf is one which is not divided into lobes or disjoined leaflets. It has an edge, which is either whole or split, either curved or without curves, finally either flat or concave. But if we prefer to observe a dichotomy, a simple leaf may be classified as flat or rounded; a rounded leaf being plump and concave or pipe-like in shape; a flat leaf may be classified as having a whole and equal margin, or an unequal margin, which is sinuous or split. A sinuous leaf is either angular or without angles.

An angular leaf is a leaf which, as it were, is one which is ambiguous between a leaf with a whole margin and one with a split margin, such as that of the adult ***Hedera*** and ***Bryonia.*** An example of one without angles is the leaf of the wild ***Smilax.***

A leaf with a split edge is either laciniate, or serrate, or crenate, or dentate [denticulate].

A leaflet is the part of the leaf included between fissures; (a fissure is a rather deep cut).

A rounded leaf is either plump as in ***Juncus;*** or pipe-like and hollow inside as in the ***Cepa;*** but in these the lowest part, which is next to the stalk, is flat.


A simple leaf is either
flat at its margin, subdivided into
whole and equal
unequal and as such
sinuate, subdivided into
angular as in *Bryonia*
without angles as in the wild *Smilax*
split, subdivided into
laciniate
crenate
dentate
or rounded, subdivided into
plump as in *Gramen Junceum*
concave and pipe-like as in *Cepa*

Leaves can also be divided in many other ways, as for example:

I. in respect of surface into:

1. smooth, called by the Greeks λεῖα, as are those of ***Beta, Lapathus*** etc..

2. hairy and woolly and downy [δασέα], as are those of ***Verbascum, Lychnis*** etc..

3. rough [τραχέα], as applies to ***Buglossus, Echium*** etc..

4. prickly or spiny [ἀκανθώδη], such as those of the ***Carduus, Agrifolium*** etc..

Whether those, which have a thorn instead of a leaf, can be considered to be plants I doubt: the ***Scorpius*** certainly, apart from its thorns, also has leaves.

II. in respect of shape and circumscription, into round and long, three-cornered, cylindrical etc..

III. in respect of extent, into large and small, broad and narrow, long and short, thick and thin.

IV. in respect of colour, into green as are the majority of leaves both of herbs and trees fading into yellow, dark green verging on blue, white and grey, reddish, spotted, striped etc..

V. in respect of duration, into perpetual or long-term and deciduous.

VI. in respect of position and place of origin, into those which surround the stalk in a regular way; that is, either they produce two at a time from single joints or divisions of the stem as in the case of ***Salvia, Urtica*** and very many others.

N.B. *It is agreed that plants given a square stalk all put out leaves jointly and in pairs, and indeed in alternate pairs; and it is well known likewise, that from the others branches are put out with either bends or angles, from which grow the leaves with the petioles of the leaf together with its stalk.*

Leaves, buds, branches and petioles are said to be produced alternately if the upper pair is positioned crosswise, or, as it were, cuts across the position of the lower pair at right angles.

Many plants, also, such as ***Bugula, Brunella*** *etc., which have a rounded and not a four-sided stalk, have leaves in pairs.* Or in threes, as in the yellow, blue and purple ***Lysimachia:*** or in fours, as in ***Cruciata***: or in sixes or more, as in ***Gallium, Rupia, Aparine*** etc.: or they are simple and attached in a random manner, although Colonna says that these latter cannot be said to be so random that they do not observe some order in the circuit of the branch in some numerical way, in fives, either more or less, as in ***Vermicularia, Tithymalus*** and similar plants.

The parts of which leaves are composed.

As far as the parts composing the leaf are concerned, it must be realised that they are the same as those from which the trunk is made, that is: woody fibres or lymph ducts: vessels bringing specific sap or *tracheæ: utriculi,* occupying the spaces between fibres, which are woven in a net-like way: and skin. For it must be realised that the petiole of a leaf is composed of woody pipes together with *tracheæ* and a peculiar vessel, with its origin in the deeper wood of the young shoot or coming from the inner pipes or fibres, whose substance is continued to the outside and collected into a little bundle. But it springs from the new shoot and never from the older branches or from the trunk itself unless from a central shoot of a bud. A petiole, behaving in the same way as a stalk, divides into stems and shoots. Frequently running outwards longitudinally under the guise of a little rib, it puts forth little branches from this point, which at length end in net-like plaits. But in other leaves the moment the petiole reaches its full width, it divides into smaller but nevertheless distinct branches, which arising, as it were, from a single umbilicus, produce other smaller ones as appears in ***Hedera*** and other examples. It is to be noted that the fibres making up the petiole first, before they reach the pedicel, are twined in a net-like way as is nature's custom.

To the petiole is attached an extended leaf, of which the principal

part is formed by little ribs or nerves produced in various ways. For the woody fibres, which are pressed together with the *tracheæ*, and the unique vessel coming out from the petiole disperse from this point like a tiny tree and are broken up into little branches, which again by a further division are divided into twigs, and these running into each other and joined into net-like plaits are woven together. In many leaves these become apparent when both the cuticles have decayed, but they are clear, especially on the under side, in the leaves of the ***Salvia*** and similar plants, which are still growing.

Proof of specific sap-bearing vessels.

It is clear from the outflow of liquid that pipes and *tracheæ* are concomitant with particular types of vessels and contain the concocted sap, which is easily visible when it has a strong and different colour or consists of a thicker substance. Thus in leaves of ***Tithymalus, Cichorium*** and similar plants, which have been cut, milk emerges and in the ***Chelidonium*** a somewhat yellow liquid; but in the remaining leaves of herbs and trees, because the liquid is limpid or watery, it gives no indication of itself, although similarity however convinces us that it is present.

The nature of utriculi.

A series of *utriculi* coming out from the little ribs, and as it were hanging from them, fills the meshes and spaces of the net-like plaits, whence the thickness of the leaves arises. These *utriculi*, however, from the nature of the sap that they contain, by compression and expansion among themselves, adopt different surface shapes, whence they appear like *cæcales* or worm-shaped twisted vesicles. Sometimes they bristle with angles, and they frequently end irregularly.

Between the *utriculi* and the fibrous net in many leaves are scattered peculiar little sacs or pockets, which, when their apertures are open, give off either breath or liquid. For a description of these in some specific plants, together with the sap which they contain, see Malpighi *(Anatomy of Plants*, page 37).

A smooth skin or epidermis stretched over the surface covers all

those parts, by which the leaves are connected. The skin reproduces the colour of what is underneath it and clothes and guards the contents themselves.

The extreme tip or margin of the leaves is surrounded by a sort of girdle or thicker line. In some this seems to consist of single membranes, with which the leaf is then protected by means of small carefully positioned *utriculi*, and which are easily penetrated by light and become transparent. In others a girdle of this kind is thicker and is covered on the outside by oblong *utriculi*, and indeed on the inside woody fibres continuous with the rest run outwards. Malpighi.

At the tip of the lobes into which the leaves are divided, while they are still young, *papillæ* grow and some *utriculi* protrude containing different saps. Malpighi.

In nearly all plants, with very few exceptions such as ***Atriplex*** and some species of ***Amarans***, after the leaves have unfolded, even the stems are imbued with the green colour of herbs; it is uncertain what is the reason for this colour. Most writers on natural history ascribe it to air, not without reason, for not only are the roots of plants hiding in the ground generally white, certainly never green, but also leaves, when air is excluded and its approach prevented, become white as we see in ***Brassica*** and in ***Ctucis capitatis***, in which, when the inner leaves are covered by the outer and are deprived of the benefit of free air, they acquire a white colour. Then, in the case of ***Lactuca, Endivia, Cichoreum, Myrrhis,*** sweet ***Apium*** and other oily plants, which are to be whitened for use in salads, people either bind up the leaves with certain kinds of bandage, bury them in the ground, or keep away the approach of air by some other artifice. Indeed the leaves of any plant sown in a place shut in on all sides fade to a yellow colour and, the more carefully the entry of external air is prevented, the paler the colour.

Dr. Grew produces still another experiment for confirming this opinion: that is, that in the stalks of ***Althaea*** and of certain other plants, which have been cut transversely, although the parenchyma of the cortex is white, yet the sap-bearing vessels included in the parenchyma are no less green than the

cuticle itself, obviously because they are next to and contiguous with the *tracheæ* and vessels bringing down the air, although the parenchyma is separated from the external air by the cuticle and from the internal air by the interposition of sap-bearing vessels.

That plants strive for fresh and warm air Dr. Sharrock shows by a splendid experiment. He placed a young plant grown from seed in an earthen pot in a window, in which one pane of the glass, by which it had been closed, was missing. The little plant, which elsewhere had grown upwards, abandoning this direction and bending itself in that, made straight for the opening, in position nearly bent down to the surface of the earth in the pot and almost parallel to it. Then, after turning the pot round in such a way that the angle of the stalk was turned away from the opening and faced in a different direction, the little plant, with its stalk angled backwards, curved in the form of a letter C, and again directed itself to the opening. When the position of the pot was moved afresh, with the upper horn of the curvature turned away from the opening, the top part of the stalk likewise changed its direction and bent itself back towards the missing pane and curved into the form of a letter S. And sometimes for the sake of his reputation, in order that he might excite admiration, he asked his friends standing nearby to say which point they wished the plant to make towards as it grew and that they should show this by some mark on the edge of the pot. When they had done this and positioned that part of the pot opposite the opening of the window, within a few hours of its own accord and with no force applied, the plant bent its stalk in that direction.

However, to me it is not so much air as light or the action of light that seems to be the cause of the green colour in the leaves of plants. For when the external air is excluded some plants nevertheless acquire in some way a green colour and keep it, as may be seen in ones covered by glass lids or cloches, as for example the humble ***Mimosa*** plant, as it is called by inhabitants of our country, which, because of the coldness of our climate, does not tolerate the effect of external air, but demands to be always covered and yet is tinged with a green colour. However, although glass admits light, it excludes air.

Whence I conclude that the action of light is the cause of green colour. For the same plants covered by an opaque vessel indubitably take on a pale colour instead of green, as happens to ones shut in an enclosed space. However, I do not think that plants become green so easily when covered by a glass covering as do those exposed to free air, since however much the glass transmits some rays of light, it still intercepts and reflects others, for otherwise it would not be visible. Indeed water either excludes air or admits it in a very modest quantity between its drops and yet plants immersed in it go green, which seems to me to be rather attributable to the action of light rather than (as Dr. Grew thinks) to internal air caught by its roots. Whatever may be the truth about light and its action, for I do not stick to this opinion with my teeth, it is very certain that for producing greenness air that is shut in and stagnant is not enough, but air that is free and open is required; whence also I observe that herbs growing in dark woods turn a paler green than ones in warm spots exposed to the rays of the sun. However, whether it is due to air or light, this colour is not produced in all parts of the plants, but only in parts rightly prepared and disposed for experiencing its action. I do not deny also that it could happen that air communicates some saline particles to the sap of the plant, which change it to a green colour. Each man follows what seems to him to be most near to the truth. But for inducing this colour heat is not required but rather moderate cold, for air in an enclosed space is warmer than that in the open air, as is clear from the quick and immoderate longitudinal growth of plants there when growing from seed. For I have seen the stem of a six-inch plantlet in places of this kind growing to almost half a foot's length below its seedling leaves, that is before it unfolds any leaves. Indeed I think that the aforementioned bending of the stalk towards the opening, when it was left in the window, arose from this, because the external air, rushing into the opening and meeting the part of the stalk facing it, constricted its pores by its cold in that part and so made the stalk bend in that direction.

It is asked what is the use of leaves and what is their function. Cesalpino thinks that leaves are given for this reason, that they may protect the

young bud (which they surround as though by hands interlaced above it), or even the fruit when the fruit bursts out with the bud. But after they have unfolded and the bud is older, they are seen to serve another function, that is, to provide shade, lest both fruit and new bud should be burned too much by the sun, for both require moderate rays of the sun; this shade is furnished by the position and form of the leaves partly transmitting the rays and partly holding them back. Thus in most plants the leaves fall in autumn when the fruits are fully grown and the buds hardened. But they say that in a hot region, where the heat is almost continuous, leaves do not fall from the trees and this for a good reason, for the plants need the continuous help of the leaves there for making shade. Cesalpino.

The most famous Malpighi thinks that leaves serve another function for the plant besides. He says that they seem to be fabricated by nature in order that they may serve for the manufacture of food. For the portion of the nutritional sap, which enters the roots below and does not flow away into the hanging transverse drops, is finally discharged by the woody pipes into the leaves; thus it is necessary, so that it can prolong its stay, as it were, in their transverse *utriculi*, that it is mingled and fermented with the old sap, with the warmth of the ambient air outside giving it sufficient help that the transpired useless elements may more easily escape. Moreover that a concoction of this kind occurs in leaves, the structure of a seedling seems to indicate. This generally consists of two leaves, which are enriched by their own little vessels and *utriculi* swelling with sap, to such an extent that they may surpass the rest of the plant in their mass. But in germination, dissolved and turgid humours of a plant of this kind ferment the incoming sap and increase the old sap in such a way that they are spread out into bulky leaves, as is clear in ***Endivia, Pepo*** and ***Cucurbita***, whose primary leaves grow to such a mass that it is scarcely credible, and when the skin is removed a row of hanging *utriculi* are so clearly exhibited that it is quite clear that leaves of this kind are conduits or a store of packed food. However, while the stem of the root and the shoot of the seedling grow, gradually such leaves begin to waste away; hence it is agreed that the

return of the fermented sap and, as it were, its peculiar circulation is from the leaves to the stem and trunk. Thus the leaves also probably send back fermented sap and collect it in the annual new shoot, for which purpose they are born, so that it is absorbed into the new young bud. For the bud increases in size not long after the development and eruption of the leaf, and the liquid, which has been matured after a long period collected in the shoot and refermented by the action of the approach of spring, is absorbed into the embryo of the bud and begins its nutrition; from this it seems that in general no bud grows, which a leaf does not precede and feed successively.

Probably leaves furnish the same help to seeds etc.. When the tiniest little channels have been destroyed in each year, when the old sap has been exhausted and when the leaves can serve nature no more, they are discarded and a new organ is formed; and in those plants, in which the leaves are still green, nevertheless, when new buds germinate in the summer, they fall after being weakened by the wastage of age. Dr. Malpighi says all of this, and I too approve it.

Chapter Ten:

Concerning the flowers of plants and particularly concerning their parts.

A flower, according to Jung's definition, is a thinner part of a plant, distinguished by colour or shape or both, attached to a rudimentary fruit. This definition even Jung himself confesses is too narrow; for not every flower is attached to a rudimentary fruit. For in ***Frumentum Indicum*** called ***Maize, Palma Christi*** or ***Ricinus, Bardana minor*** or ***Xanthium, Heliotropium tricoccum, Lachryma Jobi*** and ***Ambrosia***, it is a little way removed from the fruit. And not only in herbs but also in trees, as for example in ***Juglans, Corylus, Quercus*** etc., catkin-like flowers distinct from the fruit are produced.

Indeed nature has not only removed the flower from the fruit in one and the same plant but even in the same species has grown flowers and fruits completely separately, so that those which bear flowers are infertile and sterile, and those which are fertile do not produce flowers. Botanists wish to distinguish these by sex in an individual species and call the fertile ones female and the sterile ones male. Moreover, in many species of plants, in which flowers are indeed attached to the fruits, many useless flowers are produced, that is, ones which no fruit or seed succeeds, as is seen in the ***Pomiferi, Pepo, Cucurbita, Melo*** etc., and especially in ***Malus*** and ***Pyrus.***

According to my opinion therefore, a flower is more rightly defined as a thinner and transient part of the plant, distinguished by colour or shape, or by both, preceding the fruit and usually attached to it and serving to cover and protect the young fruit, and which shortly after the latter unfolds either falls or withers.

Even useless and catkin-like flowers can be said to be the forerunners of fruit although they are not contiguous to them, since generally they either fall or wither before the fruit matures.

The parts of a flower are:-

1. Calyx or Perianth, which nevertheless is considered by some to be an adjunct rather than a part of the flower.
2. Those delicate and transient leaves, which I, in order to avoid using a homonym, along with Colonna, am accustomed to call petals.
3. Stamens, and
4. Stylus.

Flowers are called perfect, which are blessed with all of these parts, and imperfect, which lack one of them. However, in this work I call a flower perfect, which consists of petals or coloured transient leaves and either has a calyx, as do most of them, or no calyx, as in the case of the marsh ***Caltha, Anemone*** and the flowers of some bulbs. I call imperfect one which has no petals or lacks those transient coloured leaves; I call this stamineous, because it only consists of stamens and calyx. Under the stamens too we find a stylus, which is missing in only very few flowers.

The Calyx.

The calyx is that which covers and sustains the flower and is, as it were, its basis and support and, as such, is thicker and less noticeable than the flower itself. But it originates from the external cortex of the shoot, and so (says Cesalpino) is of the colour of the herb and does not fall with the flower. But from my own observation in some kinds of plants either it falls along with the flower, as in ***Ranunculus*** and ***Lysimachia siliquosa***, or even before the flower, as in ***Papaver.***

The calyces or perianths in some plants, both in colour and in consistency, most closely resemble the delicate petals of flowers. They are distinguished because they do not drop off or wither before the seeds mature, but serve them as little containers. Of this sort are the calyces of the flowers of ***Fegopyrum, Potamogiton angustifolium, Bistorta*** etc.. For I call those parts calyces, whatever their colour, when they are neither deciduous nor transient.

The Petals.

The petals or leaves of the flower are those delicate blades,

which are distinctive in colour and transient. For to constitute a petal these two characteristics must both be present:

1. that it is thin and distinctive in colour:
2. that it is transient and falls away:

to such an extent that if this part of a plant lacks either of these characteristics, even if it possesses the other, it may not be called a petal. As a result of lacking the first characteristic, the calyces of ***Ranunculus*** and ***Papaver***, although deciduous, must not be taken for petals. As a result of lacking the second, the above-mentioned calyces of ***Bistorta*** and ***Persicaria*** are excluded from the category of petals.

As far as concerns the texture and composition of petals, the substance and indeed the pipes and *tracheæ* of the interior little stem or wood (according to the teachings of Malpighi) are extended and elongated into the leaves of the flower, which, furnished with all kinds of vessels, are made up of hanging series of *utriculi.* These swell with rare and volatile sap, as a result of which they will not tolerate cutting; for because of the gentle and pliant nature of the fluid, the rows of *utriculi* are extended to the very narrow base of the petal, and generally the vessels do not come out of a single rib but a lot of bundles rise up from the base and extend in every direction as they branch. As for colours, apart from black and green, all are seen in flowers.

The Stamens.

Stamens or *capillamenta*, according to Spiegel's description, are in the middle of the flower, which is called the *umbilicus;* oblong, thin parts like hairs, sometimes a little thicker, sometimes sticking out at the top, and frequently endowed with apices, which surround the stylus - a similarly oblong part, but thicker and emerging from the centre of the *umbilicus*.

Stamens consist of a pedicel and a top or apex.

The filaments of stamens are generally separated from each other and in many plants rise up from the bottom of the flower or from the dilated substance of a petiole (to use Dr. Malpighi's language). In the ***Digitalis*** and almost all flowers with tubular petals (such as helmet-shaped or lipped flowers)

they arise from the lowest part of the inner surface of the petal; sometimes they are completely fixed or stuck to it as in ***Symphytum majus, Lithospermum, Polygonatum*** etc..

Jung thus lists the differences in stamens:

> The filaments of stamens, which are separately attached, are generally rounded, rarely rather broad as in ***Ornithogalum***.
>
> A rounded filament is either thin or a little bit thicker.
>
> Likewise the filament is sometimes curved as in helmet-shaped flowers, in which stamens lying below the helmet imitate its curvature as in ***Salvia, Lamium, Sclarœa*** and in ***Papilionaceœ***, in which they lie in the lower keel, curved backwards and upwards.
>
> In addition the filaments of stamens are generally smooth, but sometimes hairy as in ***Blattaria***.
>
> Stamens are almost always equal to each other in size, but sometimes unequal as in ***Napellus, Colutea, Scorpioides*** etc..
>
> The filaments of stamens are almost always simple, but in ***Laurus*** they are branched.
>
> The number of stamens generally corresponds to the number of leaves or flaps surrounding them, in such a way that either they are equal in number to them, or in multiples of them, or in a smaller but proportionate number to them. Thus in the flower of ***Ruta*** there are four petals and eight stamens: in the bell-shaped flower of ***Cervicaria*** there are five flaps or *cuspides* and five stamens in the base within: in ***Iris*** nine 'leaves' and three stamens: in the ***Gladiolus Italicus*** three stamens and six 'leaves'.
>
> But there are flowers, which have so many stamens that their number cannot easily be gone into, and for this reason they must be called 'staminose' as in ***Ranunculus, Papaver*** etc..

<u>*The Apices*</u>.

The heads or tops lying upon the stamens are called *apices:* or, by Malpighi, the capsules of stamens. These are coloured and shaped in different ways but are frequently yellow or saffron; sometimes they become

black, at other times white. I have even seen, although more rarely, some conspicuous by a purple or reddish colour, as, for example, in that species of ***Hepatica trifolia***, which Parkinson calls white with red stamens, in the lesser ***Gramen leucanthemum***, in our beautiful ***Alsine*** flower with the very thin 'leaf', and in others which do not come immediately to mind. Thus Grew too assuredly declares that the colour of anthers is never red. Finally whatever may be the colour of the petals of a flower, inside they are frequently concave and contain a mass of globules.

The anthers are fixed to the filament across the mid point of their length or as it were centrally, or more rarely on end as in ***Tulipa, Iris*** etc..

The heads of stamens are generally so positioned that the length of each is transverse to the length of its filament; that is, it makes either right angles or oblique angles with it. There are also occasions when the length of the head is, as it were, positioned parallel to the length of the filament as in ***Tulipa.*** Indeed there are flowers in which the heads of the stamens are positioned in line with the filaments and stand together side by side, in such a way that they form a sort of pipe, in which the stylus is so enclosed that it only sticks out at the extreme end, as in ***Borago, Solanum*** and ***Dulcamara.*** Finally in all the florets constituting the flower heads, as in ***Eupatorium cannabinum vulgare, Ageratum, Centaurium majus, Scabiosa, Cyanus, Jacea*** and ***Carduus***, and, likewise in florets forming flower-like discs, as in ***Flos solis, Helenium, Ptarmica, Millefolium, Tanacetum*** and ***Acanthium***, there is a sort of oblong little leaf in place of the stamens, its surface split into a number of filaments like stamens, which enfolds the complicated stylus like a pipe. Dr. Malpighi more accurately says that this tube is formed from five petioles prolonged upwards from the interior substance of the flower and joined together, which are also overlapped in the head in some cases.

These parts of stamens, that is the filament and capsule appended to it (according to Malpighi) are each made up of woody fibres and *tracheæ*, to which are added *utriculi* placed lengthwise. As a result when, in

helmet-like flowers and also in certain others, they are produced from elongated floral leaves, they are necessarily composed also of the same parts.

It is doubtful what the use of these parts is. Some people think that they have been given to flowers merely for the sake of ornamentation, others for eliminating material which is harmful to the production of seeds, so that the remainder turns out more pure and refined. And so they think that they are sort of handkerchiefs, through which a certain specific and definitely airy portion of sap is filtered out, in order that the seed may become more oil-like and its beginnings more fixed. Hence (says Malpighi), using a perhaps not incongruously derived name, menstrual purgations, which in women closely precede the times of conception, are called flowers. For as a fixed portion of the sap in plants is distilled through the stamens and petals of the flower, so in viviparous creatures, because these can in some way affect the particles of conception, they are sifted and thrust out each month through the uterus, so that the rest of the refined blood languishing in the uterus may more easily be made fertile by the power of the seed and may be channelled into the nature of the animal.

Our friend Grew thinks that the stamens do not only perform this function but thinks that the pollen too or droplets, with which the anthers are laden and which they pour out in maturity, serve like masculine sperm for fertilising females; and further that most plants share both sexes. This ought not to seem so incredible since some androgynous creatures are observed even in the animal world, as, for example, land snails: although indeed they do not procreate within themselves, in which they differ from plants. Nor is it a problem that these particles (if indeed they are sperm or analogous to sperm) do not penetrate the uterus or seeds, for in fishes too sperm is only scattered externally on eggs which have just been produced. Nor does it enter the ovary in any kind of animal that I know, and not even the uterus itself in most of them, but its breath alone and subtle effluvia suffice for fertilising the eggs and for giving life to the embryo enclosed within.

If these things are so, those plants, of which some produce seed

from the flower and others [arisen from the seed of the same plant] produce a flower from the seed, not only differ somewhat in appearance, but in truth and strictly speaking are different in sex. Mostly from my own observation such are, in the world of trees, ***Palma dactylifera*** and ***Salix***, and according to Pliny even ***Cedrus major:*** in herbs, such are ***Lupulus salicatarius, Cannabis, Cynocrambe, Mercurialis, Phyllon, Urtica, Spinachia, Sesamoides Clusii*** and not a few others.

The statements handed down by ancient and more recent writers about the ***Palma dactylifera*** strongly confirm Dr. Grew's opinion that females do not ever bear fruit unless a male has been planted alongside them; indeed that the dust of the male scattered on the female makes her rather more fertile. For if the Egyptians had not done this (says Prosper Alpino), undoubtedly the females would either bear no fruits or would not keep those which they do bear, and they would not mature. But you will say that in sandy and deserted regions, where no dust of a male or pollen of flowers is scattered on the fruitful female, nevertheless the females are fertile. Indeed it is thanks to the winds, which blow the dust of the males onto the females.

However, it is rightly observed by Dr. Grew that these globules or seed-like particles, shut in the sheaths of the anthers, are that very same material which the bees collect and carry hanging on their thighs, which our natives call 'bread of bees', and which they also store in the cells along with the honey. For they carry home wax in their mouths and honey in their stomachs.

But this opinion about the use of the aforesaid pollen still lacks further confirmation; I only admit that it is likely to be true.

The Stylus.

The stylus is the part of the flower occupying its middle and attached to the rudiment of the fruit or the seed. It is called a stylus because it is generally extended into a long thin structure.

The leaf-like part of the flower sometimes attaches to the apex, sometimes to the base of the fruit or seed. Stamens are attached either to the middle or the bottom of the leaf-like part. The stylus is always attached to the

apex of the fruit or seed, and so when the other parts of the flower wither away it remains on the plant. This is what Jung says.

Dr. Malpighi says that the stylus cherishes the seed in its cavity, that it arises from the appendage and plays among the stamens. Thus Malpighi seems to make the stylus a seed-bearing vessel and appendage of the stylus that which others call the stylus itself; but he thinks that this is analogous to the uterine tubes and proves it by examples. Thus the stylus is a tube of the uterus or seed-bearing vessel always open for ventilating the seed enclosed within it and for expelling exhalations.

In whorled plants one can see whether the stylus sits on top of the seed or not; in my experience four seeds seem to stand about the stylus.

Generally a single stylus is present, but sometimes more as for example five in ***Aquilegia***, where the rudiment of the fruit matures into five parts.

Some flowers lack a stylus like ***Papaver, Tulipa*** etc. unless we want to take the seminal vessel for the stylus. In the ***Iris*** Jung makes the three internal leaves, under which the stamens are hidden, into a substitute stylus.

The stylus properly defined ends either in a cusp, or a globule, or a cone or in horns. In a cusp as in ***Digitalis, Symphytum majus*** and many others; in a cone as in some of the ***Lilium*** family; in a globule as in the wandering purple ***Convolvulus***. The horns are either short as in the common ***Convolvulus***, or abundant as in the common ***Eupatorium;*** sometimes they are so abundant that many styluses seem to be present, as, for example, two at a time in ***Staphylodendrum***. As far as the number goes they are either two as in ***Cichoreum***, or three as in ***Cervicaria:*** or, which is more rare, four as in ***Lysimachia Virginiana***. The horns are generally of equal size, but sometimes of unequal length as in ***Salvia*** and ***Aethiopis:*** generally too they are reflexed or curved back as in ***Cichorium*** and ***Cervicaria:*** sometimes they are straight.

Chapter Eleven:

On the differences of flowers: from Joachim Jung's "Isagoge Phytoscopica", with some additions and changes.

A perfect flower, such as I have described above, is either simple or composite.

I call simple a flower, which is not divided into florets or which is furnished with a single and generally simple stylus or seed capsule.

I call composite or aggregate one, which consists of more than one floret combining to form one whole flower; of these some consist not only of a leaf or coloured bract but also of stamens or at least a stylus, which are each individually attached to individual seeds. Flowers of this kind are ***Lactuca, Hieracium, Carduus*** etc..

In some respects a simple flower is the opposite of a multiplex or full one. [Jung calls absolutely simple what I call monopetalous or unifoliate.]

Thus a simple flower is either monopetalous or unifoliate or polypetalous or multifoliate; each is by accident of nature either complete in itself or multiplex.

Monopetalous is one which consists of a single continuous petal, which is generally hollow or pipe-like.

Polypetalous is one which is composed of several leaves disposed in a single series or circle. It is either dipetalous or bifoliate as in ***Circæa Lutetiana, Hypocous Clusii, Alsine 'with a new face' the plant of Colonna:*** or tripetalous as in ***Plantago aquatica, Sagittaria, Militaris Aizoides, Nymphæa alba minima:*** or tetrapetalous as in ***Leucoium, Brassica*** and many others of the same kind: or pentapetalous as in ***Alsine, Lychnis, Caryophyllus*** etc.: or hexapetalous as in the ***Bulbaceæ*** and similar plants. Colonna observed no naturally heptapetalous flowers. F. Colonna noticed that ***Trifolium hepaticum*** produced an

octopetalous flower: ***Flos Africanus*** an enneapetalous flower: ***Granadilla Mexicana*** a decapetalous flower. But in polypetalous flowers of this sort, where the petals exceed six in number, I doubt whether nature observes a fixed number.

Both kinds of flowers, monopetalous as well as polypetalous, are either uniform or diform.

Along with Jung, I call monopetalous uniform, one which has termini of two dimensions similar to each other, or which has a right hand dimension like a left hand one, and an anterior like a posterior, but the upper dissimilar to the lower, or is of a smooth turned shape.

A smooth turned shape, however, is one which arises with a flat shape above arranged into a circle with one resting rectilinear side, or the arranged shape may be rectilineal or of mixed outline.

I have said a sort of smooth turned shape, because if folds, furrows and fissures occur it ceases to be a smooth turned shape.

Monopetalous flowers are uniform in ***Convolvulus, Campanula, Buglossus, Hyoscyamus, Tabaco*** etc.

A uniform monopetalous flower has its upper margin either whole or split into flaps: whole as in ***Convolvulus***, split as in ***Buglossus.***

If the fissures are deep the flower simulates a composite flower, but it is differentiated from the latter because it falls in a whole [or complete] form, as do, for example, the flowers of ***Borago, Buglossus, Sambucus*** and ***Cyclamen.***

Split flowers differ either in the number of flaps or in shape.

In the number of flaps, either into three as in ***Casia Poetica, Phalangium Virginianum*** and very few others, or into four, or into five, or into six as in the majority.

The flaps differ in shape either by being angular, with an acute angle as in ***Borago***, obtuse as in ***Hyoscyamus***, or round or sinuous as in ***Primula veris***, or simply round and convex as in ***Buglossus.***

Further, a uniform flower has either a uniformly smooth

covering, or folds as in ***Convolvulus***, or is varied by furrows as in ***Campanula.***

A monopetalous diform flower has termini which are similar to each other in only one dimension; that is, not only do its upper parts differ from its lower parts but also its anterior differs from its posterior, as do the flowers of the ***Lamium*** and other whorled flowers. It is either:-

1. Semifistular, which consists of a pipe obliquely cut off at the upper end, as in ***Aristolochia.***

Or:-

2. Labiate, and that either with one lip, which is either upper or interior as in ***Acanthus sativus,*** or lower or exterior as in ***Scordium, Teucrium commune*** and in ***Bæticum*** etc.: or having two lips as do most labiate flowers, in which the upper lip is either turned back or bent upwards, turning a convex face to the other lip as in ***Chamæcissus*** etc. or is convexly or downwardly bent over presenting a cavity to the lower lip, which is more frequent; this kind of lip occurs in ***Galea, Cucullus*** and ***Galericulus*** and the flower itself is called galeate, cucullate and galericulate. There is also another kind of whole lip and another split into flaps etc.

Or:-

3, A monopetalous diform flower is corniculate. Jung calls the corniculus in a flower what others call a spur or heel. Thus, according to the same scholar's definition, a corniculate flower or hollow flower is one which has some part like a horn connected to its upper part, that is, a hollow and round part, which ends in an imperforate cusp, as in ***Linaria, Delphinium*** etc.

A multifoliate or polypetalous flower is uniform when its petals conform in shape and position although they sometimes differ in size, as in the case of ***Umbelliferæ***. It is diform when its petals differ in shape or position or

both, as for example in the ***Iris*** and in ***Legumes***, although perhaps rather the flower of these is monopetalous but deeply cut.

I have said above that a simple flower, both monopetalous and polypetalous, is sometimes by chance full or multiplex. [I call a flower simple, which is in contrast to one composed of florets, not one which is in contrast to a multiple flower.]

A flower happens to be full, in which the leafy part is multiplied because of its cultivation, the fertility of the soil, or some other accident. But if a non-full flower consists of a single blade, then in a full one, when a blade has been repeated several times, the first encloses the second and the second encloses the third as in ***Stramonium, Aquilegia*** etc., but if the circuit of the flower is composed of many leaves, the circles of leaves are repeated, as in ***Rosa, Ranunculus, Anemone, Papaver, Caryophyllus, Leucoium, Pæonia, Colchicum, Crocus, Caltha*** and ***Melanthium***.

Some flowers cannot be brought to fullness by cultivation, such as the ***Galeatæ*** and ***Papilionaceæ*** etc..

It remains to impart the differences of the composite flower described above.

A composite flower, therefore, is either discoid or flat-leaved and by nature full, or pipe-like.

Discoid is that which is composed of many florets, compressed and compacted in such a way that they constitute, as it were, an apparently single surface.

A discoid flower either has a radiate disc or a bare disc.

[A discoid flower with a radiate disc is by chance occasionally full, having multiple marginal leaves, as is seen in ***Matricaria*** and ***Chamæmelum***, occasionally even bearing offsets as in ***Calendula, Bellis*** etc..]

Its disc is radiate when the disc's external leaves, which as it were constitute the edge of the flower, are more prolix and scattered than those which form the disc, and, as it were, appear to be flat.

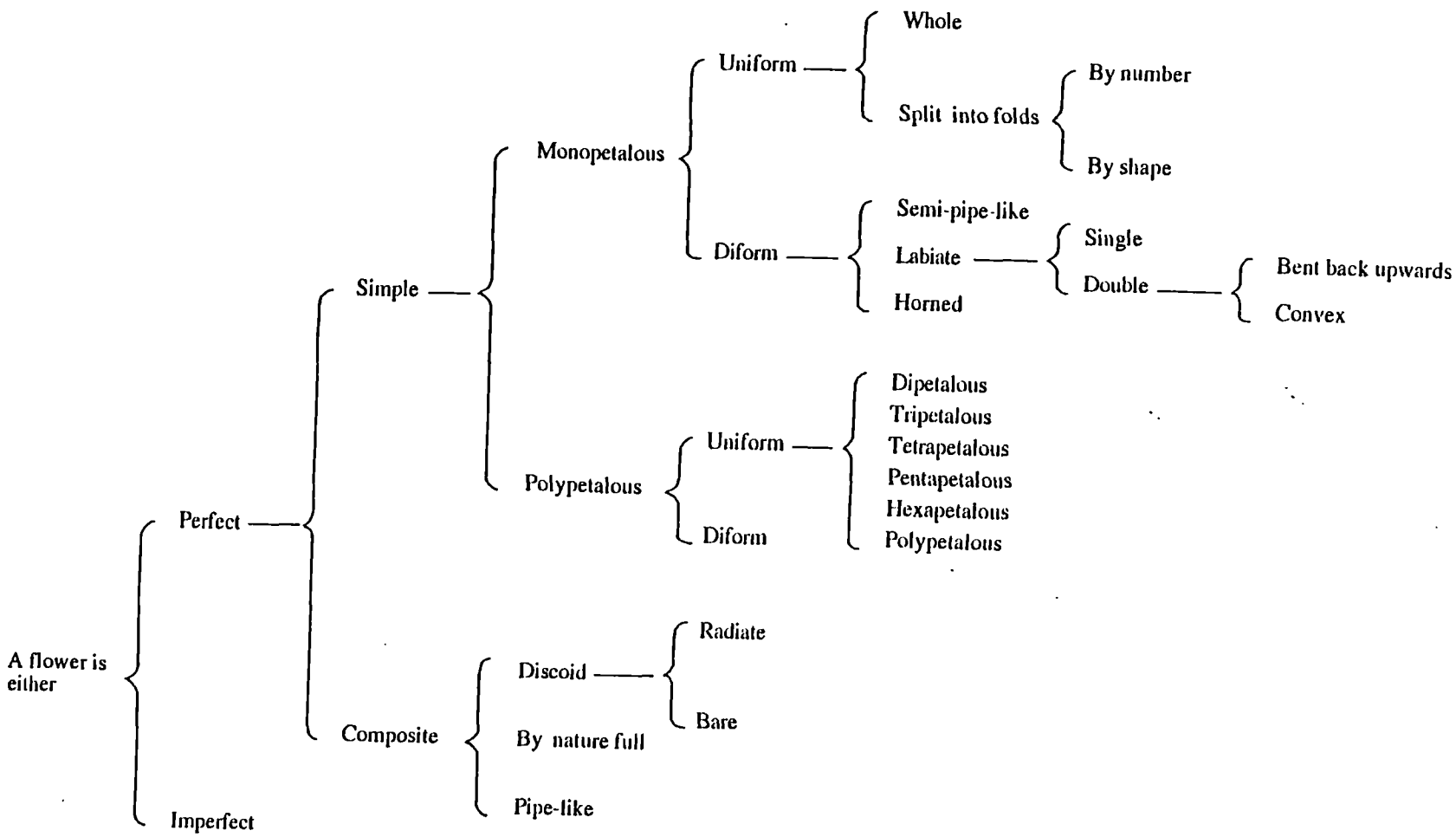
Those leaves are either external and like parallelograms, or cuspidate, as in ***Ptarmica Austriaca Clusii.*** In the ***Flos solis*** etc. they have either unbroken outer ends or have a crenated outer end as in the ***Caltha vulgaris.*** The disc is bare when it lacks marginal florets as in ***Tanacetum*** etc..

A flat-structured flower, which is naturally full, or full according to its species, is one which is composed out of virtually flat florets disposed in a number of circles.

Moreover the outer end of these leaves is generally crenated as in the ***Taraxacum, Sonchus, Cichoreum, Hieracium, Scorzonera*** and ***Tragopogon.***

A pipe-like flower is one composed of many hollow, oblong florets cut open on their margins into long flaps. There is, however, a difference to be found in flowers of this type. Some have marginal florets more elongated and larger than the rest: others have ones that are all equal.

Note. In composite flowers those florets, which are falsely called stamens by some, finish at the lower end in a lengthy white kind of pedicel, by which they cling to single seeds and also they generally have a top edge or bowl cut open into flaps. Also from each individual one a stylus sticks out generally divided into two, which is clad in a peculiar coloured pipe up to its apex or horns.


A flower is either
Perfect
Imperfect
Simple
Composite
Monopetalous
Polypetalous
Uniform
Diform
Whole
Split into folds
By number
By shape
Semi-pipe-like
Labiate
Horned
Single
Double
Bent back upwards
Convex
Uniform
Diform
Dipetalous
Tripetalous
Tetrapetalous
Pentapetalous
Hexapetalous
Polypetalous
Discoid
By nature full
Pipe-like
Radiate
Bare

Table

A flower is either:-

Perfect, consisting of petals, stylus and stamens:

or

Imperfect, lacking any one of these parts.

Perfect is either:-

Simple, which is not divided into florets:

or

Composite, which consists of many florets, of which each individual rests upon a single seed, all combining into a single total flower.

Simple is either:-

Monopetalous, consisting of a single petal or continuous layer, as in *Convolvulus, Campanula* etc.:

or

Polypetalous or multi-leaved, where the flowers are composed of many petals in a single layer or disposed in a circle.

Monopetalous is either:-

Uniform, having a right side similar to the left and anterior to the posterior, but lower dissimilar to the upper as in *Convolvulus*:

or

Diform, in which not only the upper parts differ from the lower but also the anterior from the posterior.

Uniform has a margin either:-

Whole as in ***Convolvulus***:

or

Split into folds, and that differing either:-

by **Number**, that is, in some there are three, in others four, or five or six folds:

or

by **Shape** being either angular or round.

Diform is either:-

Semi-pipe-like as in ***Aristolochia***:

or

Labiate, with a lip:

or

Horned, with a horn or spur, which is hollow and imperforate and extended backwards as in ***Delphinium, Linaria*** etc.

Labiate is either:-

Single in the upper lip as in ***Acanthus sativus***, or in the lower as in the ***Scordium*** etc.:

or

Double with the upper lip either:-

Reflexed upwards as in ***Chamæcissus***:

or

Convex, either reflexed downwards, or galeate, as in ***Lamium*** and most of the ***Verticillatæ***.

To return to Polypetalous flowers: they are either:-

Uniform, in which the petals resemble each other in shape and position, although sometimes differing in size:

or

Diform as in ***Viola, Papilionaceæ*** etc.

Uniform is either:-

Dipetalous as in ***Circæa Lutetiana***:

or

Tripetalous as in ***Plantago aquatica***:

or

Tetrapetalous as in ***Leucoium, Brassica, Thlaspi*** etc.:

or

Pentapetalous as in ***Lychnis, Caryophyllus, Alsine*** etc.:

or

Hexapetalous as in the ***Bulbosæ***:

or

Polypetalous in others.

Composite as opposed to simple is either:-

Discoid, in which short florets tightly compressed form a single, as it were, flat surface as in ***Calendula*** etc.:

or

Naturally full as in the tufted milk-producing plants:

or

Pipe-like as in the so-called ***Capitatæ, Jacea, Carduus*** etc.

Discoid is either:-

Radiate with a halo or margin of flat leaves surrounding the disc: with the marginal leaves either round the circumference, having equally crenated ends, as in ***Calendula*** and in milk-producing tufted plants: or with cuspidate margins as in ***Ptarmica Austriaca Clusii:***

or

Bare, lacking these latter petals or marginal florets as in ***Tanacetum*** etc.

The purpose of the flower is to protect tender young fruits; for before the flowers unfold, they either sit upon the fruits themselves or they surround them on every side; but as the fruit grows then the flowers open, and a little later, as though useless for the future, they dry up and fall. This according to Cesalpino. Dr. Malpighi was of the opinion that sometimes the petals of flowers distil sap in their *utriculi*, which, when it flows back inwards, they pour upon the young uterus and the beginning of the seed; at one time he thought the purpose of the petals was concerned rather with the purification of unsuitable liquid. Indeed he observed that fairly often when the petals of a flower were pulled off before they opened (especially in the ***Tulipa***) the styluses or growths of the womb were retarded for a while, and he observed that sometimes some remained static but that sometimes some of the seeds without harm reached their allotted size. He says that he still remains doubtful whether the leaves of a flower simply serve to protect the young uterus from injuries inflicted by the sun and the outside air, or whether, by purifying, they also prepare the material which swells the seed.

If the leaves of a flower are too luxuriant because of multiple growths, either the seeds become defective or they fail and generally no uterus is present, as is seen in full flowers. Is this because individual bundles of pipes are elongated into leaves and changed in form? Or is it because no woody fibres are left for the structure of the uterus and for the liquid-bearing vessels? And thus the flowers become infertile.

But although many flowers, which are naturally full, are sterile and infertile, this however is not a perpetual rule in all kinds of plants; for the ***Caryophylli*** with full flowers are nevertheless fertile. The same is also observed in composite flowers with a flat-leafed edge, which happen by chance to be full, as for example ***Matricaria*** and ***Chamæmelum***; certainly some of this kind are indeed fertile.

Yet other differences of flowers can be assumed from their configuration, and that either in respect of stem or in respect of fruit. In respect of stem a flower is either solitary or collected in a mass.

A solitary flower is one which is so disposed on its stem that it does not touch another nearby.

One collected in a mass is one, which is either fashioned into a spike, or into a whorl, or into a corolla as in ***Trifolium corniculatum*** Dod., or into an umbel, or into a corymb, or into a panicle, or into a raceme.

I have spoken above about the spike, umbel, corymb and panicle in the chapter on the differences of the stem.

Flowers and seeds surrounding the stems in a circle at their nodes are called whorls in plants, because of their similarity to those instruments which women are accustomed to place on spindles so that the spindle might turn more easily.

A solitary flower is either attached singly to its stem or in groups.

Singly, if it grows out from a single division of the stem or branch.

In groups, if they are double as in many plants, or triple as in the ***Sagittali***, or six-fold as in ***Viola aquatica.***

In respect of fruit or of the beginnings of fruit, a flower either rests upon the top of the fruit, or is attached to the bottom of the fruit.

One which rests upon the top of the fruit either rests upon the bare seed as in ***Veleriana***, or on the pericarp or follicle of the seed as in ***Cucurbita, Melo*** and the remaining apple-bearing plants, ***Bryonia,***

Periclymenum, Aristolochia, Ligustrum, Rosa, Prunus, Pomus, Pyrum, Grossularia etc., and in pulses such as ***Lysimachia siliquosa.***

A flower is attached to the base of the fruit and thus, as it were, covers and protects the beginning of the fruit in ***Solanum, Capsicum, Geranium, Papaver,*** the ***Leguminosæ*** and all the pulses (except ***Lysimachia siliquosa***), ***Lychnis, Ranunculus, Nymphæa, Arbutus, Tulipa*** etc..

It remains also to add the differences of the calyx or perianth from the *Isagoge Phytoscopica* of the aforementioned Jung.

Thus one type of perianth is closed up initially, which envelopes a whole flower not yet unfolded and splits open and then re-covers the same flower as in all the ***Papaver*** family, in ***Capparis, Palma dactylifera, Laurus*** and ***Pæonia.*** And the other is always open as in many other plants.

A perianth is generally peculiar to an individual flower; sometimes it is even common to many, especially to ones that have not yet unfolded, as in ***Palma dactylifera*** and ***Laurus.***

One kind of perianth is common to both flower and fruit; another is peculiar to a flower alone. It is of the common type in all those plants in which the flower enfolds the fruit, or where the flower is fixed to the base of the fruit as in ***Spergula***, and likewise in hollow flowers in which bare seeds lie, or in labiate flowers such as ***Salvia, Marrubium*** and other ***Verticillatæ***, or in uniform flowers such as ***Buglossus, Lithospermum*** etc..

Next the perianth is either simple or composite.

Simple is a little sac consisting of a single layer, as in the ***Salvia*** and other ***Verticillatæ, Nicotiana, Lychnis, Caryophyllus*** etc..

Composite, which either consists of many leaves placed next to each other as in ***Eupatorium cannabinum*** and ***Scabiosa,*** or which consists of leaves or scales resting upon each other tightly and like roof tiles as in ***Jacea, Cinara*** and other ***Cardui.***

A simple perianth is generally cut into flaps on its margin, either

sharp ones as in ***Salvia*** and ***Lamium***, or obtuse ones as in ***Priapeia***; likewise it is cut either into deeply folded flaps or less deeply into short ones as in ***Othonna.***

A perianth is generally tighter in its lower part but sometimes is, as it were, pot-bellied and swelling as in ***Geranium, Ocymoides, Vaccaria, Ben Album*** etc..

Some perianths are round and smooth as in ***Caryophyllus***; others are fluted and furrowed as in ***Othonna.***

The flowers of ***Cucurbita*** and ***Pepo*** come between bareness and ones clothed in a perianth. For they differ in certain green nerves or ridges or furrows stretching from the base to the edge, of which some [nerves] display within the centre of the flower a kind of narrow leafed perianth torn away, as it were, from the flower .

A peculiar thing that is observed in these same flowers is that their lower parts have something ambiguous between a stamen and a stylus, or something conflated from a stamen and a stylus.

Chapter Twelve:

On the fruits and seeds of plants.

Fruit is so-called from fructification and is that part of the plant which we enjoy as food, whether it be the pericarp or the seed. But the name fruit by analogy can be extended to similar parts of all plants, although they are of no use to us either as food or in medicine.

Thus the fruit (according to Jung's description) is said to be the annual part of the plant, attached to and succeeding the flower, which when it matures, that is, comes to its perfection, leaves the plant of its own accord, and becomes the beginning of a new plant when it is caught up by the earth or some other suitable matrix.

The fruit is said to succeed the flower, because the beginning, maturity and fall of the flower precedes the beginning, maturity and fall of the fruit. The fruit thus differs from the other annual parts of the plant because the moment it is complete or comes to maturity it ceases to be a part, whereas the other parts (such as the leaves and the flowers), until they begin to wither, rot or otherwise to be corrupted, are not separated from the plant.

A fruit is either a seed or a container for a seed [little sac, pod, capsule, envelope, wrapper].

A container is that which is especially destined for a time for the protection of the seed on all sides [or otherwise for containing it].

Those perianths, in which the seeds are hidden when the flower has fallen as happens in ***Salvia*** and in the rest of the whorled plants, are excluded from the compass of this term, for they neither protect the seeds on every side since they are open at the top, nor do they serve especially as the protectors of the seed, but are most particularly destined for the protection of the flower. Thus far Jung.

Seeds are covered either by a double container or envelope, the one going round the other, or by a simple and single one; by a double one in ***Prunus*** and ***Cerasus***, that is by the pericarp and stone: in ***Malus*** and ***Pyrus***

by the pericarp and cartilage: in nuts of ***Avellana*** by a membranaceous follicle and stone: in ***Pinus*** by the woody cortex and stone, to omit many others. By a simple one in the case of ***Faba, Pisum*** and other ***Legumes***, in ***Leucoium, Brassica, Thlaspi*** and other podded and four-petalled capsulated plants etc..

The containers of seeds are either solitary or simple with a single cavity inside as in ***Faba, Pisum*** and other ***Legumes***, in which the seeds are tied to the back of the pod; likewise in ***Lychnis, Caryophyllus, Primula*** etc., in which the position of the seed is in the middle with a little sac protecting it on the outside; or they are divided into many little cells or boxes, and these either separate, as in ***Aconitum, Aquilegia, Delphinium***, or united either:

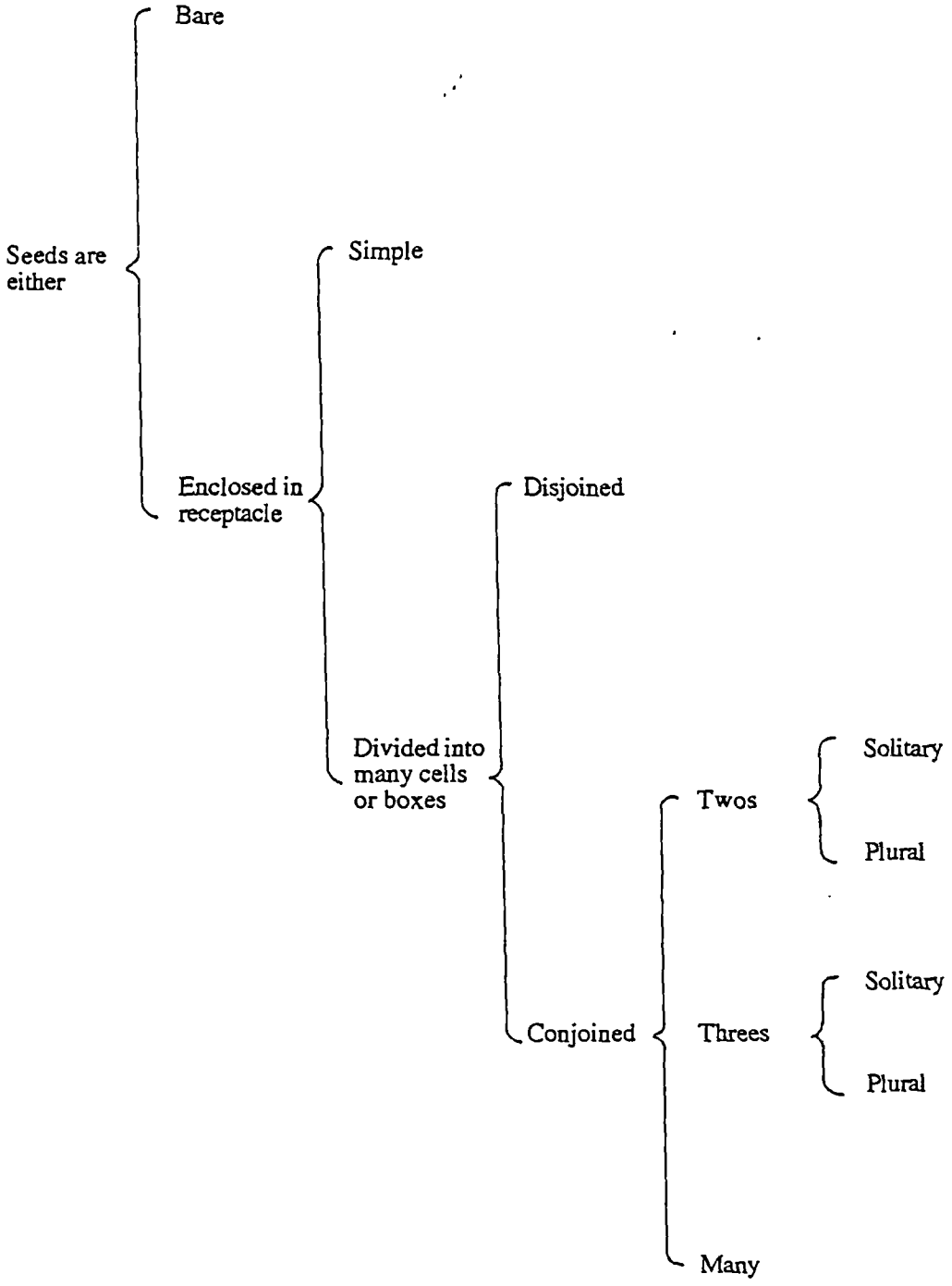
1. in twos, either with solitary seeds in individual small cavities, as in ***Xanthium, Mercurialis*** etc., or with more than one seed in each cavity, as in podded plants such as ***Brassica, Leucoium*** etc., and in capsular plants such as ***Verbascum, Thlaspi*** etc..
2. in threes, with either solitary seeds inside individual little cavities, as in ***Ricinus, Tithymalus, Heliotropium tricoccum,*** or with more than one in each little cavity, as in ***Convolvulus, Viola, Hypericum, Asarum*** etc..
3. in many of uncertain number as in ***Papaver, Linum*** etc..

Cesalpino, rightly in my opinion, defined a single fruit as one which is contained in a single external covering even if there are internal divisions; as in ***Pæonia*** and ***Aconitum*** three pods or more are contained in the same growth under the same flower, for those, which are under the same flower, are also under the same covering of the flower, which is external. But multiple fruits are ones which are protected by no common covering, even if they arise from a division of the same base, such as grape berries, for they are individual under individual flowers, provided that the raceme is separate.

I call seeds bare which are given no vessel or covering apart from the perianth, such as those of ***Valeriana*** etc..

Also as bare seeds in this work I take those which are not included in a pericarp, which fall in a solitary manner one by one and which do

not fall from their pods of their own accord but fall from the mother plant clad in them. Thus, for example, I class as bare the seeds of the ***Malva*** and also those of all umbelliferous plants.


Seeds are either
Bare
Enclosed in receptacle
Simple
Divided into many cells or boxes
Disjoined
Conjoined
Twos
Threes
Many
Solitary
Plural
Solitary
Plural

Seeds are either:-

Bare, given no covering or protection apart from the perianth, such as *Valeriana, Thalictrum,* the *Umbelliferæ* and the *Verticillatæ*:

or

Enclosed in receptacles, which are either:-

Simple, having a simple cavity within as in *Legumes* and many others:

or

Divided into many little cells or boxes, which are either:-

Disjoined as in *Aconitum, Aquilegia, Delphinium* etc.:

or

Conjoined together, either:-

In twos, with seeds in single little cavities, which are either:-

Solitary as in *Xanthium, Mercurialis* etc.:

or

Many as in plants with pods, *Brassica, Leucoium* etc., and in plants with capsules, *Verbascum, Thlaspi* etc..

In threes, with the seeds likewise in single little cavities, which are either:-

Solitary as in *Tithymalus, Ricinus, Heliotropium tricoccum* etc.:

or

Many as in *Convolvulus, Hypericum, Asarum, Viola* and all bulbous plants.

Multiple, of uncertain number as in *Papaver* etc..

About the process of nature in generating seeds from Dr. Malpighi's *Anatomy of Plants*.

The stylus in plants corresponds to the uterus in animals. For just as there is a single chamber ending in a single tube in oviparous creatures, and just as the uterus is composed of two ovaries and the same number of tubes or horns in viviparous creatures, so in plants the uterus sometimes consists either of a single ovary, which opens in a gaping tube, or sometimes consists of multiple ovaries with the same number of tubes leading from them.

Note. It seems to me that the receptacle or seed vessel should rather be called the uterus of a plant; because indeed sometimes it is a stylus as in ***Tulipa, Papaver*** etc., sometimes a body distinct from the stylus as in ***Caryophyllus***, and in ***Pomus*** and ***Pyrus*** and others, in which it lies under the flower, whereas the stylus is classed as part of the flower; in these however and in others the stylus rests on the top of the receptacle. However what I call the stylus Dr. Malpighi calls either *styl....bam* [the text is illegible here] or appendix. However, there is no reason why we should quarrel about names, if indeed the uterus of a plant is either the stylus itself or the base of the stylus or a body upon which the stylus rests, which Malpighi considers to be the stylus.

Thus the uterus of plants, or the seed receptacle, in some consists of a single membranaceous and thin body, hollow and tubular like a vesicle, and which is woven out of woody fibres, *tracheæ* and *utriculi*, in the centre of which the seeds or embryo are born and develop. In others such as those with pods, it seems to consist of a thicker substance like a pericarp. In some certain oblong appendices are added, which surround and look after the seeds, and likewise a thicker pericarp covers them with elongated bundles of fibres and *tracheæ*, from which hang *utriculi* swelling with sap, and so the substance of the uterus is produced from the little bundles already mentioned and from globules of *utriculi* united into a common body, which is called the fruit. The same kind of thing happens in women, in whom the substance of the uterus swells with the blood it contains in such a way that it exceeds its usual thickness threefold. In some plants this mass of the pericarp, taking the place of

the swelling uterus, is lined by material making an inner coating, which is generally cartilaginous, as happens in ***Pomus*** and ***Pyrus***, but in others develops into a bone-like substance, and the structure of this in plants, which are still young, trickles out as a sieved liquid from the pericarp surrounding the cavity of the uterus.

The pericarp, in those plants which have one, perhaps administers a prepared sap to the embryo contained within it, or at least reduces the force of external heat, thus preventing it from being withered by the rays of the sun. Since, however, many uteruses lack a pericarp or something similar, it is right to believe that the sap, which percolates from the pericarp into the seed, is not entirely necessary for its production; but that its substance is discharged from fertile fibres originating directly from the petiole, and indeed that the sap of the pericarp protects it rather than creates it. Indeed the fact that some pericarps supply us and other living creatures with agreeable food is the secondary intention not the primary intention of nature, which assigned the pericarp as guardian of the seed.

The coverings of a seed or the membrane enfolding a seed are like the afterbirth, by whose care the seeds are protected for a long time and when entrusted to the earth are helped by them in germination.

Dr. Malpighi takes the stones in ***Cerasus, Malus Persica*** and ***Mespilus***, by which the seed is protected, for uteruses not for afterbirths. Although they may have thicker walls, yet they are joined to the pericarp and perhaps liquid flows through them to the seed they contain. But afterbirths properly are those which fall out along with the seed when the uterus opens.

But not wanting to offend such a great man I see no reason why the shells of ***Avellana*** and ***Juglans*** should be classed as afterbirths but not the stones of ***Cerasus*** and ***Persica***. Nevertheless when, if he rightly defines an afterbirth as something 'which falls out with the seeds when the womb opens', then necessarily the fact of the matter will be that, as the womb itself opens, the shells of the former fall out with the seed but not the stones of the latter.

In most afterbirths, as for example those of ***Pyrus*** and ***Pomus***, an opening appears at the narrower end, where indeed the cone of the young plant hides, but in others a window occurs with a gaping opening. What might be the use of this little window or opening is unsure, whether it is so that the outside air may be admitted to start fermentation or advance it; or so that unsuitable elements may be eliminated as a result of the clear air blowing through; or rather whether it is for taking in nutritional liquid. What is more convincing to me is that Malpighi thinks that the opening of an egg in animals corresponds to this. For thus (he says) the fœtus in animals is not only fed through the umbilicus, receiving nourishing blood mixed with sap, but also through the mouth; that is, the juice is sucked into the stomach and thence by the usual ways into the cavities, in order that this path for the food may gradually be created, which should be maintained in the fœtus, once born, for the duration of its life, so I think probably it happens in the same way in seedlings. Little pipes [which are horizontally located in a line in the afterbirths of most seeds] supply food to the leaves of the plant, and this is mixed with pre-existing sap in the appropriate *utriculi*, and is led down inside towards the bud through the appropriate vessels, and thus the young plant seems to develop through an umbilicus. And since an opening appears in ***Pomus*** and ***Pyrus***, and similarly a little window in ***Cicero*** and ***Faba*** etc., below which are hidden the end of the conical body, which is undoubtedly the beginnings of the roots, and by these external food is administered in order that 'a royal road' of nutrition may be created, that is to say, from the ends of the roots to the stem or trunk, and from these to the branches and leaves, thus I consider that this 'road' for nutrition is analogous to that which is occupied by the mouth in the fœtus of animals. To these things it is added that the trunk of the root is increased with a vagina made up of many *utriculi*, by whose help the necessary supplementary food is supplied to the end of the trunk.

But it must be noted that nature has not in all plants placed a pericarp on the outside and positioned it round the fruit or seed, although the term pericarp seems to indicate this and demand it, but rather in some plants

nature has decided that uteruses and seeds should emerge on the pericarp fused into a globular body as is especially seen in ***Fraga***.

But the generation of the seed, or rather of the seedling, inside the afterbirth, is analogous to the productions of living creatures. For first an umbilicus which is clearly hollow develops, and gradually, when it has loosened or dilated at its end, it swells into a form of a different shape [in different seeds] filled with liquefied echor (which in ***Faba*** is fluid enclosed within the remaining *utriculi*). Through the passing of time the seed or embryo begins to emerge, very clearly at the apex of the inner membrane, with two little leaves jutting out on top open like wings, and most frequently divided in such a way that the angular apex of the inner membrane fills the fissure; but from the leaves or wings a sharpened body arises, which is the bud, and which is least like the original substance. By successive increases the mass of the inner membrane is made larger and also increases and fosters the embryo or young plant. In many plants rows of *utriculi* flow around the inner membrane in the form of an outer membrane; but the outer membrane, in those plants in which it is present, increases from its original size and gradually, when the inner membrane has grown, it disintegrates and finally the inner membrane, into which everything is filtered, is removed from the young plant. For this reason probably the seminal liquid is first dispersed from the afterbirths into the umbilicus and gradually into the distended inner membrane; whence occurs the first delineation of the young plant. But all these phenomena are more clearly understood by example and by the addition of illustrations.

The inner membrane, however, probably increases in size, not only because of the sap supplied by the umbilicus, but also because of liquid filtering through from the outer membrane, when the umbilicus is destroyed with the passage of time. And when the seedling is deprived of its own umbilicus, by which exterior food comes and penetrates it deeply, expanded into separate parts it increases and feeds them; but in order that the nearby liquid of the inner membrane may fill the gaping of the leaves as much as possible and attach to them, perhaps it will not be contrary to reason to think that by filtration

the liquid of the outer membrane is passed through into the inner membrane and enters at length into the leaves of the young plant instead of nutrition and from these is passed on to the stem and bud.

But the fertility of some plants in respect of the seed is wonderful, as for example in ***Verbascum, Digitalis, Papaver, Hyoscyamus*** and ***Nicotiana.*** In one flower of ***Helenium*** (says P.Lauremberg) I counted more than three thousand seeds and not even then did I reach the end. But the ***Helenium*** produces and bears many flowers on the same stem. From one grain of τοῦ ***Mayz*** or ***Frumentum Turcicum*** likewise one thousand and fifty; in Virginia two thousand are collected and it bears fruit twice a year in March and June. From one larger ***Flos solis*** Camerer took off about four thousand seeds, produced from one seed in the same year: I have taken off three thousand and a little more. But these are nothing if compared with the fertility of true ***Tabacum.*** Indulging my curiosity I once began to count how many grains of ***Nicotiana*** seeds weighed one drachm, and I discovered that one thousand and twelve grains of ***Tabacum*** weighed one medical grain (which is the smallest measurement). I have indeed moreover collected from one plant about six drachms of mature seeds, which make three hundred and sixty medical grains: these multiplied by one thousand (omitting the twelve) yield three hundred and sixty thousand grains, produced by one fruitful plant of ***Tabacum***, which had been born from a single grain.

The white ***Papaver*** (according to Dr. Grew's computations) produces thirty-two thousand seeds annually, which amount he thus works out: this plant mostly produces four ripe little heads, in each of which there are at least ten membranes or walls separating the same number of cells. On either side of each of these about eight hundred seeds are produced, which when multiplied by ten, the number of the membranes, gives a total of eight thousand, which again multiplied by four, the number of the heads, produces the aforesaid thirty-two thousand.

Note.This plant, if weather and soil favour it, produces, I do not say four heads, but two or three times more.

The ***Typha major*** (according to the same man's observations) makes one hundred and twenty thousand seeds each year, which he proves as follows. For the seeds make along with down a spike or cylindrical club six inches long with a diameter equal to five eighths of an inch and a circumference equal to one and three-quarter inches. When nine of these seeds are placed on the spike side by side, they make as much as an eighth part of an inch in such a way that seventy two make an inch in line. But, since on the spike hairs are interspersed between the seeds, let us take ten away and reckon on only sixty-two; if we add to these three-quarters of the number sixty two, that is forty six, the sum of the seeds for the circle of the cylinder rises to one hundred and eight, and since the cylinder is six inches long, six multiplied by sixty two seeds, that is three hundred and seventy two seeds, compose one line lengthwise. When this number is multiplied by one hundred and eight the sum produced is forty thousand, one hundred and seventy six for the number of seeds on one club; and for the three clubs, which this plant mostly produces in single years, one hundred and twenty thousand.

But the herbs called *capillares* produce the most numerous seeds of all. The annual production of one ***Lingua cervina*** plant rises to ten times one hundred thousand seeds. See the chapter on ***Phyllitis.***

Chapter Thirteen:

Certain general observations on the seeds of plants.

I. Nature does not show a correlation in size between seeds and the plants grown from them, such that a larger seed always produces a larger plant, and a smaller seed a smaller plant. For there are several herbaceous plants, of which the seeds, I declare, are not equal in size but much larger than the seeds of some trees. Thus, for example, the seeds of ***Faba, Pisum, Vicia, Lupinus, Pepo, Melo*** and ***Cucurbita***, to omit innumerable other examples, are many times larger than the seeds of ***Ulmus, Populus, Salix, Betula, Ficus*** etc..

And this can be observed not only in plants of different kinds but sometimes even in species of the same kind. Thus in the family of acorn-bearing trees the ***Ilex*** called 'berry-bearing', which scarcely ever exceeds the size of a shrub, produces an acorn equal in size to that of the ***Quercus vulgaris***: the ***Cerrus*** tree is smaller than our native ***Quercus*** but nevertheless produces an acorn twice as big. The purple annual ***Cerinthe*** is smaller than the mountain perennial one, but its seed is larger than the seed of the latter. The same difference in respect of size can be observed between the seeds of ***Rapistrum*** and ***Sinapi***, in contrast to the relative size of the plants which produce them; for the seed of ***Rapistrum*** is larger than the seed of ***Sinapi***, although the ***Rapistrum*** plant itself is smaller than that of ***Sinapi.*** Nor in egg-producing animals does nature always observe the same difference of size between the eggs, as there is between the animals which lay them. For although there is an almost indistinguishable similarity between *Locusta* and *Astacus*, despite the fact that the lobster exceeds the crayfish in size, yet the eggs of the crayfish are much larger than those of the lobster. So in the bird family the eggs of the *Anas Arctica* of de l'Ecluse and the *Anas Alka* of Hoier and of the *Lomwia* of the same man are proportionately so much larger than the eggs of domestic ducks as the birds themselves are smaller than the ducks. However, it is to be noted that these birds are web-footed and three-toed and only lay a

single egg at a time before they incubate it, and so they only produce one chick at a time. But it is most worthy of note that the smaller they are the more fertile they are: for the most fertile plants are ***Papaver, Nicotiana, Digitalis***, all ferns, ***Sinapi*** and ***Typha***, and others which I omit here, which produce the most minute seeds.

II. Concerning the seeds of annual herbs, note:

1. They are by far the largest of all, as is clear in ***Faba, Pisum, Lupinus, Cicero, Melo, Pepo, Cucurbita, Flos solis, Phaseolus*** and others.

2. In those types also, in which some kinds are annual, others perennial, the seeds of the annuals are greater than the seeds of the perennials in proportion to the size of the plants. Thus, for example, the common ***Pisum*** has larger seeds than the larger perennial ***Lathyrus***: thus ***Triticum, Secale, Hordeum, Oriza, Avena. Maiz*** or ***Frumentum Indicum***, which are nothing more than the seeds of annual grasses, have seeds larger than any perennial grass known to us, including even the largest ***Arundo.***

3. All seeds which provide food for mankind are the seeds of annual herbs; either they are corn, as for example ***Secale, Triticum, Oriza, Sorghum, Frumentum Indicum, Panicum, Avena, Hordeum*** etc., or they are ***Legumes***, such as ***Faba, Pisum, Lens, Vicia*** etc.. The reason for this seems to be that these are the best of seeds for a pleasant taste and healthy nourishment, and so they pass through the system more easily, their yield being more abundant and the proportion of meal to bran greater.

III. Although in some plants, which propagate themselves by shoots driving the roots along underground, or which multiply themselves with proliferous or creeping roots, as in the case of ***Vinca pervinca, Colocasia, Battata Canadensis, Raphanus rusticanus*** etc., the truth may be, as is observed by some, that it is clear that they rarely produce a seed and bring it to maturity, since nature, intent upon these other methods of propagation, neglects

the one which is by seed. Although I say that this may be true in some cases, yet it is far from being the general rule, since several plants are found, which either have creeping roots, or propagate themselves with shoots, and yet nevertheless produce copious and equally fertile seed. Of the former sort are ***Herba Gerardi, Solanum halicacabum*** etc.. Of the latter sort are ***Fragaria*** and ***Ranunculus repens.*** But, on the other hand, in general and without exception, I think it is true, that those same plants which produce few seeds, propagate themselves by the means touched on above; for otherwise nature, which does not fail in necessities, would seem not to have taken sufficient care for the conservation and perpetuation of such species.

IV. Pliny and other writers on natural history some time ago observed concerning animals that the longer the gestation period, the longer the spans of their lives. If you try to fit this observation to plants you will find it quite untrue. For nothing certain can be gathered about the life and duration of a particular plant, from the shorter or more productive space of time which comes between the bursting out of the flower and the ripening of the seed. For in the case of ***Ulmus***, whose seed is ripened from the flower which has been produced right at the beginning of spring, and which even falls before the leaves unfold, we see that it is quite a long-lived tree.

V. The seeds of plants are filled with more copious oil than any other part of them; they demonstrate this in the great quantity of oil which is squeezed out, when they are subjected to a press and crushed. Oil, however, since it is a viscous substance, does not easily evaporate and so is a suitable vehicle for containing the spirit of the seed. Hence it happens that seeds remain fertile for many years, and, when sown, germinate. Indeed they also contain an abundance of *sal volatile* as Wedel clearly demonstrates in *A New Chemical Experiment on the Sal Volatile of Plants*. But it is not my intention to deal with the chemical analysis of seeds in the present work.

VI. It is a very difficult question to find out for how many years the seed of plants continues to be fertile; some of the old writers have produced the number forty. Dr. Morison states that they do not remain fertile for more than

ten years; others limit the span of their fruitfulness to five years. But there is no doubt that there is a great difference between seeds in this respect; for some keep their fertility longer, others lose it more quickly and become sterile, so that it is likely that some prolong their fertility for more than ten years, while others lose it in less than five years. Dr. Toll, a curious cultivator of flowers, once showed me a dung-hill of *Lenna Norfolkia*, into which some years before some rotten raisins had been thrown so that they might decompose there; but from their grape pips each year, when the dung had been removed, a fair number of vines sprouted and even some new ones after a minimum of four years. I (to confess the truth) have made no experiment with any seed older than five years, but I have discovered that five year old ones do germinate. However the conservation of the seeds adds much to the prolonging of the fertility; for care must be taken lest they absorb too much liquid and hence become mouldy and rotten, and also that they do not become too warm and dry up. Too strong a cold also burns and destroys some. Whatever may happen, those lurking in the bosom of the earth, although they are vulnerable there to so many kinds of heat, cold, moisture and dryness, nevertheless (in my opinion) keep their fertility longer than if they are watched over most carefully by men. For both I and many others before me have observed the great strength of ***Sinapi*** produced in the recently dug banks of ditches and in grassy areas, which have been dug out, where within the memory of man a crop of ***Sinapi*** has never grown. However I suspect that this does not grow spontaneously but from seeds which are very prolific and have remained in the earth for many years.

VII. All seeds, whether sown by man or fallen to the earth of their own accord from their receptacles, first absorb their nourishment through the pores of their coverings: or (to speak more truely and philosophically) the first nourishment of seeds after sowing insinuates itself through the pores of their sheaths or coverings. In most seeds, however, a kind of little opening, or rather open little window, is observed through which the nourishing liquid first enters. Once this has been admitted, the vital spirit inside, acting as a host to the seedling, inflates and extends its coverings as though fermenting them; by this

also the moisture of the earth must flow in abundance into the seedling and thus nourish and increase it.

VIII. There is a great analogy and similarity between the germination and growth of seeds or eggs of plants in the earth and of viviparous animals in the womb. For just as the seed of a plant, which has reached its full maturity, falls to the ground, and there lying free and unattached draws to itself and absorbs its food (as I have said) first through the pores of its coverings and then afterwards puts out roots into the earth, so likewise the egg of a viviparous animal, fertilised by the seed of the male and as it were brought to maturity, slips away from the ovary into the uterus as if from a tree into the earth, where for some time, remaining free and unattached without any cohesion within the womb, it draws its food through its covering membranes or afterbirths. But a little while later, as though by putting out roots and fixing itself to the uterus, it seems to suck from there at least some portion of its nutrient. I call ovaries those organs commonly called female testicles, which someone who has carefully inspected them, overcome by the testimony of his eyes, will if the need arises confess are nothing other than a mass or cluster of eggs. Although I assert that the seed absorbs liquid or the fœtus draws in nourishment, I use a common and colloquial means of speaking and I would not wish anything else to be understood by someone taking it correctly and philosophically than that the liquid insinuates itself through the pores or flows in through the veins and vessels; for I would not concede that an attraction, in the proper sense, is given in nature in any way whatsoever. Indeed I do not think that the seeds of plants to this extent and their roots really derive the majority of their nourishment through the pores of their coverings, but derive a small amount through the extremities of their capillary fibres, which some hold to be like so many mouths. That plants absorb nourishment through the pores of their cortexes is most clearly proved by the method of fixing into the ground branches and ἀποσπασμάτια ['fragments torn off'], which P. Lauremberg mentions in *Horticult. Cap.21, § 1.* He says:

There is almost no stock which cannot be propagated by annual

cuttings, provided that:

1. the lower extremity, which has been cut off, is smeared with the following:

Take [Pχ] $^{2}/_{3}$ i of wax, $^{2}/_{3}$ i of terebinth, $^{2}/_{3}$ ii of common resin mixed together.

2. you do not plant the little branch thus smeared directly into the earth, but with a curved arch so that the upper part juts out from the earth, the middle touches the surface and the lowest part, which I have said must be smeared, bends a little upwards,

in such a way however that it is concealed. In this case no other route is open by which the nourishing sap can enter than by the pores of the cortex.

But since mention has been made of this method of planting a tree with branches or slips fixed down, I think it will be worthwhile to try this in every kind of apple-bearing tree, since if it succeeds, this will be the easiest and most fruitful way of all of propagating. For although a sucker planted in the same way produces fruit in the same year, nevertheless a trunk or stock needs some years from planting before it is suitable for planting out. Moreover, since a small branch becomes much bigger than a sucker and grows more abundantly, it produces far more fruits in the same space of time. Add to this, that if any plant does not take, it can easily be torn up and another planted in its place. But indeed I judge it very likely that this method of planting will succeed in apple-bearing trees of each kind, since no sufficient reason has been given to me why in the same kind of tree one species sown by cuttings should take, as for example those called ***Codlings and Moyls*** by our countrymen, but others least of all. I was strongly confirmed in this opinion by Dr. Josselin, who in his description of *New England* writes that this method of planting by removing branches was frequently used among the natives with success for all kinds of ***Mali*** and ***Pyri.***

Chapter Fourteen:

On the leaves of plants called seed leaves.

The majority of sown seeds at first arise from the earth with two leaves, which, since they are different from those that succeed them in many respects, are not inappropriately called seed leaves by our gardeners.

These seed leaves differ from those that succeed them:

1. In their small size, since they are smaller than the later leaves in every kind of plant.
2. In shape, in so far as they are whole and undivided even in those plants in which the subsequent leaves are split in many ways, as for example in the ***Umbelliferæ***, where they are smooth around the edges in those plants in which the remaining leaves are scalloped and toothed; in most plants they differ from the succeeding leaves in outline. Nevertheless, it is to be noted here that although the seed leaves in most plants are whole and entirely without scallop, cut or division, yet this is not constant and permanent in all, since indeed the seed leaves of ***Nasturtium hortensis*** are divided into three lobes, which imitate the same number in the leaves; the seed leaves of ***Brassica, Raphanus, Sinapi*** and ***Rapa*** have foliage cut by a single scallop, and the seed leaves of ***Nasturtium Indicum*** have foliage divided by a double scallop into three teeth; but the seed leaves of ***Geranium moschatum*** are pinnate in almost the fashion of the subsequent leaves. But so far I have known no plant of which the seed leaves are scalloped or dentate on all sides around their edges except for those of ***Urtica*** and ***Betonica.***
3. They differ in surface, which is smooth, for example, even in those plants of which the leaves are hirsute or hairy; not, however, in all, for the seed leaves are hirsute or hairy in ***Borago, Buglossus*** and some others I have observed from those called *Asperifoliæ* ['rough-leaved'].
4. They differ furthermore in position and way of developing since two develop opposite each other, not only in those plants in which the leaves

are disposed jointly on the stems, but even in those which arise singly and alternately at the lower joint on one side and at the upper joint almost opposite on the other side; or secondly, where several leaves circle the stems at the nodes like stars, as in ***Asperula, Aparine*** etc.; or thirdly, where they grow frequently in confusion on the stem and in no order as in ***Linum, Linaria*** and ***Tithymalus.***

5. The seed leaves and indeed the whole young plant before the complete germination of the seed, while it is still enclosed in its coverings, is fleshy and fragile, so that almost all of it seems to consist of flesh and moreover to contain little in the way of fibres.

Chapter Fifteen:

On the seedling and other things contained in the seed.

In all seeds of suitable size, which I have ever dissected, I have always found a seedling: in some perfectly formed to the extent that all their parts can be distinguished even with the naked eye and can be parted from each other with the fingers: in others less perfect, so that their parts definitely could not be so easily distinguished by myself.

1. This seedling in most kinds of seeds consists of two seed leaves, or at least a double lobe corresponding to seed leaves, radicle and bud. I said a double lobe corresponding to seed leaves, because there are some of this type of seed which do not push their lobes above the earth in the form of leaves, as a result of which some perhaps think that the term 'leaves' should not be assigned to them at all. But since they are entirely of this nature, and without doubt have the same function, I see no reason why they should not be assigned the same name also.
2. In some kinds of seeds the seedling is not made up of two seed leaves, radicle and bud, but either it consists of a stem alone without leaves, or of a leafy stem, or of a leaf alone without a stem at least visible to the naked eye. From this division among seeds a general distinction of plants can be adopted, and that in my opinion the first and by far the best of all, that is a distinction into those plants which are bifoliate or διλόβῳ ['double-lobed'] in the seedling, and into those which have a seedling analogous to the adult seedling.
3. Among seeds of the first kind (in which the seedling consists of two seed leaves, bud and radicle) there are some in which apart from the seedling no pulp or pith at all is contained. There are also ones in which apart from the seedling other things too are contained, or in which the seedling is only a part of the pulp or pith.

Those seeds, which contain nothing else except a seedling, are likewise different in two ways:-

1. In some the seedling is flat and extended without any fold, wrinkle or convolution.
2. In others the seed leaves are either folded or convoluted with the radicle in various ways.

In the first kind the seed leaves are nothing other than lobes of the seed fitted together along its flat surfaces as can be seen in the nut of ***Avellana.*** The swollen or external surface of either lobe is symmetrical, as if the centre of the seed is cut down the middle. Of this kind are ***Faba, Pisum, Phaseolus, Vicia, Amygdala, Prunus, Glans*** etc..

Here we may note in passing that this union or connection of the radicle with the lobes is not always or in every kind of plant at that point where the seed adheres to the fruit or seed container. As a result of this, germination does not begin from the point of cohesion in all species, as some have recorded; but in some it occurs at a notable distance from the point of cohesion, as in ***Faba, Lupinus*** etc.: in others at the opposite end as in ***acorns***, the nut of the ***Juglans, Amygdala, Prunus, Borago, Buglossus*** and the remaining ***Asperifoliæ.*** I have indeed already observed in oblong or pointed seeds a radicle situated at the sharper end, whether that end adheres to the seed container or is diametrically opposite to it. Thus, for example, in seeds of the ***Pomus, Pyrus, Flos solis, Melo, Pepo, Cucumer*** and all ***Verticillatæ,*** when the sharper end is close to the sharper end of the seed capsule, the top of the radicle is also turned back to the point of cohesion. But in seeds of the ***Acorn, Amygdala, Borago, Buglossus*** etc., in which the sharper end of the seed is diametrically opposite the point of cohesion, the radicle also has the same position. In those seeds in which the connection of the pith with the lobes is either adjacent to the point of cohesion of the seed itself or opposite to it, that is, in more elongated seeds in which it occupies either extremity, the radicle is necessarily short; but in those in which the place of connection is distant from the place of cohesion of the seed with the plant, the radicle is somewhat longer and is prolonged to the edge of the lobes until its tip ends at the point of cohesion.

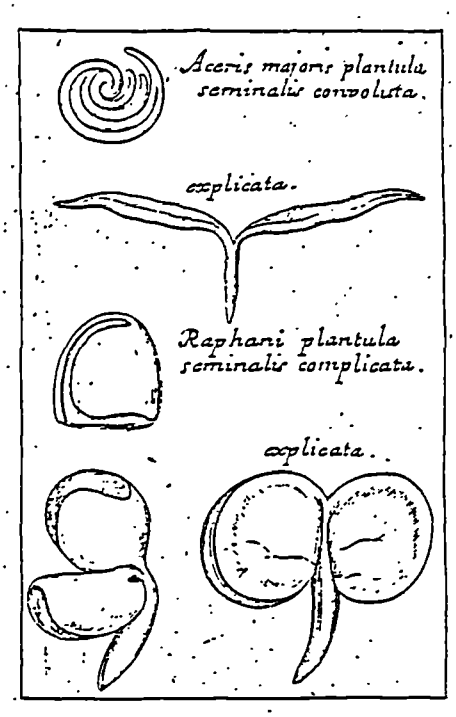
This observation can be of some use in sowing at least larger seeds, for it will without doubt promote their germination to some extent to sow them in such a way that the point of the seedling's root faces downwards; just as *vice versa* it will necessarily impede its development and growth to plant it in such a position that its point tends upwards. For in this case the root must bend through a complete semi-circle or through two right angles before it goes downwards, and conversely the bud similarly must be curved as much before it straightens upwards with the result that the nutritional sap must be bent twice before it flows from the root into the stem.

There are many varieties of the second kind of seeds, in which the seedling is convoluted or folded up, since the folding up of the seed leaves and radicle differs much in various kinds. I will produce some examples of larger seeds in which, when the coverings are removed, the method of folding clearly appears to such an extent that anyone can easily see it with his own eyes and can extend or unfold the little plant enclosed within with his own fingers.

1. In ***Raphanus*** it is very much the same as in all others, which come out of the ground with similar seed leaves, as for example ***Brassica, Rapa, Sinapi, Rapistrum, Eruca*** etc.. The seedling is elegantly folded into the shape of a globe in this way. When the seed leaves are placed or pressed close to each other as in most examples, first the bent root is superimposed upon them, then the parts of the leaves themselves embrace it in their folds, curving in right and left towards themselves above the radicle and at length running together.

I show illustrations of a seedling thus convoluted and unfolded.

Taken from Malpighi *Anatomy of Plants*, Plate 53, Figure 319.



2. In the larger ***Acer***, falsely called ***Sycamorus***, the seed leaves, which have moved close to each other, as in the former case, are both curved together inwards a little above the mid part of their length until their parts are touching each other and then they are rolled into a ball along with the radicle as if one were to double back a narrow flap and then roll it up from the place where the bending begins.

   The picture opposite [above in the translation] will illustrate this matter.

3. In the seed of the garden ***Nasturtium*** two lateral segments of each seed leaf folded against the part behind the central or chief segment (which at the same time are of exactly the same width as the latter) are enclosed in the coverings with a radicle which is not folded back bare upon the leaves, but as if it had first been extended and wrapped up in the coverings, and afterwards along with the coverings bent onto the seed leaves, as the seed itself will manifestly make clear to anyone who studies it.

4. In the seeds of all the ***Convolvuli***, but especially in those of the marine

[*Convolvulus*] or ***Soldanella***, the seed leaves are corrugated with many folds or curves to such an extent that when taken from their coverings they can easily be expanded and smoothed out, since they are thinner and less fragile than in most others, and indeed are also to some extent becoming green. This happens so much that out of all those which I have observed up to now of this kind of seed, they are the most fitted for this purpose, that is, for demonstrating nature's skill in folding up the seedling among the enveloping membranes, which truly is very admirable and most pleasing to see.

Thus far on seeds of which the whole pulp or pith is nothing other than a seedling either extended or folded up. Following this I must deal with those seeds, in which besides the seedling another body also is contained, whether it serves either for nourishing the seedling or for protecting it. These also can similarly be divided into two kinds. The first of these is the one in which the seedling is flat and extended without any fold or bend. Of this kind are the seeds of ***Fraxinus*** and some ***Umbelliferæ***. The second of these is the one in which the seedling itself happens to be bent, folded or convoluted; of this kind are the seeds of ***Malva, Stramonium, Atriplex, Spinachia*** and many others, in which the residual pulp while still tender is either used for feeding the seedling or (as I have said) seems to serve for looking after it.

In the first kind the flesh or pulp of the seed leaves or lobes seems to supply the first nourishment for the root when it begins to germinate; after it has become longer and goes down into the earth it both draws food for itself from the earth and in turn passes it on to the leaves. For the leaves or seed lobes in seeds of this type, while they still lie closed in their covers, are thick (as I have said before), fleshy and fragile, containing little fibre and much flesh. Thus the order of progression of germination in them seems to be of this kind. When the seed is committed to the earth, liquid or nutritional sap purified by double filtration through the coverings of the seed and the membrane of the plant itself, is absorbed by the pulp of the leaves, and, mixed with their salty and oily particles, supplies a suitable nourishment for the radicle. This,

moreover, when it first germinates, bursts its wrappings, and when it has lengthened descends into the earth and thence both draws up nourishment for itself and supplies it to the seed leaves, which, when grown and unfolded, burst out from the earth, put aside their split coverings, and then extend in length and width and emerge moreover rather spaced out and rather spongy and also pliant and fibrous. But in seeds of which the leaves or seed lobes do not rise above the earth, as for example in the ***Faba, Pisum, Vicia*** and the remaining legumes, the radicle (at least as far as I have been able to observe) does not supply nourishment to the lobes, which therefore are not properly said to grow and increase, although they swell considerably by reason of the liquid insinuating itself into their pores in the manner of a sponge. The lobes and seed leaves likewise continue swollen and extended for some time after the germination of the plant, and afterwards gradually thin out and grow flaccid, and at length, when dried completely, they fall off. I confess I am not sure whether they supply any nourishment to the plant after its emergence from the earth and how long they remain swollen. But an experiment can easily be conducted by cutting off the leaves or lobes the moment the plant emerges from the earth, and by comparing it with another of the same age to which leaves and lobes remain attached. For if the mutilated plant equals the whole one in vigour and growth, it is clear that at least the leaves do not supply any necessary nutrient to the seedling.

After I had first written these words there came into my hands the second part of *The Anatomy of Plants* of Marcello Malpighi, that most learned and truly incomparable philosopher in the secrets of nature itself, in which I find this experiment done by the great man himself with different kinds of seeds both before and after germination has begun; pay attention to what he says about the success of the experiment. He says:

> First I sowed many seedlings of ***Faba*** in the correct way, after I had first removed the cotyledons or farinaceous pericarp. Out of these only two seedlings grew a little bit, the rest having rotted; that is, the bud grew upwards with a conical root still adhering to it.

About the eleventh day the bud was not expanding, moreover the leaflets were drying up at the ends and the stem too was not growing any longer but was being infected with spots tending to be black. After twenty one days when the whole tiny stem had gone black, it at length wasted away; the root, which had shown absolutely no sign of growth, rotted first. Also in the month of May I placed some other seedlings of ***Faba*** and ***Phaseolus*** to be incubated, after likewise removing their two seed leaves or cotyledons; of these one ***Faba*** seedling grew, a very small bud appearing above the earth and a root extended a little way downwards to such an extent that the whole length of the plant would not exceed half a finger. After twenty one days this withered away when its root had gone black and the leaves of the bud or future stem had dried up. After I had completely removed their cotyledons I planted afresh more seedlings of ***Faba***, of which none developed completely. I have experienced the same thing in seedlings of ***Cucurbita, Pepo, Lupinus*** and ***Phaseolus***, which have a very strong trunk and bud.

I attempted this same observation during the process of incubation and after growth had begun, that is while the cotyledons were emerging above the earth in the form of seed leaves. In the case of ***Cucurbita*** and its growing seedlings, when the cortex was cut and the two seed leaves removed, the growing time was certainly prolonged but neither the bud nor the remaining stem achieved much more growth, and this frequently happened to me. The same thing occurred in the ***Lupinus*** whose cotyledons swell into ample and thick leaves. In ***Pepo*** also, in ***Lactuca, Endivia, Raphanus*** and ***Rapa,*** whose seedlings were deprived of their cotyledons, they did not manage any increase in growth but either died swiftly or continued very small and languished without growth. But in the case of growing plants right from the beginning of their development, if one leaf was removed but the other remained, the germination

process was prolonged, although, it was observed, not with such success as in plants which had not been mutilated.

To explore the strength and length of life of growing cotyledons I sowed several seeds of ***Lupinus, Cucurbita*** and ***Faba,*** from whose seedlings I removed the seed leaves on the particular day when they were breaking out above the earth. In the ***Lupinus*** I tore off the leaves when they emerged from the earth on the fourth day; in the ***Cucurbita*** I did likewise when the plant first appeared on the fifth day, and on the seventh day I removed the cotyledons growing on the ***Faba***, and likewise on subsequent days I attempted the same thing on similar plants for a space of ten days. Accordingly the first three seedlings of ***Lupinus***, deprived of cotyledons, after achieving almost no increase, withered away after a month; but the remainder lived on far smaller in size. The first four seedlings of ***Cucurbita*** died while the rest grew on. Many of the plants of ***Faba***, deprived of their cotyledons, indeed grew but were very thin and very small.

Therefore from this it may be conjectured that those two leaves, however thick, which adhere to the seedling, fulfil the role of the uterine placenta or of the cotyledons. Moreover, they demand liquid emanating from the womb of the earth, dissolved in which their fermenting and spermatic saps supply their daily nourishment and productive material to the little plant through its own umbilical vessels; as a result the fœtus of the little plant not only grows from the particles fermented and put in motion, that is in placentas or seed leaves, which have now taken shape after their channels have been expanded, but it is awakened to growth.

Thus far Malpighi.

The performance of experiments convinces me that the seed leaves are necessary to the little plant for first growth or germination; either because the liquid from the earth is very unsuitable for nourishing the little plant

while it is still tender, unless it is prepared through the admixture of the fermenting sap of the seed leaves, as Malpighi conjectures, and as is reasonable, or because the young and weak little plant is not yet strong enough to drink from the earth as much as is necessary to nourish it, but still needs additional help from the leaves, just as a calf recently removed from its mother needs additional nourishment however much food it takes in with its mouth; or for either reason.

What these leaves do for successful growth even some time after the plant has emerged from the earth experiments likewise show.

That indeed they are not always necessary, nor even useful, is clear because after some time they gradually wither and perish, with the root supplying all its nourishment to the plant.

It is also to be noted that after growth has begun a young plant recently born at least gets some part of its nourishment from the root, as is clear from the swift growth and extension of the seed leaves. So in animals we see that the embryos suck some part of their nourishment from the cotyledons or uterine placenta, and part they admit with their mouths while they are still in the womb. Indeed it is seen that in a dissected stomach the same liquid is clearly found which is seen in the amnion, and even excrements are observed in the intestines, left behind after the digestion and distribution of this kind of liquid.

From all of these things it may be concluded that the first nourishment of the seedling is prepared and produced in plants from the seed leaves and (as is likely) for the fœtus also in the womb from the cotyledons or uterine placenta. After they are nourished, partly by drinking the nutritional sap by mouth or by root and partly taking it from the cotyledons, so gradually every day absorbing more by mouth or root, they are as it were weaned from the sap of the cotyledons, and when at length the sap utterly fails, animals drink or take their whole nourishment by mouth, plants by their roots.

It remains now for me to talk about those seeds, in which the seedling does not consist of two leaves, a root and a bud, but whose leaves, when they first appear, are similar to those that follow.

I have observed two kinds of these. The first are those in which the seedling is externally fixed to one extremity of the seed, that is to the one which is contiguous to the seed vessel, almost in the shape of a bud when it is placed with its protective covering on the trunk or branch of some tree in grafting. The second are those in which the seedling is enclosed in the middle of the pulp or pith of the seed.

Of the first kind are all corns and grains which have fibrous roots, with very many tiny little fibres breaking out together from the base of the plant, not however those with a simple trunk which is later divided into shoots and fibres. Thus in a grain of ***Hordeum***, for example, I have observed six little fibres of this kind produced before the leaf began to germinate. The seedling in these scarcely equals a tenth part of the seed's pulp or pith in size. The rest of the pulp or meal serves for nourishing the little plant while it is still young, even after it has put out roots; just as in oviparous animals the yolk of the egg serves to feed the chick for some time even after it has hatched, although in the meantime it takes food for itself with its beak. Marcello Malpighi, a man never sufficiently praised, in the first part of *The Anatomy of Plants*, page 77, calls this pulp or flesh in this kind of seed a conglomerate leaf; the occasion which led him to this opinion he tells himself.

He says:

> In wheat and oats the seedling seems to be endowed with only this obscure leaf. Frequent inspection of the seeds of ***Pomus Armeniaca*** brings light to this theory, for I once came upon a seedling without its leaf and its bud with its root did not grow very well; but there was present inside the nucleus itself another seed or little plant, in whose growth nature had in the beginning conspired. So meanwhile from this marvel I formed the opinion that the seedlings of corn and similar plants possess only one leaf, to which a bud adheres with the beginnings of a stem and roots. Thus in ***Avena*** the main body or flesh of the seed is shaped into an oval and oblong body, which displays a little pit running along its centre. For

there is a kind of thick flap with its ends folded back and convoluted towards the middle, at the top of which the seedling is attached or implanted.

Thus far Malpighi.

But this pith or floury flesh of the seed, whether it is to be called a convoluted or rolled up leaf or less, certainly supplies food for the recently sown plant, as most evidently appears, for example, in ***Triticum***. For if you pluck out the little plant when it has first sprung up, you will find almost all pulp in the grain; but if from day to day you go on pulling up plants sown at the same time, you will observe the pulp or meal gradually lessen each day, until at length nothing is left except an empty follicle sticking to the base of the plant. The pulp or meal of the seed, however, after germination, when mixed with fluid from the earth, which has percolated through the pores of the coverings, turns into a thick juice not unlike the extracted juice of a plant. But in those kinds of corn, in which the grains are clad in a thin membrane, as for example in ***Triticum*** and ***Secale***, the leaf bursts its coverings and comes out from the same end as the roots. But in those in which the grains are covered in a thicker cortex, as in ***Hordeum*** and ***Avena***, the leaf creeping under the thicker cortex comes out from the top of the seed, although the bud or seedling is born from the lower end of the seed, and initial germination of both the leaf and the root begins at the same point both in the latter kind and in the former.

Seeds of the second kind, that is, in which the seedling is enclosed in the middle of the pulp of the seed differ in some ways. For in some both stem and leaves are perfectly formed. Thus, for example, in ***Pine*** nuclei (and as is likely in the seeds of all other conifers and resin-bearing trees) you will easily find a tiny pine perfectly formed with its stem and leaves distinct, so that, if you dissect them, it appears just the same when first sown as when it emerges from the earth. The exterior pulp, of which the seedling occupies the centre, does not seem to serve for nourishing it, or at least the greatest part of it. For I have observed that after the little plant has been born after germination almost all of the exterior pulp is left in the cortex. If one is allowed to follow

conjectures, it seems likely to me that the pulp serves partly for protecting the seed in case it dries up too much and its damp radicle shrivels, partly for purifying the nutritional sap by filtration, and partly, finally, so that its more tender part mixed with liquid can turn into nutrition for the young plant.

2. In others the seedling seems to be nothing other than a sort of cylinder or bacillus, in some pointed, in others coming to a little head. This cylindrical seedling is curved in some seeds, in others it is stretched out straight; in all it occupies that part of the seed which grows upon the mother, and in mass has the smallest proportion of the seminal pulp; for the rest of the pulp is a hard and cartilaginous substance, which seems to serve partly for feeding the seedling and partly for protecting it. Of this kind are the seeds of all bulbous plants, of ***Iris, Arum, Asparagus*** and (in my opinion) ***Pæonia*** and ***Cyclamen.*** I have also observed some difference between these seeds. For in the seeds of ***Cepa*** and ***Porrum*** the exterior end of the cylindrical stem or seedling, when first germinating, descends straight down into the earth and becomes a root, the pulp of the seed supplying food for it and as it were pushing it out. Then the root grasping the earth draws food from it, and in turn returns it to the stem, which extending lengthwise rises bent above the earth, since the root supplies food to one end but the seed to the other. But since the root supplies nourishment more copiously than the seed, it seems to happen as a result that the half which is extended for the root from the bent stem, growing more swiftly and becoming longer, draws from the earth the other half together with the seed adhering to it and hastens upwards.

But if anyone wishes to see a seedling, let him take for dissection any seed from the larger ones (which are more fitted for this purpose), and indeed a mature one but while it is still green and swells with liquid. If one that is dried out is offered, let him first dip it into tepid water until it swells and begins to germinate. For then he will easily unfold the little plant denuded of its wrappings and will clearly see all of its parts - seed leaves, radicle and bud. If he does this, he will be incapable of not greatly admiring the skill of nature in so curiously folding seedlings, and of being taken and

delighted greatly by such a pleasant spectacle.

Chapter Sixteen:

On the secondary or auxiliary parts of plants: tendrils, thorns etc.

Since the stems of some plants even of extraordinary size are too weak to stand by themselves, and indeed tumble about on the ground, it is necessary that they be held up on other supports. Solicitous for the safety of these [plants], ingenious nature has thought up some secondary and auxiliary parts, by the assistance of which they are strengthened and force their way up, twining themselves on nearby stems or other supports or adhering to them, and thus both protect themselves and with luck bring their fruits to maturity. For to some nature has given tendrils or little claws, by which (to use Cesalpino's words) as though with hands they clutch neighbouring plants and embrace them as though throwing a rope around them, as in ***Vitis, Cucurbita, Pisum*** and other legumes. Moreover tendrils arise either on the wings of the leaves themselves, either from the side, or from the back, or even on the tops of the leaves, as happens in the case of certain legumes. Tendrils of this kind put out stylus-shaped appendices or whips, sometimes three, frequently four, and not rarely even six. These are tender at first and are stretched out very obliquely (the words are those of Malpighi). By the passing of time when they have become more firm they are twisted into a spiral, as a result of which when elongating they tightly enfold the branches of plants. The colour of tendrils is green and they are made up of pipes or *tracheæ*, with rows of *utriculi* interposed between them. For others this same nature, the master craftsman, has contrived another kind of fetter. Thus she has granted the common ***Hedera*** certain ringlets or little hairy roots crowding over the whole stem on this side and that, like the feet of Millipedes, which, according to the observations of that most wise of men, Malpighi, pour out a glutinous liquid or turpentine, by which they tenaciously adhere to and stick to the trees or walls which they encounter. Thus she has bestowed upon the five-leaved ***Hedera Canadensis,*** as it were, certain hands, as though divided into fingers, which in the course of time twist into a

spiral like a curl. The extremities of these (according to the same man's observations) while they are young continue pointed, but at length spread into a rather thick body, which is packed with nipples or tiny siphons and which sheds turpentine, by means of which when sticking to walls it forms as it were a solid skin, which cannot be torn away from the wall or the wood under its control except by the greatest force.

To other weak plants, however, (to note it in passing) nature has conceded either twisting stems, as is seen in ***Convolvulus, Lupulus, Phaseolus, Helxine*** etc., by which they cling to neighbouring stems or stakes, twining themselves around them like serpents; or she has given them twisting pedicels of leaves, by which they bind themselves to them, as is seen in ***Clematis, Fumaria*** and ***Nasturtium Indicum.***

Moreover nature has given other less important parts or perhaps bits of refuse to plants: hairs and thorns. She has given these either as ornament or for the sake of protection, or (which is Malpighi's opinion) so that a portion of swelling support may burst out and be distributed in their incongruous shape: about which consult him as he, as usual, eruditely and shrewdly reflects on this. Nature has given them for warding off injuries or even for inflicting them, sometimes on the stems as in the ***Rubus***, sometimes on the leaves as in ***Agrifolium***, sometimes on the fruit as in ***Tribulus***, sometimes only under the leaves as in ***Ononis***, sometimes everywhere as in the many ***Acanacei*** of Cesalpino. In listing these few plants it is not enough just to admire and grasp nature's providence (says Pliny). For he explains nature's plan in forming thorns of this kind at the same time both ingeniously and succinctly, in his own way, in the following words.

> For this reason nature has invented some parts which are repellent to see and rough to touch, so that not only do we seem to hear the voice of nature herself on the fashioning of them but giving her reasons for it: lest some greedy quadruped feeds itself upon them, or lest bold hands snatch them away, or lest neglectful footsteps crush them, or lest a bird sitting on them should break them, and so by

fortifying them with these thorns and arming them with these weapons she is providing safety and protection for her remedies. Thus this thing too, which we hate in them, has been thought up because of men.

Chapter Seventeen:

On the nutrition of plants.

Nutrition is defined as the distribution to all parts of the plant of nourishment taken in and altered and its transmutation into their substance, for supplying that which is continuously consumed and which evaporates by the force of heat either inherent or external. For the warmer parts of plants, as of animals, are in a perpetual state of flux; this is most clearly apparent from leaves and flowers which have been plucked off. For they instantly grow limp and contract because of the flight of the sap which fills and distends their vessels and vesicles. Moreover this same evaporation of sap happens in these parts while they still adhere to the mother plant but it is not however noticed, since the leaves nevertheless keep their consistency and extension because of the continuous flow of new liquid undoubtedly supplied from the root. But the nutrition of plants differs from the nutrition of animals in that the latter digest in the stomach food taken through the mouth and so break it down and loosen the union of its parts, so that almost of their own accord, they divide from each other in turn, so that at least without difficulty pure can be separated from impure, clear from sedimentary, that suitable for nourishment from excrement, and so the former enters either the pores or the orifices of the vessels in the middle of the intestines (which correspond to the roots of plants), and the latter is expelled through the parts and passages destined for this duty. But plants do not prepare nutritional sap; for there is no apparatus of parts in them to perform this function: no mouth, no stomach, no main passages; but instead they extract and assimilate by their roots the sap which they find in the earth.

It is doubtful whether plants exercise a kind of choice in taking in food and repudiate what is unsuitable, in order that they may imbibe what is fitting and suitable for nutrition; or whether rather they admit whatever offers itself indiscriminately. Some scholars assert that there is a choice in the attraction, although I am not convinced. For firstly I scarcely concede that it is at all possible that there occurs in nature what is properly called attraction.

Nevertheless it could happen that the pores of roots are shaped in such a way that they take in particles which are friendly and suitable for nourishing a plant, but exclude alien and unsuitable ones; just as the liver and the kidneys by transmitting bile and urine separate them from the blood kept within. However that this does not happen is proved by many experiments.

For ordinary water easily enters the hollows of the fibres and freely permeates them, as I have shown above. Then in spring the liquid which flows out when an incision is made, especially in frosty weather, can scarcely be distinguished from common water by taste. Therefore it seems to me more probable that all plants take into themselves whatever sap they find in the earth, and that this is digested and assimilated in the vessels when mixed with the peculiar saps of each, whilst what is superfluous and useless for nutrition is rejected and evaporated. This happens in the same way as the third digestion (as it is called), which takes place in animals, which assimilates some part from the extracted juice received into the blood, and the rest which is superfluous to nutrition they evacuate through an imperceptible transpiration, which clearly is by far the greatest part of it. For an animal expels more excrement in this way than in all other ways taken together, as Santorio demonstrates.

It is agreed that plants can be nourished and increased by water alone, both from my own experience and that of others. Dr. Sharrock presents us with a catalogue of those herbs, which have germinated when their shoots have been immersed in glass bottles filled by him with water, a catalogue which it will not annoy him to have transcribed here. ***Balsamita fœmina***, each type of ***Mentha, Pulegium, Sedum multifidum, Prunella, Nasturtium aquaticum, Bugula, Trifolium purpureum, Clematis daphnoides, Herba Doria, Ranunculus, Becabunga, Althœa, Lauro-cerasus, Scordium, Tripolium, Polygonum, Nummularia, Panax coloni, Matricaria***, and some others which he does not mention. There is no doubt but that many others too, of which he has no experience, would equally sprout and produce roots. For water is not a simple and pure element, but contains within itself many heterogeneous particles, especially salts.

But how air enters the roots of plants of this kind is not so clear, for since it does not permeate the pores of the glass, it must enter through the mouth of the jar and insinuate itself through the pores of the water. But the pores of water are very tight and do not admit air except in a very small quantity and divided into the smallest particles. And yet (which is wonderful) these particles, which air communicates to the water, suffice not only for the growth of plants but also for the respiration of fishes. For as long as air flows over the surface of the water, so long do fishes incarcerated in a glass vessel do well; but the moment the external air is excluded they labour for lack of it and swim hurriedly to the surface of the water that they may enjoy it more liberally. If therefore air precipitates nitrous particles into the water (as some wish) or some more subtle substance, it is certain that particles of this continuously withdraw from the air without any interruption in their flow and are spread through the water. For if air is cut off for even a very little time (as I have said), the fishes shut in notice its absence and begin to feel ill, something which they also suffer in stagnant pools and in the largest fish ponds, when the surface of the water is frozen over because of winter. But if soda, whose particles allow fish to breathe, has been dissolved and precipitated by the water, and so the water imbibes nitrous particles continuously from the air, then how does it come about that all water has not been by now impregated by more soda than it can sustain, with the result that its salinity would be perceptible to taste? At least in the case of immense stagnant pools and fish ponds: for flowing waters and ones which have percolated through a lot of earth can easily deposit these particles again upon it.

How the nutritious sap reaches the very tops of even the tallest trees through the pores of the fibres, I must confess is not completely clear to me. Experience tells that water climbs in thin tubes open at both ends, even when some are perpendicularly erected, and the higher they are, the narrower are the tubes. What indeed may be the final point of this ascent escapes me, whether certain or uncertain, and so much higher in accordance with the narrowness of the tubes, that in the most narrow it reaches the very tops of even

tall trees. However, the contrary is seen when it ascends with some difficulty to three or four inches, according to the note of the most noble Boyle. By what impulse this occurs is difficult to investigate. Experiments confirm that water indeed can either insinuate itself of its own accord or be compelled by force into narrower passages than air, and thus enter the narrownesses of tubes which are impervious to air, because obviously water is composed of smaller particles than air. Therefore, although the hollows of fibres exclude air because of their narrowness, they do admit water, and moreover the weight of the external air has its own effect, but in what way does it compel the liquid upwards into the fibres evidently to that height until it reaches an equilibrium with the external air, that is, to thirty-two feet more or less? Although this may seem probable to someone merely thinking about it, if you consult your own experience however, you will find that the fact is otherwise far from this. Since indeed the most noble Boyle learned from experiments and taught us that water in tubes or filters of that kind is suspended no less inside a receptacle or large vessel exhausted of air than outside in the free and open air.

But (to concede this point) the tallest trees exceed this measurement by two or three times. Therefore another reason for this ascent is still to be sought, at least one that helps. It is consistent with experience that water dissolved into vapour and divided into its smallest parts loses its weight and ascends through the middle of the air, whatever the reason for its weight may be. Thus it seems that weight can achieve its effect, that it can require that a heavy body has some mass and magnitude; for otherwise (as we have seen) if it is divided into the smallest parts, it can happen that it may either be sustained by the fluid in which its particles swim, as even the heaviest metals in solvents, which dissolve them as small as possible, or even be compelled upwards, as water dissolved into vapour in the air. Perhaps therefore the division of the sap into the thinnest filaments in the very narrow channels of the fibres can help in promoting its ascent upwards.

Dr. Grew attributes the rise of sap in the vessels of plants partly to the narrowness of the vessels, partly to the pressure of the parenchyma

surrounding the vessels, which is composed of innumerable vesicles. For these vesicles dilate themselves by a certain natural propensity at the entrance of any liquid as is apparent in sponges, the texture of which is not so dissimilar from the parenchyma of plants. Therefore the parenchyma filled and swelling with sap pushes outwards in a continuous attempt at dilating and extending itself, whence it is necessary that it compresses and squeezes the vessels together, and thus compels the sap upwards. But since compression has an effect both downwards and upwards, I do not see why it does not impede the ascent of the sap in the first place unless valves prevent it, valves which neither I nor Dr. Grew allow because of the reasons mentioned above. Added to which, why this propensity for dilating itself arises in the parenchyma of plants is lacking in further explanation.

I indeed concede that sap enters and climbs up the fibres of plants in almost the same way as water is accustomed to do in the pores of bread or sponge, and in the folds of a linen or woollen cloth or other filter. The structure and conformation of fibres also helps the ascent of liquid (as Dr. Malpighi observes). For the tubular bodies of a fibre are composed of a very large number of concave little bodies, square or sometimes round, or of some other shape, opening one by one. Thus the liquid entering (the words are those of Dr. Malpighi) ascends upwards and is, as it were, suspended. For the single portion, which unites the little bits of the fibres, although it protrudes very little inside, takes the place of a valve, and thus takes the very smallest drops as though by a rope or by steps to a great height. But what may be the instigating or impulsive cause of this ascent, which takes and compels the sap upwards, so far escapes me; for I am not satisfied with any of the reasons which have been offered.

Chapter Eighteen:

On the sowing and propagation of plants.

There are various ways of sowing and propagating plants. The ancients used seed, branch, graft, cutting, mallet-shoot, bud, sucker and layer.

It is easier to know what a seed is than to define it; likewise with a branch and a graft.

A cutting to some is a graft cut on both sides. Varro, *De Re Rustica,* Book I, Chapter 11. Especially in trees bearing olives it may be seen that it should be taken from a young branch, cut off equally; these some call grafts and some call cuttings, and they should be about a foot in length.

Pliny distinguishes a cutting from a branch and even from a graft. He makes a branch bigger than a cutting, and a cutting bigger than a graft. His words are [Book I, Chapter 17],

> Many are grown thus (that is by using branches), especially the ***Ficus***, which indeed can be grown in all the other ways, except from a cutting. Best indeed if, after a fairly large branch is pointed at the end like a stake, it is driven deep into the ground with a little of the top left above the ground, and covering even this with sand. ***Punica*** too are also grown from a branch, an opening first having been made with a spade; likewise the ***Myrtus***; in all of these instances [a branch is used which is] three feet long, less than the thickness of an arm, with the cortex carefully preserved, and the trunk sharpened. The ***Myrtus*** is also grown from cuttings; the ***Morus*** only from a cutting, since religious practices connected with lightning prohibit it from being grown from branches. For this reason something must now be said about the growing of cuttings. In this before everything care must be taken that the cuttings are from fruitful trees, neither curved not diseased or forked, nor thinner than fills the hand, nor less than a foot in length, so that with undamaged cortex and ensuring that the cut part, which was from

the root end, is always placed downwards, and, while germinating, earth is heaped over it until the plant gains strength.

Palladius distinguishes the graft from the cutting, which Varro (as we have seen) confuses with it. He says,

> In the month of March the ***Citrus*** tree is planted in four ways - by seed, by a branch, by a cutting, and by a graft.

And a little bit later:

> It is more convenient to plant the graft, which is to be of a thickness which can be held in the hand, a cubit in length, smoothed on both sides, knots and thorns cut off, but the top left with its buds through which the hope of future progeny may swell, etc..
>
> A cutting can be both thinner and shorter, and if so it becomes like a graft. But a cutting should be two palms length above the ground, whereas a graft is all buried.

A mallet shoot is thus defined by Columella in *De Re Rustica,* Book III, Chapter 5:

> A mallet shoot is a young vine sprig, grown on a young branch of the previous year, and so-called from its similarity to the fact that in the part where it is cut off from the old branch it juts out and produces the shape of a hammer on both sides.

Also Pliny, Book XVII, Chapter 21:

> It was usually sown as a shoot cut off on both sides from the hard wood; by which argument it is called a mallet shoot even now.

Also Columella, Chapter 17:

> But they were grafted by means of mallet shoots by these same [ancient farmers] in such a way that some part of the old branch clung to the new one: but practice condemned this habit. For whatever part of the old material was left was quickly overtaken and destroyed by damp and rotted away and it used to kill by its diseased nature the nearest young roots, which were scarcely breaking through. When this happened the upper part of the seed

withered away. Therefore later [farmers] cut off whatever was left of the old vine sprig at the very join itself, where the new material grows, and so planted the twig with its own little head.

For making a mallet shoot they cut off the top part of the young vine shoot and only approved the part which is joined with the old shoot. What length it ought to be is not very certain (he says) since if it has many buds it must be made shorter, if few longer. Nevertheless it ought not to be longer than a foot, not shorter than three-quarters of a foot.

The upper part of a graft or young vine shoot was called an arrow by country people according to the same author, either because it left its mother far behind and, as it were, has darted and jumped away; or because with its attenuated top it has the appearance of the aforesaid weapon. The wisest farmers said that this ought not to be planted and they had good reason. For every fertile vine twig within the fifth or sixth bud has an abundance of fruit and in the remaining part, however long, it either ceases or produces very tiny racemes. For this reason the sterility of the top was rightly condemned by the ancients.

A sucker (*stolo*) is called after a man called Stolo, who acquired his cognomen on account of his careful cultivation of suckers; that is because no sucker could be found on his estate, because he used to dig out around the trees what were called *stolones* ['suckers'], which grew in the soil from the roots. Therefore a sucker according to J. Bodæus à Stapel is something which grows around stems and is torn up with a root and part of the body and is sown thus. In this it differs from a layer, in that it is extracted whole at a distance from the trees. Pliny, Book XVII, Chapter 10. Nature has also shown us another similar kind, when suckers have lived when torn from the trees. In this method they are torn away with the haunch as well and also take away with them some part from the body of the mother with its fibrous substance. If it is taken in this sense I do not see how tearing away differs from a sucker. However any kind of offspring from the root, already weaned from the mother, and relying on its own roots, seems to be called a layer by my countrymen: also any other offshoot which has

already put out roots.

Before I set out how many ways plants are propagated artificially, it seems that we must enquire how many and in what ways they propagate themselves by the will of nature. These then are either:-

1. By seed.

2. By putting out young shoots or cords, producing roots at the nodes and growing upwards: these young shoots seem to be born for propagating a plant. For those offshoots which put out roots at the nodes, when they are growing strongly, are spontaneously separated from their mothers as the cords dry out and become new plants: as is seen in ***Fragaria, Pentaphyllum*** etc..

3. By runners from the root and these either growing from a root moving or creeping sideways like a kind of sucker or twig: or with the appearance of buds or little bulbs: and likewise either rising from the base of the root or from fibres swelling into little bulbs. Those plants which are spontaneously propagated from tubers are to be referred to as another type, that is, as those which swell up into little tubers from transverse roots.

4. From the stems themselves, bending down to the ground and putting out roots at the nodes, which is what happens in the case of most plants.

There are also other peculiar ways in which several plants propagate themselves, as for example ***Ficus Indica***, which sends down gum from its branches into the earth like a rope. Some kinds of ***Allium*** propagate themselves by bulblets or spikes growing together on top of the stem: ***Chelidonium minus*** on tubers arising on the wings of the lowest leaves: ***Moly Homericum*** so-called from a bulb growing on top of a leaf: ***Opuntia*** from leaves fixed in the ground. But since they are of very few kinds, there is no reason why we should take account of them.

It now remains to set out how many ways there are by which plants can be, or are accustomed to be, propagated artificially. However these

can be reduced to two, that is, sowing and insertion. As far as the first goes, plants are sown either:-

1. By a seed.

Or

2. By a branch [under branch I also include cutting, scion, mallet shoot and graft]. This may be either cut off or torn from the stem before it has put out roots and is planted in the earth; or it is submerged in the earth and not separated from its mother until it has put out roots.

Or

3. By a runner, either from a young shoot, as in ***Fragaria***, or from a root creeping under the ground, rising like a shoot, which is either called a sucker or a layer, or coming out from the bottom of the root like a bud, as in bulbous plants. For a bulb (as I have said) seems to be nothing more than a rather large subterranean bud. However in bulbous plants the runner does not always come out of the bottom of the parent bulb but sometimes from a thicker fibre swelling into a bulb, or finally from tubers of the roots in those plants which have tuber-like roots. A plant can also be propagated by dividing its root, that is, into as many parts as you please, into as many buds as come out of its top, the bud being cut off with some part of the root adhering to it.

But plants are inserted in many ways, concerning which I will later treat briefly, when I have put in order the various methods of sowing. First, therefore, plants which are sown from seed.

However, before seeds are consigned to the earth the soil ought to be prepared in the proper manner, that is of course that it be turned frequently with a plough, dug with a hoe, split with a fork, broken down with a double mattock and divided into the smallest parts with a harrow and a rake. Moreover it is a good idea to do this, partly so that the soil may be freed of useless weeds - pulled up, dug in or thrown out: partly so that the soil may be made looser and lighter, softer and thinner, both so that the roots of plants that are sown will be able to penetrate it more easily, and thus scattering their fibres everywhere

will spread themselves more widely and attract nourishment in more abundance, so that the plants may be happier and more vigorous: and also in order that the particles of nitrous air, by which growth is chiefly promoted, more freely and copiously insinuating themselves into the interstices of the earth may be hastened there and stick to the earth. Indeed rain water perhaps helps the dissolving of salts, which it carries along with itself into the pores of the roots. Besides in soil loosened and broken up water subsides more swiftly and thus does not suffocate the roots with too much dampness nor rot them with cold. Moreover earth that is loosened and broken up helps more abundant air enter the *tracheæ* of the roots so that they can breathe, which I have shown above is no less necessary for plants than animals.

Nature indicates the most suitable time for sowing, that is when the seeds after reaching their full maturity either fall to the ground when their receptacles are gaping, or are shaken out as the valves contract themselves, or carried on floating down they are borne hither and thither at the will of the winds and are spread widely.

Some of these produce plants in autumn growing through the whole winter; others remain in the ground through the winter and do not break out of their wrappings until the following spring. Of those which come up in autumn some, as for example those of ***Angelica***, from my observation and that of others, when collected and kept in storage, generally frustrate the planter in the spring, but after falling off of their own accord and being taken to the bosom of the earth or even consigned to it soon by the planter, without doubt will germinate unless the weather is very dry and hot, in which case, after lying in the earth throughout the winter, they will still emerge into the light in the following spring; although if they had been put aside by the collector and sown in spring they would never have germinated. Other seeds, although also sown in the spring, fortunately come through, but more reliably and more sturdily from an autumn sowing, when the plants which germinate at that time would also be more resilient to injuries inflicted by weather, and in the following summer would have a more abundant yield than spring sown ones, and other

things being equal they make the farmer or gardener rich by producing a more swollen grain and more substantial produce. For, according to the observation of the most prudent farmer, our friend very much to be honoured, the longer any plant sown from seed has lasted before it runs to seed, that is, the longer it has been from sowing, the more abundantly, fully and heavily it produces seed, other things being equal. Thus ***Triticum*** and ***Avena*** sown in the winter are stronger and more substantial than those that are sown in the spring.

The remaining seeds, which remain in the earth throughout the winter, without doubt either softened by the moisture of the earth or impregnated with the salty particles which they imbibe, are prepared for germination; and meanwhile they hide more securely and more constantly endure all the changes of the weather than those which are hidden in storehouses, however carefully kept.

Yet if we wish to have exotic plants and natives of warmer regions, we should sow their seeds in spring, since of course these do not tolerate our winters but are easily destroyed by the cold.

Indeed if we want early fruits from tender plants, or if we wish to bring rarer and more delicate plants completely to maturity, then we must commit the seeds to a warm bed made of fresh horse manure mixed with straw then with rich sieved earth, strewn in to a depth of three or four fingers, and covered with a lid drawn over it made of straw mats.

But whatever time you sow seeds, fresh ones must be chosen from the summer just past, if they can be obtained. For although some plants keep their fertility to the tenth year and beyond, yet others lose it more swiftly and in all cases the older they are the more difficult and more sparing is their germination.

Those which sink in water are stronger and more reliable for sowing; those which float are weaker and more unfitted for propagation.

In pulses and plants with ears the middle seeds are approved of more by us than the lowest or highest, although Ferrari recommends the lowest in the case of ***Caryophyllus***.

If you want multiple or variegated flowers, it is a good idea to collect seeds from the pods or containers which follow flowers of this kind. For if those varieties are either symptoms of diseases or errors of nature or one of nature's little jokes, obviously nature will be more prone to make the same mistake again or play the same joke in these instances; just as in animals we see parents with some disease or fault of their body, for example lacking a limb or having an extra one, when they are in labour, frequently produce an offspring afflicted with the same faults and liable to diseases. This must be looked out for, especially in ***Mirabilis Peruviana***, if you wish to obtain a plant displaying striped flowers.

All seeds are to be sown in dry weather on the third or fourth day after a considerable amount of rain. Ferrari says,

> However, you should not sow as soon as the earth has become sodden with a lot of rain but you should wait for a while until that dampness produced by the rain has dried up somewhat, because roots rot, which are planted in sodden or marshy soil.

But in the case of seeds which easily dissolve into a musty liquid because of too much damp, as for example ***Myrrhis, Ocymum*** and ***Scorzonera,*** particular care must be taken that they are not sown in sodden soil or watered when recently sown.

Care must also be taken that no kind of recently sown seeds are watered in cold weather nor with cold water from a spring or well, unless it has first been properly exposed to the sun.

Some people dip seeds either into either pure water, nitrated water, wine or some other liquid before they commit them to the earth in order to promote germination. However I do not think that this is necessary in the case of fresh seeds or ones that are native, perhaps even harmful in some. But in the case of old and drier seeds, or exotic ones, I do not disapprove of the practice of Hen. Corvinus, the Roman, of whom mention is made by Ferrari in these words:

Before he commits seeds of a stubborn and tenacious hardness to

the soil, he pours water into a bowl, then pours a little bit of nitrate on top and allows it to dissolve; he puts the seeds into the nitrated water; he allows them to soak and react for two hours more or less according to their different hardness and then sows them. He sprinkles the same water on them so that the nitrate solidified by the fiery breath of the earth may provoke the seed's stubbornness into a fertile germination.

A general rule in all sowing is that the seeds must be covered by the earth, not because ones which are exposed and uncovered germinate less, since ones that fall of their own accord sprout no less happily, but so that they do not become the prey of seed-picking birds. Moreover they are sown and covered over in various ways, that is, either in a furrow with earth turned in over them by the plough, or on the surface of the earth and then buried by a hoe or harrow, or in a levelled area, scattered with dust, or as it were with meal of the earth, by hand or sieve, or finally separately buried one by one in little holes made with a dibber.

But most of all care must be taken that the seeds are not planted too deeply or covered with too much earth so that they are buried without hope of resurrection. For I see many people making mistakes in this respect. For although ***Triticum*** and other cereals, whose more healthy spirits are also aroused with a soft colour, and whose stronger seeds penetrate the heavy mass of the earth lying upon them without difficulty, and so that they may more easily tolerate the winter they are accustomed to be buried more deeply, so that of course their roots may not be burned up by too much frost, nevertheless this is not the way of all seeds but indeed of very few. For most seeds are slower to grow and must be fostered by the kindly warmth of the sun's rays and coaxed into productivity and so should be laid out on top of the earth with a little dust scattered upon them.

The earlier seeds are sown in the spring, the more carefully plants grown from them must be protected from the cold: the later, the more they must be watered and shaded.

It is a difficult question whether some plants arise from the earth of their own accord with no seed preceeding them.

Those who believe this are not lacking in reasons and experiments to support their opinions. For since every region has its own peculiar plants, it seems likely that the earth itself, although not impregnated with seed, produces plants familiar in these regions.

Next I wondered at the immense abundance of ***Sinapi*** growing on the banks and ditches dug for drawing off the water so as to dry the marshes in the Isle of Ely and also elsewhere in grassy areas which have been dug out. It is not likely that ***Sinapi*** owes its existence to seeds lying in the earth, since no ***Sinapi*** had ever grown there in living memory. Also in the ruins of the city of London after that most dreadful conflagration, which occurred in the year 1666, we have authors of trust, who say that no less an abundance of ***Erysimum angustifolium Neapolitanum*** grew there, and occasionally I too saw it myself, although those places had been occupied by buildings for many centuries and no crop of ***Erysimum*** had ever been heard of there. Therefore it must either have arisen of its own accord or from seeds hiding in the ground for many years; unless perhaps we would like to suspect some idle good for nothing of deliberately scattering seeds of that plant in order to make mockery of the curious and arouse their admiration. But there is no reason why anyone should wonder where such an amount of seed, as would suffice for sowing two hundred acres of land, could have been collected. For I observed that plant coming up in great quantities on the roads between the city and the village of Kensington and elsewhere around the city; for it produces the most minute and numerous seeds.

Thirdly, it is clear that imperfect plants, ***Fungi, Tubers, Mosses*** and that kind, do not grow from a seed, since (as far as has been observed up to now) they do not have any. Indeed I too think that all submarine plants, ***Algæ, Fuci, Corallia, Alcyonia*** etc. grow of their own accord for the same reason, that is, because no seed has as yet been noticed on them, and this, however, we cannot wonder at enough in such a multitude of types and

with the most abundant yield of all. Perhaps others coming after us, who are more careful or luckier, will detect the seeds even of these or will discover their method of propagation.

It is commonly accepted and (as they say) confirmed by daily experience that if water, in which fungi have been dipped at some time and rotted away or even have been washed, is sprinkled over old warm dust, such as I have just described, or even if the smallest particles of the fungi after they have been broken up into litle pieces are scattered upon it, a vast quantity of fungi will grow up there. I firmly believe that every single prolific and fertile little piece or morsel of that imperfect plant is endowed with the power of a seed, as for example is seen on the branches of ***Malus Cydonia,*** where nature avoiding visibility has hidden some seed, certainly not yet detected, in some part of it.

Fourthly and lastly, the ***Viscum*** supplies us with a strong argument that even more perfect plants sometimes grow of their own accord or germinate from the sap of others; it grows on trees even on the underside of branches. Whence the story, which the ancients produced about its origin, is agreed to be entirely fabulous, and which is held to owe its origin to that proverb:

The thrush itself defiles the evil itself.

How much more rightly Maro sang:

The mistletoe grows with a new shoot, which its tree did not seed.

On the other hand we cannot wonder enough that nature, who does nothing in vain, gave any plant a seed without purpose and despite its appearance useless for generation.

To all of these reasons and experiments I offer in opposition the contrary experiment of that most famous of men Marcello Malpighi. For, in order to discover whether the earth made fertile by no seed could produce any plants of its own accord, he enclosed earth dug up from the depths in a glass vessel. He sealed the mouth with many layers of silk on top so that air and water poured upon it might be admitted but so that the smallest seeds, which are

borne upon the wind, should be excluded. But in this, he says, no plant whatsoever grew.

I indeed would freely embrace the opinion of those who think that no spontaneous generation occurs in plants, if experiments would permit it. But those which we have conducted persuade us of the contrary, and I can see no satisfactory way in which a response may be made to them. For it would be too rash to assert that even plants commonly believed to be imperfect produce a seed, when we can show none in them.

Nevertheless it is to be noted that it could be the case that plants grown from pieces of roots or branches may trick us into thinking that they are born spontaneously. But I myself have experienced pieces of roots germinating in ***Raphanus rusticanus*** and ***Scorzonera***. J. Bodæus à Stapel has experienced the tiniest pieces of branches germinating in the case of ***Salix*** and ***Rosa centifolia***, as may be seen in his work *A Commentary on Theophrastus' Historia Plantarum*, Book II, Chapter 1, Page 73. See also Dr. Sharrock on ***Malus Cydonia*** in his book on *The Propagation of Plants*, Chapter 3, Note 5.

Besides it helps to sow rarer seeds in earthenware pots, so that the plants when they grow can be more conveniently transferred from there and can be taken into a hot-house for the winter if there is need. However the bases of the earthenware pots must be pierced with holes, as Pliny once warned us, lest the liquid stagnating in the base should putrefy by its long delay and should rot the roots of the plants either by its moisture or its coldness; perhaps also lest they be suffocated by their inabilty to breathe. Pliny himself hints at this reason elegantly in his own way, saying:

> Through the holes a means of breathing is given to the roots down below.

Secondly, plants are grown from a branch or graft, either torn off or cut off and planted in the earth, or while pressed down and buried in it is still attached to the mother at least until it puts out roots.

These grafts can be longer or shorter according to the nature of

the plant to be propagated. For some are grown from a larger branch, others from a cutting, others from a mallet shoot, others from an arrow, terms which I have expounded above.

Cuttings or grafts ought to be planted when fresh. However branches of ***Olea*** germinate even when dry. The ancients are witness to this, as for example in Vergil:

A root of Olive is produced from the dry wood.

Despite the opinions of some more recent authors, nevertheless the authority of Fortunius Licetus moves me to agree with the ancients and to think that these more recent authors, whilst they rashly laugh, have made themselves the subject of laughter. Moreover Licetus writes that he saw in the garden of his uncle Rechus a stem of cultivated ***Olea*** almost dry and lightweight, which had been separated from its trunk for ten years and more, since when it had never been planted in the earth, but had been put into the earth as a support for another piece of wood and fastened with iron nails to the wood, which it served as a post, putting out and sprouting in that same year many new Olive shoots laden with leaves and fruits and indeed furnishing them for many years to come. Hence that dry twig, which the monk assiduously watered after being ordered to do so by his superior in order to prove his obedience, if perhaps it was an Olive branch, could without a miracle put out roots and germinate.

The more tender plants are, the later their cuttings should be planted; that is, when spring has fully come in these colder regions. Also, if the weather permits, it is a good idea to water things when sown; 'if the weather permits', I say, for if the air is rather cold, too much fresh water easily rots those which have been planted. Indeed, even in serene weather, the rays of the sun are to be carefully kept away with a little shading erected lest the planted cuttings quickly burn and dry out.

It must also be observed in the case of plants whose stems have nodes at intervals, that the cutting to be planted is cut off either at a node itself or immediately below a node. For since roots only sprout from nodes, if any internodal material is left it must necessarily rot and wither, and so as the

blemish spreads there is a danger that it might infect the next node with its poison and destroy the cutting.

P. Lauremberg teaches the way of propagating trees from cuttings or little branches with these words:

> Use a little branch which is elegant, not twisted or eaten away, vigorous and a year old, (a small portion of the two year old branch may be left attached to it). Therefore plant a branch of this kind cut off from the tree and clipped at each end into a depth of half an ell of fertile earth in the form of a bow, with either cow's or sheep's dung spread underneath. Fill the hole with earth and tread it down.
>
> For planting little slips or cuttings of fruit trees or herbs, first crush each end with a hammer to form filaments. Then irrigate them with water, not manure which they cannot tolerate; afterwards cover them up with earth.

He continues:

> There is almost no stock which cannot be propagated by means of a one year old little branch, provided that:-
>
> 1. The lower end where it has been cut off is smeared with the following plaster or similar:
>
> Take [ρχ] of wax
>
> $2\ {}_3$i ana of turpentine
>
> $2/{}_3$ii of common resin
>
> all mixed together. Thus natural sap will not sweat out, nor will useless liquid enter into it, which usually produces rotting by some means.
>
> 2. You do not plant the little branch directly into the earth but in a curved arch, in such a way that the upper part juts out from the earth, the middle touches the lowest point and the lower part, which I have said is to be smeared, bends upwards a little bit in such a way

however that it is hidden. From the middle of the back of the little branch you will see innumerable roots sprouting.

À Stapel proposes yet another method. A branch is torn off the tree from the top downwards so that a sort of foot sticks to it. This little foot or apendix is perforated everywhere with an awl; it is dug in to a depth of half an ell into fertile earth and watered fairly often.

Even nature herself has taught us that form of propagation which consists of burying little branches, the little branches of some plants putting out roots spontaneously as soon as they have bent back to touch the earth. But buried little branches must not be weaned or separated from the mother before they have put down deeply many roots and have firmly gripped the earth. But where they attach to the mother they must be cut transversely from the edge to almost the middle so that, while the sap is provided sparingly by the mother, they may become accustomed to drawing it from the earth and thus more easily and safely, when circumstances demand it, be weaned.

In ***Caryophylli*** (Dr. Sharrock advises us) the layer should be buried with the shaft below the lowest or nearest head of the root, or at least with the second joint cut transversely from its lowest part almost to the middle, then from the incision so made split upwards to the second space between nodes (or from the base which is nearest to the incision) with a bit of leaf put into the fissure to keep it open, although this is not altogether necessary. For although the incision may be (as I have said) at the lowest end facing towards the earth, the layer however should be bent or depressed gently from the first head of the root, as is customary, then the top part of it held up with the middle bent into an arc with the earth underneath; thus the split will open and gape of its own accord if everything has been properly done. Some hold the layer down with a little wooden hook driven into the earth so that it does not spring back but may continue in that position in which it was first placed. Lastly cover the arc or the bent part of the layer with rich earth and water it frequently.

It will be most useful, not to say necessary, to cut the scions or whips of other plants too, which are to be buried in the same way, with the

exception of those which take no matter how they are planted like ***Vitis*** etc.. Also layers buried in dry weather must be watered assiduously, for otherwise they do not easily put down roots.

But the most suitable times for carrying out this operation with success are the beginning of spring or summer turning to autumn when the heat is past.

Air-layering does not differ from burying except that in the latter a little branch is pressed down to the ground and that in the former earth taken in a suitable vessel made of wicker or wood is lifted up to the little branch and is placed around it, that is, the little branch being passed through the receiving vessel or that containing the earth by holes made for this purpose. Moreover its natural position is such that the little branch cannot be pressed down because of its height and distance from the earth. Some, moreover, are in the habit of peeling the little branch somewhat at that point where the earth is placed around it or of piercing its bark above with an awl.

The Italians use little square wooden boxes, which are made in such a way that they not only have a hole in the base but are put together from two halves, which can be separated or joined again at will; and thus they can more easily be placed around the branches and after these have been pressed down into the earth can again be removed. P. Lauremberg.

This is what these words of Pliny show in Book XVII, Chapter 13:

> The other method is more elaborate; it is brought about by encouraging roots to grow on the tree itself by passing branches through earthenware pots or baskets and packing them round with earth and so persuading roots to grow right among the fruit and at the ends of the branches by the daring device of creating another tree a long way from the ground.

Thirdly, plants are propagated from offspring and that either:-

1. From whips or little stems, twining like ropes and putting out roots underneath as in ***Fragaria, Pentaphyllum, Ranunculus*** etc..
2. From transverse roots, shaped like whips, creeping under the

earth and meanwhile germinating and putting out suckers, as in ***Ulmus, Prunus sylvestris, Cerasus*** etc.. And this type of offspring are properly called layers. For ones which arise from the larger trunks of roots near the body of the parent plant itself or from the bottom of its stem are called suckers on the authority of J.Bodæus à Stapel.

3. In herbs which have tuberous roots, developing from the tubers of the roots themselves as in ***Chelidonium minus, Flos solis pyramidalis*** and ***Crocus.***

4. In bulbous plants from the bottom of the bulb itself or from some thicker fibre near the bulb, germinating like little bulbs or nuclei, as in ***Tulipa, Narcissus, Allium*** etc..

I have no precepts to make about these, except that they should be transferred at a suitable time, and from somewhat sterile soil to a more fertile and richer one; nor should they be weaned from their parent plants before they have gained some firmness and strength.

Chapter Nineteen:

On grafting.

Grafting, if the word is taken in its broadest sense, is the application of some kind of shoot or bud to a trunk or branch, either one of its own kind or of a different kind, so that they may in the end unite and coalesce.

But since the most potent part of the nourishing sap ascends between the inner bark and the wood, the whole art of grafting consists of making inner bark contiguous to inner bark and wood to wood in trunk and shoot and arranged at the same level. Or in having the shoot or the bud applied to the stem or branch in such a way that the gap between the inner bark and the cortex is almost contiguous in both [in trunk and graft], and as it were makes a single surface as a result of which the passing of sap from trunk to graft [to shoot or to bud] may be easy and unimpeded.

A graft is either of a shoot or of a bud. But a bud does not otherwise differ from a shoot except as an infant from an adult. For a bud is nothing other than, as it were, the embryo of a shoot, indeed perfectly formed and with all its parts distinct but wrapped in coverings or, as it were, afterbirths, and lying hidden throughout the winter to be brought out into the light the following spring and gradually extended into a shoot.

A shoot is grafted either by external application, or fitting together, or by what is strictly called grafting.

External application or fitting together is either:-

1. When a shoot of equal thickness is applied to a minor branch obliquely cut across, itself being cut obliquely at the same angle in such a way that the gap between the inner bark and the cortex in both (as I have said) is almost continuous, then it is tied firmly by a fastening or bandage wound about it so that it is held in place. The oblique cut ought to be at least an inch or longer. This method of grafting is called by our countrymen 'Whip Grafting' and is less frequently used because of the difficulty of making the shoot equal to the twig, or section to section, so that they meet exactly.

2. Or secondly, fitting together is when a shoot is cut obliquely as before, but in such a way that in the upper part of the oblique section, after a knife has been drawn perpendicularly across it, the cortex is taken away with a very little piece of wood, after the trunk has first been cut transversely or horizontally, then on one side [the south-west] when the cortex has been denuded by an oblique section as far as the east side so that it exactly corresponds to the plane of the section on the shoot, is so applied that its angle or projection rests upon the plane of the horizontal section of trunk; and then it should be tied on with a fastening and smeared with mud. This method of grafting is called 'Shoulder Grafting' by our countrymen.

What is properly called grafting is again double, either:-

1. Between the cortex and the wood. The ancients, indeed, were afraid, as Pliny says, to split the trunk and so they grafted between the cortex and the wood. This method is brought back into use by some nowadays and in trees, of which the cortex can be separated from the wood because of the rising of the sap, before the shoots are unsuitable for grafting because the buds have unfolded too much, it is held to be the best of all. (But ***Mali*** alone are of this kind among fruit trees.)

Therefore in a trunk and shoot prepared as in the second method of joining together do not take the cortex away but only split it or cut your second length from the top downwards almost to the length of the oblique section of the shoot on the south-west side of the trunk. Then when you have gently separated and lifted the cortex from the wood, first by inserting a knife, then an instrument of ivory, bone or some hard wood made for this purpose in the shape of the oblique section of the shoot but smaller, push the shoot between cortex and wood, after first removing the cortex from the extreme point of the shoot in case it is folded back at the moment of insertion. Then since the inserted shoot, by lifting the cortex from the trunk and leaving a gap at each edge of its point, interrupts the flow of sap, the cortex of the trunk must be cut up to both sides of the shoot in case it comes away from the trunk and so that its edges might coincide with and fit together with the margins of the cortex of the

shoot in order to provide a passage for the sap from the trunk into the shoot. When all this has been done it must be tied up with a fastening and protected with mud, as in the preceeding operations.

2. Into a fissure of the wood itself, which I explain in the words of Pliny. He says that the surface should be levelled off with a saw and the trunk smoothed with a pruning knife; the job is done when it has been gently split through the middle keeping the fissure open with a thin wedge until the graft, the end of which has been pared into a point, goes right down into the crack. The point of the graft to be inserted is usually cut in such a way that it makes angles with its base sticking out on both sides so that the base may more firmly join the side of the trunk. However some disapprove of this practice because as a result the point is weaker.

But since this method of grafting is by far the most commonly used of all and moreover Pliny's description may perhaps seem too concise and obscure to the reader, I will give one that is fuller and more explicit borrowed from Peter Lauremberg's *Horticulture*, Book I, Chapter 24. He says:

> Choose in spring-time a little bush with a thickness of around three thumbs. Take the upper part of it away with a saw, leaving a height of one ell, and take care that you do not wound the inner bark, that is the cortex. If any roughness is left by the saw cut it away with a knife and give it a smooth shape. Split the stem thus shaped through the marrow with a light blow of the knife, taking great care that the fissure does not lead to other fissures. You will keep this fissure open with a little ivory or box-wood wedge, so that it may more promptly receive there the approaching guest shoot; but do not neglect to bind the stem with string or osier at that place where you think the fissure ends. If it penetrates more deeply the stem will die and you will waste all your efforts. When you have made these preparations take the graft to be inserted, which cut at the top at a rather thicker part just below a node or swelling (which is present in all good grafts where the growth of one year begins) and shape it

with a knife into a triangular form like a wedge with the cortex not cut from one place and the pith kept whole as much as is possible.

Now insert this shoot with its wedge-shaped point into the split in the previously prepared stem with this proviso, that the cortex of the shoot should correspond to the cortex of the stem and that the whole shoot should be firmly gripped by the split, when the wedge has been taken away again. Then stop up and smear over the split above and at the sides with grafting plaster, and soon afterwards put potter's earth or mud around it and tie it strongly with a plain linen bandage or hempen tie.

I consider this grafting plaster not necessary and perhaps even harmful; but if anyone wants to try it let him prepare it thus:-

Take [ρχ] of common resin

$^{2}/_{3}$i of wax

$^{2}/_{3}$β of bird lime

3 (?) ij of old butter

all mixed to this formula.

1. Many things must be taken care of in grafting of this kind. First of all which tree and the shoot of which tree permits such a joining? Those most easily coalesce in which the nature of the cortex is the same and which equally in flowering have their germination at the same time and have similarity of saps. Pliny. Certainly the shoots must be cognate with, and of the same kind, as the trunks, otherwise they do not coalesce. Hence it does not seem surprising to us that a ***Pyrus*** grafted onto a ***Cydonia***, or a ***Mespilus*** onto an ***Oxyacantha***, or ***Armeniaca*** onto a ***Prunus*** takes and *vice versa.* For what is a ***Malus*** called ***Cydonia*** than a ***Pyrus*** with a stuffed fruit? Or what is a ***Malus Armeniaca*** than a type of ***Prunus***? Nor does the fruit of the ***Oxyacantha*** differ much from the little ***Pyrus*** either in shape or in quality. The ***Pyrus*** and ***Malus*** do not join because of their dissimilarity, just as neither do the ***Malus*** and ***Oxyacantha***, nor (according to Dr. Sharrock's observations) do the

Pyrus and ***Sorbus***. These, however, (as I know from the observation of the same scholar) and also others of a different kind, if grafted onto each other, sometimes take; but yet, after the union has been brought about (as it seems) and offshoots have grown longer, gradually the grafts, however much care you take, wither and finally die, either because of failing sap or sap that does not suit them.

2. Another observation is that the split should not be at a node. The inhospitable hardness in fact repudiates the newcomer, so that [the split] must be in a very smooth part not longer than three fingers, not oblique, not translucent, the crack must not gape too much and hold the graft too loosely, nor should it squeeze it so hard that it might kill it. Pliny. Hence if the trunk is a little thick, gardeners advise that the inner part of the point of the shoot, which otherwise is usually thinned to an edge, should be left a little thicker lest its outside should be so compressed that the cortex is loosened or folded up and thus the flow of sap would be impeded or interrupted. Others prefer that the split in trunks of this kind should be held open by the application of a thin wooden wedge.

3. It is certain (says Pliny) that grafts should be sought from the shoulders of trees facing the east in the summer and from trees which bear well and from a new shoot, unless they are to be grafted onto an old tree, for these should be stronger. Besides this they should be pregnant, that is, swelling with germination, and as such as would hope to be productive that year; finally that they should be chosen from the most beautiful and strongest branches; above all the budding [shoots] should shine and there should be no wound and drying up anywhere. Our gardeners lay it down that something of the old branch (at least an inch), that is, of the second year's wood, should remain attached to the graft in such a way that the point of the graft is a little below the joint or point of union of the old wood with the new. For thus it will be both better at resisting injuries of the weather and harder and stronger. They forbid too slender a graft and one taken from a new shoot only to be inserted, contrary to Pliny's precept, for contrary reasons. They also advise that the top of the graft should be cut

when it is inserted.

4. As far as the length of shoots and the number of buds goes, they lay down the following rules. If the cortex of the trunk shows itself by its green sheen to be swelling with sap so that it promises that it will supply much nourishment to the graft, more buds may be left on the graft: generally three or four are sufficient to supply a means of exit for the sap. Moreover grafts on which the buds are more frequent are preferred so that they are not too far apart either from each other or from the foot of their graft. If you want a spreading tree, insert a long graft, which extends above the top of the trunk for five or six fingers so that it will put out more frequent branches; if you want a tree rising straight up and tall, take a short graft, which does not stick out above the cut for more than four fingers with two buds left above the mud; or if you prefer allow only one bud to sprout. For the longer the graft the more slowly it draws up sap and thus is more prone to suffer from both the shaking of the winds and injuries inflicted by birds.

5. It is a good idea to keep grafts that have been cut off for two or three weeks before they are inserted; so that the trunks may swell more with sap, the grafts may be exhausted and so being thirsty they will drink the new sap more avidly. But they ought not to be buried in damp earth in case they are induced to germinate too soon, and thus when inserted and exposed to the cold air they are burned and dried up. It is enough to lay them under a tree or roof, or in some other cold place, or if there is any danger of frost, to cover them with dry earth or sand. If the grafts are to be carried any distance they are thought to keep their sap best if they are placed in straw, says Pliny. Some of our gardeners bid us plant a small quantity in damp mud and to cover the rest up with moss or straw; but it is enough to protect them by shutting them up in a vessel, especially in warmer weather, with damp moss or sieved earth placed around them.

6. It is best to insert them as near as possible to the ground, if the layout of nodes and trunk allows it. Pliny. Especially if you are inserting a graft from a naturally thicker and larger tree into the trunk of a more slender one as a ***Pyrus*** into a ***Cydonia*** or ***Oxyacantha.*** Likewise it is best to make the graft in the

part of the trunk facing the south-west wind or *Libonotus* (for here amongst us this blows the most strongly of all) in order that it may be rather forced against the trunk with its foot by the strength of the wind than pushed away from the trunk; for in the latter case there is a danger that it might be broken off or dislocated.

7. If you want a lot of fruit from the graft as soon as possible, decapitate an older trunk and insert your stalks into that.

8. It is a good idea to insert more than one graft into the same trunk so that you may get round the death rate by number. Pliny. Also, if by chance the one and only graft should fail, the trunk itself may be endangered. However the more cautious farmers say that you should not split the trunk across or in a cross form, since there may be too much injury then to the trunk and the wounds may heal with difficulty. It is best to make a graft on a lesser branch and one which only admits one insert.

9. If you want mild and generous sap, do not make a graft on a woodland trunk or on one that has grown of its own accord but rather on a domestic and cultivated one. For from this the fruit comes out milder and better prepared, although the tree itself is believed to be less durable and has a shorter lifespan. A graft, which has been cut off and again inserted in its own tree will give better fruit than one which is still adhering to the tree.

10. The best time for grafting is considered to be the beginning of spring, or the time just preceeding spring, before the buds begin to unfold; although grafting quite happily and generally succeeds throughout the whole winter. And Dr. Sharrock asserts that he has observed grafts inserted in a ***Malus*** in the month of November and around the time of the birth of Christ which have taken. On the authority of Pliny it is possible even to graft a ***Pyrus*** when flowering and to put off the grafting even to the month of May. But from more recent observation, a graft in which the buds have already unfolded coalesces with difficulty; it does not reject the union because the trunk has germinated.

11. For protecting the graft against injuries inflicted by weather and insects, Cato once ordered sand and cow dung to be mixed with potter's earth and chalk

until it became sticky and said that this should be applied and smeared around the graft. In Pliny's time they frequently thought to pack inner barks with mud mixed with chaff, the graft sticking out for two inches. Some gardeners nowadays smear cow's dung thoroughly mixed with clinging mud and made into a lump onto grafts. It does not much matter which method you use. P. Lauremberg recommends grafting plaster, about which I talked above.

New kinds of fruits are hoped for in vain from grafting. For there is a general and perpetual rule in horticulture that 'fruit always follows the nature of the graft'.

Nevertheless they say that certain overseas horticulturalists have so skilfully fitted together and joined to each other, and thence have discovered how to graft, disparate halves of grafts or buds different in species, split lengthways down the middle or down the pith in such a way that they coalesce and take and produce mixed fruits of both kinds.

Some do not split the trunk but carve out a channel or furrow in its side with a knife and carefully insert a graft shaped for that place and tie it with binding.

Other methods also have been given for applying a graft to the side of a tree trunk which has not been beheaded at all, methods which you can look up in Dr. Langford's book on the planting and cultivation of fruit trees.

But it is not an unworthy question which of these methods of grafting is the better. The long practice of all ages has approved that which is done in a fissure. But the author just praised prefers the third to all others and after that the second to the rest for these reasons:-

1. Because trunks capable of operations of this kind are ready to be split for taking a graft several years earlier.

2. Because they are damaged less by the former methods than by the latter kind. For a fissure easily admits damp, which rots trees, as a result of which the trunks become less suitable for repeated grafting, if perhaps the grafts do not take at the first attempt or are damaged by some other means.

3. A graft much more quickly envelopes and covers the head of an amputated trunk with its cortex and wood and this greatly adds to the strength, health and quicker growth of the tree.

4. These operations are easier, are done more quickly and generally succeed more happily.

There is still another means of grafting that is given, which they call *Ablactatio*, when the shoot of some tree with its bark removed on one side, still clinging to the mother plant, is applied to a branch of a neighbouring tree with its bark removed equally and is tied to it until it coalesces. Then, when separated from its own stem, it is permitted to be fed only by the sap of the other tree. Pliny describes this briefly in the case of ***Vitis***, taking it from the precepts of Cato. If vines touch among themselves, bind them together obliquely with the opposing sides bared and the piths joined. But it is to be noted that some plants are implanted into each other and grow together in this way, which cannot be brought into union by the methods of grafting which I have already talked about, as for example ***Vitis*** of varying species, ***Malus*** with ***Armeniaca*** and ***Persica***.

So much for grafting by means of a shoot. The method of grafting by bud is twofold: one is called Inoculation: the other which alone is in use nowadays is called Scutcheon Grafting.

Inoculation, which was used by the ancients, according to Pliny's description, took the form of opening an eye on a tree with a pipe like an awl, having cut the bark away and enclosing with that same pipe seed taken from another tree.

Scutcheon grafting, according to the same author Pliny, can be seen to have arisen from inoculation. Therefore (he says), after cutting off all the branches so that they may not draw away the sap, in the smoothest part, where the most luxuriant part is to be seen, and, after removing a little lozenge (without allowing the knife to descend too far), cortex of equal size from another tree is pressed in to the cortex together with its protruberant bud, the joint made so tight that there is no room for a wound and so that a union may

immediately take place, not allowing damp or air to blow in; yet nevertheless it is better to protect it with mud and a fastening.

Some do not take away the cortex but only cut at first straight down with a perpendicular incision one inch long, and then in the top part of this in a transverse line extended on both sides so that the corners of the cortex can easily be lifted and a scutum (which in its lower part ought to be sharpened to an angle) should be applied to the wood so that it takes it into its fold, and finally the cortices are kept completely in place when the angles or lips have been pressed onto the scutum and tied with a fastening.

Some, when a perpendicular incision has been made, impress a transverse line in its central part, and when as before four corners or lips of cortex have been taken away with a little knife or blade, they insert the scutum with its bud and bind it, as in the preceding section.

Others make a square incision in the cortex for a similar scutum as in the first method, but they do not remove the whole cortex, but, when the lower half has been left and lifted, they apply the scutum beneath it to the wood and tie it with a fastening.

The best method of taking a whole and uninjured bud from a shoot is by lines defining the scutum marked by drawing a knife through the cortex, to remove the cortex from the rest of the wood, leaving the scutum alone intact with its bud; then, after making a hollow with the quill of a goose feather split down the middle and after inserting its extremity (which ought to be sharp) under the cortex, cut off the bud or pluck it out.

It is necessary that the scutum should exactly fit the bared place and so both the length and the breadth of the scutum taken by a pair of compasses are marked on the branch to be denuded; or when the graft where the scutum is taken has been cut on both sides to its length and split down the middle to its width, let the scutum be applied with a little piece of wood still sticking to the graft, which is to have its bark removed and lines drawn round them.

Before the scutum is removed with its bud, let the place into

which it is to be transferred be correctly prepared so that it can be grafted as quickly as possible, otherwise the bud when exposed to the air may contract a disease or dry up. Let the fastenings be of a material which can be stretched, for example, smooth rushes, or linen or woollen thread, so that the trunks and *scuti* can yield to the swelling cortex. For it is better that the fastenings are not unfastened before the buds unfold.

The time for grafting with a bud lasts from the beginning of spring when the frosts have finally ceased until there is enough time remaining before the return of frosts as to be sufficient for attaching and consolidating the bud to the trunk to which it is applied. The best time of all is considered to be the middle of summer, about the time of the festival of Saint John the Baptist.

As far as the matter of choosing the buds goes, the same principles are to be observed as I laid down concerning grafts.

If a bud takes, in the following March everything which is above it should be cut off and all the buds in the remaining part removed with one exception (which some think necessary for leading down and absorbing the sap).

Any tree with a shoot grafted onto it can also be propagated by scutcheon grafting, unless the thinness and weakness of the scutum prevents it. Pliny says that:

> The ***Vitis*** does not accept scutcheon grafts, nor do trees in which the bark is thin, peels off or is cracked. Inoculation is the most fertile of all but nevertheless the weakest. Shoots which only rest upon the bark can be dislodged very quickly by even a light breeze. Grafting by insertion is the strongest method and more fruitful than growing from seed.

The ***Malus Persica*** and ***Armeniaca*** are propagated rarely and with difficulty by grafting but easily by scutcheon grafting.

Dr. Langford endeavours to prove in many ways that scutcheon grafting in the case of plants where it succeeds is much preferable to grafting.

1. Because the stem or trunk reaches a size suitable for scutcheon

grafting two or three years more quickly than for grafting; and thence time is gained and the tree grows much more quickly after its nature has been altered than before.

2. The tree as a result is made healthier than by a graft, because the bud with the scutum spreads over and covers the cut off stem more quickly and securely than a graft.

3. It hurts the tree less than a graft and if the bud happens not to take, the tree can be scutcheon grafted again in the following year or sometimes even in the same year.

4. This task is easier, quicker and more enjoyable than grafting, for it is done in the middle of summer, when no danger of frost threatens, which is often savage and is scarcely tolerated by more delicate plants without injury or detriment to their health in the months of February and March, the time which is best for grafting.

Chapter Twenty:

Concerning the specific differences (as they call them) of plants.

So that the number of plants can be gone into and the division of these same plants set out, we must look for some signs or indications of their specific distinction (as they call it). But although I have searched long and hard nothing more definite occurs than distinct propagation from seed. Therefore whatever differences arise from a seed of a particular kind of plant either in an individual or in a species, they are accidental and not specific. For they do not propagate their species again from seed; thus, for example, we do not have ***Caryophylli*** with a full or multiple flower distinct in species from ***Caryophylli*** with a simple flower, because they derive their origin from their seed, and when sown from seed produce simple ***Caryophylli*** again. But those which never arise with the same appearance from seed, are indeed to be considered specific; or if comparison is made between two kinds of plant, those plants which do not arise from the seed of one or the other, nor when sown from seed are ever changed one into the other, these finally are distinct in species.

For thus in animals a distinction of sexes does not suffice for proving a diversity of species, because both sexes arise from the same kind of seed and frequently from the same parents, although by many striking accidents they differ among themselves. It requires no other proof that a bull is of the same species as a cow, and a man as a woman, than that both have very often arisen from the same parents or from the same mother. So, equally in plants, there is no more certain indication of a sameness of species than to be born from the seed of the same plant either specifically or individually. For those which differ in species keep their own species for ever, and one does not arise from the seed of the other and *vice versa*.

Hence I do not think that those are to be considered as distinct species of plants which:-

1. Differ only by the colour of the flower, or by doubling or multiplicity.

For since in nature the number of species is fixed and determined, since 'God on the sixth day rested from all his labour', that is, from the creation of new species, however infinite might be the number of plants varying in colour and multiplicity of flower, with new ones arising each year, we properly reject and exclude them from the grade and dignity of species.

Next, if these facts were sufficient for inferring a specific difference, the Ethiopian too by an equal reasoning would differ in species from a European, the black bullock from the white, red or mottled; something which no-one of sound mind, I think, would ever concede.

Further indeed these variations are owed to differences of weather, soil or food; for it is clear what influence they have for producing these and similar effects in domestic and tame animals. For although wild creatures in many species keep the same colours, tame and domestic creatures vary infinitely in colours and not only do they differ from wild creatures in colours but also in taste of flesh and other accidental qualities, so that they can be without difficulty distinguished in taste by a not very discriminating palate.

Besides these varieties are propagated not by seeding but either by torn off shoots, or by means of a runner or by suckers.

Finally they can be produced by skill and choice of position, that is by repeated transference from place to place, and by watering with water tinged with some colour. For P. Lauremberg, a man worthy of trust in *Horticulture*, Chapter 28, Section 3, writes that he has frequently found in ***Caryophylli***, simple ***Caryophylli*** which he had transplanted first in spring and then in autumn, and again in the following spring (and which he had not allowed to flower meanwhile), in the summer put out flowers which were all multiple. Then he repeats this in various places for inducing the change of colour in a flower. Fill some vessel with very fertile earth dried out in the sun or sieved. Into it implant a sprig of white flowers (for these alone are able to be coloured) and for watering do not use any water other than reddened if you want red flowers, green if you want green etc.. For three weeks irrigate the

plant with such water day by day, morning and evening, and at night transfer it into the house in case it drinks nocturnal or morning dew. You will find that flowers are produced not entirely stained with that colour which you poured into them, but partly with that colour and partly with their natural colour. Although these observations are laughed at by some, I do not dare to withhold belief from Lauremberg, an author worthy of trust in those matters which he treats and are known to himself. [He states] that plants which are spectacular by the colour or multiplicity of their flowers, when left and neglected in the same place for some time without care, gradually lose the delicacies of their colours and get rid of the cluster of their petals and revert to their wild nature.

Let there be the same judgement about bare flowers in those plants which usually produce radiate flowers, such as ***Chamæmelum, Cotula, Parthenium:*** the so-called *proliferi*, such as ***Bellis, Calendula*** and some other ***Corymbiferæ:*** in those given pipe-like petals, in which the petals are usually flat such as ***Bellis*** and ***Flos Africanus***, and whether there are otherwise any differences in flowers of this type.

Since indeed these varieties distinguished by full and variegated flowers are greatly esteemed by cultivators of flowers because of their beauty, elegance and rarity, and since they are also sometimes bought for insane prices, it will not be beside the point to show by what methods they can be obtained.

As far as ***Caryophylli*** are concerned I believe Lauremberg and other experts that they become multiple from simple by repeated transplantation from place to place; nor do I doubt but that the same thing would happen to other plants, which are capable of producing full flowers if they are likewise transplanted from place to place.

Indeed I read that in the case of some plants, flowers have been transformed from simple into full by a single solitary transplantation. Dr. Sharrock says that he has known people who have ***Anemone nemorum*** and ***Colchicum*** with multiple flowers in their gardens, who asserted that they had transplanted these from the fields to their gardens when wild with a simple flower, and had produced that change by richness of soil and careful

cultivation.

But whatever may be the case with transplantation, you will most certainly and easily obtain the aforesaid varieties by sowing. For if you sow generously the seed of any plant whatsoever, which is apt to change its flower, in soil that is fertile and rich, among a large number with a simple flower, a few will be born conspicuous for a full flower but with no variety of colour and some also marked by variegation. According to the opinion of gardeners in order to obtain more of this kind a choice must be made of the seeds to be sown. Thus, for example, from seeds that are sown of the flowers of ***Caryophylli*** tinted with the colour of ***Malus aurantia***, very many and very beautiful varieties of both pure and variegated flowers result. According to the author Ferrari, a multiple variety usually results from the seed of white ***Caryophylli;*** likewise from that distinguished by dark spots.

The observation of some for obtaining ***Leucoium*** with a full flower that seeds should be collected from a pod succeeding a flower with five petals in luxuriance, is according to my experience frivolous and false.

In the case of early ***Tulipæ***, Parkinson observed that seeds of a purple colour or purple with white edges are the best of all for producing variations; and those which have clear colours in the middle are preferred to the rest.

2. Plants differing in size alone. For although fixed limits of size occur in each species, which individual examples can neither exceed nor fall short of, for the ***Grossularia***, for example, never reaches the stature and dimensions of the ***Quercus***, whatever cultivation you apply to it, yet there is considerable latitude within these limits and perhaps a ten-fold proportion of the greatest to the smallest. However this is due to a difference either in the fertility or sterility of the soil, or of the temperature of the area in respect of warmth or cold, or to dry or wet weather, or to some other accident, not to the specific nature of the plant. For if you take the seed of a plant, able to be cultivated, which in itself is very small and very poor, and if you sow it in a fertile and rich soil in a place exposed to the sun and protected from injuries of the air, in a little while you

will obtain an offspring perhaps ten times larger than the mother plant. Furthermore if you transplant the root of some perennial plant, which is able to be cultivated, from a sterile exposed hillside open to the winds, which 'through the winter the penetrating cold of the north wind burns up', into a rich and warm garden, it is wonderful how much it will flourish and grow in size, to such an extent that you will scarcely recognize it as the same plant. No less a difference in this respect is found in animals between individuals of the same species. Indeed in our native England, sheep, which pass their time in hilly, sterile and cold country, are almost five times smaller than those which pasture in rich and temperate places, to such an extent that the former sell for scarcely five shillings of our money, whereas the latter are sometimes worth two pounds, that is eight times the price of the former. Horses too, which are raised and pastured in the Cambrian mountains, burned by too much cold, are so diminutive and of such contemptible smallness that they are not much bigger in size and stature than a Molossian hound. For I have seen in Chester horses which can be bought for four or five *solidi*.

Nevertheless some species of plants have been discovered by myself and by others, which seem to be exceptions here, and which as far as I have observed up to now do not differ in any other respect than size. However I suspect that there are other differences also among them and I put the matter aside for further observation. I am of the opinion that they are different in species, because I and others have observed them growing together in the same place, and yet the larger exceeded the smaller in size by three or four times. Such are the greater and lesser ***Hyssopifolia*** observed by myself; the greater and lesser ***Alchimilla*** observed by Morison; the greater Sicilian ***Heliotropium*** and the greater common ***Heliotropium*** observed by P. Boccone, the greater and lesser ***Millefolium aquaticum*** with its helmeted yellow flower observed by Dr. Dent of Cambridge, all seen growing together. For I have seen in the garden of that most noble man Dr. Charles Hatton a lesser species of the black ***Astrantia,*** which seemed to me to differ from the common ***Astrantia*** in no other respect than size. You will also find not a few

examples in Dr. Morison's *Historia Plantarum Universalis.*

3. Variegation of leaves, such as is seen in ***Alaternus, Buxus, Rosmarinus, Dulcamara*** etc. is so far from being an indication of a specific distinction, that it is rather a symptom of a diseased constitution in some plant, which can be induced by placing chalk below the root or an equal mixture of chalk with broken earth, whence it survives in plants grown from cuttings but vanishes in plants grown from seed. The question whether variegation in the petals of a flower is also the symptom of a disease must be looked into.

I am unsure as to whether plants having leaves with curled edges differ in species from flat leaved plants of the same kind. For, as far as I have seen hitherto, those which are of the former kind always propagate their species by seed and never produce flat leaved plants. Indeed the seed leaves of the curly garden ***Nasturtium*** differ from the seed leaves of the common garden ***Nasturtium*** in their shape and indentations, since the latter are tripartite or divided into three lobes and the former are split this side from that merely by a single incision. This is an argument for believing that they differ in species.

But 4. Those which differ solely in colour of root, of which kind are ***Pastinaca tenuifolia*** with yellow, white and dark red roots, ***Rapa*** with white and yellow roots, I consider are not to be thought of as distinct species; no more than those which differ only in shape of root, as ***Rapa*** with a long root or a round one.

Finally 5. Those which differ in size, taste, shape and colour of fruit or pericarp, such as the almost infinite varieties of ***Pomus*** and ***Pyrus***. Besides (according to the observation of Dr. Sharrock) trees grown from the sown seeds of garden and cultivated ***Malus*** and ***Pyrus*** do not always degenerate into the nature of woodland trees; but they sometimes produce more tasty, sweeter and more noble fruits than their parent plants or the ones that produced them, contrary to what is commonly believed and received.

Those too, which delude us by the colour of the seed, such as ***Phaseolus, Faba vulgaris*** and ***Frumentum Indicum***, I do not concede as differing in species for the reasons offered above. Indeed I once sowed many

red ***Fabæ*** together deliberately as an experiment; yet the plants which grew from them generally produced white ***Fabæ***. Nevertheless it is to be noted that distinct propagation from seed is not that which constitutes an essential or specific difference, or in which that difference lies, but is only its outward sign or indication.

Finally when I say in the case of plants that are different in species that this one does not arise from the seed of that one, I speak of that which generally and naturally happens, not of that which rarely and unusually happens outside the rule of nature. For as I shall show below, the seeds of some plants sometimes produce a degenerate offspring and one which is of a different kind; whence I conclude that a true transmutation of species does occur in plants.

Chapter Twenty-one:

On the transmutation of species in plants.

I have shown above that plants, which originate from the same seed and propagate their species again by sowing, coincide in species; and thus I have concluded that those differences in the colour of flowers, in their doubling and multiplicity, in the variegation of their leaves, in the colour of the root, in the taste or even colour of the fruit or seed, are not characteristics or indications of what is called a specific difference.

But this distinguishing mark, although it is quite constant and a sign of coincidence of species, is not nevertheless permanent and infallible. For experiments prove that some seeds degenerate and sometimes, although more rarely, produce plants of a different species from the parent plant, and thus transmutation of species does occur in plants.

Triticum in Sennert's reference degenerates into ***Lolium:*** ***Rapa*** into ***Rhaphanus:*** ***Sisymbrium*** into ***Mentha:*** ***Ocimum*** into ***Serpyllum:*** black ***Vitis*** is changed into white, and white into black: ***Zea*** into ***Triticum,*** and conversely ***Triticum*** into ***Zea.*** If German ***Secale*** is sown in Hungary, ***Triticum*** is derived thence. If a field is somewhat sterile, our ***Avena***, which they call white, degenerates into black. If the same seed is sown in the same field for some years it degenerates into poorer quality. Galen's father once sowed ***Triticum*** and ***Hordeum***, after picking out all the seeds of a different kind which had been mixed with them, in order that he might definitely find out whether from their changes ***Lolium*** and ***Ægilops*** could develop, or whether these too would have their own individual seed. But when by chance he saw together with the pure seeds quite frequent ***Lolium*** among the ***Triticum*** and moreover that in the ***Hordeum*** a great abundance of ***Ægilops*** had originated, he tried the same thing with other seeds too. Thus he also found originating among ***Lens*** hard and round ***Aracus*** and ***Securinum*** besides ***Aparine*** .

Although some of these proofs seem likely to me, I hold as

uncertain and suspect those collected from various authors, both ancient and more recent, partly, however, because they owe their origin to ordinary people taking in error that which is not a cause for a cause, and partly to learned men either too credulous or too little circumspect in assigning cause to phenomenon and addicted to received opinions. Nor do I think that they are sufficient to establish a notion so dubious and controversial.

Thus I think that Galen's father was deceived in giving a reason for the phenomenon just mentioned. For it does not follow that because ***Lolium*** frequently originates among ***Triticum*** that the ***Triticum*** has changed into ***Lolium***, or that the ***Triticum*** has originated from a seed of ***Lolium***; for the ***Lolium*** could have arisen from a ***Lolium*** seed left in the field the previous year. And as far as ***Ægilops*** is concerned, I myself once observed in a particular field, where pure ***Triticum*** had been sown, a great abundance of ***Ægilops*** originating and that more often even after sowing had been postponed, as is the custom, and that field had lain fallow for a whole year. But the ***Ægilops*** owed its origin to seed of ***Ægilops*** not to that of ***Triticum***. For since ***Ægilops*** matures and perfects its seed more quickly than ***Triticum*** and since its seed easily falls through maturity, either because of the wind or is shaken to the earth by hand in the process of reaping and is left there, although the field is not sown in the following year, it will last for a whole two years and will grow up along with the corn which is sown afterwards. Nor is there any doubt but that the seeds of plants frequently remain fertile in the earth, I do not say for two years but for ten and more, as I have shown above.

But although the proofs mentioned above may be uncertain and suspect to me, nevertheless there is no lack of other more definite proofs confirmed by suitable witnesses, which plainly establish the matter and put it beyond all hazard of doubt.

I believe, since many gardeners among us confirm it, that ***Brassica capitata*** has quite often originated from the sown seed of ***Brassica florida***. Indeed R. Morison affirms and proves by experiments that all species of ***Brassica***, when sown, mutate into each other in turn. Seeds of

Brassica tophosa sent from Italy to the most reverend bishop of London, Dr. Henry Compton, produced ***Brassica tophosa***, but its seed, when sown again, degenerated into the common, open, smooth ***Brassica.*** The same is to be said about ***Brassica florida botrytis***, which, when sown from a seed of plants originating and cultivated in England, grew as long leaved open ***Brassica,*** a fact which Richard Baal, a gardener of Brainford, learned to his cost by the experiences of many. For this man sold a great quantity of the seeds of ***Brassica florida*** collected in his garden to a very great number of gardeners in suburban parts of London, for growing in what are commonly called "Heat-Houses"; and they sowed these same seeds with great care and industry in rich earth, which had been well manured for many years, and which produced for them quite large ***Brassicæ*** with long and open leaves. Because of this the aforementioned gardeners, realising that they had wasted their toil and effort and had spent both labour and cost on something of no value, complained that they had been cheated and brought a suit against the aforementioned Richard Baal in the court at Westminster. He was condemned by the opinion of the judges sitting there, not only that he should restore to them the money which he had received but also that he should reimburse them for loss of time and for the wasteful use of their ground.

The same thing happens to ***Brassica Sabauda***, both winter and summer varieties, whose seeds sent to me recently from Italy, turn out happily here [in England], but the seeds when collected and sown from the same plant grown here, degenerate into open ***Brassica.*** Thus it is necessary if we wish to have these species that we seek new seeds every year from the regions beyond the sea.

Not do only the seeds of ***Brassica*** when sown produce degenerate offspring but also those of ***Primula veris*** or ***Paralyseos.*** When I was in Oxford, Jacob Bobert, the custodian of the public academic garden, confirmed to me that from a seed of the greater ***Primula veris*** he had grown ***Primula vulgaris*** and the yellow odourless ***Primula pratensis.***

Olaus Worm in *Museus*, Book II, Chapter 7, Page 150 in my

copy, asserts that he has ***Hordeum*** which he calls hermaphroditic, because in one ear it contains both ***Hordeum*** and ***Secale***, the description of which you will find in the place cited. Johnson too, in *Gerard emac.* Book I, Chapter 46, Page 65, refers to the fact that an ear of white ***Triticum*** was shown to him by Dr. Goodyer around the central part of which had grown three or four grains of ***Avena*** perfect in every way.

If these things are true, in so far as they are told by people worthy of trust, they compel me to abandon the negative opinion to which I was rather inclined, and, even if unwilling, to concede that there can be transmutation of species in plants.

However it must be observed that this transmutation occurs only between cognate species and ones that share the same genus; some perhaps would not concede that these differ in species.

Moreover I would not believe either Bobert or anyone else, even on oath, that some bulbous plants by a longer stay in the same place and without being moved, by a marvellous metamorphosis, either degenerate or are transformed into other species, as for example ***Crocus*** into ***Gladiolus***, ***Leucoium*** into ***Hyacinthus*** and *vice versa.*

Chapter Twenty-two:

On the stature and size of plants.

Concerning the size of plants, I have nothing worthy of note to add to what has been handed down by the founders of natural history.

I am of the opinion that there are certain limits to the dimensions in each species, which individuals can neither exceed nor fall short of. But a great latitude exists among these and the proportion of the greatest can be almost ten times that of the smallest. Trees exceed animals in stature and size, at least land animals (for it would seem that marine beasts must be excepted) as much as the minutest plants are exceeded in smallness by animals. For there are tiny animals which even escape the sharpness of lynx eyes.

Both Indias and other hot regions produce the largest and tallest trees of all, in which places the heat is strongest.

'And where the middle of the day seethes with burning hours.'

There too animals of a great size are to be seen: among the quadrupeds are Elephant, Rhinoceros and Hippopotamus: among the birds are Ostrich and Emu: among the reptile kind are Crocodile and others of a stupendous length and thickness: among the aquatic bloodless Testaceans are Murex, Buccina and other innumerable creatures of portentous bulk.

What is said about the thickness and tallness of some trees is wonderful and almost beyond belief. Let us consider Pliny, who produces examples in Volume XVI, Chapter 40.

> The largest tree seen at Rome up to now is thought to be that, which Tiberius Cæsar exhibited on the bridge in a mock sea battle, because it was a wonderful thing, which had been brought with the rest of the material. It was moreover a beam from a ***Larix***, one hundred and twenty feet long and two feet thick throughout. From this could be estimated the almost incredible remaining height to its topmost extremity. There was within our memory also one left in the galleries of the voting booths by M.Agrippa, just as much a miracle,

> twenty feet shorter and eighteen inches in thickness. An ***Abies*** worth particular admiration was found in the ship, which brought from Egypt at the orders of the emperor Caius the obelisk set up in the Vatican circus and four trunks of the same stone for holding it up. The girth of this tree filled the outstretched arms of four men clasping it. The largest ***Cedrus*** is reported from Cyprus, cut down for an undecireme of Demetrius, one hundred and thirty feet long, and indeed three men's arms spanned its girth. German pirates sail in single hollowed-out trees, some of which carry thirty men.

What is this compared to related trees, from single examples of which, when hollowed out in the same way, canoes (for thus they call this type of skiff from a single piece of wood) can be made which are capable of carrying two hundred men.

In the kingdom of Malabar in Eastern India a tree grows of stupendous size, called by the natives ***Atti-meer-alou*** with a trunk frequently fifty feet in circumference; one of this kind is grown in the province of Cochin near the temple of Beyka, which is said to have lived for two thousand years. *Hort.Malab.*

But here it is right to warn in passing that what Pliny and others have said about the size of the ***Ficus Indica*** is entirely false, that is, that the parent plant is of such a vast body that they are generally sixty feet in circumference. For that most famous man, and likewise a man most worthy of trust, Dr. Walter Raleigh, the golden knight, who saw at least twenty thousand trees of this kind growing in a particular valley not far from Paria in America, and as many in the hinterland of Trinidad, and who elsewhere writes that he made a journey of no less than twelve miles under their shade, attributes a moderate size to their trunks, and he says that it is very difficult to find any one larger than the rest among ten thousand.

In order to spare myself work I have generally transferred the examples of very large trees which follow from *Sylva*, written by that most celebrated man Dr. John Evelyn.

As far as stature goes Sebosus has published that the height of trees in the Fortunate Isles reached one hundred and forty four feet. Pliny, Book VI, Chapter 31. The same man says that in India some trees have been found of such a height that arrows cannot be shot above them; Book VII, Chapter 3. But there is something which exceeds all these miracles on the island of Barbados, one of the Antilles, where Ligonus has not only written that the ***Palmitæ*** called royal, with a diameter of trunk not greater than six feet, grow to a height of three hundred feet, but also eye witnesses have confirmed the truth of this to us. Matthioli mentions a tree growing on the island of Cyprus, which produced material to the height of one hundred and forty four feet.

As far as size is concerned, according to Pliny, the wooded region around Memphis produces such vast trees that three people could not embrace one. Julius Scaliger mentions trees growing by the river Gambra with a diameter of thirty seven feet. Others refer to trees of such thickness growing in Nicaragua and Gambra that seventeen men with arms extended could scarcely embrace them, and they refer to some of no less a size in Brazil, amongst which one held in religious awe by the natives was one hundred and twenty feet in circumference. In a history of China not so far published we read that a certain tree called ***Ciennich*** [that is, a tree of one thousand years] was found in the province of Suchu near the city of Kien, of such portentous size that it covers and hides under one branch alone two hundred sheep to such effect that they cannot be seen by those who approach. We read of another monster too, rather a miracle of a tree than a tree, in the province of Chekiang of such stupendous girth that even eighty men could scarcely embrace its trunk.

However in order that I might omit exotic trees, let me produce some examples of domestic and European species.

Our author mentions a ***Pyrus*** near Ross in Herefordshire eighteen feet in circumference, which every year produced seven fairly large jars of Perry.

On Mount Etna in Sicily Kircher mentions three ***Castaneæ*** at a place thence called *gli Castagne* ['the Chestnuts'], the bark of one of which was

of such a size that inside it a whole flock of sheep was shut up for the night by the shepherds as though in a most commodious sheepfold.
Chinæ illustr. page 185.

That most famous and erudite man Dr. Thomas Brown of Norwich describes in a letter sent to Dr. Evelyn a ***Tilia*** of a size and stature to be gazed at, seen and measured by himself at Depeham in Norfolk whose dimensions were as follows. The circumference of the trunk at its most slender part, two arm spans above the ground, was at least eight and a half arm spans of our measurements, that is twenty four feet: at its lowest part next to the earth and root it was sixteen arm spans: above at a cubit's distance it was almost twelve arm spans. Its height at the highest branches was thirty. It was larger than that famous ***Tilia*** of Tigur in Switzerland in all dimensions. It is uncertain whether this kind of tree is exceeded by any in foreign lime groves. For that prodigious ***Tilia*** to be seen at Neustadt in the Duchy of Würtemberg, so famous because of it enormous size that it gave a nickname to the city itself, thence called by the Germans 'Neustadt, otherwise called the great Lime tree', was humbler in so far as the circumference of its trunk was not more than twenty seven feet and four inches: the circumference of its extended branches four hundred and three, and its diameter from south to north one hundred and forty five, and east to west one hundred and nineteen.

Pliny mentions a huge ***Platanus*** in his twelfth volume with these words:

> There is now in Lycia, with the benefit of a cold spring nearby, next to the road a celebrated plane tree like a house with a hollow cavity of eighty one feet, a leafy top, and protecting itself with huge branches like trees covering the fields with long shadows. And so that nothing is missing from the image of a cave, embracing mossy pumice stones in a rocky crown within its foundations: a tree so worthy to be deemed a marvel that Licinius Mutianus, who was three times consul and recently legate of the province, thought it worth handing down to posterity that he himself had dined inside it

with eighteen companions, the tree itself providing leafy couches on a generous scale, and that he had then gone to bed in the same tree, free from all draughts and receiving more delight from the agreeable sound of the rain dripping through the foliage than gleaming marble, painted decorations or gilded panelling could have afforded.

In the manor of Horton in the parish of Elsham in Surrey, of which the owner is the brother of our author, very many ***Ulmi*** even now remain in the hedgerows, with trunks three feet square and up to forty and more feet high. An ***Ulmus*** with smooth leaf fallen three or four years ago in the park of Dr. Walter Bagot in the county of Stafford, extended to forty arm spans, yielded forty eight wagon loads of wood for the fire from its top or branches, and moreover its trunk produced at the bottom, where it was seventeen feet in diameter, eight pairs of cylinders and eight thousand, six hundred and sixty feet of planks or beams. The whole material was estimated at ninety seven tons. That most erudite man Dr. Robert Plot in his *Natural History of Oxfordshire* mentions a certain ***Ulmus***, which furnished a refuge and dwelling for a particular poor woman, who was pregnant and had been banished from the inhospitable neighbourhood and who gave birth to a child in its hollow interior, a male still living who has grown up into a strong young man.

I have heard of ***Fraxini*** one hundred and thirty two feet long recently sold in Essex.

Add to these a huge ***Taxus*** in the cemetery of the church of Crowherst in Surrey ten arm spans in circumference: and another aged specimen of a great size to be seen in the cemetery of Brabourne in Kent, of which the trunk was fifty eight feet and eleven inches in circuit, whence it can be calculated that its diameter was almost twenty feet.

Salix too of enormous girth occur. Dr. Plot mentions one given by Joannis Ferdinand of Hortoda growing in Moravan, a village in Moravia, with a hollow inside of twenty seven feet in circumference.

But let us pass to the ***Quercus***. That same most celebrated man

records a tree of this kind, still standing on the green at Kidlington in the county of Oxford, of which the hollow interior was used as a temporary prison. For they used to shut up there within it for a short time people to be imprisoned until they could be conveniently transferred to the public prison. The incredible size of some oaks, standing and flourishing not so long ago in Westphalia, of which one is held to have been fortified as a citadel and bastion, the other one hundred and thirty feet tall and thirty feet in diameter.

Those memorable trees which Geoffrey Chaucer, the most celebrated poet of his age, is said to have planted in the park of Dennington are not to be passed over in silence. They were worthy of such a planter; one was called after the king, one after the queen and the third after Chaucer himself. The first of these, that of the king, was branchless and without nodes to a height of fifty feet, at the bottom five feet square, the whole firm and solid and of the best material. The second, that of the queen, was straight and jointless to a height of forty feet, of the most excellent material, in the lowest part four feet square and at the highest nearly three. The third, that of Chaucer, was inferior in stature and size, but it too was beautiful. Hence, if what is said about the planting of these trees is true, it can be realised to what height and width a ***Quercus*** can grow in three hundred years (for Chaucer is not more ancient than that). The tree from which the transverse beams were fashioned for that by far the largest and most beautiful ship, called The Royal Sovereign, was especially huge and noble; it was built by that best of princes Charles the first. It was cut up into four beams, four feet and nine inches in diameter, each one forty four feet long. Nor should we omit that outstandingly large and tall tree, although it was of another kind, which furnished a mast for the vessel just mentioned, ninety nine feet long and thirty five feet in diameter.

That most learned man Dr. Robert Plot in his much praised *Natural History of Oxfordshire* mentions a ***Quercus*** growing between Newenham-Courtney and Clifton, of which the diameter from one extreme to the other of its extended branches was eighty one feet, shading an area of five hundred and sixty square arm spans, in which two thousand, four hundred and

twenty men could conveniently stand together. He mentions another still larger near the door of the cloisters of Magdalen College, Oxford, of which the branches extended up to sixteen arm spans from the trunk. He mentions finally another at Ricoti in the park of the most noble Baron Lord Norreys, of which the branches stretched out to fifty four feet from the trunk and were sufficient for covering three hundred and four horsemen and four thousand, three hundred and seventy four infantry.

Dr. Robert Harley, in the letters mentioned above, tells of a ***Quercus,*** which fell down not so long ago, in the neighbourhood of his house, of which the thickness was five feet square, height up to forty feet, in each foot of which (it having been split up for all purposes, as it were, at the same time) there was half a ton of material. The branches besides supplied twenty five cords of wood for the fire.

The very learned author whom I follow adduces many further examples of the ***Quercus***, of enormous size and width, either still standing or fallen down not so long ago, especially in the fields of Sheffield, in the county of Yorkshire, and in neighbouring places, not unworthy of being known, and proved by suitable witnesses, all of which it would be too long and laborious to record here. Anyone who wants more on the subject should go to the book itself, chapter 30.

Chapter Twenty-three:

On the age and life span of plants.

Plants differ immensely in respect of life span; some are very short lived, others very long lived.

Some are summer plants, which arise in the spring, die in the autumn, and in the following spring again renew themselves from seed remaining in the earth. Of this kind are ***Atriplex, Blitum, Sonchus*** etc..

Others complete their life span within the space of a year. These emerge in the autumn, live through the winter, begin to put out stalks in the following summer, flower and at last after the seed has come to maturity wither away to the roots. However these too, if sown in spring, perish in the following autumn.

Some are biennial or triennial, or even of more years, as for example ***Petroselinum vulgare, Angelica*** etc.. These do not develop into a stalk in the first or second year after they are sown; indeed some of them sometimes remain without stalks for five years and more, but once the stalk has been produced and the seeds have reached maturity they completely wither away.

Others finally are perpetual and do not have a fixed span for their lives.

However these are either perpetual in root only or in the upper part also.

Those which are perpetual only in root are called residual; those which are also perpetual in the upper part are called perennial.

Those, which are classed as perpetual in root, do not all keep the same individual root for ever, except improperly and (as the philosophers love to say) by equivalence, repairing the damages to the roots with a new annual additional growth, as I showed above in the chapter on the roots of plants.

That trees are very long lived Pliny proves by many examples listed in Volume XVI, Chapter 48. He says:

> If one thinks of the remote regions of the world and the impenetrable forests, the life span of some trees can be believed to be immense.

> But of those which the memory of man preserves, there still lives an ***Oliva*** planted by the hand of the elder Africanus at Liternum, and likewise a ***Myrtus*** of remarkable size in the same place. Indeed there is a ***Lotos*** in the precinct of Lucina at Rome, which was founded in the year in which there were no magistrates, three hundred and sixty nine years from the founding of the city; it is uncertain how much older is the tree. But indeed there is no doubt but that it is older, since Lucina takes her name from that grove. This is now about four hundred and fifty years old. Still older, although its age is uncertain, is that which is called the 'hair tree' because hair of the Vestal Virgins is brought to it. Moreover there is another ***Lotos*** tree in the precincts of Vulcan, founded by Romulus from some of his spoils of victory, which, on the authority of Massarius, is understood to be of the same age as the city. Its roots penetrated the municipal offices as far as the forum of Cæsar. With this grew a ***Cupressus*** of equal age, which about the end of Nero's principate, fell down and was left lying. Moreover on the Vatican hill there is an ***Ilex*** that is older than the city, on which is a tablet of bronze with an inscription written in Etruscan letters indicating that even then it was thought to be venerable.

I omit the rest because it seems to me uncertain and fabulous; anyone who wishes can see it in the passage of Pliny cited.

That same most famous author in Book XVI, Chapter 2, says that:

> the vastness of the trees of the Hercynian forest, untouched by the ages and of the same age as the world, surpasses marvels by its almost immortal destiny. In order to omit others lacking credence, it is agreed that the collision of the roots in encountering each other raises up hillocks of earth, or, where the ground has not kept close to them, their arches in their struggle with one another rise as high as the branches and curve over in the shape of open gateways, so as to allow a passage to squadrons of cavalry.

Josephus, in his book on *The Jewish War*, Book V, Chapter 31, records that a ***Terebinthus*** may be seen at the sixth stade from the city of Hebron, which they say has stood there ever since the creation.

Lawson, a writer on horticulture not uncelebrated, strives to prove with reasons not to be despised that our fruit trees too, ***Malus*** and ***Pyrus***, prolong their lives for as much as nine hundred years. He says that he has trees in his garden, which it is agreed by the testimony of older men, were planted eighty years before. Moreover these were at least three times inferior in size and perfection to others of similar kind, which he had known and which were not yet fully grown nor more conveniently positioned, nor more carefully cultivated, but rather neglected and badly treated. Whence he concluded that these kinds of trees depend upon increasing for around three hundred years before they reach their peak. And since in animals the intervals of growth of stature and decline are at least double, how much more in the case of trees of which the substance is solid, firm enough for endurance, capable of withstanding injury inflicted by the weather, being natural and pure of sustenance, contaminated by no excrements or excretions. But if fruit trees, liable to punishment by so many injuries from repeated transplantation and from the pruner's hook and other accidents, and indeed also exhausted in strength by the prodigious spending of nutritional sap upon so many annual harvests of fruit, endure for so many years, how much the more right is it that those trees should be believed to be long lived, which excel in stature and size, in strong and unconquered substance, growing up in the places of their birth, not having to waste sap on fruits, and to which the earth is mother, not stepmother, and which have suitable nourishment and whose strength is not weakened by cultivation or display.

But let us have done with these reasons however plausible; we want proofs not arguments. What is said about the longevity of trees does not easily find faith with me. For since there are not any, or only very rare, pieces of evidence recorded in literature worthy of belief about the times at which trees

were first planted, what is passed down concerning their age consists of uncertain and ill-founded rumours and opinions, and so either seems entirely false and fabulous to me, or uncertain and full of conjecture. Certainly what Dr. Robert Harley wrote in letters to Dr. Robert Murray ten years ago disproves the longevity of the ***Quercus.*** That is, he had convinced himself by enquiry, going back for about two hundred years from that time, that in a particular park of his (for thus they call an enclosure for wild animals surrounded by fences) and in the adjacent wood, not a single ***Quercus*** then existed capable of bearing acorns because of its age; when he was writing this, he had observed many of exceeding size and height, amongst which some now past their prime and failing in vigour were standing in the last decline of old age and wastage.

Chapter Twenty-four:

On the powers and uses of plants in food and medicine.

The use of plants is widespread and occurs in every part of life. Without them life cannot be happy or comfortable; indeed there would be no life at all. Whatever is necessary for basic foodstuffs, whatever for delicacies, they supply abundantly from their very wealthy store. How much more innocent, neat and healthy is a table spread with them then one with slaughtered and mangled animals? Certainly man is by nature not one of the carnivorous animals, nor is he furnished with any arms for plunder and pillage, nor does he have sharpened and serrated teeth and hooked claws. His hands are developed for collecting fruit, his teeth for chewing them. Nor do we read that before the flood meat was allowed him for eating. But plants do not only supply us with food but also with clothing and medicine, houses and other buildings, also ships, and furniture, and wood for the fire, and delights for our senses and spirit. From them perfumes for the nose and fumigations are prepared. Their flowers delight the eyes by their indescribable variety and elegance of colours and shapes, and the pleasant fragrances of scents which they exhale refresh the spirits. Their fruits provide second courses of attractive taste and arouse the languishing appetite. I pass over in silence the very pleasant greenness, friendly to the eyes, which they lay before those strolling through meadows, pastures, fields and woods, and the shades which they furnish against the heat and burnings of the sun. Indeed, leaving these things aside, I will talk only about their strengths or uses in medicine, and what I am going to say I will contract into a few words. Both ancient doctors and more recent ones differ widely on the temperaments of plants, which they call primary qualities: heat, cold, humidity and dryness respectively. For they also subtly distinguish each individual quality into four grades and each grade into three sections. But since this doctrine seems to me more elaborate than useful, and since authors do not agree about the gradations of qualities in most plants, and from the differences and grades of their tastes come to their opinion about their temperaments, I do

not consider it necessary to dwell on minutiæ of this kind. Those who are attracted by these things should go to the writers of medical principles. It will be more to the point to investigate the differences, causes and effects of scents, but especially of tastes. For all agree that the powers and uses of plants in medicine can be more certainly understood from these than from any other marks or indications whatsoever. For whatever plants have similar tastes, it is most likely that they also have similar properties. But before I treat of specific tastes, let me dispose of other ways of investigating the strengths of plants, of which the first is from what are called 'signatures'. They call the signature of a particular plant or of a part of it, for example of its root, stem, leaf or fruit, its likeness or congruity - in shape, colour, texture or other particular - with some part of the body or disease symptomatic of it, whence they conjecture that it is friendly and salutary for such a part of the body or useful for such a disease. For they think that a similarity of this kind is an indication or mark of such propriety imprinted by nature. Chemists especially prattle about signatures. But Davison long ago defined a chemist, as I remember, (how rightly he made this observation) as 'a credulous and lying animal'.

I have rejected signatures elsewhere and I have demonstrated that no marks are impressed upon plants by the intention of nature to make them the indicators of natural powers, nor have I changed my opinion since for the reasons listed there, which I will repeat here:

1. Of plants, which are called specific, that is those which are said to be proper and salutary for any part or member of the body, the number of those which lacks signatures is by far the larger, as it is easy to show in the cardiac, thoracic, cephalic, hepatic ones etc..
2. Different parts of the same plant exhibit different, indeed sometimes contrary, signatures.
3. Many plants give the appearance of natural and artificial things, to which nevertheless they have no relationship.

   For example, the flowers of certain ***Orchidæ*** give the appearance of flies, bees, butterflies and a naked man etc. [amongst which so great a

similarity occurs (as I note in passing) that anyone would immediately recognize it and would not easily persuade himself that it happened by chance especially in so many species but rather that it demonstrates the intention of nature to have fun with us].

The seed vesels of ***Bursa pastoris*** give the appearance of little sacs.

Those of ***Thlaspi*** the appearance of a double shield.

Antirrhinum vulgare the appearance of a bullock's head.

The seeds of ***Phaseolus*** the appearance of the kidneys.

Tragopogon the appearance of a goat's beard.

Radix terræ the appearance of a mouse's gland.

Gladiolus the appearance of a sword.

The pods of ***Fœnugrœcus*** the appearance of horns.

The leaves of the most common ***Medica cochleata*** the appearance of a heart, of which also the so-called ***Pisum cordatum*** shows a stamped image.

They neither ought nor can be related to these by any means.

4. The parts of some plants sometimes represent those parts of the body to which they are the most harmful.

Thus the fruit of ***Anacardium*** represents a heart but it is nevertheless poisonous.

Fungi arborei suggest lungs in their shape, colour and spongy softness: ***Fungus phalloides*** the penis; but both are malignant and deadly.

The sap of ***Tithymalus*** is very sharp and like milk but no-one offers it to wet-nurses for increasing their milk.

The flesh of ***Mespilus*** corresponds to excrement in colour and consistency yet it does not loosen the bowels but binds them up and constipates.

5. The same parts of the body are affected by different and frequently contrary diseases, which demand different remedies and ones which differ in their qualities.

6. In different plants parts of the same appearance and shape have different or even contrary powers, as is the case with bulbous roots, of which some induce vomiting such as those of ***Narcissus***, whereas others furnish most pleasant food such as those of ***Tulipa, Cepa, Allium*** etc..

7. Fewness of signatures and the obscure similarity of signatures with the things which they are said to represent, which is not easily observable to everyone, do not argue any intentional plan in nature but rather the subtlety of the human mind which observes them and tries to fit them to each other. Yet in this way they serve to help the memory and bring it about that we may more easily remember the powers of these plants, which bear a mark of this kind as though branded on their foreheads. Another method of investigating the virtues of plants is by observation of the insects which are feeding upon them, which in truth can be of some use. Firstly those, which no animal or even insect touches, are without doubt poisonous. And Europeans had knowledge of this sign when they wandered among the woods of America that some fruits are edible or at least may be eaten with impunity, that is, if they saw them being plucked or bitten by birds.

It is also likely that all those which a particular insect eats have the same powers. I myself have often observed a little kind of Scarab, a black one (which our gardeners are accustomed to call the garden Pulex from its equal smallness and likeness), which only seeks bitter and hot plants - ***Piperitis, Nasturtium*** and ***Iberis***, whence it can certainly be concluded that whatever plant it touches shares the same quality. In the same way I have also seen a certain caterpillar marked with black and gold transverse rings generally feeding off ***Jacobæa*** but sometimes also off ***Senecio***, whence I conclude that those plants are alike in powers just as they are in appearance.

But if some kind of insect prefers some peculiar type of plant, despising all the rest, it is likely that that plant also is powerful with a particular strength or peculiar quality, although perhaps it does not appear so to our

senses. For insects distinguish tastes more subtly then we do.

But this observation is not definite and universal for every kind of insect; for there are some polyphagous and pamphagous insects, which are not averse to almost any kind of food.

There remains a third and best means of investigating the virtues of plants, the one proposed at the beginning, that is from their tastes.

Older medical writers defined nine differences or kinds of tastes indicative of their characteristics: three hot, three cold and the same number of medium or temperate ones, which the *Schola Salernitana* embraces in three little lines:

These three, saltiness, bitterness and sharpness, excel in warmth:
The vinegar is cold etc..

Jo. Fernel, an author especially learned and elegant, substitutes acerbic for astringent, sour for Pontic taste, but he describes the differences or kinds of tastes as follows:-

> A taste is sharp which strikes and pricks the tongue and mouth with its acrimony and at the same time warms and sometimes, as it were, burns them. This is most conspicuous in ***Piperitis, Pyrethrum*** and ***Euphorbia.***
>
> An acid taste also penetrates the taste buds and strikes them with its thinness but without any feeling of warmth. This is most detected in vinegar, and after that in the juice of ***Malus cytria, Limonum*** etc..
>
> A rich taste does not trouble the taste buds with warmth or acrimony but smears the tongue and parts of the mouth with a sort of viscosity. This is principally noticed in oil, butter, lard etc..
>
> A salty taste does not warm the tongue in any way but scrapes it by sharply drying it up. This is chiefly clear in common salt.
>
> A sour taste constricts the mouth and tongue somewhat and forces them together with a certain roughness; hence to a certain

extent it dries and cools them. This is properly called a crude taste and is peculiar to unripe fruits, as in the juice of a bitter grape or an immature ***Pomus, Pyrus*** or ***Mespilus.***

A sweet taste, pleasant to the taste buds and agreeable, delights me, and is soft, with no quality in particular being predominant. A taste of this kind is conspicuous in sugar, honey, liquorice etc.

A bitter taste is directly opposed to a sweet one, being unpleasant and grim. It, as it were, scrapes or tears apart the very sense itself. ***Aloe*** is an example of it, also ***Absinthium, Centaurium minus*** and ***Colocynthis.***

An acerbic taste is like a sour one but nevertheless harsher and more harmful than the latter and it constricts and roughens the tongue and all sense of taste more, and further dries and chills the mouth more. This is seen clearly in ***Malicorium, Galla, Rhoe*** and in the nuts of the ***Cupressus.***

Tasteless, so-called clean [ἄπνος], which is properly not a taste at all but a negation of taste, strikes the taste buds with no clear quality. Such is seen in every kind of grain and in ***Cucurbita*** and ***Citrulus.***

Thus far Fernel, who also gives the reasons for these tastes, in which however he does not satisfy me.

But neither he nor others, whether medical or physical writers, seem to have observed the differences in tastes carefully enough; and they seem to have considered some too which are composite as though they are simple, and others which are only different in degree as though they were different in kind. For which reason our friend Grew, not content with the doctrine handed down in the Schools, examining the whole matter again and pondering it more curiously, notices and distinguishes at least sixteen different kinds of simple tastes.

They are:-

1. A bitter taste, such as is experienced in ***Absinthium***,
   to which is opposed:
2. Sweet, as in sugar.
3. Acid, as in vinegar,
   which is contrary to:
4. Salty.
5. Hot, as in ***Caryophyllus***,
   to which is opposed:
6. Cold. For certain bodies occur, which manifestly impress the sense of cold on the tongue, as for example *Sal Prunella*, and this is so despite the fact that the liquid in which it has been dissolved tastes hot.
7. Aromatic: for something can be no less aromatic to the taste as to the sense of smell. But it is clear that an aromatic taste is distinct from a hot taste, since many substances may be observed with a hot taste either slightly so or even intensely so, which are by no means aromatic, as for example ***Euphorbia***. So much so that, although an aromatic taste is very often conjoined with a hot one, nevertheless it is not the same kind of taste but different.
8. Nauseous or malignant, contrary to the preceding, such as is experienced in ***Rhabarbarus*** along with astringency and bitterness, and along with bitterness and sweetness in ***Aloe***. It is called malignant because it is unpleasant, although it is not as powerful when mixed with other tastes.
9. Vapid, as in the albumen of eggs, starch and in some ***Boli***.
10. Oily, as in oil, lard etc.. These two tastes our author also calls soft, just as he calls the following four hard.
11. Penetrating, which without any bitterness insinuates itself into the tongue just as some insects do into the skin; such as is tasted in the root and leaves of the ***Cucumer agrestis***.
12. Stupefying, such as is perceived in the root of ***Helleborus niger***,

which when chewed and placed upon the tongue for some time affects it with a certain paralysing stupor, even if it has been cooked so that it is too hot to swallow. He makes these two tastes just mentioned contrary to the vapid taste, in the same way as the following two:-

13. Astringent, for example as is tasted in ***Galls***,

and:

14. Pungent, such as in the spirit of salt of ammonia, which he opposes to the oily or fatty taste. Then he divides tastes into continuous ones as most people do,

and:

15. Intermittent, of which kind an example is observed in the root of ***Dracontium***, which, after the taste has plainly become dormant and extinct, is revived and renewed at intervals as if especially from the pressing of the tongue against the teeth and gums.

Finally there are the tastes which are either equal as most people say,

or:

16. Fluctuating, as is the warmth produced by ***Pyrethrum***, which a certain vibration accompanies.

But these last two kinds seem to me to be rather the acquisition of tastes since they can occur with many tastes and do not exist of themselves and separate from all others.

Composite tastes are very numerous, for sometimes two, sometimes three, four, five or even more occur together in the same subject.

From the almost innumerable conjunctions of tastes, which can be observed in various substances, only six names have been given (as far as I know) because of the neediness and barrenness of words in the Latin language; they are:-

Acerbus - harsh or acerbic

Austerus - sour

Acer - sharp

Muriaticus - briny

Lixivus - made into lye or alkaline

Nitrosus - nitrous

Most of these are usually ennumerated as simple tastes, but very improperly, since all are composite or complex.

For:-

1. Sour is composed of astringent and bitter, as in the immature and soft nuclei of grapes or grape pips.
2. Harsh, to describe it correctly, is composed of astringent and acidic, as in the juice of unripe olives or grapes.
3. Sharp is composed of pungent and hot, for it is not simply hot, since many hot substances can be found which are not sharp, for example the roots of ***Zedoaria, Millefolium*** and ***Contrayerva;*** also there are no fewer that are equally pungent but not sharp, of which kind is the root of the ***Arum.***
4. Briny is salty mixed with a slight pungency, such as the taste of common salt.
5. Alkaline is said to be something salty mixed with pungency and heat.
6. Nitrous is so described because it is salty accompanied by pungency and coldness.

Moreover tastes differ in various ways:-

1. In respect of degrees,
2. In respect of duration.
3. In respect of the subject which they affect.

1. Tastes differ in each species in respect of degrees.

   For in some substances they are weaker, in others more intense, and that increasingly to such an extent that in some ten degrees can be distinguished. Thus for example, the root of ***Curcuma*** is bitter in the first degree, the root of ***Gentiana*** in the tenth: the root of ***Carduus benedictus*** is hot in the first degree, the pods of ***Clematis peregrina*** in the tenth degree. And although such a spread of degrees or difference is not found in all kinds of tastes, nevertheless most have

at least five observable degrees of intensity and weakness.

2. Tastes differ in respect of duration and of terms of movement.

For as in diseases, so in tastes, there are four times or terms of movement; that is, beginning, development, stability and decline.

In order to rightly observe and distinguish these, the harder substances, of which the tastable parts do not so promptly disappear and occur to the sense of taste, must be reduced to the finest powder. Otherwise there cannot be any judgement from the beginning.

I call the beginning that space of time, which comes between the first contact with the substance to be tasted and the first clear perception of the taste. Thus for example, acid or bitter substances, such as vinegar and ***Absinthium***, at the first immediate contact affect the sense in so far as they are acid and bitter and are detected as being such, and thus they have a very short beginning. Sharp substances have a somewhat longer beginning. Thus in the case of the leaves of ***Clematis peregrina***, although they have a very powerful bitterness up to the tenth degree, nevertheless this is not immediately perceived nor does it affect the sense of taste as quickly as the bitterness of ***Roses***, which does not exceed the second grade. But the beginning of hot tastes is generally longer or slower to come about than that of other kinds. Thus the bitterness of the roots of ***Helleborus niger***, which does not transcend the second degree, nevertheless is felt soon after contact; but the heat which they arouse on the tongue, although more intense by at least one degree, is not fully perceived until two minutes from the first contact have passed. Similarly the bitterness of ***Enula***, which does not exceed the fourth degree, is nevertheless perceived more rapidly than its heat, which reaches the eighth degree.

I call the development the space intervening between the first perception of taste and the greatest degree of intensity which it achieves. Thus the heat of ***Galanga*** is not only immediately perceived but within half a minute rises to its peak or its greatest degree of intensity. But the

heat of a root of ***Enula*** does not reach the end of its development until a whole minute has passed; nor does that of ***Helleborus niger*** before four minutes have passed from the first contact.

Stability or the space in which taste persists in its strength is different in different substances. Thus, for example, the heat of the pods of ***Helleborastrum*** comes to its peak and begins to decline within half a minute; the heat of the root of ***Nasturtium hortensis*** not until a minute has passed; the heat of the root of ***Asarum*** after two complete minutes.

Decline extends from the first slackening off of taste to its total extinction; its duration also is different in accordance with the difference between substances tasted. Thus, for example, the leaves of ***Millefolium*** are bitter in the fourth degree but only hot in the first and yet the heat continues for some time and the bitterness vanishes on the spot. ***Calamus aromaticus*** is bitter in the fourth degree, hot in the first degree, aromatic in the third degree; yet its bitterness is extinguished on the spot, its heat lasts for two minutes and its aromatic taste for seven or eight. The heat of the root of ***Contrayerva*** extends for nearly two minutes: the pungent taste of ***Gialappa*** for almost six: the heat of ***Nasturtium hortensis*** for seven or eight: the bitterness of ***Cucumer agrestis*** for almost a quarter of an hour: but the heat of ***Euphorbia*** and also that of ***Helleborus niger*** for much longer, that is for half an hour or more. The root of the ***Arum*** in truth, when tested, even continues sometimes to stab the tongue for twelve hours.

Thus as the development rarely extends beyond four or six minutes from the first contact, the decline extends up to thirty, forty or even more.

3. Tastes differ in respect of the subject or location or parts of the body which they chiefly affect. And in this respect they are either fixed or mobile.

A taste is called fixed, which from the beginning to the end,

keeps itself within the limits of the same part, as for example the tip or the root of the tongue.

Mobile taste is either diffusive or transitory, if one may speak like this.

I call a taste diffusive, which gradually spreads and propagates itself into the neighbouring parts but yet meanwhile does not desert that part which it affected to begin with. Thus the bitterness of the dried roots of ***Helleborus niger***, which is first felt at the tip of the tongue, spreads itself to the middle part of the same; the bitterness of the leaves of ***Cucumer agrestis*** extends itself from the tip to the very roots of the tongue.

A taste is called transient, which after a short delay, completely deserts the part which it affected to begin with and transfers itself to another part. Thus the bitterness of ***Gentiana*** passes immediately from the tip of the tongue to its central part.

Those parts which tastes affect in the ways described, in which respects also they can be said to be the seats of tastes and the organs of the taste buds, are lips, tongue, palate, throat and gullet.

The root of ***Helleborus albus***, also of ***Pyrethrum***, impresses a feeling of heat on the lips, which lasts for nine or ten minutes; in other parts much longer.

Tastes affect the tongue in three places particularly:-

1. On the tip, as most of them do.
2. Near the base, where the taste of the leaves of ***Cucumer agrestis*** especially manifests itself.
3. In the central part, where the taste of ***Gentiana, Colocynthis*** and of many other substances is strong, although it is not felt on the tip of the tongue or in any other part whatsoever.

The root of ***Solanum lethale*** (as far as I remember) imprints its flavour especially on the palate and lasts there for four minutes.

The throat or pharynx is often the seat of the tastes. For several substances, although they produce no tastes on the tongue and the other

parts already mentioned, nevertheless inflict a quite strong sensation on the pharynx and throat. Thus the leaves of ***Bellis minor, Chelidonium minus*** etc., and also the roots of ***Jalappa, Mercurialis, Asparagus*** etc., when chewed, impress a scanty or non-existent sense of taste on the tongue; but the juice of these same plants, when swallowed, stings and irritates the pharynx in a particular way like sharp phlegm. This effect is not produced by other sharp and hot juices when swallowed such as those of ***Pyrethrum*** and ***Gentiana.***

Finally, by a term widely accepted, the gullet or the œsophagus can also be the seat or subject (as they call it) of the same taste. Thus, for example, the heat produced by the root of ***Absinthium vulgare***, which is first perceived on the tip of the tongue, thence first moves to its root, then descends into the throat and gradually into the gullet, so that at length it seems to warm the stomach itself with a feeling of heat that can last for a quarter of an hour, and that despite the fact that none of the juice whatsoever has been swallowed. But it is not unpleasant and does not affect the head as do the leaves. Whence it may be concluded in passing that this root, which is commonly rejected by everybody as useless, ought to be numbered among the most outstanding medicines for the stomach, as in truth I too have learned it to be from experience.

I omit what our author has to say about the causes of tastes, which may be sought in his own book, lest I wander too far from the olive grove (as they say).

On the other hand a careful and curious observation of the tastes in plants can be of outstanding use for investigating the powers of ones not yet understood or adduced, for since in those, whose powers are handed down, those with the same tastes have also been discovered to have the same powers, then what place does the same observation have in the case of those not yet passed down or discovered? Thus, for example, since ***Jalappa, Mercurialis*** and ***Bellis***, which have the same taste which roughens the throat, are all

powerful with a stronger or weaker cathartic force, it may be concluded that other plants too, which impress the same taste on the pharynx (and there are many of this kind) are also furnished with the same faculty of purging, to omit other examples.

Then in plants of the same kind, which differ in tastes, it is also very likely that they differ in powers too; in the same way as ***Rhabarbarus*** from the other ***Lapathi.***

It is also of the greatest importance to observe the differences in tastes of different parts of the same plant. Thus, for example, the bark of the ***Sassafras*** tree is three times as strong as the wood of the same tree, something which we also find in many other trees, which are commonly known. Whence it is likely that the barks of S***antalus, Lignum Rhodii, Lignum Aloe*** etc. (if they can be had) will be more efficacious and of greater strength than the woods of the same trees. The tastes of some parts of the same plant too are more delicate and pleasing to the palate than the rest, as for example the taste of the flowers of ***Carduus Benedictus*** than the leaves of the same plant. I have also shown [in the *Cambridge Catalogue of Plants*] and have confirmed by the examples given, that different parts of the same plant are sometimes endowed with different or indeed plainly contrary qualities and powers.

It is also worthy of observation how the tastes and powers of plants are either changed, or lessened, or plainly abolished and lost by keeping them, drying them or preparing them. Thus, for example, a root of ***Arum***, freshly dug up, is very bitingly sharp and pungent, but the same root, if completely dried, and especially if it is kept for a long time, turns out to be quite insipid, and then, as seems likely, is entirely inefficacious and of no strength. Let the judgement about other plants, whose virtue consists of a damp or vaporous part, be the same. The oils, which drip from many plants, are generally stronger than the parts from which they are drawn but in some, as in ***Euphorbia***, weaker.

Finally from what has been said above about tastes, our author concludes with the greatest of probability, that what they call specific powers

are inherent in some plants, that is in respect of some part of the body: brain, heart, liver etc., which some medical practitioners and philosophers deny all together and others call into doubt. For since one particular plant or part of a plant impresses the sensation of its taste on a particular part of the mouth especially and not on another, why does the same also, or another like it, not affect some specific internal part but not another likewise, especially since the parts of the mouth seem to differ less in texture and constitution than some inner parts amongst themselves?

I thought it worth the effort to translate most of these remarks here into Latin from the most learned book of Dr. Grew on the causes and differences of tastes, since they are most worthy of knowledge, and perhaps some, who read these words of mine, do not understand the English language in which they were written.

Chapter Twenty-five:

On the position of plants.

Plants can be divided in respect of position into:-

1. Those which are so restricted to some fixed position or site that they cannot continue to exist or even live at all elsewhere. Of this kind are ***Viscus arboreus*** and all undersea plants.
2. Those which, although they are predisposed to some particular place and are not found by chance growing somewhere of their own accord, yet admit of cultivation, and if care is taken can be grown in gardens, flower, produce seed and propagate themselves.
3. Those which are common to many places and do not reject almost any soil or climate.

The second kind admits of many subdivisions in respect of climate and soil. For some are happy in cold places, others in temperate places, others in hot places. Some are mountain plants, others of the plain, others of the woods, others of the fields, others of the marsh and water, others are maritime etc..

On the position of plants in respect of climate, I have observed that the nearer you come to the south and the path of the sun, the more species of plants you will find growing there of their own accord. For although the cold northern regions also have their own peculiar plants, nevertheless these are very few if they are compared with the multitude of those which only grow in the temperate and hotter regions. To which is added that the passes, tops or even the sides of mountains in hot regions resemble the low lying, flat and wooded regions of cold countries in the temperature of the air, in such a way that they produce almost the same plants and thus not even northern plants are deficient in southern regions.

Next many plants, which in cold and northern regions do not exceed the size of fruit bushes, in warmer areas reach the stature and magnitude of trees, as I have shown above.

Finally in hot regions many fruit-bearing species of herbs are seen, as for example ***Sempervivum majus, Althæa, Malva, Tithymalus, Scabiosa*** etc..

In respect of a higher or lower situation in the same region, I have observed that high mountains, whose tops are covered in snow for the greatest part of the year, are especially abundant in a variety of species. Certainly the Alps, which divide Italy, France and Germany, to this day suffice for the scrutiny of botanists with their inexhaustible provision of plants and with a great multitude remaining of ones that have still not been published. Nor is there almost any summit too high, particularly a rocky and steep one, which does not produce some peculiar species and ones which are not to be found elsewhere except on summits of similar height and nature. Indeed I have observed that even the highest mountains of all, and the summits of mountains, bear both the most and the rarest species of plants. This diversity of species seems to be due to the difference of the soil and partly also to the temperature of the air. For if mountains owe their origin to the movements of the earth, as is the opinion of that famous man Hooke, it is certain that material belched out from the bowels of the earth and piled up into mountains is not uniform on all summits, indeed not even on the same one, or of the same nature or temperament but most varied, whence it is no wonder that it produces different species of plants.

I have observed in addition that mountain plants are usually the largest of all their kind and produce the most beautiful flowers on parts of the mountains which are not too warm and which are exposed to the north winds. I declare that such a great fertility of soil and richness is to be put down to the snows, at least so it seems to me; either because the snow cherishes the roots like a garment spread over them and protects them from the injuries of the weather and the fierceness of cold, or because it makes the earth rich in nitrous salt, in which it is believed to abound, and fertilises it. For these reasons even our farmers want the snows of winter to lie for a while on the surface of the earth to protect what has been sown. But on the mountains, the moment the

snows have melted, in a short space of time the pastures have such a fast rate of growth that the mountain ridges give the appearance of verdant fields.

Chapter Twenty-six:

On the division of plants according to their genus.

It would be very difficult, indeed plainly impossible, to lay down a division of plants, in which the members or subordinate genera embrace all species, with no further anomaly remaining of the genus itself and which would limit each individual genus by its characteristic marks so that they would not be mutually communicable, that is, that no species could be found with an uncertain home (so to speak) and assignable to more than one genus.

For firstly the nature of the problem does not allow it. For since (as is usually said) 'nature does not takes jumps' nor 'passes from extreme to extreme except through an intermediary', she is accustomed to produce between superior and inferior kinds of things some species of a middle or ambiguous condition, which connect both as it were, so that it is entirely uncertain to which they belong as, for example, between plants and animals the so-called Zoophytes. Then also in each kind nature exhibits many singular and anomalous species, *sui generis* as they say, like exceptions from the general rules as a demonstration, that is, of her freedom not to be liable to any rules.

Nor in the second place, even if the nature of the subject allowed it, would the human condition admit it. For since the number of plants is enormous, in this narrow space of life, due to weakness of memory, lack of attention and fog of intellect, who would hope that he could ever attain such a universal catalogue of all species, such that it would be clear and distinct among individuals? Who can be so circumspect that he could pay attention to all the similarities and differences of all and comprehend them within one intellect, as it were, which nevertheless is necessary for comparing them with each other?

So I do not promise an absolute *Methodus* for all numbers of plants, since nature (as I have said) refuses to be confined within the limits of any rule. The *Methodus* which nature allows is not perfect and finished; for it is not given to one man or age to understand it; but I will be as accurate as possible in accordance with the narrowness of my mind and my modest

knowledge of these things.

However I reject those *Methodi*, which set out plants according to the places where they grow, or the time at which they flower, or their powers and uses, since all of these rules separate cognate species and unite alien ones. But I accept and employ the rule which takes the characteristic marks of genera to be the similarity and congruence of the chief parts, that is of flower, calyx, seed and its receptacle.

Chapter Twenty-seven:

On the division of plants into trees, shrubs, subshrubs and herbaceous plants: and of individuals into their subordinate genera.

The perfect plant is usually divided by botanists into tree, shrub, subshrub and herbaceous plant.

A tree [δένδρον] according to the definition of Jo. Bodæus à Stapel, of whose definition I approve, is a wooden plant, the largest of all in girth and height, of which the trunk is the part above the ground, perennial and by nature simple, which is divided into many larger branches and thence into many little branches, for example, ***Pyrus, Abies, Quercus*** etc..

A shrub [θάμνος], according to the same author's definition, is among the woody ones a medium sized plant in height and girth, which has a perennial stock as its part above the ground, naturally multiple, and which easily climbs to the form of trees by the cutting away of side shoots.

A subshrub [φρύγανον] is defined thus by the same scholar according to the opinion of the ancients: a plant of the least girth and height among the woody kinds, with a perennial stem, sometimes simple, sometimes multiple and with many twigs, with a small and thin leaf, such as ***Rosmarinus, Lavendula*** etc.. This definition contains no indications by which a subshrub may definitely be distinguished from a shrub, so I will give a more suitable definition in a little while.

An herbaceous plant [πόα], according to the same scholar's definition from the opinion of the ancients, is a plant such as ***Phyllitis*** etc., of which the part above the surface consists only of leaves, or consists also of a stem, but the latter being annual and fleshy and which cannot last any longer than a year and is not woody unless it has dried up.

This division, although it was commonly noted by each scholar

and accepted in all ages by popular usage and frequently adopted, nevertheless is not to be considered accurate and philosophical.

For firstly some plants are ambiguous between two types, so that it is difficult to judge to which they belong, some botanists ascribing them to one, others to the other. As for example, to Theophrastus ***Vitis*** is a tree, to the remaining botanists it is a shrub, to omit other examples. For nature, in plant life as in animal life, is accustomed to produce some species of a middle and ambiguous condition between the upper and lower orders, which, as it were, connect both so that it is entirely uncertain to which they belong.

Secondly, some trees, when their young shoots have been cut back, change into shrubs, and shrubs, when their side shoots have been torn away or cut off, easily turn into trees. Thus, for example, says de l'Ecluse, ***Lentiscus*** for the greater part only puts forth shoots, rising with many side shoots and twigs from one root; but sometimes when it is not cut but rather neglected (as I have observed in many places on the river Ana) it grows up into a tree of reasonable size. ***Juniperus*** too, a very common plant on the heaths of our country, when cut or eaten by cattle, generally puts forth shoots, but it grows up into a tree if it is allowed to and is not damaged. The same may be said about ***Buxus*** and (as it seems to some) about ***Ilex coccifera***, which are confined to the order of shrubs in Gallia Narbonensis for the same reasons. On the other hand ***Myrtus***, unless it is frequently pruned, becomes a shrub. Theophrastus, *Historia Plantarum*, Book I, Chapter 5. ***Comarus [Arbutus]*** is naturally weak but if its branches are pruned it rises to a great height just as does ***Malus Punica***. Bellon, *de neglect. stirp. cult.* Prob.12.

Thirdly, some plants in some regions do not exceed the size of shrubs; in others they reach the stature and size of trees. Thus ***Ricinus***, which is called an annual and not a perennial plant by de l'Obel in *Adversar.*, in Crete lasts for many years and grows to such a height that it cannot be climbed except by bringing ladders to it, as Bellon records. De l'Écluse too observed ***Ricinus*** on the coasts of Bætica having the girth of a man, the height of three men, branched with many very large branches and lasting for many years, and these

exactly fitted Dioscorides' description in *Schol. in Monard,* Chapter 4. I also observed frequently in the hedges in Sicily a small tree of ***Ricinus***, woody and perennial and resembling a ***Sambucus***. ***Rhododendron***, which elsewhere is small, grows in some places on the island of Crete suitable for making the beams of houses. Bellon *de neglect. stirp. cult.* Prob. 12. The same man says *Observ.* Book I, Chapter 43, that ***Rhododendron*** with red flowers grows to the greatest height on Mount Athos and its trunks are as large as that of ***Ficus*** in girth. ***Arbutus*** too, which in other places generally only puts out shoots, becomes a huge tree there. Bellon *ibid.* The female ***Cornus***, which the Gauls, in imitation of the Latins, call 'the bloody shrub', grows no smaller on Mount Castagnis, not far from the city of Philippi in Macedonia, than our larger male ***Cornus***. The same scholar observes in Book I, Chapter 56, that in many parts of Austria too female ***Cornus*** trees grow no smaller than male ones. De l'Écluse *Annot. ad dictum locum Bellon.* Subshrubs also grow in some places to the height even of trees. Josephus records a particular ***Ruta*** planted at Macæruntis in the palace itself, which was not overtaken by any ***Ficus*** either in loftiness or in magnitude. I too have seen a walking stick three cubits long of a sufficiently hard and solid wood made from the stem of a particular ***Ruta*** growing in Virginia, as a certain generous friend of mine recorded, who was accustomed to wield it and carry it around with him.

Fourthly and finally, some trees are similar to the nearest kind of shrubs and shrubs and subshrubs to each other and to herbaceous plants, and they have the same characteristics or generic and essential marks. Thus in the genus of ***Buxus*** one tree-like version is found and one diminutive; in the genus of ***Amygdala*** one tall one is found, another dwarf; the same thing happens in the genus of ***Ilex*** to omit others. But in ***Sambucus, Hypericum, Tithymalus, Sempervivum, Malva, Scabiosa*** and in many others the facts are very plain. For ***Ebulus***, which is an herbaceous plant in which the part above the surface dies back each year, has completely the same generic and essential marks as ***Sambucus*** (which is considered to be a tree by botanists). ***Tragium*** too (which is a woody shrub) shares its characteristics with

Hypericum, the tree-like ***Tithymalus (dendroides)*** with common herbaceous plants; the ***Sempervivum*** which grows into a tree, the tree ***Scabiosa*** of Crete, the tree ***Malva*** etc. are similar in gereneric marks to plants which share their names, and at first sight are acknowledged to belong to the same genus.

But not withstanding all these facts, since this division is widely recognised and accepted and has been approved by the usage of almost all ages and no other more suitable one occurs, I too will retain it but I will give more definite distinguishing marks between shrubs, subshrubs and herbaceous plants.

To begin with therefore I will divide plants by a double division into those which have an annual stem, or ones which if they have a perennial stem it is not woody, and those which are perennial with a woody stem. Those which have annual stems I call herbaceous, whether their roots are perennial or not. Some seem to be classed as herbaceous even if they have a perennial stem which is not woody, as for example some species of ***Brassica, Nicotiana*** whose stem is sometimes perennial, ***Malva arborea marina*** etc.. Plants which have a perennial stem are either bud producing, and yearly produce simple shoots without branches, or do not produce buds, producing sprigs in the same year sometimes divided into branches and little branches. These I call subshrubs: the former I still subdivide into trees and shrubs, between which so far I have not found any definite and fixed marks of distinction and thus I must be content with the definitions of them laid down above. I call buds the new growths of trees and shrubs, which they conceive each year in the autumn or sometimes even in the summer, covered in scaly wrappings like afterbirths in which they lie hidden throughout the whole winter, and, when it is over, in the new spring they begin to unfold into shoots as I have said above.

Therefore I distinguish trees and shrubs from subshrubs, because the former are bud producing but the latter very rarely. Therefore let a subshrub according to my definition be a plant of the smallest height and girth among those which are woody, not producing buds and with a perennial stem.

Or, a plant with a perennial stem, woody, not only producing simple shoots each year but having branches divided and subdivided into little branches and twigs.

But since most subshrubs have the same generic marks as herbaceous plants and are not very numerous, I include them with herbaceous plants and thus I define three main types of plants, the tree, the shrub and the herbaceous plant.

Moreover, having laid down the main types, it follows that I should examine the lesser or subordinate kinds of each of these.

Of these however the characteristic marks are to be taken not only from the seed and its receptacle (although from these chiefly) but also from the flower and its calyx. The shape and the constitution of the root and the position of the leaves are not to be entirely neglected. For the flowers and perianths of some genera show more definite and more conspicuous characteristics than the seeds or their coverings. Thus, for example, in the genus of ***Leguminosæ***, the butterfly-like flower is a marked characteristic, which all species of Legumes display to those who study them as if stamped on their brows, since it would be difficult to select an indicating mark of their genus from the number of their seeds or their receptacle, from their shape, their position or other accidental characteristics.

There is no reason why I should spend too much time on laying down a division between trees and shrubs, since the types of these are not very numerous. But since herbaceous plants are very numerous there is a particular difficulty in correctly distributing and cataloguing them. After much long consideration, no other difference seems to me more important or stronger than that which can be taken from the seedling. Therefore in the first place I divide plants into those which have a double-leaved or bivalve seedling, or if you prefer, are furnished with two cotyledons, and those which have a seedling lacking one or other leaf or cotyledon. In the latter the leaves which emerge from the earth first are similar to those that follow.

All plants of the latter kind, with few exceptions, ***Asparagus,***

Pæonia, Arum, Cyclamen and other similar ones, have grassy leaves. In respect of flowers they are divided into those having flowers which have no petals or are stamineous and those having flowers with petals or bracts. Those which have stamineous flowers are divided into ***Culmiferæ***, that is, those which produce a round, jointed and frequently hollow stem with single leaves wrapped round a single joint and into those which have grass-like leaves on a stem not divided by node-like joints. The ***Culmiferæ*** with a larger grain, whose seeds supply men with food, are called corns and cereals, the rest with a smaller grain are called grasses. Plants having petal-bearing flowers either have a seed receptacle divided into three chambers or are properly said to have a bulbous root, that is, either with many scales lying upon each other or woven out of many coverings with the outer ones enclosing the inner ones; or they have a tuberous root like ***Crocus colchicus, Asphodelus*** etc., or they have a fibrous root like ***Phalangium***, or they are berry-bearing like ***Asparagus, Arum, Dracontium*** etc..

Herbaceous plants of the former kind, that is, those which have a bifoliate or bivalve seedling, seem most conveniently to be able to be divided by the condition of the flower into those having a flower without petals or stamineous, that is, made up of stamens alone with a stylus and a calyx and lacking those transient, slender, coloured leaves, called by me, along with Colonna 'petals', which either fall or wither before the seeds mature, and into those having a flower with petals or bracts, furnished with those fleeting, coloured leaves.

Note. For defining a petal two conditions must co-exist:-

1. That it is thin and distinguished by some colour other than that of the herbaceous plant.
2. That it should be fleeting or deciduous, that is, that it either falls away or withers before the seed matures.

Plants, which have a flower furnished with petals or bracts, either have a composite flower or a simple one.

I call composite a flower which consists of many little flowers

coalescing into one whole flower. I call this a single composite flower rather than a column of little flowers because it is given a single pedicel and is included in a single calyx and because in many species it has a circle of flat leaves of different shape and size from the remaining little flowers at the edge encircling a central disc in radiate fashion.

Herbaceous plants with a composite flower either produce milk and have flat leaves which are usually naturally full. Or they are filled with clear sap. However these either have a discoid flower, that is one composed of many short compressed little flowers crammed together, disposed in one apparent surface, as it were, succeeded by a seed or pappus growing there, of which kind are the herbaceous plants called ***Papposæ***; or they have a solid and solitary pappus as in the case of the so-called ***Corymbiferæ***; or they have a pipe-like flower, that is one composed of many hollow, oblong little flowers, split at the edges into long flaps. In this type even the little flowers on the edges are pipe-like. These are commonly called ***Capitatæ*** because their calyx is scaly and generally swells out into a stomach shape.

Those which have a simple flower, that is, consisting of petals alone with stamens and a stylus, may be divided into two types in respect of seed. The first are those which have bare seeds, either in reality or only apparently, that is, they are not given any vessels or covering except the perianth. The others are those which have their seeds covered by a proper receptacle, which is distinct from the perianth.

Those which have bare seeds may be divided according to the number of seeds succeeding each flower, that is, into those which produce seeds for each flower as follows:-

1. A single seed.
2. Two seeds.
3. Three seeds.
4. Four seeds.
5. Many seeds of uncertain number.

Those having two seeds for a single flower are different in two ways. Some are

pentapetalous, generally spread into umbrellas and these are called ***Umbelliferæ***. Others have monopetalous flowers, divided into four, with many leaves surrounding the stems at single joints like stars and these are called ***Stellatæ***.

Likewise those producing four seeds after each flower are of two kinds. One kind has two leaves opposite each other on the stems at single joints and labiate flowers, and are called ***Verticillatæ***. The other has alternate leaves, or leaves positioned singly on the stem, and on which is bestowed the title ***Asperifoliæ***.

But since the seeds, which appear to be bare in some plants of this kind, are really not so but are included in little leaves or envelopes, I will emend the definition of this branch of the division thus.

Herbaceous plants with a perfect flower either have bare seeds or single seeds in single little sacs, which fall from the parent plant all at once.

Indeed in the *Methodus plantarum* not so far published, I consider as bare the seeds of ***Verticillatæ***, as they are commonly called, although in some as in ***Libanotis cachryophora*** I was not unaware that they have been given a nucleus distinct from the spongy bark, since in many of this kind the bark sticks closely to the nucleus and Theophrastus himself considers some seeds of this kind to be bare. The same thing must be said about the remaining seeds of this kind, as for example those of ***Stellatæ***, ***Asperifoliæ*** and ***Polyspermæ***, that I number them among the bare ones, because the little sacs, in which they are enclosed, adhere to the interior nucleus in many species, and in all (even in the ***Malvæ*** themselves) they fall together from the producing plant with the seeds included; and so they seem, and are commonly thought, to be not receptacles or wombs of seeds but only membranes wrapping them and to be analogous to afterbirths.

Those plants carrying their seeds in receptacles or in their own vessels distinct from the perianth can be divided into those which have seeds enclosed in a pericarp or in a damp or soft pulp. These are of two kinds, that is, either:-

1. With a larger fruit having a skin round it, on which the flower is situated. These are called ***Pomiferæ***. Or
2. With a smaller fruit clad in a thinner membrane, which are called ***Bacciferae***. And these also carry their seeds in drier receptacles. These too are subdivided into many types again. For they either have many disjoined receptacles succeeding each flower, which I call multi-podded, as for example ***Aconitum, Aquilegia, Delphinium*** etc.. Or they have single receptacles or conjoined ones, which I consider to be the cells of the same vessel, Cesalpino and others to be separate but conjoined receptacles. Moreover I divide these according to the number of leaves on the flower and according to their shape into:-
    1. Monopetalous, that is those where the flower consists of one continuous leaf, which is either uniform or diform. I have described a uniform flower above in the chapter on the flowers of plants.
    2. Tetrapetalous, equally with a uniform flower, which is succeeded by a seed vessel, either oblong as in podded tetrapetalous ones or short and abbreviated as in capsulated tetrapetalous ones: or with a diform flower, such as the ***Papillionaceæ*** so-called because their flower seems to a certain extent to imitate a butterfly with outstretched wings.
    3. Pentapetalous, which is either either properly pentapetalous, in which the flower consists of five distinct petals: or is apparently pentapetalous, in which the flower is in fact monpetalous since the flaps into which it is divided are joined at the bases, but it reminds one of a pentapetalous flower by its deep fissures almost reaching to the petal's base.

Chapter Twenty-eight:

On the collection, drying out and preservation of plants and their parts.

In the collecting of plants or their parts I am of the opinion that no consideration should be given to heavenly and astrological observations concerning the parts of the zodiac, the aspects of the planets and their configurations, influences etc.. For as far as I have been able to observe up to now, these are both uncertain and groundless and lack success.

Moreover I do not think it matters much at what phase of the moon plants have been collected, since I think that they are equally long-lasting whether collected at the waxing or waning of the star.

Finally I condemn all ridiculous observations about the method of collecting them which belong to superstitious vanity.

In general however I think that they should be collected when they are firmly established and vigorous, swelling with sap which is both bland and properly nurtured, and before they begin to go woody as their fibres then become hard; and as far as the weather is concerned, on a clear day when they have been completely dried out by the rays of the sun after the morning dew has evaporated.

Indeed (as Schroder rightly observes) the collection of plants has two ends in view: preservation and use.

For the sake of preserving them (as he continues) they are to be collected at that period of time, when the qualities which are conducive for keeping are in full vigour, such as dryness, warmth or moderate coolness.

For reasons of usefulness they need to be collected while the qualities are vigorous, which are more suitable for their use as medicine.

But I will now treat of the parts of plants by type.

1. As far as roots are concerned some judge that they should be collected in the spring rather than in the autumn, because then (before the sap has been taken up into the leaves and fruits) there is a greater and

more powerful strength in them and a more abundant liquid. By contrast, in the autumn they have a more sparing sap, since, by the passing of time, all their energy has been absorbed into the stems, leaves, flowers and fruits, and hence the root has been weakened. Others think that it is better to collect them in the summer when the plant is in full vigour and maturity. Indeed they think that just as in the case of a whole plant, likewise the root becomes invigorated by maturity. Others finally lay it down that it is better that they are collected in the autumn when the leaves fall and the stalks wither away for these reasons:-

1. Because all the liquid recedes from the stem to the root.
2. Many of them when left in the earth through the winter frequently perish at the approach of spring from cold, or they are rotted because they are frost bound, as, for example, ***Cichorium, Beta, Carrota*** etc..
3. In the winter the roots do not have anything else to nourish and so they are at liberty to feed themselves alone and should be strongest at that time.
4. When the cold of autumn arrives, it condenses the warmth of the roots and nurtures everything more exactly.
5. It is also a convincing argument that roots are stronger in the autumn, because when they are transplanted in the autumn they grow more easily than when they are transplanted in the spring. P. Lauremberg says all of this.

But these reasons do not put an end to the matter and there is an easy answer to them. For:-

1. There is no ebbing, to use the correct term, of the liquid from stem to root in the autumn; whatever else falls back into the same, the liquid which was in the stem evaporates and when its ascent is prevented by the cold a new liquid is not supplied from the root, after which the leaves fall and also at that time in some

plants the stem itself dries up. But it is necessary for the root hiding in the earth to swell with sap and therefore there must always be liquid available, which it absorbs from the earth and does not supply at all to the leaves and stems. Nevertheless it does not follow from this that the root is stronger in the autumn but rather in the spring after the sap has been enhanced by a long digestion in the veins throughout the winter and by a kind of circulation and has become more bland and more mature.

2. I concede that those plants which are rotted by the winter's cold must be excepted or even those which suffer harm and injury; for it is better to collect these in the autumn.

3. Since roots have nothing to nourish during the winter, it is likely that they are strongest at that time, not however at the beginning of winter but when by the passage of time their sap (as I have said) has been properly nurtured and matured.

4. I concede that the cold of autumn condenses the heat of the roots and nurtures everything more exactly. Therefore the longer the roots have experienced its insults (unless it is too vehement) and when the sap has been better nurtured, they become blander and more mature; as we find in ***Pastinaca latifolia***, the roots of which, if pulled up at the time of Quadragesima, feel far more sappy and pleasant than if pulled up in the autumn.

5. That roots transplanted in autumn grow more easily does not prove convincingly that they are stronger at that time. For they thus take more easily because all germination upwards is inhibited by the cold and they have nothing else to do but have time meanwhile for producing roots; nor are they distracted by putting out leaves and stems before they have become accustomed to the soil by the passage of time and have become firmly embedded in it. Added to which, during the winter the earth is generally full of liquid so that there is no danger to them

from thirst, when in summer they generally perish because the heat evaporates the dampness of their surroundings.

Therefore I think that the roots of all herbaceous plants are to be collected when they have reached their full maturity, before they begin to put out a stem: some in the autumn, others in the summer and most in the spring: the roots of annual plants in the summer: of biennial plants, if there is a danger that they might be rotted by the winter's cold or might contract a disease as do ***Carotæ***, at the beginning of autumn. If they easily tolerate the winter and do not become woody, they should be collected at the beginning of the spring before they begin to grow, as in the case of ***Pastinaca latifolia***; but if they begin to become woody before the end of winter they should be collected during winter itself, as for example in the case of ***Rapa***. Those which die at the roots when the stem has grown should be collected in spring before they begin to grow. Most roots of perennial plants also demand to be collected at this time. Some, however, such as ***Acetosa, Althæa, Asarum, Buglossus, Cyclamen, Dracunculus*** etc. can be collected at any time of the year except winter. The reason why the roots of most plants are to be collected before they put out a stem or begin to grow is because when they put out a stem the sap abandons the root for it and the root fibres become woody.

Flowers are to be collected (as Schroder rightly says) when they luxuriate in their beauty but are not becoming withered, except for a few, which require to be collected when in bud, such as ***Rosa, Jasminum*** and similar flowers.

Herbaceous plants and leaves should be collected when their scent, colour, taste and top are at their best and when they are near to flowering, that is to say for medical use or for making a dry *Herbarium*; for when they are too young their sap is too watery and almost the whole plant dissolves into liquid and evaporates. For this reason too they do not cut grass for hay before it has formed a stem. For although it is better for pasturage while it is still young and fresh, nevertheless it is no good for drying into hay, because, although at that time it swells very much with liquid, yet, after it has dried up as the sap

evaporates, very little solid remains for food and it contracts almost to nothing. Then too sap which has been too little raised provides nourishment which is not firm and solid enough. Finally that specific sap, contained in its own vessels, in which the whole strength of the plant such as this is contained, needs some time to be correctly prepared and to mature.

For use in cooking, or in salads, or for vegetables, herbaceous plants are almost better while they are still tender and newly grown, as we see in ***Asparagus, Lactuca, Portulaca*** etc..

Herbaceous plants, in so far as they are mostly preserved for medical use with their flowers, are to be collected when their flowers are at their best, as in the case of ***Calamintha, Centaurium, Chamædrys, Chamæpitys, Daucus, Fumaria, Majorana, Origanum, Polium, Pulegium, Serpyllum, Thymus*** etc. Schroder.

Seeds are to be collected when they are well matured and have begun to dry but have not yet fallen: *idem.*

Fruits are to be collected for medicine when they are well matured, as the same Schroder rightly says. They are to be collected for preserving, as the same man says in *Babt. Porta in Mag.*, before they have entirely matured and are not completely harsh, nor have reached their proper maturity.

But I rather approve the advice of those who advise that fruits are not to be collected before their full maturity. The signs of maturity moreover are that they begin to fall of their own accord or that their grains or seeds begin to change colour and to become black.

For those which have been plucked when immature shrivel too much and become wrinkled, and their flesh is dry and tough.

There are doubts about the drying of plants and their parts. For the majority of doctors prescribe that they be dried in the shade. But I rather agree with those, who order that they be dried quickly and in the sun, which I find is also most suitable for drying hay. For the quicker they are dried the better. For those which are dried in shade, unless diligent care is shown, easily

contract mould and rust, and eventually rot. But if you want flowers and leaves to retain their natural colours for longer it is better to dry them in shade. But when I say that leaves, flowers and the tips of plants are to be dried in the sun, I do not wish them to be laid out individually and exposed to the rays of the sun but that they should be piled in little heaps and turned quite often until they are properly dried.

Soft fruits consisting of pulp, such as ***Prunus*** and ***Uva***, need to be dried out in the sun or in an oven: the rest do not need to be dried out.

For making a dry *Herbarium*, the leaves and flowers of plants, when they have been carefully unfolded, must be placed between dry pieces of paper and moderately pressed; for if they are pressed too hard their vessels are broken and the liquids are mixed up and they change colour and go black. Thence they must quite often be transferred to new and dry pieces of paper otherwise they easily become mouldy and rot. When they have become completely dry, I say that they should be left resting on the paper rather than glued to it, since glueing is less firm and durable.

The leaves, flowers and tips of herbaceous plants, after they have been properly dried, should be kept in little paper packets (others prefer leather wallets), and these should be shut up in wooden boxes and deposited in a dry and cold place rather than a warm one. For heat, by agitating the spiritous and odiferous parts (in which the strength of plants is chiefly housed), makes them able to be easily evaporated and to vanish. Certainly it helps preserve them for a long time to exclude the air carefully from them, the air which evokes and dissipates the active parts of a plant exposed to it for a short time. For the particles of air are in perpetual motion and moreover as they move they divide and carry off with them the more volatile parts of the plant, especially if the weather is warmer. For it is a property of heat to separate and divide parts from each other in turn by agitation. But if this were not so and the parts of plants liable to evaporation breathe no less in a closed vessel than in the open air, nevertheless the sides of the vessel prevent them receding further and moreover reflect them back again onto the enclosed plant and there create a certain

circulation as it were. Hence I disapprove of that method of collecting herbaceous plants into bundles and suspending them from the roofs of workshops.

Fruits, which do not require to be dried, such as ***Malus*** and ***Pyrus***, are quite conveniently kept exposed to the air and piled up in heaps, provided that they are kept in a dry and cold place; for if the place is too warm I have learned from experience that they lose their sap and so shrivel and become wrinkled. But so that I might not be excessive, see the various methods of preserving fruits in P. Lauremberg, *Horticulture*, Book II, Chapter 3, § V.

Seeds in their receptacles are best kept in a rather cold and dry place; quite conveniently they can also be kept in little packets or envelopes made of paper and then shut up in wooden chests and placed in a dry place, which is not too warm. For too much heat dries seeds to such an extent that they become unsuitable for germination.

Some seeds, if they are properly preserved, keep their fertility for a whole ten year period and still germinate when sown. They experience the greatest damage from dampness and thus are disposed to rottenness. Nevertheless (which is amazing) when received into the bosom of the earth, however much they are almost continually soaked throughout the winter, yet they hide there safe and undamaged and the next spring more promptly and quickly germinate than those which have been most diligently kept, as I hint above.

Chapter Twenty-nine:

On the chemical analysis of plants and the use of their dissolved parts.

Putting aside that greatly celebrated controversy between chemists and philosophers as to whether fire is a true analyst of substances, it is usually noted that the constituent elements of vegetables are spirit, salt, phlegm, oil and earth.

Vegetable spirits are either vinous or urinous: the former either vinegary or sulphurous: the latter are indeed nothing other than volatile salts dissolved in ordinary phlegm. Salts are divided into volatile and fixed: the former into urinous and oily (for the oily ones sometimes coagulate into salts of their own kind): the latter into essential or marine, into alkaline and even into sugars. Phlegm, depending on whether it contains more or less salt or oil, gains various epithets such as simple, insipid, watery, cold, white, aromatic, bitter and warm; properly speaking phlegm in itself is elementary wetness. Oils are either distilled or squeezed out, and these are either odoriferous, balsam-like, fœtid, inodorous, inflammable, air-like or thick etc.. Earth is said to be rejected and insipid, although sometimes it can serve for various operations and uses, which some chemists know very well. These elements of vegetables are interchangeable amongst themselves for they are secondary elements.

The means of eliciting and preparing these elements or vegetable substances from seeds, fruits, flowers, leaves and other parts of plants by putrefaction, fermentation, division, distillation, separation, rectification, incineration, boiling, filtration, evaporation or crystallisation are so well worn and familiar to all that there is no need 'to put a cabbage so often cooked on the table'.

In the medical schools it is most notable that the vinegary spirits have the power of an antidote, that they subdue volatile and poisonous bitterness and control ungovernable humours and blunt them; whence among chemists they very frequently are used instead of a correcting liquid in the

preparation of ***Antimonium, Saturnum, Helleborus, Opium, Arum*** etc..

Sulphurous spirits are inflammable, they make one drunk, they fire the blood, they take away the nectar of dewy parts and they dry out the straining of the guts and they also make liquids bitter, whence those who drink them most frequently turn out to be consumptive, hyperactive or hydropic. Nevertheless when moderately consumed they are used as cordials and often revive the flagging strength. In external applications they are of excellent use against hypothermia and they also serve for extracting tinctures and resins.

Urinous vegetable spirits and volatile salts produce sweating and are diuretic; they destroy acid and unite themselves with it, whence a composite salt is resolved into something like ***Armoniacum***. They resuscitate and restore torpid, thick or dead blood and make it fluid and volatile again; they are very pleasing to animal spirits and to people of a nervous disposition, as a result of which they are of help in scorbutic, cephalic and convulsive afflictions. But it must be noted that these salts or urinous spirits, if frequently or copiously drunk, depress the appetite and impede the digestion. For they blunt the glandular fermentation of the primary paths and sometimes arouse hypochondriacal, convulsive and scorbutic paroxysms (although it is admitted that they can also eradicate and remove the same) by fermenting with the disease-producing material, which very often has an acid texture.

The volatile salts of plants rarely ascend into a distilled state in a dry form or adhere to the sides of the vessel but mingle with the liquid and are dissolved. This is clear from their smell and when mixed with acids. These urinous and volatile spirits are rendered fixed with the spirit of salt or spirit of vitriol. Some affirm that all of this volatile salt arises from tiny creatures very abundantly found in rotten plants, but these people indulge their imaginations too much; for many experiments make for a contrary view. These urinous spirits or volatile salts are not only elicited from warm, aromatic or what are commonly called anti-scorbutic, cephalic and stomachic plants, such as ***Cinnamomum, Galanga, Zingiber, Cochlearia, Arum, Nasturtium,***

Lepidium, Beccabunga, Raphanus, Rosmarinus, Majorana, Salvia, Ruta, Lavendula, Thymus, Mentha, Absynthium, Chelidonium etc., but also from colder or tasteless plants such as *Gramen, Papaver, Lactuca, Portulaca, Endivia, Acetosa, Sempervivum, Melissa, Muscus, Nymphæa, Lenticula palustris* etc., which the experiments and arguments of Drs. Wedel and Cox have placed beyond doubt. This is to be understood as applying to vegetables, while they are fresh and green. The seeds are said to be for the most part very fertile with this salt.

Phlegm mostly performs a function as a vehicle and serves for julep; Laudanum, spirits, tinctures and oils can scarcely be produced without a suitable vehicle.

Distilled oils have their uses both internal and external; for they rarefy, penetrate, disperse and strengthen, but nevertheless must be taken internally with care and judgement, lest by their inflammable propensity they bring fever to the blood and a burning to the guts particularly in infants. But oils that are pressed out and cooked are richer and lubricate and loosen and are conveniently mixed with distilled oils, for thus both the warmth of the latter and the sluggishness of the former are corrected, as Wedel rightly advises. They also serve for various mechanical uses.

Fixed salts seem to differ in their powers, tastes, shapes and other qualities in accordance with the plant or the operation. Nevertheless all of them blunt and destroy acids and open and dissolve coagulations; whence they are of help in consumption, hypochondriacal afflictions, jaundice and fevers. Our most famous Cox confirms that these salts do not differ among themselves; but Dr. Grew shows that they are discrepant in their powers; and Dr. Lewenhœck demonstrates that they vary very much in their shapes. They also serve for making glass and soap.

Wedel seems (at least in my opinion) to have hit the nail on the head, confirming that salt and alkali do not differ from one another in kind, external form or general effect, but they are not, however, at all similar in shapes, porosity and strengths.

Essential salts and marine salts crystallised from alkalis, for the preparation and shape of which see in Dr. Grew's works, have their uses in medicine for purging or cleansing; nor do they so easily blunt and debilitate the fermentations of the guts as do volatile and alkaline salts.

Salts or sugary concretions (such as come from the saps of ***Fraxinus, Acer major, Canna Indica*** and the so-called ***Arbor Coco***) aid factories in making syrups, conserves, medicine that melts in the mouth, seasonings etc. and have various domestic uses. Nevertheless the most famous Willis and also St. Paul contend that scorbutum, consumption and other chronic diseases are generated and propagated by the use of these. For they contain sharp and corrosive particles mixed with round and dewy ones, moderating the sharpness, which manifests itself by distillation.

Decoctions of plants, provided that they are produced closely and with care, are numbered among the best preparations; for they, for the most part, contain the strengths and virtues of vegetables as do tinctures, extracts and powders. Nevertheless single parts of plants dissolved by chemical analysis are not endowed with all the specific virtues which we find in the plants themselves; very often they are capable of doing separately what they cannot do jointly.

Vegetable saps when fermented produce all kinds of wines and inebriating liquors, which take various names and qualities in accordance with the nature of the plants and their regions, and are primarily useful as necessities for human life, provided that they are soberly used following the safety rule of nature. These saps are collected either by incision or by soaking and pressing. Thickened saps are called Rob, which comes about either by cooking alone or by an admixture of sugar or honey. Rob diluted with liquids makes efficacious essences or serves as the basis for sweets and pills. Gums or resins seem to be nothing else than vegetable saps cooked, dissolved and coalesced more. All are effective in accordance with the characteristic of the plant; hence they are called diuretics, cathartics and narcotics: for example ***Terebinthina, Gummi Gotta, Opium*** etc..

Better and more noble medicines are derived from urinous spirits, salts and oils, mixed up together and joined together by separating, circulating and distilling in repeated turns. Balsams and soaps are composed of alkalis and oils and are of excellent use in pharmacy and mechanics.

Vegetable tinctures and extracts are best elicited and prepared with spirits or purgations drawn from the plants themselves, for substances are most easily dissolved by their own spirits or purgations; for example, the tincture of roses is extracted by using the spirit of roses itself.

Colours or varnishes are elicited from flowers with the strained and purified juice of lemons: or with a well filtered alkali derived from living chalk and crushed ashes or with soda. This is done by separation, decanting and evaporation. These colours or varnishes serve for painting flowers and for colouring or painting other things, when they are dissolved and prepared in water containing gum, or with the albumen of an egg; and they also have their own uses in pharmacy.

That most brilliant man and particular friend of mine, Dr. Tancred Robinson M.D., contributed this chapter on the chemical analysis of plants and the use of their dissolved parts.

Chapter Thirty:

On the diseases of plants and their remedies.

Although many things have been said by others about the diseases of plants and their remedies, still more may also be said with profit by those who have spent much time and effort on their cultivation and observation. Nevertheless observations and experiments are not for me because I have something else to do and because I contemplate the plants, as it were, in passing and only for the sake of my soul, and there is almost nothing that can be said which has not already been said by others. I would rather send the reader to them than tediously waste my time in writing out their commentaries. For this reason I will finish this chapter in a few words and put an end to this first book.

The diseases of plants are either internal or external.

I call internal those which derive their origin from the nutritional sap held within. For this produces diseases in plants, if either it is too sparingly provided, or flows too copiously, or if it is too cold and watery, or is imbued with any malignant or harmful quality. There is no doubt that plants no less than animals waste away and at length are killed by hunger. Some struggle from obesity because of too much food according to Pliny:

> as all those which carry resin are changed into the pitch pine tree by too much richness; and when their roots also grow too fat they begin to die as do animals with too much fat.

There is also another disease from too much rich food, which the Greeks call 'running to leaf without seeding', when trees or even herbaceous plants have so many leaves or fronds that they produce either no fruit or very little or meagre fruit.

> This over abundance is corrected in crops by the teeth of the flock, provided the corn is still in the blade, and indeed when eaten down even several times it suffers no injury in the ear.

But cutting also is of use, whatever Pliny may say to the contrary. Most plants are particularly damaged by too much liquid continuously feeding the roots or

flooding them, either because of cold, which is the worst enemy of vegetation, or perhaps the liquid by obstructing the pores prevents a free contact and influx of air to the roots. Hence heathers occupy the whole land far and wide, and very few other plants besides grow on the northern mountains of England and Scotland, where the soil, which is marshy, thin and containing a lot of fungus, drinks and retains water like a sponge. Hence plants planted in clay pots, which have a base with no hole, languish and do not come to fruition; although in these perhaps the fact that the water is also stagnant helps to rot them and leads to the corruption of the plants. Hence, unless I am mistaken, too much constriction and density of bark on trees, which impedes the free ascent of the sap, also does not permit the trunk to be extended sideways and to increase. Our gardeners treat this evil by cutting the bark lengthwise by drawing some lines down it; as a result in the end the trees are infested with moss, which derives its origin from raw, cold water. I am doubtful whether rust of corn and some grasses is to be classed with internal or external diseases. Certainly the disposition towards this disease lies in the seed itself, although perhaps some precipitating or external cause may be produced, which acting upon material prone to disease easily induces disease. But rust will be more widely treated in the chapter on corn.

I call external diseases those which are induced by an external cause. External causes, which produce diseases, are either injuries of the weather and of storms, or holes made by insects, erosions or even malignant breezes. An evil of the weather (to use Pliny's words) and the greatest pest in crops is *Rubigo*, which we call in English Mildew. This is most common in a dewy place and in valleys, which do not have air blowing through them; in contrast windy and lofty places lack it. Pliny proposes a superstitious and magic remedy, that is, planting branches of ***Laurus*** in the field, into the leaves of which the curse passes from the fields. I would rather approve the religious rites and solemn feast days, which they instituted for averting this pest, calling them *Robigalia*, if only they had been sacred to a true divine power and not to certain false and fictional deities.

Many tumours and swellings in plants, which that great man Marcello Malpighi embraces under the general name of Galls and whose history and anatomy he follows through, with his accustomed sagacity and exactness, in the second part of his *Anatomy of Plants*, owe their origin to the punctures of insects, erosions or even noxious breezes. Moreover he concludes this tract on Galls thus. Therefore Galls and the remaining tumours of plants, which are diseased excrescences, erupt from an egg laid [by an insect], and are developed from the disturbed structure of the plants and the spoiled movement of liquids, in which the eggs and larvæ are enclosed as though they are fostered and increased in the uterus until, with their proper parts distinguished and strengthened as it were, they swell up seeking fresh air. For he demonstrates above, by giving many examples, that tumours of plants and the remaining diseased parts foster and feed flies and different kinds of insects until they are freed and make their own way out. For (he says) many insects bring forth their eggs lacking almost all enlarging sap, some of which are deprived of cortex so much so that a soft primeval conglomeration of parts occurs like a kind of worm. Therefore so that the animal which is enclosed may acquire a due manifestation and solidity of parts, it demands a womb or at least something to take its place, which the cunning nature of insects finds in plants. For which reason because of the differences of the eggs and the needs of the animals contained within, eggs are deposited or laid variously by their parent flies in different parts of plants. For those, which are protected by a strong cortex and enclose food along with the animal, are well protected by whatever part of the trees has been made diseased. But those which are softer are laid on the leaves themselves, or, if they need a better supply of liquid and greater protection they are laid within the young body of the bud. They are placed within shoots, flowers, catkin, pericarp, seeds, wood, roots and almost all parts of plants by means of the ovipositor, with which Gall flies are more able than the rest. For the root of the ovipositor, which I have mentioned, is attached to the ovary so that eggs distributed among many tubes are propelled out through a common duct, as if through the womb or vagina from the base of the ovipositor. It is

possible to add the evidence of the senses to these conjectures. Once near the end of June I saw a fly [such as he described elsewhere] sitting on a still germinating bud of a ***Quercus***. For it was clinging to a stable little leaf bursting from the apex of the gaping bud, and with its body bent into an arc it was unsheathing its ovipositor and was plunging it in, after it had become stiff, and with swollen stomach was developing a swelling around the root of the ovipositor, which it kept putting out at certain intervals. Thus on the leaf, after I had removed the fly, I found tiny diaphanous eggs which it had ejected like those which still remained in its tubes. Thus so ferocious a family of flies breaking out of Galls, since nature dictates it this way, by the use of its ovipositor or double file wounds and drills the soft parts of plants, so much so that from their different nature and structure different diseased excrescences and tumours equally emerge. For from the liquid, which is injected dripping from the end of the ovipositor and which is particularly active and effervescent, a new fermentation or a motion of the intestines is aroused in the young growing particles, so much so that the nutritional sap moving forward, collected in the transverse *utriculi*, and filled up with strange air, begins to ferment and swell, as frequently in us and perfect blood-bearing animals as a result of a wound inflicted by bees, after which we feel the serum which has been injected within. But the diseases are not only aroused as a result of the wound and the effervescent liquid that is injected but the parts of the plants are affected and consumed by the breath itself of the egg or of the insect. It is more wonderful (says that same most famous Malpighi) what happens everywhere in the leaves of ***Vitis, Quercus*** and similar trees from one or two tiny eggs of a fly left there; for the fibres are squeezed and the whole leaf withers, twisted into a spiral around the egg that has been laid. Indeed so great is the strength of the deposited egg that not only the leaf in question, but the whole young branch dries up as a result of the disease being communicated by the pedicel and thence through the whole shoot and through the leaves hanging from it, twisted into a spiral with complete loss of colours. Dr. Malpighi says all of this.

It must be noted however that not all tumours and excrescences

of plants are produced by wounds inflicted by insects or by poisoned breaths but some arise from an internal source, that is as a result of the nutritional sap being altered or faulted in some way and departing from its proper mixture and consistency. Sometimes also they arise from an external binding or pressure, or from a contusion preventing the nutritional sap from flowing freely through its proper vessels. For, since it is always provided in abundance by the root and is prevented from continuing its course for the reasons given, it spreads to the side, and bursting the vessels by its force produces tumours. But for this, the recently praised book of the most famous Malpighi should be consulted. Let us be content with this and finish this book.

General table of herbaceous plants showing the main types.

Herbaceous plants are either:-

Imperfect, which lack or seem to lack the principal parts, that is flower and seed, but especially the seed, and so have a spontaneous origin: such as several species of ***Fungi, Algæ*** and ***Mosses.*** Book II.

Or

More perfect, which are endowed with flower and seed, or at least with a seed. These are either with a seed, which is either:-

Very small and inconspicuous to the naked eye so that most of them before the invention of the microscope were considered to be sterile by some botanists, even by those of great fame; examples of these are the herbaceous plants called ***Capillares*** etc.. Book III.

Or

Larger, which are in the seedling either:-

1. Bifoliate, or
2. Single leaved or leafless.

Bifoliate is either bivalved or formed from two cotyledons. These when sown from seed emerge from the earth usually with two leaves in the first instance; more rarely they do not put forth above the earth valves or cotyledons with the appearance of leaves. Moreover they are, in flower, either:-

Imperfect or stamineous, that is composed of stamens alone with a stylus and a calyx, lacking those tender little leaves, which are fleeting and coloured and which we are accustomed to call petals. Book IV.

Or

Perfect, or petalled or bracteate, formed with those fleeting leaves. Moreover these are either in the same way:

1. Composite, or
2, Simple.

Composite is either compiled from many little flowers coming together into one whole flower, which is either:-

1. Flat-leaved, or
2. Discoid, or
3. Pipelike.

Flat-leaved is usually naturally full and on a milk-producing plant. Book V.

Or

Discoid, that is from many short, compressed and closely packed little flowers composed into one, as it were, apparent entity, followed by seed.

Or

Pipelike, that is composed of many hollow, oblong little pipes, cut into long flaps at the edges, even with the marginal flowers pipelike; this genus of herbaceous plants is called ***Capitatæ***. Book VII.

The seeds of discoid flowers are either:-

Bearded, carrying a natural tuft, as in those thus called ***Papposæ***. Book VI.

Or

Solid and lacking a tuft as in ***Corymbiferæ***. Book VIII.

Simple, either consisting of petals only with stamens and stylus.

These are either with seeds:-

1. Bare, or
2. With proper receptacles, which are endowed separately from the perianth.

Bare, that is having been given no capsule or covering except for a perianth; in the case of individual flowers either:-

1. Single, or
2. Double, or
3. Triple, or
4. Quadruple, or
5. More than four.

Single. Book IX, Part 1.

Double, with flowers either:-

Pentapetalous, with petals disposed usually in the form of an umbel, as in ***Umbelliferæ***. Book IX, Part 2.

Or

Monopetalous, with petals cut into four flaps, with leaves surrounding the stems in a star pattern at the nodes, as in ***Stellatæ***. Book X, Part 1.

Triple, of which kind is the plant called ***Nasturtium Indicum.***

Quadruple; these have leaves on the stem which are either:-

In twos opposite each other with labiate flowers surrounding the stems mostly in the fashion of whorls, as in ***Verticillatæ***. Book XI.

Or

Alternate, or positioned in no order, with Monopetalous flowers having the margin split into five; thse are called ***Asperifoliæ*** because of their rough leaves in many species. Book X, Part 2.

More than four, with no certain or definite number, which I call ***Gymnospermæ polyspermæ***. Book XII.

With proper receptacles, which are endowed separately from the perianth, consisting of either:-

1. A soft pericarp, or
2. Material which is drier through maturity.

A soft pericarp, either with a pulp surrounding the seeds with dampness for the maturity of the fruit; these have a fruit either:-

Larger, covered with a thicker cortex, whose monopetalous flower sits on the five-sectioned margin and also has larger seeds: these are called ***Pomiferæ***. Book XIII, Part 1.

Or

Smaller, clothed in a thin membrane with even smaller seeds: these are called ***Bacciferæ***. Book XIII, Part 2.

Material which is drier through maturity. Moreover these contain the seeds in either:-

Many distinct receptacles succeeding one flower, which I call ***Multisiliquæ***. Book XIV.

Or

Solitary and single receptacles, either conjoined, which I divide in respect of flowers into:-

1. Monopetalous, or
2. Tetrapetalous, or
3. Pentapetalous, or

Monopetalous, which are in flower either:-

1. Uniform, or
2. Diform.

Tetrapetalous, with flowers divided in the same way either:-

1. Uniform, or
2. Diform.

Uniform, which is either:-

Siliquosæ, with an oblong capsule succeeding the flower.

Or

Siliculosæ, or capsulated with a short capsule succeeding the flower.

Diform, resembling a butterfly to some extent with wings outstretched, which therefore they call ***Papilionaceæ.***

Pentapetalous, either:-

True and genuine, in which the flower consists of five distinct petals.

Or

Apparent, in which the flower is really one petal, since the flaps into which it is divided are joined at their inner ends, but seems pentapetalous because of the deep cuts reaching almost to the inner point.

Single leaved or leafless, that is, either given only one or no cotyledons, and thus it emerges from the ground with leaves similar to those that follow. These either have:-

1. An imperfect flower, or
2. A perfect flower.

An imperfect flower, or stamineous flower, which is either:-

1. ***Culmiferæ***, or
2. With a stem not interrupted by jointed nodes.

Culmiferæ: that is, those which put forth a rounded, jointed and frequently hollow stem, with individual leaves growing round it at individual joints; they either have a grain which is:-

Larger, whose seeds give mankind food, called corn and cereals.

Or

Smaller: Grasses.

With a stem not interrupted by jointed nodes, or not rounded. ***Graminifoliæ*** with stamineous flowers.

A perfect flower or petalled flower, which are either in the root:-

Bulbous, that is, covered by many wrappings, the outer ones encircling the inner ones.

Or

Tuberous or fibrous, which I say have an affinity to bulbs.

Among these I list some plants, producing seeds enclosed until maturity in a moist pulp, such as ***Arum*** and ***Dracontium***, which since they do not have generic marks in common with others, I would place more correctly among the ***Bacciferæ***.

Table One:

Imperfect plants.

I call **imperfect plants** those which lack a flower and a seed, or at least seem to do so, since neither flower nor seed has been observed in them up to now, and so they are believed to come into being spontaneously. These can be distinguished according to their place of origin as:-

1. Water plants, or
2. Those growing outside the water.

Water plants, which are either:-

1. Marine, or
2. Inhabitants of sweet waters.

Marine, which in consistency is either:-

Rather hard and stony, as are many species such as ***Corals***: red corals and tufa.

Or

More tender and herbaceous, referring to:-

1. Herbaceous plants, or
2. ***Moss*** or ***Fungus.***

Herbaceous plants, with fruits either:-

Greater and almost stem-bearing, such as ***Lichen.***

Or

Smaller such as ***Algæ.***

[Many species of each kind are observed.]

Moss or ***Fungus*** such as ***Sponges.***

Inhabitants of sweet waters, either having leaves:-

Absent, with either capillaries or with filaments, as ***Conferva.***

Or

Split into three, such as ***Lens palustris, Lenticula.***

Growing outside the water, which are of a substance either:-

1. Thicker, or
2. Thinner and drier.

Thicker, resembling either flesh or wood. These have almost nothing in common with more perfect plants; for neither herbaceous colour, nor similar texture, nor any flower or seed or proper leaf is present in them; they are ***Fungi***, which are either:-

1. Tree-borne, or
2. Earth-borne, or
3. Subterranean.

Tree-borne, which can be distinguished in accordance with the trees on which they grow; moreover peculiar names are assigned to them: the fungus of the ***Larix*** is called ***Agaricus***, the fungus of ***Sambucus*** is called ***Auricula Judæ***.

Or

Earth-borne, and these are either:-

1. Stem-bearing, or
2. Lacking a stem

Stem-bearing, which are either:-

1. Pileate, or
2. Non-pileate.

Pileate, beneath a felt cap either:-

Lamellate, of which many species are edible and harmful.

Or

Porous: ***Fungus porosus.***

Non-pileate, which have a stem either:-

Simple: ***Fungus ophioglossoides***, the fingered fungus.

Or

Branched: ***Fungus ramosus.***

Lacking a stem, either:-

Thinner, having a membrane or skin: the ***Pezicæ*** of Pliny.

Or

Thick and formed into a round shape: ***Fungus pulverulentus, Crepitus lupi..***

Subterranean: 'tubers of the earth'.

Thinner and drier, approaching closer to the nature of herbaceous plants. These are either:-

Stem-bearing and branched, of many species: ***Mosses.***

Or

Lacking a stem, encrusted only on the upper face of the earth, creeping either on trees, wood, stones etc.: ***Lichen,*** both arboreal and terrestrial.

Plantsmen closely mix up the names of ***Lichen*** and ***Algæ*** and it is, in truth, very difficult to reduce these plants to any genera, which differ in certain essential characteristics.

Those which are thought to be ***marine mosses*** by botanists are to me species of ***Algæ***.

I distinguish marine plants from maritime thus: that those are called marine which float perpetually in water or at least are covered by the individual waters of the tides when they come in: those are called maritime which grow outside the water on the sea shore, or in the marshy neighbourhood of the sea or elsewhere in the confines of the sea.

Except for mosses deprived of seed, about which I treat in this table, there is also another genus of small plant with the same name, bearing a very small seed, about which I will deal in the following section.

Sennert in *Hypomn. Phys.* probably thinks that tubers and all fungi come into being and are born from plants.

Table Two:

Herbaceous plants with very small seed, which is scarcely visible to the naked eye, are either in the same way:-

Born after the leaves have fallen: see the following table.

Or

Born on or sitting on the stems themselves or on the stripped pedicel: these are either:-

1. More imperfect, or
2. More perfect.

More imperfect, perennial in appearance, either:-

1. Lacking a stem, or
2. Stem bearing.

Lacking a stem, spreading themselves widely with leaves creeping along the surface of the earth, bearing their seeds on pedicels arising from the leaves: ***Terrestrial Lichen.***

Or

Stem bearing, which are either:-

1. Greater, or
2. Smaller.

Greater, either:-

1. Spiny, or
2. Non-spiny.

Spiny and creeping, either:-

Fir-like: ***Lycopodium.***

Or

Cypress-like: ***Sabina sylvest.***

Non-spiny and erect: mossy or fir-like or polyspermic.

Smaller with seed capsules, either:-

1. Terminating the stems, or
2. Growing out of the sides of the stems.

Terminating the stems: ***Adiantum aureum.***

Or

Growing out of the sides of the stems: either erect or creeping such as ***Terrestrial Moss.***

More perfect, annual in appearance: they are either:-

1. Single leaved, or
2. many leaved.

Single leaved, either:-

1. Spiny, or
2. Paniculate.

Spiny, with a whole simple leaf: ***Ophioglossum.***

Or

Paniculate, with a leaf composed of many segments: ***Lunaria.***

Many leaved, with many rounded leaves, which surround the stems at the nodes in circles in the manner of wheel spokes: with leaves and stems jointed in box-like fashion: ***Equisetum.***

Although moss is also recognised by a very unskilled person immediately on sight, since that name is spread very widely, it is very difficult to embrace all its differences in one definition.

HISTORIA PLANTARUM

Species hactenus editas aliasque insuper multas noviter inventas & descriptas complectens.

In qua agitur primò

De Plantis in genere,

Earúmque

PARTIBUS, ACCIDENTIBUS & DIFFERENTIIS;

Deinde

Genera omnia tum summa tum subalterna ad Species usque infimas,

Notis suis certis & Characteristicis

Definita,

METHODO

Naturæ vestigiis insistente disponuntur;

Species singulæ accurate describuntur, obscura illustrantur, omissa supplentur, superflua resecantur, Synonyma necessaria adjiciuntur;

VIRES denique & USUS

recepti compendiò traduntur.

AUCTORE

JOANNE RAIO,

E Societate Regiâ, & SS. Individuæ Trinitatis *Collegii apud* Cantabrigienses *quondam Socio.*

TOMUS PRIMUS.

LONDINI:

Typis MARIÆ CLARK: Prostant apud HENRICUM FAITHORNE Regiæ Societatis Typographum, ad Insigne Rosæ in Cœmeterio D. *Pauli*, cIↃ IↃ clxxxvi.

The title page of *Historia Plantarum Generalis*, Volume I: first edition, published in 1686.

HISTORIÆ PLANTARUM

LIBER PRIMUS

QUI EST

De Plantis in Genere.

QUÆ Hiſtoriæ noſtræ Botanicæ de Plantis in genere præmittenda duximus ad ſequentia Capita reducemus.

I. Primum erit de Definitione Plantæ. CAP. i.

II. Secundum, de Partibus Plantarum: Primò in genere. CAP. ii. Secundò in ſpecie:

1. De earum Radicibus. CAP. iii.
2. De Caulibus. CAP. iv, v, vi, vii.
3. De Gemmis. CAP. viii.
4. De Foliis. CAP. ix.
5. De Floribus. CAP. x, xi.
6. De Fructibus & Seminibus. CAP. xii, xiii, xiv, xv.
7. De Partibus auxiliaribus. CAP. xvi.

III. Tertium erit de Actionibus Plantarum. Quæ ſunt, 1. Nutritio, CAP. xvii. 2. Auctus, CAP. vi. 3. Propagatio. CAP. xviii.

IV. Quartum de Accidentibus Plantarum reſpectu Quantitatis. 1. Permanentis; ſc. De Statura & Magnitudine Plantarum. CAP. xxii. 2. Fluentis; ſc. De Ætate & duratione Plantarum. CAP. xxiii.

V. Quintum de Qualitatibus Plantarum. 1. Primis; Frigore, calore, humiditate, ſiccitate. 2. Secundis; Odoribus, Saporibus. CAP. xxiv. Viribus in Medicina. Ibid.

VI. Sextum de Adjunctis Plantarum externis, *v. g.* 1. De Loco Plantarum. CAP. xxv. 2. De uſibus quos hominibus præſtant in Cibo, Medicina, Ædificiis, Mechanicis, *&c.* CAP. xxiv. 3. De operationibus circa Plantas, *v. g.*

1. De Satione. CAP. xviii.
2. De Inſitione. CAP. xix. De reliqua cultura, *v. g.* Tranſlatione, putatione, ſtercoratione, protectione, *&c.* Vid. Agriculturæ & Horticulturæ Scriptores.
3. De Collectione, exſiccatione, aſſervatione, *&c.* Plantarum earumque partium. CAP. xxviii.
4. De Chymica Plantarum Analyſi, & partium reſolutarum uſu. CAP. xxix.

VII. Septimum, De iis quæ præter naturam Plantis accidunt, *v. g.* De morbis Plantarum eorumque remediis. CAP. xxx.

VIII. Octavum, De Plantarum differentiis genericis & ſpecificis, & de diviſione Plantarum. CAP. xxi, xxvi, xxvii.

CAPUT PRIMUM.

Quid ſit Planta.

PLANTA [Φυτὸν] definiente *Jungio, eſt *corpus vivens, non ſentiens, certo loco, aut certæ ſedi affixum, quod nutriri, augeri, ſe denique propagare poteſt:* * *Iſag. Phytoſcop. cap. i.*

Vita eſt unio ſeu conjunctio animæ cum corpore. Animam voco principium illud internum, quodcunque tandem ſit, ſive Subſtantia, ſive Accidens, à quo operationes Vegetabilium propriæ, uti ſunt Nutritio, Augmentatio, ſeminis Productio, fluunt: quandiu enim principium illud intus corpori unitum manet, tamdiu Planta vivere dicitur. *Vita quid:*

Non ſentiens in Definitione additur ad excludendum Animalia, quæ non minùs quàm Plantæ vivunt & vegetant.

Objiciet quiſpiam, Plantas nonnullas *Æſchynomenas* ſeu *pudicas* Veteribus dictas, Recentioribus *Vivas* & *Senſitivas* & *Mimoſas*, haud obſcura ſenſûs indicia prodere: Siquidem folia earum manu aut baculo tacta, & paululum compreſſa, pleno etiam meridie, ſplendente Sole, illico ſe contrahunt & veluti marceſcunt, quod idem ab Aeris frigidioris appulſu patiuntur.

Fatemur equidem quomodo hæc fiant, ſi ſenſum omnem & motum ſpontaneum plantis denegemus; mechanicâ aliquâ ratione explicare perdifficile eſſe.

Herbarum folia & summitates avulsas aut decerptas brevi flaccescere & collabi experientiâ constat: cujus Phænomeni ratio manifesta est, nimirum ob succi eorum vasa & poros replere & distendere soliti fugam & evaporationem, novo non succedente. Quemadmodum enim Animalium pulmones aere inspiraro repletæ extenduntur & attolluntur, sic pariter folia plantarum spiritibus & vaporibus per nervos influentibus: quemadmodum etiam è contrario iidem pulmones, aere seu exspirato seu per poros elapso vacui, concidunt & collabuntur; sic itidem folia succo evaporato exinaniri. Cur, inquies, *in decerptis expirat succus, in matri hærentibus non item?* Imo in utrisque expirat: Plantarum enim omnium partes humidæ in perpetuo fluxu sunt, perque earum poros indesinenter evaporant: at in matri hærentibus novæ jugiter in locum abscedentium à radice subministrantur, non item in avulsis aut decerptis, unde hæc flaccescunt, illa etiamnum extensa manent. Fieri ergo potest ut tangentis manus nervorum compressu succi vaporosi influxum tantisper impediat & retardet, unde eo qui nervos & vasa replebat exhalante, folia necessario contrahentur & collabascant.

Præterea Plantarum nonnullarum partes, [folia, ramuli, aristæ,] siccitate etiam contrahuntur & interdum convolvuntur, humore iterum explicantur & extenduntur, quod in aristis Avenaceis inque Planta illa, *Rosa Hierichuntina* perperam dicta, evidentissimè cernitur. Hæc enim postquam planè exaruit, imò per multos annos sicca reposita in globum coeuntibus ramulis contracta fuerit, si radice tenus in aquam tepidam immittatur, illico se explicat, & ramulos in orbem denuo expandit, humore scilicet in ramulorum poros sese insinuante eósque extendente. Notandum etiam tam folia, quàm ramulos plantarum siccitate sursum seu introrsum contrahi & curvari: cujus ratio esse videtur, quia partes internæ seu supinæ solaribus radiis expositæ humore evocato priùs & magis siccentur, unde necessariò illorsum contractio fit, non secus ac in tabulis seu asseribus ligneis aut etiam librorum operimentis membranisve videmus, quæ si Soli aut igni exponantur, in partem Soli obversam curvantur & inflectuntur. *Verùm contractio quæ fit ex siccitate hic, ut quæ, locum non habet.*

Datur adhuc & alia contractio ex frigore, quod corporum fluidprum, præsertim in vaporem resolutorum, motum illico sistit eaque in angustius spatium coarctat: Atque ex hoc genere videtur esse contractio illa in foliis plantarum mimosarum, qua de agitur. Frigus enim seu digiti, seu ambientis, succi in nervis motum expansivum cohibet, ejúsque influxum magna ex parte sistit, unde sponte se contrahunt fibræ, & foliorum lobos unà adducunt; non secus ac idem frigus corporis nostri cutem condensare & corrugare, uti è contrario calor eandem extendere solet. Lobi autem foliorum introrsum ad se mutuo trahuntur, quoniam fortasse fibrillæ in nervis superiores siccriores sunt adeóq; promptiùs & citiùs contrahuntur, inferiores autem molliores, adeóque faciliùs cedunt & extenduntur.

Quòd contractio hæc foliorum à frigore fit, argumento est Leguminosarum fere omnium quæ folia pariter lobata seu pinnata obtinent, similis prorsus nocturno tempore contractio & diurno expansio foliorum. Item florum nonnullorum internoctu se claudentium compressio, ut *v. g.* Calendulæ, Cichorii, Convolvuli, *&c.* Etenim, Jacobi Cornuti experimento Flos anemones, qui ex hoc genere est, decerptus & loco calidissimo reconditus, velut arculâ exiguâ fideliter oblignata, illico præter tempus aperitur, si modo ejus pediculus aquæ tepenti immergatur.

Verùm in causis hujus phænomeni assignandis mihimetipsi non satisfacio. Valvulas autem, quas nonnulli comminiscuntur in plantarum vasis dari neutiquam concesserim.

Augeri dicitur planta quæ plus substantiæ sibi restituit quàm dissipata est. Planta autem non solùm secundùm omnes non satis adultas partes in omnes dimensiones major redditur, verùm etiam novas partes sibi semper aggenerat, *folia, flores, fructus*: in quo ab Animali differt, quod neque amittit ullas partes, neque aggenerat, nisi pilos plumásque pro partibus accipias, quæ quotannis desluunt novis succrescentibus. Excipiendum tamen hic videtur Cervinum genus, in quibus cornua quotannis decidunt & regerminant. Cornua enim æquo si non potiori jure partes Animalium quàm folia Plantarum censeri possunt; nec obstat quòd sentiendi facultate careant, cùm & ossa periosteo denudata sensûs expertia sint; nec minùs tamen Animalium partes ab omnibus habentur. *Fructus* qui in plantis pro partibus reputari solent, non minùs in Animalibus quàm in Plantis à matre decedunt; an verò novi in Animalibus perinde ac in plantis generentur, est cur dubitem. Cùm autem Animalium ova plantarum fructibus adeò exactè respondeant, eodémque fere modo ex ovario germinent quo plantarum fructus è gemmis & racemis, cur nomen Partis iis denegetur, his concedatur, rationem non video.

Plantæ perennes augmenti respectu, ab Animalibus differunt, quòd partes illæ quæ perennant, quandiu planta vivit augentur, ut in arboribus quantumvis annosis manifestè cernitur, quibus quotannis novus accedit ligni circulus: Animalia autem cùm justum magnitudinis terminum assecuta sunt, augeri desinunt.

Additur in definitione, *certo loco, aut certæ sedi affixum*, quod tamen nec omnibus in universum plantis, nec solis convenit. Non omnibus; siquidem *Stratiotes* Veteribus dicta, (Dioscoride teste,) *aquis supernatans sine radice vivat, quamvis folium habeat Aizoo simile ac majus*; quod & * Prosper Alpinus in parte confirmat, *pro radicibus*, inquiens, *exigua quædam & rara lanugo dependet:* & eruditis. † Vellingius, *Planta tota sessili basi Nilo incubat, aquis innatans citra radicem, quamvis radicum vicem demissa terram versùs tenuissima fibrarum veluti filamenta sustineant.* Tenuia autem istiusmodi filamenta, quæ versùs terram extendi, non terram attingere scribit, non videntur plantam stabilire posse aut sistere quo minùs huc illuc fluitet & locum mutet. At nec solis plantis convenit terræ alitve sedi affigi; verùm id Animalibus etiam nonnullis commune est, iisque non imperfectis tantùm, aut ancipitis naturæ, quæ Zoophyta appellare solemus, sed etiam perfectioribus. Sunt enim ex genere testaceorum certæ sedi affixa, quæ *fabricæ*, id est, stabilia, Aristoteli ob eam rationem dicuntur; idque non casu aliquo, sed ex ipsius naturæ instituto. Vidimus enim ipsi Mytilorum speciem funiculo è testa egressio petris adnexum: quin & balani illi *Conchæ anatiferæ* dici soliti apophysi quadam fistulosâ, coriaceâ, rugosâ, oblongâ navium carinis aliisque lignis vetustis in mari fluitantibus adhærescunt. Verùm terræ alitve sedi ità adhærere ut alimentum inde attrahat seu exugat, id plantæ proprium est, nec ulli (quod sciam) Animali convenit. Nam quæ de *Agno Scythico* traduntur pro fallis & fabulosis habeo.

* *De Plantis Ægypt. c. 35.*
† *Observat. in Alpin. Ægypt. plant. cap. 35.*

CAP.

Cap. II.

De Partibus Plantarum in genere.

Antequam partium Plantarum divisionem instituam, non incommodum erit celebrem illam distinctionem partium in *similares* & *organicas* paulisper excutere, quidque per similares intelligimus, quid per organicas, paucis exponere.

Pars *similaris* (verba sunt * Sennerti) ut vel ipsum nomen Græcum ὁμοιομερὴς indicat, est quæ simplicis & unius est naturæ, & ex partibus naturâ diversis non constat, & proinde propriè opponitur *dissimilari*: cujus generis sunt *Ossa, Cartilagines, Caro, Membranæ, Nervi, Venæ*, &c. Pars ergo *similaris* quatenus est similaris, nullum publicum Officium habet, sed saltem nutritionem suam procurat. Pars *Organica* est quæ præter sui nutritionem aliam aliquam actionem habet, quâ vel aliis partibus, vel toti corpori inservit. Hinc patet partem similarem non propriè opponi Organicæ sed dissimilari, ut modò diximus: Eadem enim pars potest esse & similaris & Organica diverso respectu: similaris nimirum respectu texturæ & constitutionis; Organica respectu figuræ & conformationis, adeóque usûs & officii in corpore. Sic vena quidem suâ naturâ similaris pars est, sed quatenus eo modo conformata est, ut sanguini refluo ad cor derivando aptus canalis sit, Organica dicitur: sic tibiæ os suâ naturâ simplex est, sed quatenus suam habet peculiarem figuram & magnitudinem, tibia nominatur.

* *Institut. lib. 1. cap. 3.*

Pars *organica* alia est *simplex*, alia *composita*. *Simplex* est, quæ constat ex partibus ejusdem quidem naturæ & temperamenti, verùm peculiarem aliquam figuram & conformationem requirit ad actionem communem, hoc est in usum vel corporis totius, vel aliarum partium, exercendam. Hujusmodi sunt *Os, Vena, Nervus*, &c. Pars organica *composita* est, quæ constat ex pluribus partibus diversæ naturæ & constitutionis, quæ tamen simul ad eandem actionem concurrunt, atque hoc sensu accepta *Pars organica similari* opponitur. Sic *v. g.* Oculus est Pars organica, composita ex variis tunicis & humoribus, diversæ texturæ & constitutionis, quæ tamen simul ad visionem conspirant. Hujusmodi actiones quæ ab organis è multis diversæque naturæ partibus compositis obeuntur Perfectas vocat Galenus.

His ad distinctionis istius intelligentiam præmissis, nos partes plantarum dividemus in *simplices* & *compositas*.

Simplices sunt quæ constant ex partibus ejusdem texturæ & constitutionis.

Compositæ quæ ex partibus diversæ naturæ coalescunt.

Simplices sunt vel *continentes* seu vasa, vel *contentæ* seu succi.

Verisimile enim est partes simplices in universum omnes, corpus integrantes, in Plantis saltem, si non & in Animalibus, vel vasa esse, vel succos seu liquores, in vasis contentos.

Partes *contentæ* omnes ad sensum similares sunt: quamvis enim chymicâ Analysi in alias adhuc simpliciores possint resolvi, sunt tamen ita per minima divisæ & commixtæ, ut quælibet pars sensibilis pariter ex omnibus hisce simplicioribus mixta sit, adeóque ejusdem naturæ cum reliquis sensibilibus partibus.

Partes *continentes* dupliciter considerari possunt; vel respectu *substantiæ* & texturæ suæ uniformis, quomodo *similares* sunt; nec aliam habent actionem præter sui nutritionem, vel respectu *figuræ* & *conformationis* ad usum aliquem & officium in corpore obeundum destinatæ; adeóque *organicæ* appellantur.

Partes *compositæ* quæ ex pluribus partibus simplicibus iisque (ut diximus) diversæ naturæ constant, *Organicæ* etiam appellantur, quia partes hæ simplices simul ad unam quandam actionem concurrunt.

Partes compositæ in quas Planta dividi solet sunt *Radix, Caulis, Folia, Flos, Fructus*, de quibus in specie agemus.

Sunt etiam aliæ partes minùs principales seu secundariæ, ut *v. g. Capreoli* seu *Claviculæ, Pili, Spinæ*, &c.

Cap. III.

De Radicibus Plantarum.

Radix (definiente Jungio) est *pars Plantæ inferior, quæ intra corpus solidius, quod Plantæ sedem præbet (sive illud terra sit, ut plerumque, sive saxum, sive calx, sive arena, sive lignum, sive quodcunque aliud) abdita, & alimento attrahendo destinata est.*

Radices dividi possunt in *fibrosas* & *crassiores*. *Fibrosas* voco quæ plurimis fibris seu filamentis è plantæ fundo separatim exeuntibus constant.

Crassiores quæ corpore pro plantæ modo crassiore sunt vel in surculos diviso, vel fibras emittente. Hæ vel carnosæ sunt, & in *latum extumescentes*, vel in *longum extensæ*, plerunque strictiores & lignosiores.

Carnosæ & in *latum extumescentes* sunt vel *Bulbosæ*, vel *Tuberosæ*.

Bulbosas voco quæ unico constant tubere seu capite, eóque vel squamato vel tunicato, fibras plurimas ex ima sede seu basi emittente.

Bulbosæ ergo strictè dictæ sunt vel *tunicatæ*, hoc est, ex pluribus corticibus in orbem se amplexantibus compositæ; cujusmodi sunt *Cepa, Allium, Hyacinthus, Tulipa*, &c. vel *Squamosæ, h. e.* è pluribus squamis imbricatim ferè dispositis coagmentatæ, ut *Lilium* & *Martagon*.

Notandum autem *Bulbosas* strictè dictas Fibrosis rectiùs accenseri. Fibræ enim è bulbi fundo exeuntes propriè duntaxat radices sunt; Bulbus ipse nihil aliud esse videtur quàm gemma grandior sub-

terranea, ut rectè eruditissimus & ingeniosissimus Vir, D. *Nehemias Grew.* M.D. ob præclara sua inventa & observata, in *Anatome Plantarum,* reliquaque earundem Historia meritò celeberrimus.

* *Lib. de Anatome radicum.*

Tuberosæ sunt quæ carne solidâ continuâ constant, suntque vel simplici tubere ut in *Rapa, Croco,* &c. vel multiplici, ut in *Asphodelo, Pæonia,* &c.

Not. Plantæ nonnullæ duûm generum radicibus donantur, tuberosis & fibrosis, ut *Orchis.*

Radices in longum extensæ quæ plerunque strictiores sunt & lignosiores, vel *sarmentosæ* sunt & transversim progredientes seu reptantes, ut *Glycyrrhizæ, Cardui viarum, Acetosæ Ovillæ,* &c. vel *cauliformes* & in altum descendentes.

Notandum autem, in plurimis reptatricibus propagines sub terra reptantes, geniculatæ cùm sint, & è geniculis fibras emittant, ut in *Gramine canino Offic. Menthâ, Pilosella aurea, Ptarmica,* &c. caules potiùs subterraneos videri quàm radices.

Radices *cauliformes* & in altum descendentes sunt vel *simpliciores,* fibras tantùm è lateribus emittentes, vel *ramosæ:* Hæ autem ad modum caulium vel ab exortu statim ramosæ sunt, vel simplici scapo aliquousque descendunt, deinde in ramos; rami in surculos & fibras sparguntur. Nonnullæ etiam plantæ plures è fundo emittunt radicum truncos.

Possent & aliæ radicum differentiæ, à coloribus, sapore, odore, facultatibus sumi, quas hoc in loco prosequi nostri non est instituti; alibi forsasse earum catalogos daturi sumus.

Radices nonnullas bulbosas ut *v. g. Tuliparum,* annuatim in terram descendere à Botanicis dudum observatum est: idem nuper in aliis plurimis & quidem diversorum generum radicibus observavit † D. Grevius, ut *v. g. Ari, Valerianæ, Scrophulariæ, Hellebori nigri, Tanaceti, Lychnidis, Crithmi, Primulæ, Caryophyllatæ, Acetosellæ, Iridis,* &c. quarum omnium, eodem observante, Radix quotannis ex trunco seu caule ipso renovatur, aut potiùs particulatim reparatur. Basis sci. seu ima pars caulis, sensim infra superficiem terræ descendens, sêque in ea occultans in naturam geminæ radicis transmutatur, ejúsque locum occupat, & officium præstat. Ad motum autem caulis radix etiam unà descendit, & pro durabilitate substantiæ suæ brevior aut longior evadit, vetustiore & inferiore ejus portione eisdem gradibus putrescente quibus superior è caule descendente & transmutato augetur. Sic in *Scrophulariâ v. g.* sed præcipue Succisa, quæ ab radice præmorsa apparet, ima pars caulis gradatim subsidens donec terræ immergatur superior radicis pars officitur, & descensu continuato, sequenti anno, inferior ejusdem pars evadit, proximo deinde anno corrumpitur & evanescit; novâ scilicet quotannis è caule accessione facta, prout inferiores & vetustiores partes putrescunt & absumuntur. Ità pariter in *Dracontio, Croco, Gladiolo,* &c. ubi bulbus geminus est, superior & inferior, basis caulis anno insequenti fit superior radix, proximo inferior, tertio interit & absumitur.

† *E cujus lib. de Anat. Radicum sequentia omnia transtulimus.*

Hujusmodi descensus caulis & transformatio in radicem in nonnullis plantis evidentiùs cernitur & clariùs demonstratur quàm in aliis, ut in transversis & tuberculosis radicibus *Primulæ* & *Acetosellæ.* Harum enim Plantarum foliis successivè marcescentibus & abscedentibus bases eorundem copiosiore succo enutritæ in totidem nodulos crassiores turgescunt. Idem in aliis nonnullis colligi potest ex simili vasorum & partium lignosarum situ in trunco & in radice, ut *v. g.* Helleborastro, sed præcipuè Iride tuberosâ, in qua quamvis folia proximè juxta caulis superficiem decidunt, postquam tamen caulis descendit & in radicem intumuit, foliorum delapsorum sedes seu vestigia unà cum vasorum iis inservientium extremitatibus non obscurè apparent, radice sci. annulis quibusdam, & lineis punctatis variegatâ, annulis foliorum sedes, punctis vasorum orificia demonstrantibus.

Descensûs hujusce causa proxima & visibilis seu manifesta sunt radices fibrosæ, quas hujusmodi caules emittunt: hæ enim in terram rectà descendentes, velut totidem funiculi truncum post se rapiunt. Hinc radicum nonnullarum figura veluti invertitur. Nam cùm pleræque inferiùs in ramos aliquot ceu totidem crura divaricantur, nonnulla supernè in plures veluti cervices seu cornua [capita vocant Botanici] dividuntur, ut in *Dente leonis* aliisque nonnullis cernitur. Hæ enim radices è summo capite plures protrudunt gemmas, quæ in totidem caules abeunt. Gemmæ hæ seu germina nova successivè folia emittentia, vetera abjiciunt, adeóque paulatim continuò descendentia, in totidem tandem cervices, 3, 4, 5. aut etiam plures uncias longas, abeunt.

Hinc intelligitur quomodo radices nonnullæ præmorsæ videntur, ut in *Succisa,* perennésque evadunt, nimirum successivâ aggeneratione novarum portionum in locum earum quæ quotannis corrumpuntur & intereunt, ut in plantis de quibus egimus, ex parte trunci quotannis descendente annua sua damna reparantibus, inque *Orchide, Battata, Napello, Chelidonia minore* aliisque tuberosis in quibus, vetustioribus radicibus seu tuberibus marcescentibus, novæ earum loco aggenerantur. Cum his etiam consentiunt *Tulipæ* aliæque radices bulbosæ: tunicæ enim ex quibus præcipuè bulbi constant quotannis exarescunt, & in tenues membranas seu cuticulas exiccantur, novis assiduè in medio succrescentibus foliis & corticibus. Ad eundem modum fibrosæ earum radices aliæ aliis annuatim succedunt; unde post aliquot annos bulbus quamvis idem perseverare videtur, alia omnino revera res est, nullâ ejus particulâ primitivâ relictâ.

Partes Radicis uti & Caulis sunt Cortex, Lignum aut in herbaceis pars ligno respondens, & medulla.

CORTEX.

Cortex componitur ex cuticula & substantia interiore.

Cuticula.

Cuticula à cortice originem habere videtur, & nihil aliud esse quàm corticem veterem exarescentem & contractum, novo quotannis subnato; quemadmodum spolium Serpentis quod quotannis exuit ejusdem cutis exarefacta est. Cuticula in radice iisdem partibus componi videtur quibus & in caule, nimirum utriculis seu vasiculis velut parenchymate, ligneis aliquot vasis seu fibris fistulosis intermixtis, quæ quamvis etiam microscopio ægrè visibiles sunt, adesse tamen colligit *D. Grevius* ex eo quòd cuticula multo difficiliùs finditur aut dilaceratur transversim quàm secundùm longitudinem, aliisque argumentis, quæ apud ipsum vide.

Corticis substantia interior crassitudine plurimùm variat, in nonnullis enim radicibus ut *Flore Seseli pyramidali, Tragopogone,* & arboribus plerisque prætenuis est, in aliis crassa admodum, lon-

gâ

gò maximam radicis partem conſtituens, ut in fibris *Aſparagi*: Quin cortex radicis in plurimis plantis multò majorem obtinet proportionem ad lignum, quàm Caulis; atque hac in re radix à caule inſigniter differt, corticis nimirum craſſitie.

Cortex in radice iiſdem ferè partibus componitur quibus & in caule, nimirum, 1. Utriculis ſeu veſiculis ceu parenchymate, Sphæricis plerunque, interdum tamen oblongis; minimè perviis ſeu in ſe mutuò hiantibus, ſed undique clauſis, & aquæ bullarum inſtar pellucidis, adeò ut corticis Parenchyma, quoad compoſitionem ſuam, ſpumàm Cereviſiæ aut ovorum conquaſſatorum proximè referat, aut panis probè fermentati medullam. Veſiculæ hæ adeò parvæ ſunt ut abſque microſcopio ægrè ſint viſibiles; magnitudine tamen differint, tum in eadem, tum præcipuè in diverſi generis radicibus. In rectas lineas ſeriatim non rarò diſponuntur tam ſecundùm longitudinem quam ſecundùm latitudinem radicum. Liquore limpido ſeu pellucido ſemper turgidæ ſunt, qui per earundem membranarum poros ſe inſinuat, nec enim datur patentior janua quà intret. D. Malpighius utriculos in ſe mutuò hiantes & pervios facit.

Utriculos hoſce in nonnullis plantis duûm generum eſſe obſervavit D. *Grevius*: præter deſcriptos enim alii dantur albidiores nec tranſparentes, ſicciores etiam nec liquore *turgidi*, unde vere repletos eſſe opinatur. Pleniorem horum deſcriptionem videſis apud laudatum autorem in libro de *Anatome radicum*.

2. Præter utriculos fibræ etiam ligneæ ſeu vaſa ſucciſera, plura pauciorave, corticis compoſitionem ingrediuntur, ut ex facilióre dilaceratione corticis ſecundùm longitudinem quam tranſverſaliter; ex ductu earundem fibrarum ſecundum longitudinem viſibili, tenuium filamentorum ſpecie; & ex aſcenſu ſucci cortice tranſverſim ſecto, iis in locis ubi filamenta iſthæc terminantur, patet.

Reticulares plexus eodem modo componunt fibræ hæ quo in cortice caulium. Quamvis tamen ad ſe invicem accedant, & iterum reflectantur, nullæ omnino (obſervante *Grevio*) dantur inter eas anaſtomoſes, ſed unumquodque filamentum unicum & ſimplex vas eſt ab imo ad ſummum continuum, non ramoſum, cavitate ab imo ad ſummum æquali. At neque alia aliis circumvolvuntur, alitérve implicantur, ſed ſibi mutuò duntaxat contigua ſunt. Plexus hi in variis plantis numero & figurâ variant, in aliis rariores, in aliis crebriores. Notandum autem ſingula filamenta, non ſingula vaſa eſſe, ſed vaſorum parallelorum faſciculum ſeu congeriem, quæ tamen nec in ſe mutuò pervia ſunt, nec ſibi invicem in faſciculo ſuo convolvuntur alitérve implicantur, ut de filamentis diximus. Eadem de tracheis ſeu vaſis aerem deferentibus quæ in lignea parte occurrunt dicta ſunto. Eſt tamen cur ſuſpicemur dari in hujuſmodi *vaſis anaſtomoſes*, nec D. Grevii ſententiæ penitus acquieſcamus, præcipuè quod ad fibras ligneas attinet, partim ab analogia venarum & arteriarum in animalibus quarum propagines manifeſtè in ſe mutuò perviæ ſunt & reticulariter inoſculatæ, partim à foliorum, quæ ſunt ligneæ expanſiones, ſtructurâ, in quibus fibræ ſibi mutuò occurrentes inoſculatæ & reticulariter implexæ videntur: partim denique ab experimento de ſucci motu deorſum in ſectione tranſverſa inferiùs proponendo.

Color radicum in pleriſque plantis albus eſt, in nonnullis flavus, in paucis ruber aut atro-rubens, ut Anchuſa, Erythrodano, Paſtinaca tenuifolia.

Vaſa hæc diverſorum generum eſſe ex diverſitate liquorum quos continent colligit D. Grevius, quem conſule: alia enim lympham continent, alia lacteum ſuccum, alia in plantis nonnullis rorem ſeu vaporem. Verùm vaſa hæc iis quæ in cauliuni corticibus obſervantur analoga eſſe, & ſuccos congeneres deferre opinamur, atque ideirco plura de iis dicere ſuperſedemus.

Lignea radicis pars eiſdem ferè partibus conſtat, eodémque modo contextis quo in caule, nimirum, 1. Parenchymate ſeu utriculis in radios diametrales à circumferentia ad centrum tendentes diſpoſitis, ut in tranſverſa ſectione patet. LIGNUM.

2. Fibris ligneis ſeu vaſis ſucciferis, quæ etiam ut in cortice duûm generum ſunt, nimirum vel lympham deferentia, vel ſuccum lacteum, aliúmve plantæ peculiarem, ſeu, ut vocant, ſpecificum.

3. Fiſtulis aeri excipiendo & derivando deſtinatis ſeu tracheis, de quarum textura ſeu compoſitione infra dicemus. De earum magnitudine, numero, ſitu, quæ in variis plantarum generibus variant, vide *Grevii* lib. de *Anatome Radicum*, cap. 4. Has autem in radicibus majores plerunque eſſe & magis patentes quàm in trunco ac ramis annotat *Malpighius*.

Medulla plantarum omnium radicibus communis non eſt: Nonnullæ enim, ut *v. g. Nicotianæ, Stramonii*, &c. eâ carent. Aliæ quamvis parte inferiore nullam habeant, ſupernè tamen ſatis conſpicuam obtinent. Ex utriculis componitur ut in caule, iiſque etiam magnitudine & figurâ diverſis, quibus vaſa aliquot ſuccifera interdum admiſcentur.

Notandum autem utriculos ſeu veſiculas haſce ex quibus Medulla componitur, non meras & rudes membranas eſſe, ſed ex plurimis ordinibus ſeu ſeriebus tenuiſſimarum fibrarum ſeu filamentorum ab imo ad ſummum veſicularum juxta poſitorum, & à veſicula ad veſiculam tranſverſim, (ut in ſubtegmine à ſtaminis filo ad filum) decurrentium compoſitas; adeò ut Medulla nihil aliud ſit quàm rete quoddam mirabile, ſeu infinitus fibrarum minutiſſimarum mirabili ordine complicatarum numerus. Quinetiam fibræ hæ non ſimplices ſunt, ſed ex pluribus ſimul conjunctis compoſitæ, fibrillis etiam tranſverſis, (quæ ſimplices eſſe videntur) contextæ.

Qui ratione alimentum radices ſubingrediatur meos adhuc ſenſus fallit (inquit *Malpighius*) ut probabiliter tamen conjectari licet; aquæ particulæ ſolutos ſales, & reliqua mineralia per terram diſperſa ſibi aſſociant ac fluida reddunt, appellénſque hujuſmodi heterogeneum corpus ad plantarum radices, veluti per cribrum trajectum, in ligneas fiſtulas exprimitur; ſeu per pilorum, qui circa tenellas radices copioſè luxuriant, orificia intret; ſeu per exteriorem ambientem cuticulam percoletur, adeóque vel ſenſim utriculis communicetur & ab his in contiguas fiſtulas derivetur, vel per extrema fiſtularum ora intro excipietur, & ab iiſdem tranſverſalibus utriculis miniſtretur; ut in minimis radiculis quæ fibræ appellantur probabiliter *accidit*, *in quibus* ad extrema uſque fiſtulæ deducuntur, tranſverſalibus utriculis parum luxuriantibus.

CAP. IV.

De Caulibus Plantarum, & eorundem partibus continentibus, è Clariſſ. Malpighii & Grevii ſcriptis.

[a] *In Iſag. Phytoſcop.*

CAulis, deſiniente [a] Jungio; eſt pars Plantæ ſuperna in altitudinem ità exporrecta; ut anteriora à poſterioribus, vel dextèra à ſiniſtris non differant. Caulis in arboribus & fruticibus *caudex* [*Stipes, truncus*] in fiſtuloſis *calamus*, in frumentis *culmus* dicitur.

Caulis eſt vel *ſimplex*, vel *ramoſus*.

Scapus caulis eſt pars caulis ramoſi, quæ à fundo ad cacumen ſummum unâ quaſi lineâ extenditur, cui rami utrinque adhærent.

Caulis partes ſunt *Cortex*, *Lignum*, aut in Herbaceis pars ligno reſpondens, & *Medulla*.

Cortex eſt qui caulem & ramos undique inveſtit. Componitur autem è *cuticula* & ſubſtantia interiore.

Cuticula.

Cuticula utriculis ſeu ſacculis horizontali ordine locatis, ità ut annulus efformetur, componitur, qui ambientis rigiditate & ætatis vitio deplentur, & in ſeipſos collapſi aridam interdum epidermidem efficiunt, ut in Betula, Ceraſis, Pomiſque præcipuè obſervatur. *Malpigh.*

De Cortice.

CORTICIS ſubſtantia interior conſtat, 1. Ex *fibrarum lignearum* in plexus retiformes contextarum plurimis involucris, exteriore interius tunicarum Cepæ in modum ambiente: deinde, 2. Ex utriculis ſeu ſacculis ſubrotundis [interdum ovalibus aut anguloſis] plexuum modò dictorum maculas ſeu ſpatia replentibus, horizontali ſitu lignum verſùs radiorum inſtar directis. 3. Denique ex vaſis peculiaribus; ſuccum plantæ proprium & ſpecificum continentibus.

D. Grev. ſubſtantiam corticis interiorem in vaſa & parenchyma primò diſtinguit: parenchyma vocat utriculos modò dictos qui parenchymati viſcerum in animalibus reſpondent. Vaſa dividit in lympham deferentia quæ dudùm generum eſſe ſtatuit: exteriora enim & cuticulæ proxima ſuccum ſpecie diverſum ab interioribus & ligno vicinis deferre opinatur: [hæc vaſa ſunt quas fibras ligneas diximus] & ſuccum plantæ proprium & ſpecificum continentia, qualia ſunt *v. g.* in Abiete & Pinu reſiniſera; in Prunis & Ceraſis gummiſera, in Tithymalo lactifera. De tribus huſce partibus explicatiùs paulo agemus.

Fibræ ligneæ, ſeu Vaſa lympham deferentia.

1. *Fibræ ligneæ*, deſcribente Clariſſ. *Malpighio*, ſunt tubuloſa corpora, ſubingredientibus liquoribus perviæ, ipſarumque ſtructura è quadratis [aliiſve interdum figuræ] corporibus, concavis, invicem hiantibus conſtat. Vaſa hæc nec recta, nec parallela ducuntur, & ut plurimùm in faſciculos coagmentantur. Horum aliqua iterum inclinata, & [à faſciculis ſuis] ſeparata rete efficiunt, unde reticularia quæ diximus involucra, quibus lignum ambitur. Fibras haſce Lymphæ-ductus ſeu vaſa lympham deferentia appellat D. *Grevius*, quia ſcilicet liquorem aqueum, limpidum & pœne inſipidum continent. Plexus hi fibrarum retiformes è faſciculorum portionibus digredientibus & ad proximos tendentibus cúmque iis unitis, & rurſum reflexis contexti in radice Rapæ cauleſcentis, præſertim coctæ, manifeſtè poſſunt diſcerni, imò digitis extendi.

Utriculi ſeu Parenchyma corticis.

2. *Utriculi* dicti ſunt veſiculæ ſeu ampullæ liquore turgidæ, quem è fibris ligneis excipiunt, horizontaliter plerunque ſitæ in lineis rectis ſeu radiis à cuticula ad lignum tendentibus, ſiuntque veluti corticis parenchyma, ut ſuperiùs diximus. [D. Grev. utriculos corticales in radios diametrales rariùs diſponi ait: quo à radicis corticis parenchymate differunt.] A fibris fiſtuloſis ligneis horizontales (verba ſunt Malpighii) utriculorum ordines pendent & erumpunt. Etenim dum tenelli adhuc corticis fiſtulæ *vi* evelluntur, continuatæ utriculorum appendices ſubſequuntur. In hos igitur tranſverſales utriculos aſcendens humor chyli inſtar exoneratur, ibique longiorem paſſus moram antiquiori ſucco intimè commixtus & fermentatus in naturam alimenti exaltatur. Copioſus admodum in corticis hujuſmodi horizontalibus appendicibus excoquitur ſuccus, qui ligno, reliquiſque plantarum partibus diſtribuitur; unde nil mirum ſi cortex abundantius & validius pabulum præ reliquis plantarum partibus igni ſubminiſtret.

Vaſa ſuccifera.

3. Vaſa ſuccum plantæ proprium & ſpecificum deferentia in variis plantis diverſum ſuccum continent, ut *v. g.* in Abiete reſinam, in Tithymalo & Lactucaceis lac. Succus hujuſmodi è valis extractus humore aqueo evaporante plerunque concreſcit in reſinam gummi, aliúdve craſſamentum.

Succi hujus (inquit *Malpighius*) varia eſt natùra, frequenter aquei diaphaniique humoris ſpecie effluit, quandoque Lactis inſtar, non rarò luteo inficitur colore, & interdum ſemiconcretus lentorem acquirit, ità ut quot Plantarum ſpecies extant, totidem peculiares ſuccí inveniantur. *Hic* (pergit) *ſuccus, in ſingulas partes delatus, roris inſtar affunditur, & concreſcendo ipſas auget, & ad debitam magnitudinem perducit.* Videtur ergo reſpondere ſanguini animalium: quamvis (ut verum fatear) ſententiæ D. Malpighii, nimirum ſuccum hunc ultimum & ſpecificum plantæ alimentum eſſe, non penitus acquieſco. Eſſe eum Quinteſſentiam (ut vocant) totius plantæ, ejúſque & odorem & ſaporem reddere viréſque velut concentratas in ſe continere non diſſiteor.

Vaſa aerem deferentia nulla in cortice obſervantur, certè ſi adſunt, adhuc inconſpicua ſunt, nec ſuo funguntur munere, ut in Animalibus intra uterum concluſis accidit, & ſola converſione corticis in ligneam naturam manifeſtantur & patent, ut loquitur Malpighius.

De Ligno.

LIGNUM eiſdem partibus, eodémque modo connexis componitur quibus cortex, nimirum, 1. *Fibris ligneis* fiſtuloſis, in faſciculos coagmentatis, & in retiformes plexus contextis; 2. *Utriculis* earundem maculas & ſpatia replentibus; 3. Valis ſuccum ſpecificum deferentibus; & 4. Peculiari inſuper vaſis genere aeri derivando deſtinato, & animalium trachiæ & pulmonibus reſpondenti.

1. *Fibræ ligneæ* ejuſdem ſunt naturæ cum corticem componentibus: iiſdem enim (ut *Malpighi* verbis utar) componuntur minimis vacuiſque orbiculis, invicem hiantibus, & conſimilem amittunt ſuccum. Cæterùm inter corticis & ligni fibras hæc intercedit differentia, quòd illæ trunco tranſverſim diſſecto ſuccum ſponte effundunt omnes; harum autem nullæ ſemper, pleræque nunquam

quam id faciunt. Fibræ hæ ad majorem firmitudinem & robur transversalium utriculorum ordines superequitant, ità ut ex horum mutuâ implicatione quædam veluti storea efficiatur. Præcipua autem & potior trunci caulisve portio ligneis hisce fistulis constat. Hæ in variis plantarum speciebus magnitudine, numero, situ differunt, ut facilè esset ostendere. Vide *Malpighii* & *Grevii* Plantarum & Truncorum Anatamen.

Inter ligneas fibras anastomosin intercedere, non aliter quàm in Animalibus inter venarum ramos probat Malpighius, *Anat. Plant. p.* 11.

2. *Utriculi* in radios diametrales fibras & vasa intercurrentes, à cortice ad medullam extensos disponuntur; non tamen omnes ipsam attingunt, sed interdum versùs interiora ligni obliterantur, novis subortis in penitioribus ligni circulis: patent autem secto per transversum ramo seu caudice. In fruticibus (observante *Malpighio*) & in quibus non valdè crassum est ligneum corpus, & condita medulla ampla, à cortice utriculorum appendices in medullam deducuntur & in ipsum laxantur: unde eadem natura in utrisque [corticalibus & medullaribus utriculis] reperitur: quin & eadem phænomena quæ in corticis utriculis contingunt, quandoque in medulla occurrunt. Utriculorum autem ordines ovalibus invicem hiantibus corporibus compaginantur, unde & contento succo turgent, in nonnullis plantis diaphano, in aliis colorato; tenui autem pellucidâ, diaphanâque membranâ singuli utriculi constant. In diversis plantarum speciebus plurimùm variant, numero, magnitudine, texturâ, extensione, *&c.*

3. Vasa succum plantæ propriùm & essentialem continentia in tot circulos disponuntur quot sunt tunicæ seu involucra annui incrementi à medulla ad corticem; eadémmet enim sunt cum corticalibus interioribus quæ à cortice quotannis abscedunt, & ligno se applicant, angustiora duntaxat ob fibrarum lignearum undique circumstantium pressuram reddita.

4. Vasa aeri excipiendo & derivando destinata, quæ fistulas spirales & tracheas appellat *Malpighius*, argenteâ laminâ in spiram contortâ componuntur, ut facilè laceratione in oblongam & continuatam fasciam resolvantur. Lamina hæc si ulteriùs microscopio lustretur particulis squamatis componi deprehenditur. [Lamina hæc (observante Grevio) è multis fibris teretibus collateraliter in eodem plano sitis, tæniæ seu fasciolæ Staminum in modum, & minoribus transversis fibellis velut subtegmine contextis constat.] Ampliores spirales fistulæ frequenter pulmonares quasi vesiculas, trachearum substantiâ, continent, quandoque invicem hiant, interdum ovali constant formâ, & altero nonnunquam fine impervia sunt, ità ut parùm dissimiles insectorum pulmonaribus vesiculis extent. D. Malpighius Naturam in Insectis & Plantis spiralem laminam squamosis frustulis compactam tracheæ vice fabrefecisse opinatur, ut constrictionem & dilatationem in vehementibus flexuris & curvationibus arborum, & in elastico concluso aeris motu pati possit. Tracheæ hasce fibræ ligneæ persæpe fulciunt & undique stipant & interdum coarctant, unde insecto per transversum ligno earundem orificia frequenter ovalia apparent, vel rotunda, interdum angularia: Tracheæ autem non multùm à recto declinantes, à radicibus sursùm in truncum, caulem, & ramos dispergantur, in foliis verò curvatæ in rete implicantur. Vasa hæc exceptis succiferis corticalibus propriis omnium longè maxima; per totam ligni substantiam frequentissima occurrunt, in cortice autem nulla observantur. *Tracheæ.*

Tanta est Respirationis necessitas & usus, ut natura in singulis viventium ordinibus varia sed analoga paraverit instrumenta, quæ pulmones vocamus, cum hoc discrimine, ut quæ perfectiora nobis censentur, ea minori pulmonum apparatu gaudeant, ut per Quadrupeda, Aves, Pisces, Exanguia aquatica & Insecta discurrendo ostendit Cl. Malpighius. In plantis verò, inquit, quæ infimum Animalium attingunt ordinem tantam trachearum copiam & productionem extare par est, ut his minimæ vegetantium partes præter corticem irrigentur.

Qua parte aer vasa hæc subintret quæstio est, an sci. per radicis, an per trunci, foliorum, reliquarúmque partium superficialium poros. D. *Malpighius* se diu anxiè quæsiviisse scribit, an in foliis & cortice orificia pro aere paterent, nec ea unquam deprehendere potuisse: radices verò tot tantísque coagmentari tracheis observavit, ut in quibusdam plantis & arboribus hæ reliquarum molem longè superarent. Quare (ut conjectari licet) vapor seu respiratorius succus, à terra aquæ & aeri admixta separatus, tracheas subintrans ipsas replet & distendit. Ligneæ autem fibræ aut horizontalium utriculorum ordines separatam à trachearum tunicis halitûs partem seu succum pro respiratione recipiunt, cùm ligneæ fibræ Hederæ instar tracheas ambiant. D. *Grevius* aerem omnium partium tam superficialium quàm subterraneorum poros subingredi statuit, hos autem posteriores copiosissimè. Pori enim in plantarum nonnullarum truncis adeò ampli sunt, ut nudo & inermi etiam oculo pateant, ejusmodi sunt *cannæ Indicæ* quibus pro virgis & scipionibus utimur: quin & in Pinuum foliis eleganti ordine per totam foliorum longitudinem dispositi cernuntur; verisimile ergo est aliquam Aeris partem per hos se insinuare. Potissima tamen & quasi regia via quâ ingreditur Aer, sunt radicis oscula, in quæ succo commixtus se ingerit. Radix enim in Plantis Animalium ori respondet. Deinde si aer per partium superficialium tantùm poros intraret, antequam cum radicis succo commisceri possit, necessario deberet descendere, contra motum succi qui perpetuo ascendit, adeóque Aer & Succus sibi mutuò occurrentes impedimento essent, quod non videtur verisimile; cùm si per radicem reciperetur motu ascensûs facili & naturali unà cum succo conspiraret. Quod idem ulteriùs argui potest à paucitate & parvitate diametralium portionum [utriculorum] in trunco præ quàm in radice, quas natura ibidem Aeri à succo, quocum commixtus excipitur, separando designâsse videtur. Hactenus D. *Grevius*, apud quem plura vide.

Medulla, cordi & cerebro analoga olim credita, multiplici globulorum per longum locatorum ordine constat. Globuli quos diximus membranosi utriculi seu veliculæ sunt, in plerisque quidem plantis rotundi, in nonnullis tamen angulosi & vel cubici, vel pentagonis, vel hexagonis lateribus. Medulla quamvis à ligni & corticis parenchymate [ità voco utriculos diametrales fibrarum spatiâ replentes] diversùm nomen obtineat, naturâ tamen & substantiâ cum eo convenit, ut & textura & continuitas evincunt; continuitas, inquam: Nam utriculorum ordines à cortice emanantes (ut D. *Malpighii* verbis utar) per ligneas fibras producti in medullam terminantur, unde eadem natura *De Medulla.*

natura iis utrisque [corticalibus & medullaribus utriculis] reperitur: nec aliter quàm magnitudine inter se differunt utriculi *medullares*, qui omnium maximi sunt, *corticales*, qui mediæ magnitudinis, & *lignei*, qui minimi.

Medullæ magnitudo in variis plantis varia est: in *Absinthio*, v. g. *Rhoe*, *Ficu*, *Oxyacantha*, (observante D. *Grevio*) amplissima: in *Pino*, *Fraxino*, *Agrifolio*, *Juglande* minor seu angustior ferè duplo: in *Quercu*, *Malo*, *Pyro*, *Corylo* adhuc minor: in *Ulmo* minima.

Herba & Frutices majores plerunque obtinent medullas quàm Arbores, pro magnitudinis ratione, ut in *Rhoe*, *Ficu*, *Oxyacantha* apparet. Medulla ex vasis & utriculis componitur; vasa ad marginem medullæ sita sunt, eámque circulariter ambiunt: continent autem succum plantæ essentialem & proprium.

Medullares utriculi quamvis reliquorum ejusdem plantæ respectu majores dicantur, in diversis tamen plantis magnitudine insigniter differunt: In nonnullis enim, ut *v. g. Cardùo* vulgatiss. centuplo majores sunt quàm in aliis, *v. g. Quercu*.

Notandum etiam utriculorum magnitudinem non sequi medullæ proportionem; cùm in medulla Sambuci, quæ multò amplior est medulla Oxyacanthæ, utriculi componentes duplo minores sunt quàm hujus.

Medullæ primi anni, eique soli convenit succulentam esse: post primum enim annum medulla exarescit, nec unquam postea succum admittit; unde laxæ molléque supersunt pelliculæ. *Grew.*

In medullæ utriculis, necnon in transversalibus vascula utriculos reticulariter ambientia occurrunt, undè conjectari licet vasorum plexibus tum medullarium tum transversalium sacculorum ordines irrigari.

CAP. V.

De Partibus caulium contentis & de motu succi.

Partim è *Clariss. Malpighii*, & *Grevii* scriptis, partim ex nostra observatione.

QUot vasorum genera sunt in truncis & radicibus, totidem etiam partium contentarum differentiæ. Utriculos hic è vasorum numero excludimus, & parenchymatis asscribimus, quamvis & hi revera vasa sint, Partes ergo contentæ sunt, 1. Lympha seu succus limpidus & aqueus, in Lymphæ-ductibus seu fibris ligneis fistulosis; 2. Succus plantæ essentialis seu specificus, in vasis peculiaribus succiferis reconditus; 3. Aer in fistulis spiralibus delatus; qui tamen plantæ pars non videtur dicendus. Succum limpidum in nonnullis plantis ex structura & situ Lymphæ-ductuum duûm generum esse colligit D. *Grevius*.

Utriculi (ut diximus) sunt veluti parenchyma trunci, nec succum à supradictis diversum continent, sed inter vasa mediant, & vel succo crudiori concoquendo inserviunt, ut vult D. *Malpighius*; vel etiam aeri è fistulis spiralibus excipiendo & in vasa succifera derivando, eodem ferè modo quo in animalibus pulmonum vesiculæ aerem à bronchiis tracheæ exceptum Arteriis impertiunt, ut opinatur D. *Grevius*.

Lympha. Succus limpidus seu lympha ab aqua communi, cùm primùm effluere incipit, nec gustu, nec consistentiâ multùm differt. Tantâ copiâ verno tempore ascendit, ut in nonnullis arboribus è vulnere inflicto ubertim emanet. Vasa autem per quæ movetur, autore D. *Grevio*, sunt fistulæ spirales seu tracheæ D. *Malpighio* dictæ. Ratio, seu causa (inquit) propter quam primo vere per fistulas hasce ascendit, est, quia corticis Lymphæ-ductus seu vasa per quæ totâ æstate fertur, tum primùm formari incipiunt, cùm ergo hâc viam non invenit, in vasa aerea digreditur; quamprimùm verò lymphæ-ductus prædicti consistentiam & extensionem debitam consecuta sunt, succus è diverticulo in viam redit, & tracheis derelictis in hæcut in proprium suum receptaculum se confert. Hæc D. *Grevius*, qui tamen nobis non undequaque satisfacit: quamvis enim satis causæ sit cur succus in tracheas primùm irruat, cùm tamen vasa ista ampliora sint & patentiora quàm noviter extructi lymphæ-ductus, & nihil obstet quo minùs cursum continuet, cur hisderelictis velut electione quadam ad novos canales se reciperet, rationem non video. Interim tamen succum verno tempore per vasa aerea sursùm ferri, & vulnerato trunco per eorum orificia effluere minimè negamus.

Quæ de motu succi vernali in *Betula*, *Vite*, *Acere majore & minore*, *Juglande*, *Carpino*, *Salice* (nam has solas arbores in nostra regione lachrymare hactenus observavimus) experiendo didicimus, subjicimus.

1. Per quæcunque tandem vasa ascendat succus, per totam ligni crassitiem ascendere experimenta evincunt: Siquidem terebrato trunco aut ramo radicéve, quò profundius factum fuerit foramen eò copiosior succus extillat, & quidem pro altitudinis proportione, ut ex duplo profundiore foramine dupla ferè succi quantitas eodem tempore emanet.

Deinde ut omnem vel scrupulosissimo cuique dubitandi ansam præscinderemus, grandiorem Betulæ ramum serrâ reciprocatâ ad medullam ferè incidimus, spatióque circiter semipedali interposito, ab eadem parte paris altitudinis sulcum seu incisionem fecimus, deinde ligno serraturas, intercedente exempto, inque areæ ligneæ complanatæ medio foramine terebrato, panni lacinium seu filtrum ei immisimus, cauto interim nè quid desuper liquoris in filtrum deflueret. Quibus peractis succum nihilominus è foramine copiosè extillare deprehendimus.

2. Succum in vasis tam deorsum quam sursùm liberè moveri constat. Virga enim Salicis aliúsve arboris cùm succo turget recisa, & perpendiculari situ suspensa, ab inferiori majore extremo lachrymam aliquandiu extillabat: quin si talea aut baculi saligni aut Acerni utrinque recisi superiori extremo fistulam ceream ita applices & agglutines, ut vasculum quoddam efformet, cujus latera sint circumferentia tubi, fundus planum extremi baculi recisi, eique perpendiculariter erecto aquam infundas, videbis

videbis brevi aquam transito ligno ab altera baculi extremitate paulatim extillare, nec cessare antequam vasculum prædictum eximanitum fuerit. Idem in Tithymalo aliisque lacteſcentibus cernitur, quæ recisæ ab utraque parte, tam supernâ quàm infernâ succum lacteum pariter effundunt. Unde patet nullas in plantarum vasis valvulas dari. Quod indè etiam confirmatur, quod si talea aut surculus inversus plantetur, superiore nimirum extremitate terræ immissâ, nihilominus comprehendit, & quantumvis mutatâ succi directione germinabit, ut in *Salice* experti sumus. Hoc tamen perpetuò evenit (*Malpighio* monente) plantatos taliter surculos minùs proficere.

3. Vasa succifera in progressu inter se communicant per mutuas anastomoses, quod hujusmodi experimento probamus. Serrato profundè per transversum Betulæ adultioris caudice, deinde interposito spatio ab eadem caudicis parte ad eandem quantum conjectari potuimus profunditatem serrâ adactâ, non ab inferiore tantùm sulco lachrymavit truncus, sed etiam à superiore, & quidem æquâ quantitate, idque non tantùm cùm primò serraturæ seu sulci facti essent, sed etiam post aliquot dies, & de novo iterum postquam cessâsset aliquoties effluere. Vasa autem dissecta non aliunde succum excipere potuerunt quàm ab integris & intactis in altero trunci latere ascendentibus, cum quibus in superiore arboris parte per anastomoses conjungebantur. Hic autem obiter monere convenit, Sectionem Corticis transversam circularem non semper aut omnem arborem perimere, ut vulgò creditum est. Siquidem ex nostra observatione in Agrifolio corticis annulo palmaris propè latitudinis detracto, & ligno denudato, arbor nihilominus per plures annos supervixit. D. autem Malpighius in variis diversarum arborum surculis & ramis *Opuli* v.g. *Prunorum, Mali Cydoniæ, Quercûs, Salicis, Populi, Avellanæ*, horizontalem sectionem in cortice fecit, ablata ejusdem & libri annulari portione: quo facto pars superior surculi seu caudicis supra sectionem brevi vegetans ità excrevit ut longè turgida redderetur. Cortex enim, in *Quercu* præcipuè, in *Prunis* & *Cydonia malo*, horizontales utriculorum ordines ita elongat, ut frequenter appendices promantur, quibus denudata ligni portio cooperitur; & factâ denuo mutuâ anastomosi cum inferiori lecti corticis labio continuus redditur cortex: rami quoque portio ultra sectionem ligneo superexcrescente circulo & involucro, impensè crassa protuberat. Denudata verò lignea portio gracilis adhuc subsistit nullo vigente incremento, quod reliquo quoque surculi infra sectionem contingit. *Hinc autem patet,*

Succum non tantùm inter corticem & lignum sursum repere, sed etiam in vasis in ipsa ligni substantia sitis ascendere.

Quandoque dubitavi (inquit D. *Malpighius*) & nos quoque unà, an expositus tumor ultra circularem sectionem in superioribus ramorum partibus excitatus, ab impetu succi sursum propulsi contingeret: Secto namque cortice per solas ligneas fistulas ascendens alimentum quasi ab angusto & arcto loco, laxiorem corticis campum ultra sectionem inveniens ad extra dilatari posset; undè hærendo nutritionem in proximis partibus promovere valeret. Quoniam tamen in novellis, præcipuè Quercûs, facta corticis laceratione, si exigua rami portio ultra sectionem circularem superfit, amputatâ sci. rami extremitate, nullus ferè tumor subcrescit: & in arboribus, in quibus factâ pariter horizontali sectione, ità tamen ut portio ejusdem corticis minimi unguis latitudinem æquans adhuc integra supersit, cortice ità continuato; certum est nutritionis augmentum subsequi in relicta corticis parte, & in superiori portione: Quare ex his probabiliùs conjeci nutritii succi motum à superioribus etiam ad inferiora promoveri. Hactenus Malpighius, cui & nos etiam suffragamur, imò succi descensum ex superiùs allato experimento, atque etiam ex discissa radice ab utraque parte, tam quæ trunco hæret, quàm quæ in terra restat, lachrymante, necessariò colligi & concludi opinamur, adeóque ramuli supra annulum decorticatum germinationem & augmentum succo descendenti deberi, qui cum ulteriùs inferiora versus ob corticem interruptum motum suum continuare nequeat, in corticis & ligni novum involucrum erogatur.

4. Succus non tantùm inter corticem & lignum, ut olim & vulgò creditum est, neque inter annuos tantum ligni circulos seu tunicas sursum repit, sed etiam in vasis in ipsa ligni substantiâ sitis, ut modo ostendimus.

5. Arbores nonnullæ citiùs lachrymare incipient quàm aliæ ejusdem generis & ætatis: adultiores & majores citiùs perpetuò quàm minores & juniores, & copiosiùs etiam ex æqua incisione.

6. Arbor quæcunque ex incisione antequam succus ascendat facta, cùm idem ascendere incipiet lachrymabit.

7. Dissecta particulari aliqua radice, ab utrâque parte, hoc est, tam ab ea quæ trunco unita manet, quàm ab ea quæ ab eodem separatur; ut mox innuimus, succus exstillabit, unde etiam constat eum susque deque in utramvis partem moveri.

8. Succus è vulnere inflicto in eundem locum aliquandiu destillans gelatinam quandam seu coagulum albicans paulatim præcipitabit, & copiosius cùm arbor folia explicare incipit. Coagulum hoc videtur esse materia ligni.

9. In motu & effluxu succi in varii generis arboribus magna est differentia. *Acer majus* Autumno etiam post delapsa statim folia, & deinceps per totam hyemem idoneâ tempestate vulnerata succum extillat: idoneâ inquam tempestate, hoc est, aeris temperie gelida & leviter pruinosa. *Acer majus, Juglans*, &c. incisæ aut terebratæ, post nocturnum gelu splendente Sole, modò frigus non nimium vehemens sit, succum uberrimè manant, non internoctu quidem aut summo manè, sed duabus tribúsve à Solis exortu horis, & circa meridiem maximè. Post gelu vehementius & diuturnius, cùm frigus incipit se remittere, succus maximâ omnium quantitate effluit, etiam è vulneribus pridem factis, iisque arboribus quæ vix unquam aliàs vulneranti respondent. Quod adeò verum est, ut si gelu fortè inciderit adulto vere, cùm jam succus extillare desiit, fluxum demùm repetit, & matutinis saltem horis emanat. Gelu ergo modò non sit valdè vehemens succi motum promovet, imò jam cessantem revocat: vidimus enim è vulneribus Aceri majori & Juglandi inflictis noctu diúque extillantem liquorem cùm statim post egressum vi frigoris in stirpas concrescerent & condensaretur. Notandum etiam in gelu vehementi, cùm terræ superficies nive obtegeretur, radicem Aceris majoris discissam, è parte terræ hærente uberrimè lachrymâsse, & copiosiùs

copiosiùs quàm aliàs unquam, cùm tamen ob vim frigoris succus in trunco vel congelatus vel ad motum pigrior redditus incisione facta non efflueret. Unde patet copioli hujusce effluxûs causam gelu fuisse; an quia superficies terræ constricta vapores ascendere solitos cohiberet & repercuteret: qui exitum non invenientes, paulò infra terræ superficiem constipati, impetu facto in radicis poros irruerent? Verùm (ut verum fatear) in ratione hujus phænomeni reddenda mihimet ipsi non satisfacio: eadem tamen proculdubio est quæ copiosissimæ emanationis fontium vivorum in gelu vehementissimo, quale brumâ præcedenti accidit.

Succi plantarum proprii & specifici plerumque concrescunt vel in gummi, vel in Resinam, vel in mediam quandam naturam inter gummi & resinam.

Gummi quid. *Gummi* est succus concretus qui in aqua facilè dissolvitur, in igne nec liquescit, nec flammam concipit, sed duntaxat crepitat; cujus generis sunt Gummi *Arabicum*, Gummi *Cerasi*, &c. Hoc genus [D. Grevio] nihil aliud est quàm mucilago exsiccata, cujus substantia parum vel nihil olei continet.

Resina quid. *Resina* est liquor pinguis & oleaginosus ex arbore sæpiùs sponte, interdum cà vulneratà desluens: Est autem ratione consistentiæ duplex, liquida & sicca. *C. B.* Cùm aquæ paucum, plurimum olei contineat, in aqua non dissolvitur, sed in oleo duntaxat. Hujus generis sunt *Terebinthina*, *Mastiche*, &c.

Medii generis succus inspissatus cum partibus suis oleosis plurimum aquæ admixtum habet; idcóque tam in aqua quàm in oleo dissolvi potest, ut Galbanum, Sagapenum, Ammoniacum, *&c.* Hæc autem nihil aliud initio sunt quàm succi lacteï inspissati. Cujuscunque enim plantæ lacteſcentis succus probè exsiccatus flammam facilè concipit, eámque lucidam & diuturnam emittit, non secus quàm *Terebinthina* aut Pix liquida. Color enim lacteus in plantarum succis ex admixtione partium oleosarum cum aqueis copiosiore oritur. Eadem utique (ut rectè *D. Grevius*) vegetabilium quæ annualium lactis origo & causa est, mixtura nimirum prædicta partium oleosarum cum aqueis per minima, ut vocant. Hinc partes lactis serosæ & oleosæ ab invicem separatæ utræque diaphanæ evadunt. Hinc in destillatione aquæ Anisi aut Cinnamomi *v. g.* qui primò exit spiritus limpidus est & diaphanus, verùm cùm spiritûs pars maxima exhausta est, cumque residuo aqueæ particulæ ascendunt quæ oleosas secum sursum rapiunt, liquor turbidus & albidus, ac si lacte sulfuris esset, evadit.

Color lacteus in succis unde.

CAP. VI.

De annuo trunci incremento.

ARborum & fruticum trunci, indéque emergentes rami, novis quolibet anno additis ligneis involucris augentur. Quolibet enim anno novus fibrarum annulus interiori libro accrescit, & bifariam tandem divisus in diversa discedit, pars exterior cortici adjungitur, interior sensim indurescens ante exactum Autumnum ligni duritiem & soliditatem acquirit, & à cortice abscedens ligno agglutinatur, adcóque truncum auget: *ita ut non rarò oblongam & continuatam fibram, mox in lignum ferruminatam; paullò infra corticis, naturam adhuc servantem animadverterit* D. Malpighius: *unde (inquit) nil mirum si in truncis & ramis arborum, quibus corticis exigua portio detracta est, subjecta lignea pars cortice destituta nunquam incrementum capiat.* Cùm ergo trunci & rami hoc tantùm modo augeantur, hinc olim creditum succum nutritium inter corticem & lignum duntaxat ascendere; quam opinionem erroneam esse superiùs ostendimus.

Circuli hi seu tunicæ ligneæ in arboribus intra tropicos nascentibus omni ex parte æqualiter inter se distant, & medullam pro centro legitimo obtinent, ut in ligno Brasiliano Acanthino dicto observavit * Gassendus, in cæteris verò regionibus vel ad Austrum, vel ad Septentrionem positis meridiem versùs dilatantur, & à parte polum respiciente contrahuntur, adoò ut medullæ respectu habito semper excentrici reperiantur: hinc multi ex hac circulorum politura meridianum invenire docuerunt; & Geoponici peritiores arbores translaturos monent, ut eundem denuò plantatis partium situm respectu plagarum cœli servent quem in priore statione obtinebant.

* Tom. 2. pag. 178.

Ex circulorum ligneorum numero trunci vel rami ætas innotescit, siquidem numerus circulorum numerum annorum quos duraverit æquat.

Circuli interiores angustiores sunt quàm exteriores, tum quia cùm planta robustior est copiosius alimentum attrahit & crassiores circulos effingit; tum quia interiores ab exterioribus premuntur & constringuntur, tum denique quia lignum tempore arescit & contrahitur. Hæc de arboribus vegetis & nondum staturam & magnitudinem justam adeptis; nam in annosis & γηράσκουσις aliter se res habet.

Interiores circuli, dum annis & siccitate contrahuntur, medullam spongiosam magis magisque comprimunt & coarctant donec in quibusdam omnino occultetur & evanescat.

Lignum circulorum interiorum durius est quàm exteriorum, & plerumque colore saturatiore tinctum, nunquam certè dilutiore. Hinc exterior ligni pars à colore Alburnum † Plinio dicitur, nostratibus The Sap of the Tree. D. Malpighius fibris & transversalibus utriculorum ordinibus, quibus lignum contexitur, peculiarem affundi succum existimat, cujus corporaturâ & concretione varia firmitas & durities ligno comparatur. Longum tamen (inquit) tempus requiritur, ut recenti ligno talis concilietur soliditas, qualis deprehenditur in præexistente ligno: unde nova inducta lignea additamenta talem duritiem non sortiuntur quam subrescentia inducta non erodant, sed teredini summè obnoxia sunt. In Quercu octo circulos & involucra alburnum constituere vidi, quare cum aeris & aquæ injuriis cedant, à mechanicis ut inutilia abjiciuntur.

† *lib.* 16. *c.* 33.

Arbores & rami qui in altitudinem per plures annos crescunt in parte superiore pauciores circulos ostendunt quàm in inferiore, exteriores autem circuli utriusque communes sunt, non interiores:

res: exteriores enim interioribus quotannis superinducuntur, unde & interiores qui cacumen non attingunt, semper in punctum desinunt, & singuli velut conum concavum efficiunt, ut perspicuè videre licet in Abietis tabulis per longitudinem arboris sectis.

Ex comparatione horum circulorum in variis arboribus innotescit differentia annui incrementi quarumlibet collatarum. Sic *v. g.* triennale augmentum Quercûs quinquennale ulmi incrementum crassitudine adæquat. Ex comparatione etiam circulorum annui incrementi in eadem arbore (qui non semper æquales sunt, sed crassitie plurimùm differunt, pro anni, ut verisimile est, constitutione) colligere licet qualisnam anni temperies latitudinali arboris cujuscunque incremento maximè propitia sit.

Cap. VII.

De Caulium differentiis è Joach. Jungii *Isagoge Phytoscopica, additis & mutatis nonnullis.*

Caules multipliciter differunt,

Differentiæ caulium foliorum respectu.

1. Respectu Foliorum, Caulis vel est *foliis vestitus*, vel iis omnino destitutus, sive *nudus*. Foliis vestiti plerique plantarum caules sunt. Caulis *nudus* vel *absolutè*, vel *secundum quid* nudus est. *Absolutè* nudum dicimus qui nullis omnino foliorum rudimentis donatur, ut *Taraxaci, Plantaginis, Bellidis,* &c. *Secundùm quid* nudum, qui foliis admodum exilibus, & à caule non satis distinctis est amictus, ut *Tussilaginis, Petasitis, Dentariæ aphylli,* &c.

Caulis foliis *vestitus* est vel *determinatè* vel *indeterminatè* foliatus. *Determinatè foliatus* est qui ex certa distinctione tantùm folia profert: Ex *unica* quidem in Anemone, Pulsatilla, Herba Paridis, Aconito hyemali: Ex *duabus* in Phthora, Unifolio, Cotyledone altera. *Indeterminatè* foliati sunt reliqui.

Differentiæ caulium ramorum respectu.

2. Respectu ramorum & petiolorum, Caulis est vel *simplex*, vel in *ramos divisus*: *Simplex*, ut in Taraxaco, Bellide, Plantagine, Pulsatilla, Anemone, Nymphæa, Bistorta, Vincetoxico, Pyrola vulgari, *&c.* *Ramosus* in plerisque.

Inter simplicem & ramosum ambigit caulis in umbellam sparsus, ut in Primula veris, Auricula ursi. In his tamen caulis petiolis potiùs quàm ramulis est diffusus.

Differentiæ foliorum situs respectu.

3. Respectu situs florum, Caulis vel *determinatus* est, vel *indeterminatus*.

Determinatus est qui in extremitatibus sive fastigiis stipitis flores & semina producit, ideóque vel in *capitulum*, vel in *spicam* sive *thyrsum*, vel *paniculam*, vel *umbellam*, vel *corymbum* terminatur.

Capitulum quid.

Capitulum est quod constat ex pluribus floseulis & seminibus arctè in globosam aut circularem sive disci figuram congestis, ut in Cyano, Scabiosa, Jacea, Carduis, *&c.* inque Bellide, Chrysanthemo, *&c.*

Spica quid.

Spica est quod ex floribus & seminibus spissè compositum est, ità ut conus erectus sed oblongus sive admodum acutus inde evadat, ut in Lysimachia purpurea, Verbasco, Plantagine, Luteola, Reseda, Bistorta, Secali, Hordeo, *&c.*

Panicula quid.

Panicula, item *Juba*, est spica laxè diffusa, præsertim perpendentibus petiolis, ut in Milio.

Umbella quid.

Umbella est extremitas caulis in plures longiores pediculos divisa, qui in latius continuo radiantur, inque minores divisi flores sustinent in orbem circumactos: à similitudine umbellæ, quâ mulieres faciem à Sole arcent, dicta.

Corymbus quid.

Corymbus est extremitas caulis ita subdivisa & floribus aut fructibus onusta ut sphærica figura indè oriatur, ut in Hedera arborea, Sambuco aquatica, Cepa, Porro. Corymbus interdum pendulus est, ut in Sambuco aquatica, seu rosea.

Corymbi nomen latiùs patet, & in genere quodvis summum significat. Nam prima notio τὸ κορυφὴ est, in capite veterum Atticorum, tutulus seu meta suggestûs capillorum, autore Scaligero. Verùm apud Plantarum scriptores Corymbi propriè Hederæ racemi appellantur. *Plin. lib.* 16. *cap.* 34. in descriptione hederæ ponit, *Racemis in orbem circumactis, qui vocantur Corymbi.* Dioscorides in capite de Hippophae, *Flores corymbis Hederæ similes*, inquit, *velut racemi cohærentes inter se.*

Corymbi aliâ acceptio.

Corymbus etiam aliàs sumitur apud recentiores Botanicos pro flore composito discoide, qui in pappum non resolvitur.

Caulis indeterminatus quis.

Caulis *indeterminatus* est qui petiolis à latere caulis prognatis flores & semen gerit.

Ideoque nullum extensionis habet terminum nisi quem hybernum frigus imponit.

Differentiæ caulium respectu figuræ.

4. Respectu *figuræ* Caulis vel *angulosus* est, vel *teres*; & utrque vel *solidus*, vel *cavus*.

Angulosus caulis vel *triquetrus* est, ut in Cypero & Gramine Cyperoide, Papyro, *&c.* Ad triangulum caulem etiam referri potest caulis qui ternis foliorum processibus, præsertim spinosis distinguitur, ut Carduus chrysanthemus.

Vel *Quadrangulus*, in Salvia, Mentha, Lamio, Marrubio, Rubia & sexcentis aliis.

Vel *Quinquangulus* in Campanula, Polygonatha vulgari:

Vel *Sexangulus* in Lysimachia purpurea trifolia.

Inter angulatos & teretes caules ambigunt striati, ut in Siciliana.

Caulis *teres* seu rotundus est in Anagallide aquatica, Nummulariâ, & infinitis aliis, præsertim in Bulbosis.

Caulis *inanis* vel totus inanis est, vel in nodis seu geniculis consolidatus, ut in Arundine, Frumentis, Graminibus, Fœniculo, Gentiana, *&c.*

Differentiæ caulium situs respectu.

5. Tandem Caulis situs respectu vel *rectus* est, vel *repens*. *Rectus* vel suis viribus se sustentat; vel adminiculis indiget, quibus vel circumvolvendo sese implicat, ut Lupulus & *Convolvuli*; vel claviculis se alligat, ut *Vitis, Bryonia alba*, & *Legumina* pleraque; vel foliorum pediculis annectit, ut *Nasturtium Indicum* & *Fumaria*; vel cirris adhærescit, ut *Hedera*.

Repens

Repens est quæ horizontaliter extensus ad intervalla folia emittit & radices agit: ut in Fragaria, Pentaphyllo, Ranunculo. Quibus caules hujusmodi sunt Plantas plurium fundorum appellat Junius. Pleræque autem hujus generis plantæ duûm generum caules emittunt, alterum *erectum*, alterum *repentem*, ut in Fragaria, Bugula, Ranunculo cernitur.

CAP. VIII.

De Gemmis, è Clariss. Malpighii & Grevii *præcipuè scriptis.*

GEmmæ dicuntur arborum & fruticum fœtus novelli, quos quotannis Æstate aut Autumno pariunt squamosis tegumentis veluti secundis obvoluti, in quibus per totum hyemem latitant, & vere tandem novo in surculos explicari incipiunt. Hæ (inquit Malpighius) in nostris hisce regionibus circa Junium mensem [serius apud nos in Anglia] è tenello surculo erumpunt, intra folii axillam cubantes. Singulis enim annis è quibuscunque tenellis ramulis novæ emergunt partes, à quibus excoquitur & derivatur non tantùm seminum materia, sed & Spermatica organa. Non enim idem uterus perpetuo viget, & reliquo inservit vegetanti corpori cui appenditur, ut in Animalibus, sed singulus quique ramus anno quo luce fruitur propriis gaudet spermaticis organis, & fœcundus brevi viget, reliquum vero suæ vitæ infœcundum transigit.

Nec surculi tantùm arborum & fruticum, sed & radices quoque herbarum restibiles gemmas quotannis Autumno pariunt.

Gemma cùm sit compendium surculi, seu tenellus surculus cum futurorum foliorum inchoamentis compendio quasi conclusus, iisdem partibus integratur quibus & rami componuntur. Media enim & profunda substantia tenellum est lignum suo cortice circumdatum, fibris ligneis utriculisque medullaribus contextum, & frequentissimè candidis pilis obsitum, à quo hinc indè erumpunt folia, squamatim locata, quorum exteriora quæ protegendæ gemmæ inserviunt, vel temporanea sunt & caduca, vel in alienam degenerant formam, ut multis exemplis ostendit D. Malpighius. Hæc autem (ut ille philosophatur) non tantùm interioribus & conclusis custodiam pariunt, sed contentus ipsorum reliquorúmque succus in propriis utriculis excoquitur, & longa illa [per hyemem] quiete digeritur, donec exaltatus spermatico illo spiritu, ope ambientis aeris, in gemmæ carinam, surculum sci. tenellum revehatur, ut ulteriorem foliorum vegetationem excitet. Unde hujusmodi gemmarum folia non unicam costulam, ut in stabilibus foliis ferè semper miramur per medium productam pollident, sed multiplices fasciculi à basi assurgentes in proprios appensos utriculos desinunt. Contabescunt postremò foliola hæc gemmarum, dum gemina uni adstant stabili folio, exhausto jam concocto humore, & tandem concidunt, vel gracilescendo in petioli formam absumuntur.

Non autem una perpetuò est naturæ methodus in augendis gemmarum foliis, ità ut primò caduca erumpant folia, mox stabilia emergant, & tandem adauctis illis ista contabescant & decidant, sed passim in pluribus arboribus gemmarum folia, & præcipuè quæ basin ipsius componunt, mitrali amissâ figurâ, novis mutationibus tandem in stabilia evadant folia, quibus surculus condecoratur.

Naturæ pariter methodus in producendis stabilibus foliis mirabilis est. Primò enim costula seu petiolus, carinæ instar, humore turgidus cum appensis fibrulis manifestatur, à quibus probabiliter sacculorum seu utriculorum transversalium membranulæ pendent, ut in Animalium primæva delineatione observatur. Patent autem deducto novo alimento, quia complicata sacculorum moles subintrante succo turget, & ità folio latitudinem & laxitatem conciliat.

Foliorum stabilium situs intra gemmæ claustra mirabilis pariter est: ità enim ipsorum partes contorquentur & complicantur, ut sibi mutuò adaptata turò custodiantur & minus occupent spatium.

Sic, exempli causâ, in *Lapatho, Acetosa, Bistorta*, &c. singula folia membraneo tenuique sacculo involvuntur, geminæ pariter foliorum partes convolutæ versus exteriorem partem, minori folio intra proprium sacculum contento locum supra excurrentem costulam parant: quod pariter intra involucrum suum custoditum, eandem suarum partium revolutionem patitur, minúsque adhuc foliolum suo sacculo circumdatum supra costulam custodit, & ità usque ad minima, vel si à minimis exordiamur, hæc cum proprio suo velo seu involucro, semper cum folio proximè majori alteri utrique communi velo includuntur, deinde utraque hæc folia velis suis obtecta unà cum folio proximè majori alteri itidem omnibus communi involucro obteguntur, & ità progrediendo usque ad maxima. Est autem (inquit D. Grevius) regula generalis quam observat natura in gemmis, cùm foliorum pediculi longiores sunt quàm ut folia sibi mutuo commodè obvolvi possint, nec alia specialis tutela providetur, è pediculorum basi membranas latas extendere, velut stragula foliis protegendis, interdum binas, interdum singulas.

Varios autem modos quibus natura folia tenella complicat, ut in gemmæ angustias coerceantur, pro uniuscujusque certè figura & compositione commodissimos, vide apud Grevium lib. de *Anatome Plantarum*, cap. 4. itemque lib. 4. de *Anat. Foliorum* cap. 1.

Gemmarum duo sunt genera, aliæ folia tantùm intra se continent, & in surculos foliosos explicantur, aliæ etiam floribus prægnantes sunt, quæ facilè ab illis veris initio magnitudine sua discernuntur.

Flores autem omnes, (observante *Grevio*) non secus quàm surculi perfectè formantur omnibus suis partibus absolutis tribus aut quatuor mensibus, & interdum dimidio anno, aut etiam ampliùs antequam in lucem & conspectum prodeunt: Adeò ut perennium herbarum omniúmque in genere Arborum & Fruticum, qui censentur anni cujuscunque flores, anni illius revera non sint, sed diu antea extiterunt, præcedenti sci. anno integram omnium partium formam & dispositionem adepti: ut singularum gemmas dissecando patebit. Sic flos *Mezerei v. g.* qui Januario mense interdum aperitur, circa medium Augustum anni præcedentis integrè formabatur: quo tempore foliis gemmæ viridibus cautè detractis floris petala ejusdémque apices, seminis conceptaculum cingentes

gentes, perſpicillo etiam mediocri clarè & diſtinctè viſibilia redduntur. Alia exempla adducit laudatus Autor quæ apud ipſum vide. Tempus autem quo Flos generatur ſeu formatur à nemine ante ſe obſervatum miratur. Invenio tamen in Lunaria min. tempus illud ab oculatiſſimo F. Columna obſervatum. In hac ſpecie (inquit) omnes plantæ in imo petiolo ſupra radicem folliculum quendam habent, veluti Ari florem exiguum, in quo plantulam exiguam, veluti fœtum complicatum extare vidi, intra folliculum, uteri vicem gerentem integram, folioſum tantùm quæ racemo vidua erat, poſt annum proferendam, & quæ racemoſa cum ipſo exiguo ſed integro racemo convolutam. Et hoc mirum Naturæ inſtitutum. Alias plantas ſimili modo infra terram uterum gerere agnovimus & ſuo tempore proferrè, ſed non anno integro, & forſan non medio, verùm à nova radicis ipſius extumeſcentia, ut in bulboſis quibuſdam, in quibus intra bulbum ipſum ſpicatum cauliculum obſervavimus, ſuo tempore proferendum.

Cap. IX.

De Foliis Plantarum è Joach. Jungii *& aliorum ſcriptis.*

Folium, definiente *Jungio, eſt quod à ſede cui adhæret ità in longitudinem & latitudinem extenditur, ut tertiæ dimenſionis termini inter ſe differant, hoc eſt, ſuperficies folii interna ab externa. *In Iſag. Phytoſcop.*

Superficies folii interna, quæ & ſuperior, item ſupina dicitur, eſt quæ caulem reſpicit, ideóque vel cavitatis aliquid obtinet, vel ſaltem minùs convexa eſt quàm altera exterior, ſive inferior ſive prona ſuperficies.

Folium aliud eſt *ſimplex*, aliud *compoſitum.*

Folium *compoſitum* eſt quod ex petiolo ſive nervo, ſive coſta, & lobis vel laciniis [potius quàm, ut vult Jungius, ſimplicibus foliis] conſtat. Totum enim illud, ut Theophraſtus nos docuit, quod cum petiolo decidere ſolet, folium appellari debet, ut in *Juglande, Fraxino, Sorbo,* &c. Partes autem illæ, quæ in multis folia videntur diſtincta, lobi ſunt & laciniæ, non propriè folia. *Folium compoſitum quid.*

Petiolus ſive pediculus folii pars eſt in longitudinem extenſa, quæ folium ſuſtinet & cauli connectit. *Petiolus* ſtrictè dictus à caule uſque ad folii initium intelligitur; id quod inter folia eſt *nervus* ſæpiùs aut *coſta* dicitur. *Petiolus quid.*

Folium compoſitum, dividente Jungio, eſt vel *digitatum*, vel *pennatum*, vel *triangulatum.*

Folium *digitatum* eſt ubi plures laciniæ, [ſeu plura ſimplicia folia Jungio] quaſi ad unum petioli punctum ſive terminum aptatæ ſunt, ut in *Trifoliis & Pentaphyllis, Fragaria, Lupino, Cannabe, Vitice,* &c.

Folium *pennatum* eſt in quo bini lobi [Jungio folia] è regione ſibi ad idem quaſi coſtæ punctum ſive ad eandem coſtæ diſtinctionem opponuntur. [*Lobi non ſemper ſibi mutuo directè opponuntur in hujuſmodi foliis, ut in multis Filicum ſpeciebus aliiſque obſervavimus.*] Hoc genus folia ſunt vel *pariter*, vel *impariter* pennata. *Pariter* pennata, ut in Faba, Vicia, Piſo, *&c.* [Una arbor Lentiſcus pariter pennata folia obtinet.] *Impariter* pennata, ubi ultimus coſtæ terminus ſingulari folio clauditur, quod imparem loborum numerum tribuit, ut in Roſa, Juglande, Fraxino, Potentilla, Sorbo, *&c.* Folium pennatum porro vel eſt *uniforme*, vel *difforme*. *Uniforme*, ſi lobi circa eandem coſtam hærentia magnitudine ferè æqualia ſint. *Difforme*, ſi majoribus minora ſint interpoſita, ut in Ulmaria, Agrimonia, Filipendula.

Folium *triangulatum* eſt cujus coſta ità ramoſa eſt ut bini rami ex eadem diſtinctione ſibi primariò oppoſiti in tot ramos ſindantur quot reliqua exterior coſtæ primariæ portio obtinet, dicitur etiam ala folioſa ſive folium ramoſum. Hæc *Jungius*. Verùm nos cum oculatiſſimo F. Columna Lynceo Folium compoſitum malumus dividere in 1. *digitatum* ſeu circumſcriptione rotundum & ad pediculum uſque inciſum: 2. *pennatum* ſeu πτερόφυλλον & 3. *multifidum* ſeu πολυσχιδὲς *h. e.* in plures lobos ſeu lacinias diſſectum. In hoc autem genere quæ latos habent lobos ſeu lacinias folia πλατυπολυσχιδῆ, ut Apii, Cicutæ, Angelicæ, Sphondylii & ſimilium; quæ verò anguſtioribus lobis ſeu ſegmentis dividuntur, λεπτοπολυσχιδῆ dici poſſunt, ut Liguſtici, Thapſiæ, Rutæ, *&c.* quæ denique in capillares omnino lacinias dividuntur, τριχοσχιδῆ merito appellantur, ut Ferulacea, Ammi, Millefolii, Fœniculi & ſimilium.

Folium ſimplex eſt quod non dividitur in lobos ſeu lacinias disjunctas. Eſtque margine vel integro vel ſciſſo, vel ſinuato vel ſine ſinubus, denique vel planum, vel concavum. Sin dichotomiam obſervare malumus Folium ſimplex dividi poteſt in planum & teres, teres autem in fárctum & concavum ſeu fiſtuloſum: *Planum* in *margine* integro & *æquali* donatum, & *margine inæquali*, eóque vel *ſinuato* vel *ſciſſo*. Folium ſinuatum eſt vel anguloſum vel abſque angulis.

Angulatum folium inter integri & ſciſſi marginis folium quaſi ambigit, ut Hederæ adultæ, Bryoniæ: Abſque angulis, ut Smilacis aſperæ.

Sciſſi marginis folium eſt vel laciniatum, vel ſerratum ſive crenatum, vel dentatum [denticulatum.]

Lacinia eſt portio folii inter fiſſuras (fiſſura eſt profundior ſciſſura) incluſa.

Folium teres eſt vel farctum, ut in Juncis; vel fiſtuloſum & intus vacuum, ut in Cepa: in his autem infima pars & cauli proxima plana eſt.

Folium ſimplex eſt vel
- *Planum* margine vel
  - *Integro* & æquali.
  - *Inæquali*, eóque vel
    - *Sinuato*, ſeu
      - *Angulatum*, ut in *Bryonia.*
      - *Abſque angulis*, ut in *Smilace* aſpera.
    - *Sciſſo*, eſtque vel
      - *Laciniatum.*
      - *Crenatum.*
      - *Dentatum.*
- *Teres*, iſque vel
  - *Farctum*, ut in *Gramine junceo.*
  - *Concavum* & fiſtuloſum, ut in *Cepa.*

C Poſſunt

Possunt etiam folia aliter multis modis dividi, ut v. g.

1. Respectu Superficiei, in 1. Lævia à Græcis λεῖα dicta, qualia sunt Betæ, Lapathi, &c. 2. Hirsuta seu lanuginosa & tomentosa, [δασέα] ut sunt Verbasci, Lychnidis, &c. 3. Aspera [τραχέα] qualia obtinent Buglossum, Echium, &c. 4. Aculeata vel spinosa [ἀκανθώδη] ut Carduorum, Agrifolii, &c. An dentur plantæ quæ spinam pro folio habent dubito; Scorpius certè præter spinas folia etiam habet.

2. Respectu Figuræ & circumscriptionis, in rotunda & longa, triquetra, teretia, &c.

3. Respectu Quantitatis, in magna & parva, lata & angusta, longa & brevia, crassa & tenuia.

4. Respectu Coloris, in viridia, ut sunt major pars foliorum tam herbarum quàm arborum, in luteum languentia, obscurè virentia, ad cæruleum vergentia, candida & incana, rubentia, maculosa, striata, &c.

5. Respectu Durationis, in perpetua seu diuturna, & decidua.

6. Respectu Situs & ortûs, in ea quæ ordinatè caulem cingunt, nimirum è singulis geniculis seu caulis distinctionibus vel *bina* prodeunt, ut in Salvia, Urtica & aliis quamplurimis.

Notand. *Plantas quadrato caule præditas omnes conjugatim & bijugo ordine, & quidem alternatim proferre folia; itémque ramos ex aliis, sive sinubus, sive angulis quos folia & pediculis foliis cum caule constituit.*

Alternatim pronasci dicuntur folia, aut germina, aut rami petiolive, si superioris paris oppositio decusset aut quasi ad angulos rectos secet inferioris paris oppositionem.

Multæ etiam plantæ teretis & non quadrati caulis bijuga habent folia, ut Bugula, Brunella, &c. Vel *terna*, ut in Lysimachia lutea, cærulea, purpurea; vel *quaterna*, ut in Cruciata; vel *sena* aut plura, ut in Gallio, Rupia, Aparine, &c. vel inordinatè & singula hærent: quamvis, inquit Columna, nec ista tam inordinata dici possunt, ut non aliquo numero, quino, aut majore vel minore in circuitu ramuli ordinem aliquem observent, ut in Vermicularia, Tithymalo & similibus.

Partes folium integrantes. Quod ad partes folium componentes attinet, sciendum est eàsdem illas esse quibus truncus integratur, nimirum fibras ligneas seu lymphæ-ductus; vasa succum specificum deferentia, tracheas; utriculos fibrarum reticulariter contextarum spatia replentes; & cuticulam. Sciendum enim est, folii petiolum fistulis ligneis unà cum tracheis & vase peculiari à tenelli furculi profundiore ligno seu intimioribus fistulis fibrisve ad extra continuatâ substantiâ derivatis, & in fasciculum collectis componi. Enascitur autem è tenello furculo & nunquam ab antiquioribus ramis aut trunco ipso, nisi medio gemmæ furculo. Petiolus velut peculiaris caudex in ramos & furculos scinditur. Frequenter per longum excurrens sub costulæ specie hinc inde promit ramulos, qui tandem in reticulares plexus desinunt. In aliis autem foliis petiolus statim ac latitudinem attingit scinditur in minores ramos, conspicuos tamen, qui quasi ab uno exorti umbilico alios minores producunt, ut in Hedera aliisque apparet. Notandum fibras petiolum componentes, initio antequam pediculum ingrediantur reticulari opere implicari, ut mos est Naturæ.

Petiolo appenditur folium dilatatum, cujus præcipua pars occupatur à costulis seu nervis vario ritu productis. Fibræ etenim ligneæ unà cum tracheis & peculiari vase conglomeratæ, à petiolo excedentes, velut minima arbor hinc inde disperguntur, & solvuntur in ramulos, & hi denuo ulteriore divisione in furculos, qui sibi mutuò occurrentes & unitæ in reticulares plexus contexuntur, qui in plerisque foliis consumptâ utrâque cuticulâ emergunt, in Salviæ autem & similium foliis etiam virentibus, aversâ præsertim parte, conspicui sunt.

Vasa Succifera peculiaria dari probatur. Fistulas & tracheas concomitari peculiaria vasa, quæ concoctum succum continent, humoris eruptione patet, qui cùm alieno pollet colore, vel crassiore constat substantiâ facilè in conspectum se dat. Sic in sectis foliis Tithymali, Cichorii & similium lac emergit, in Chelidonio subluteus humor: in reliquis autem herbarum & arborum foliis, quia limpidus aut aquosus humor est, nullam sui exhibet notam, cum tamen adesse analogia evincit.

Utriculi quales. Reticularium plexuum maculas seu areas utriculorum series à costulis emanantes & quasi ab ipsis pendentes replent, unde foliorum crassities consurgit. Hi autem utriculi ex contenti succi natura, mutuâ compressione vel laxitate varias subeunt in exteriori regione formas, unde quasi cæcales aut vermiculares veliculæ contortæ apparent: Interdum angulis scatent, & frequenter irregulariter terminantur.

Inter utriculos & fibrosum rete in plerisque foliis peculiares folliculi seu loculi disperguntur, qui patenti hiatu foràs vel halitum vel humorem fundunt. Horum descriptionem in plantis aliquot peculiaribus unà cùm succo quem continent vide apud * *Malpighium.*

* *Anat. Plant. pag. 37.*

Has omnes partes quibus folia coagmentantur levis superextensa cuticula seu epidermis obducit, quæ subjectorum colorem refert, ipsáque contenta investit & custodit.

Foliorum extremus unguis seu margo quasi zonâ seu crassiore lineâ circundatur. Hæc in aliquibus solæ membranæ esse videtur, quibus hinc indè tegitur folium exiguis interceptis utriculis, unde facilè à lumine pervaditur & diaphana fit. In aliis hujusmodi zona crassior est, & exterius oblongis cooperitur utriculis, interiùs verò ligneæ fibræ reliquis continuatæ excurrunt. *Malpig.*

In lacinularum apice in quas folia dissecantur dum tenella adhuc vegetant papillæ & utriculi quidam eminent diversos continentes succos. *Malpigh.*

Plantarum ferè omnium, paucis admodum exceptis, Atriplicibus v. g. & Amarantis nonnullis, folia postquam explicantur, Herbarum etiam caules colore viridi imbuuntur: cujus coloris quæ causa sit ambigitur. Plerique rei naturalis scriptores aeri eum ascribunt, nec præter rationem. Nam non tantùm radices Plantarum in terra latitantes albæ plerumque sunt, nunquam certe virides, sed & folia aere exclusa, ejúsve appulsu prohibito, albescunt, ut in *Brassicis* & *Lactucis caputatis* videmus, quarum interiora folia exterioribus obvoluta, & liberi aeris ulterà privata colorem album contrahunt. Deinde ad *Lactucam*, Endiviam, Cichoreum, Myrrhidem, Apium dulce, aliáque olera dealbanda pro Acetariis, vel ligamentis quibusdam folia vinciunt, vel terrâ obruunt, vel alio quodam artificio aeris appulsum arcent. Quin & plantæ in cenacvi undique occlusis suæ folia in luteum colorem languent, eò pallidiorem quo aeris externi ingressus diligentius prohibetur.

Aliud

Aliud adhuc experimentum ad hanc opinionem confirmandam producit D. *Grevius*: nimirum quòd in caulibus Althææ &c aliarum quarundam plantarum transversim dissectis, quamvis corticis parenchyma album sit, vasa tamen succifera parenchymate inclusa non minùs virent quàm cuticula ipsa; nimirum quia tracheis seu vasis aerem deferentibus proxima & contigua sunt, cùm parenchyma ab aere externo cuticulâ intercludatur; ab interno vasis succiferis interpositis.

Quòd plantæ Aerem liberum & apricum affectent luculento experimento ostendit * D. *Sharrocus*. Plantam tenellam è semine ortam, fictili exceptam in Fenestra collocavit, cui unica vitri quo obturata erat quadra deerat. Plantula quæ aliter sursum succreverat, relictâ hac directione, illico se inclinans versùs foramen rectà tendit, situ ad superficiem terræ in fictili propemodum depresso & ferè parallelo: Deinde fictili converso ita ut inclinatio caulis à foramine aversa aliorsum spectaret; plantula caule reflexo & in formam literæ C incurvato, ad foramen iterum se direxit; mutato denuo fictilis situ, & superiore curvaturæ cornu à foramine verso, caulis pariter summa pars directionem suam mutavit, & versùs patentem quadram sese retroflexit, & in literæ S figuram incurvavit; & interdum animi causa ut admirationem excitaret, amicos aut adstantes rogavit ut dicerent versus quam partem vellent ut planta crescendo tenderet, eámque notâ aliquâ in margine fictilis signarent; quod cum fecissent parte illa fictilis fenestræ foramini obversâ, intra paucas horas, sponte suâ, nullâ vi adhibitâ planta illa caulem suum illorsum inclinavit.

* *Lib. de Histor. propagationis Vegetabilium.*

Nobis tamen non tam aer quàm lumen, luminisve actio coloris in plantarum foliis viridis causa esse videtur. Nam externo Aere excluso plantæ tamen nonnullæ viridem utcunque colorem acquirunt & retinent, ut in vitreis operculis seu campanis tegi solitis cernitur, ut v. g. Plantâ mimosâ humili nostratibus dictâ, quæ ob cœli nostri frigiditatem aeris externi appulsum non patitur, sed perpetuò tegi postulat, & tamen colore viridi tingitur. Vitrum autem quamvis lumen admittat, aerem excludit. Unde colligimus luminis actionem causam viroris esse. Eædem enim plantæ vase opaco tectæ haud dubiè pro viridi pallidum induerent colorem, ut in conclavi clausis contingit. Nec tamen adeo lætè virere puto plantas vitreo operculo tectas ac aeri libero expositas, quoniam vitrum quamvis radios aliquos luminis transmittit, alios tamen intercipit & reflectit, nec enim aliter visibile esset. Quinetiam aqua vel aerem excludit, vel modicâ admodum quantitate intra poros suos admittit, & tamen plantæ ei immersæ virescunt, quod nobis luminis potiùs actioni tribuendum videtur, quàm (ut *D. Grevius* opinatur) aeri interno radicibus excepto. Verùm quicquid sit de lumine ejusque actione, nec enim huic sententiæ mordicùs adhæremus, certissimum est ad virorem inducendum non sufficere aerem conclusum & stagnantem, sed liberum & apertum requiri: unde in sylvis etiam opacis nascentes herbæ dilutiùs virent, quàm in locis apricis & solaribus radiis expositis. Nec tamen omnibus plantarum partibus colorem hunc conciliat sive aer, sive lumen, sed tantùm ritè præparatis & dispositis ad actionem suam excipiendam: Fieri etiam posse non negamus ut Aer salinas aliquas particulas plantæ succo communicet, quæ eum in viridem colorem mutent. Unusquisque quod sibi verisimillimum videtur sequatur. Ad hunc autem colorem inducendum non requiritur calor, sed potiùs frigus moderatum: Aer enim in conclavi occluso calidior est quàm sub dio, ut patet ex celeri & immodico in longitudinem auctu plantarum inibi ex semine nascentium: vidimus enim ejusmodi in locis plantulæ semipalis scapum in semipedalem ferè longitudinem excrescentem subtus folia seminalia, seu antequam folia explicaret. Quin inclinationem prædictam caulis ad foramen in fenestra relictum indè ortam putamus, quòd Aer externus in foramen irruens & parti caulis eidem obversæ occurrens, frigore suo poros ex ea parte constringeret, adeóque caulem illorsum incurvari faceret.

Quis foliorum usus sit, quodnam officium quæritur. Cæsalpinus hujus gratiâ folia data existimat ut tenerum germen (quod tanquam manibus invicem superpositis circumplectuntur) tueantur, vel etiam fructum, ubi fructus erumpit cum germine. Postquam verò eadem explicata sunt, germine adultiore, alium usum præstare videntur, umbram scilicet, nè à Sole nimis urantur cum fructus, tum novella germina; moderatos enim Solis radios utraque desiderant, quod foliorum positione & formâ præstatur, illos partim transmittentium partim retinentium. Ideo plurimis in Autumno decidunt folia perfectis fructibus & germinibus induratis. Ferunt autem in regione fervente, ubi perpetui ferè sunt æstus, nullis arboribus folia decidere, quod rectâ ratione sit: egent enim plantæ perpetuâ inibi foliorum operâ ad umbram faciendam. *Cæsalp.*

Clarissimus *Malpighius* alium præterea usum plantæ præstare folia existimat. A natura, inquit, fabrefacta videntur ut coctioni alimenti inserviant. Nutritii namque succi portio quæ radices subingreditur, nec in appensas transversales fistrias derivatur, postremò à ligneis fistulis in folia exoneratur; ideò necesse est, ut in ipsorum quasi transversalibus utriculis moram trahat, & antiquo succo commisceatur & fermentetur, juvante non parùm externo ambientis aeris calore, ut faciliùs inutilia transpirata evolent. Dari autem hujusmodi concoctionem in foliis, seminalis plantulæ structura indicare videtur. Hæc geminis plerumque constat foliis, quæ propriis vasculis & utriculis succo turgidis ditantur, ut mole suâ reliquum plantulæ superent. In germinatione verò soluti & turgidi hujusmodi plantulæ humores advenientem succum fermentant & antiquum augent, ità ut in ampla folia extendantur, ut patet in *Endivia, Peponibus & Cucurbita*, cujus seminalia folia in tantam excrescunt molem ut vix credibile sit, & ablatâ cuticulâ series pendentium utriculorum tam manifestò exhibentur, ut evidenter pateat folia hujusmodi conditoria esse seu penu concreti succi. Quoniam tamen sensim, vegetante radicis trunco & plantulæ germine, contabescere incipiunt hujusmodi folia, hinc constat à foliis in caulem & caudicem regressum esse concocti succi, & quasi peculiarem circulationem. Remittunt itaque & *folia* probabiliter concoctum succum, ipsumque in annotino & novello surculo, cui adnascuntur, congregant, ut in tenellam gemmam absumatur. Etenim non longè ab insertione & folii eruptione gemma post aliquod tempus succrescit; & maturatus per longum tempus in surculo coercitus humor, advenientis veris ope refermentatus, in gemmæ fœtum absumitur, & nutritionem inchoat: Unde videtur nulla succrescere, ut plurimùm gemma quàm non antecedat & successivè alat folium.

Idem ministerium præstant probabiliter folia seminibus, &c. Corruptis singulis annis minimis meatulis, exhaustóque antiquo succo, cùm folia ampliùs naturæ nequaquam inserviant, abjiciuntur, novumque organum formatur: & quibus in plantis folia adhuc virent, novis tamen æstate germinantibus gemmis antiqua marasmo consecta collabuntur. Hæc omnia D. Malpighius, quæ & nobis probantur.

CAP. X.

De Floribus Plantarum, & primò de eorum partibus.

FLos, definiente *Jungio*, est pars plantæ tenuior, colore vel figurâ, vel utroque insignis, rudimento fructûs cohærens. Hæc definitio, vel ipso Jungio fatente, nimis angusta est: nec enim omnis flos rudimento fructûs cohæret: nam in *frumento Indico Maiz* dicto, *Palma Christi* seu *Ricino*, *Bardana minore* seu *Xanthio*, *Heliotropio tricocco*, *Lachryma Jobi*, *Ambrosia*, à fructu aliquantulum removetur. Nec in herbis tantùm sed & in arboribus ut v. g. *Juglande*, *Corylo*, *Quercu*, *&c.* dantur flores amentacei à fructu disjuncti.

Quinimo non in eadem tantùm planta florem à fructu removit natura, sed etiam in eadem specie flores & fructus totis individuis disterevit, ità ut quæ flores ferrent, infœcundæ & steriles essent, quæ fœcundæ, flores non producerent: Has in eadem specie sexu differre volunt Botanici, & fertiles fœminas, steriles mares appellant. Præterea in pluribus plantarum speciebus, in quibus etiam flores fructibus cohærent, dantur plurimi flores inutiles, hoc est, quibus nullus fructus seménve succedit, ut in Pomiferis, *Pepone*, *Cucurbitâ*; *Melone*, *&c.* inque *Malo* & *Pyro* manifestè cernitur.

Rectiùs ergo meâ sententiâ definitur *flos*, Pars plantæ tenuior & fugax, colore vel figurâ vel utroque insignis, fructui prævia, eique plurimùm cohærens & tenello tegendo fovendóque inserviens, quæ postquam explicatur brevi aut decidit aut marcescit.

Fructui prævii dici possunt etiam flores inutiles & amentacei, quamvis eidem contigui non sint, quoniam plerunque aut decidunt aut marcescunt antequam fructus matureścit.

Partes floris sunt. 1. *Calyx* sive *Perianthium*, quod tamen nonnullis adjunctum potiùs quam pars floris censetur. 2. *Folia* illa *tenella* & *fugacia*, quæ nos ad Homonymiam vitandam cum Columna *petala* appellare solemus. 3. *Stamina*: & 4. *Stylus*.

Flores *perfecti* dicuntur qui omnibus hisce partibus donati sunt: *imperfecti*, qui harum partium aliquâ carent. Nos tamen in hoc opere florem *perfectum* vocamus quicunque petalis seu foliis fugacibus coloratis constat, sive calycem habeat, ut plerique, sive non, ut *Calthæ palustris*, *Anemones* & bulbosarum nonnullarum flores; *imperfectum* qui apetalos est, seu foliis illis fugacibus, coloratis caret: Hunc etiam stamineum vocamus, quia staminibus & calyce duntaxat constat. Sub staminibus etiam stylum comprehendimus quo pauciissimi flores carent.

CALYX. *Calyx* est qui florem tegit & sustentat, ejusque velut basis & fulcimentum est, ideóque crassior est & minùs insignis flore ipso. Oritur autem ex exteriore surculi cortice, ideóq; (inquit Cæsalpinus) herbacei coloris est, nec decidit cum flore. Verùm ex nostra observatione in nonnullis plantarum generibus vel unà cum flore decidit, ut in *Ranunculo* & *Lysimachia siliquosa*; vel etiam ante florem, ut in *Papavere*.

Calyces seu Perianthia in nonnullis plantis, tum colore, tum consistentiâ, tenella florum petala proximè referunt, distinguuntur quòd non defluant aut marcescant antequam semina matureścant, verùm ipsis pro vasculis inserviant. Hujusmodi sunt *Fegopyri*, *Potamogitonis angustifolii*, *Bistortæ*, &c. florum calyces. Calyces enim voco quantumvis coloratas has partes, quia nec deciduæ sunt, nec fugaces.

PETALA. *Petala* seu floris folia sunt laminæ illæ tenellæ, colore insignes & fugaces. Ad petalum enim constituendum duæ hæ conditiones concurrant oportet: 1. Ut sit tenue & colore insigne: 2. ut sit fugax & caducum: adeò ut siqua pars plantæ harum conditionum alterutrâ careat, quamvis alteram habeat, petalum dicenda non sit. Ob defectum primæ conditionis Ranunculi & Papaveris calyces quamvis decidui pro petalis non sunt habendi: ob secundæ carentiam Bistortæ & Persicariæ supradicti calyces à petalorum numero excluduntur.

Quod ad petalorum texturam & compositionem attinet, Interioris cauliculi seu ligni (docente * Malpighio) substantia, fistulæ scil. & tracheæ extenduntur & elongantur in floris folia, quæ omni vasorum genere instructa pendentibus utriculorum seriebus integrantur. Hæc tenui halitu oque turgent succo, unde incisuras non patiuntur: ob humoris etenim benignitatem & ductilitatem utriculorum ordines extenduntur usque ad extremum unguem, & ut plurimum vasa non ab una excedunt costula, sed copiosi fasciculi à basi exurgunt, & productis ramis in omnem dimensionem elongantur. Quod ad colores, excepto nigro & viridi, omnes in floribus spectantur.

* *Anat. Plan. p.* 55.

STAMINA. *Stamina* seu capillamenta, describente * Spigelio, sunt in floris medio, quod umbilicus appellatur, partes oblongæ, tenues, veluti capillamenta, interdum paulò crassiores, paulò prominentes in summitate, apicibus frequenter præditæ, quæ stylum partem similiter oblongam sed crassiorem atque è centro umbilici emergentem ambiunt.

* *Ispig. ad rem Herbariam.*

Stamina pediculo constant & capitulo seu apice.

Pediculi staminum plerunque liberi sunt, & in quamplurimis plantis à fundo floris seu dilatatâ petali substantiâ (ut cum D. Malpighio loquar) oriuntur: in Digitali & plerisque omnibus tubulosa petala habentibus (ut galeatis & labiatis) ab interioris superficiei petali ima parte erumpunt, interdum toti eidem affixi sunt seu cohærent, ut in *Symphyto majore*, *Lithospermo*, *Polygonatæ*, *&c.*

* *Ispig. Phyto. scop. c.* 20. Differentias staminum Jungius sic * persequitur.

Pediculi staminum liberi plerunque tereres sunt, rarò latiusculi ut in *ornithogalis*.

Pediculus teres vel tenuis est, vel crassiusculus.

Pediculus

Pediculus item, alius curvus est, ut in galeatis floribus in quibus sub galea latentia stamina curvaturam ejus imitantur, ut in Salvia, Lamio, Sclarea: & in Papilionaceis in quibus latent in inferiore carina sursum recurva.

Staminum pediculi porro plerunque glabri sunt, interdum hirsuti; ut in *Blattaria*.

Stamina ferè semper inter se æqualia sunt, interdum inæqualia; ut in Napello, Colutea, Scorpioide, &c.

Staminum pediculi ferè semper simplices sunt, in Lauro ramosi.

Staminum numerus plerunque foliis aut laciniis ambitus respondet, ità ut aut æqualis sit, aut multiplus, aut submultiplus. Sic in *Rutæ* flore 4 petala sunt, 8 stamina; in Cervicaria flore campaniformi 5 laciniæ seu cuspides intus in fundo 5 stamina; in Iride 9 folia, 3 stamina; in Gladiolo Ital. 3 stamina, folia 6.

Sunt autem flores tam copiosa habentes stamina, ut eorum numerus non facilè possit iniri, staminosi idcirco dicendi; ut Ranunculo, Papavere, &c.

Capitula sive cacuminula staminibus incumbentia *Apices* dicuntur; Malpighio staminum capsulæ. Hæc diversimode colorantur & figurantur, frequenter tamen lutea aut crocea sunt, interdum nigricant, aliàs albescunt; observavimus etiam purpureo aut rubente colore conspicua, quamvis rarius, ut v. g. in Hepaticæ trifoliæ specie illa, quam Parkinsonus albam staminibus rubris appellat, Gramine leucanthemo minore, Alline pulchro flore, folio tenuissimo nostrate, aliisque quæ non occurrunt memoriæ: ideóque securè nimis * affirmat Grevius, Apicum colorem nunquam rubrum esse; quicunque tandem floris petalorum color sit, intus non rarò concava sunt, & globulorum congeriem continent. APICES. * *De florum Anat. cap. c. 3. & 5.*

Eadem vel ex medio longitudinis suæ aptata sunt pediculo vel quasi medio, rariùs extremo, ut in *Tulipis, Iridibus, &c.*

Staminum capitula plerunque ità sita sunt, ut longitudo cujusque ad longitudinem pediculi sui sit transversa, hoc est, angulos cum ea vel rectos, vel obliquos constituat. Est & ubi longitudo capituli longitudini pediculi in directum quasi sita est, ut in *Tulipis*: imò sunt flores in quibus staminum capitula pediculis directim sita, lateribus inter se cocant, ut fistulam quandam constituant, in qua stylus ità includatur, ut extimâ tantùm parte promineat, ut in Boragine, Solano, Dulcamara. Denique in omnibus flosculis capitula florea constituentibus, ut in Eupatorio cannabino vulgari, Agerato, Centaurio majore, Scabiosis, Cyanis, Jaceis, Carduis; item in flosculis discos floreos constituentibus, ut in Flore Solis, Helenio, Ptarmica, Millefolio, Tanaceto, Acanthio loco staminum est foliolum aliquod oblongum, fronte in aliquot quasi staminum petiolos scissâ, quod complicatum fistulæ instar stylum involvit. D. Malpighius accuratiùs, tubum hunc effformari aut petiolis quinque ab interiori floris substantia sursum productis & unitis, qui etiam in capite laciniatur, in nonnullis.

Hæ staminum partes, pediculus nimirum & appensa capsula (autore Malpighio) ligneis fibris & tracheis integrantur singulæ, quibus utriculi per longum locati adduntur. Quare cum in galeatis & quibusdam etiam aliis ab elongatis floralibus foliis producantur, iisdem etiam particulis necessariò componuntur.

Quis harum partium usus sit ambigitur: nonnulli ornatûs tantùm gratiâ floribus concessas putant: alii ad materiam generationi seminum incongruam eliminandam, ut residua purior & defæcatior evadat: adeóque velut emunctoria quædam esse, per quæ determinata quædam succi portio excernitur, nimirum aerea, ut semen oleosius reddatur, ejusque principia fixiora. Hinc (inquit *Malpighius*) fortasse non incongruè derivato nomine, *menstruæ purgationes*, quæ in mulieribus conceptionis tempora proximè antecedunt, *flores* dicuntur: nam ut in plantis determinata succi portio per stamina & floris petala excernitur, ità in viviparis, quæ conceptûs particulas quoquo modo inficere possunt, singulo mense cribratæ per uterum foràs protruduntur, ut reliquum defæcati sanguinis in utero stagnantis, faciliùs vi seminis fœcundetur, & in animalis naturam dirigatur.

Grevius noster non hunc tantùm usum staminum præstare opinatur, sed & pollinem illum seu globulos quibus apices prægnantes sunt, quósque per maturitatem effundunt, spermatis masculum instar seminibus fœcundandis inservire existimat; ac proinde maximam plantarum partem utriusque sexûs participem esse. Quod non adeò incredibile videri debet, cum & in Animalium genere nonnulla androgyna observantur, ut v. g. Cochleæ terrestres; quamvis quidem in seipsis non generent, quo à plantis differunt. Nec obstat, quòd particulæ hæ (si modò sperma sint aut spermati analogæ) in uterum aut semina non penetrent, nam & in piscibus externè tantùm ovis jam editis insperguntur genitura, nec in ullo animalium genere, quod sciam, ovarium intrat, at nè uterum quidem ipsum in plerisque, sed solus ejus halitus & effluvia subtilia sufficiunt ad ova fœcundanda, & embryon intus concludum vivificandum.

Hæc si ità sint, non similitudine aliqua duntaxat, sed revera & strictè loquendo sexu differunt plantæ illæ, quarum aliæ semen absque flore, aliæ [ab ejusdem plantæ semine ortæ] florem absque semine producunt. Tales sunt in Arborum genere *Palma dactylifera*, *Salices* pleræque ex nostra observatione, & secundùm Plinium etiam *Cedrus major*: in Herbarum, *Lupulus salicitarius*, *Cannabis*, *Cynocrambe*, *Mercurialis*, *Phyllon*, *Urtica*, *Spinachia*, *Sesamoides* Clusii, aliique non pauca.

D. *Grevii* sententiam magnopere confirmant, quæ de Palma dactylifera à * Veteribus & Recentioribus traduntur, nimirum fœminas non omnino fructificare, nisi mas juxta ipsas conditus fuerit: quin & pulverem maris fœminæ aspersum eam fœcundiorem reddere. Ni enim Ægyptii hoc fecerint (inquit Prosper * Alpinus) sine dubio fœminæ vel nullos fructus ferent, vel quos ferent non retinebunt, neque hi maturescent. At inquies in arenosis & desertis, ubi nemo maris pulverem seu pollinem florum fœmineo fœtui aspergit, fœminæ nihilominus fœcundæ sunt. Imo verò ventorum beneficio, qui pulverem marium fœminis afflant. * *Plin. Hist. Nat. lib. 13. c. 4.* * *Lib. de Plantis Ægyptiis.*

Cæterum rectè à D. *Grevio* obſervatum, globulos hoſce ſeu particulas ſeminiformes apicum thecis incluſas, illud ipſum corpus eſſe quod Apes colligunt & femoribus appenſum geſtant, quod noſtrates *panem Apum* vocant, quod etiam in cellulas unà cum melle recondunt. Ceram enim ore domum portant, mel ventriculo.

Opinio autem hæc de uſu pollinis prædicti ulteriori adhuc confirmatione indiget; nos ut veriſimilem tantùm admittimus.

STYLUS. *Stylus* eſt pars floris medium ejus occupans & rudimento fructûs ſive ſeminis inhærens. Dicitur Stylus quia in longitudinem tenuem plerunque extenditur.

Folioſa pars floris modò apici, modò ſedi fructus ſeminiſve cohæret; Stamina vel medio, vel imo folioſæ; Stylus ſemper apici fructûs ſeminiſve inhæret, ideóque reliquis floris partibus defluentibus in planta remanet. Hæc *Jungius*.

D. *Malpighius* Stylum concavitate ſua ſemen fovere, appendice aſſurgere, intérque ſtamina ludere ait. Vaſculum ergo ſeminale Stylum facere videtur *Malpighius*, & Styli appendicem, quem alii Stylum vocant: hanc autem uterinis tubis analogam exiſtimat, & exemplis probat. Eſt ergo Stylus uteri ſeu vaſculi ſeminalis tubus perpetuò hians, ad ſemen intus concluſum ventilandum, & halitus expellendos.

Videndum in verticillatis an Stylus ſummo ſemini inſideat nécne: nobis quatuor ſemina Stylum circumſtare videntur.

Stylus plerunque unicus adeſt, interdum tamen plures, ut v. g. in Aquilegia quini, quia rudimentum fructus in quinas maturatur ſiliquas.

Flores nonnulli Stylo carent, ut Papaver, Tulipa, &c. niſi vaſculum ſeminale pro Stylo admittere velimus. In Iride tria folia interna ſub quibus ſtamina occultantur Styli ſuccedaneum facit Jungius.

Stylus propriè dictus terminatur vel *cuſpide*, vel *globulo*, vel *cono*, vel *cornibus*: *Cuſpide*, ut in Digitali, Symphyto majore aliiſque plurimis; *Cono*, ut in Liliis nonnullis; *Globulo*, ut in Convolvulo peregrino purpureo: *Cornua* vel *brevia* ſunt, ut in Convolvulo vulgari, vel *prolixa*, ut in Eupatorio vulgari: interdum adeò prolixa ut plures adeſſe videantur Styli, ità bini in Staphylodendro: quod ad numerum attinet vel *bina* ſunt, ut in Cichoreo; vel *terna*, ut in Cervicaria; vel quod rarius, *quaterna*, ut in Lyſimachia Virginiana. Cornua plerunque *æqualia* ſunt, interdum *inæqualis* longitudinis, ut in Salvia & Æthiopide; plerunque etiam *reflexa* ſive recurva ſunt, ut in Cichorio, Cervicaria; interdum *recta*.

CAP. XI.

De Florum differentiis: è Joach. Jungii *Iſagoge Phytoſcopica, additis & mutatis nonnullis.*

FLos *perfectus*, qualem ſuperiùs deſcripſimus, vel eſt *ſimplex*, vel *compoſitus*.

Simplex nobis dicitur qui non dividitur in floſculos, ſive qui unico & ſimplici plerunque ſtylo ſive vaſculo ſeminali donatur.

Compoſitus ſeu *aggregatus*, qui ex pluribus floſculis in unum totalem florem cocuntibus conſtat; quorum unuſquiſque non tantùm folio ſeu bracteâ coloratâ, verùm etiam vel ſtaminibus vel ſtylo ſaltem conſtat, & ſinguli ſingulis ſeminibus cohærent. Ejuſmodi flores ſunt, Lactucæ, Hieracii, Carduorum, *&c.*

Flos ſimplex interdum opponitur multiplici ſeu pleno. [*Jungius* ſimplicem abſolutè vocat quem nos monopetalon ſeu unifolium.]

Flos ergo ſimplex eſt vel *Monopetalos* ſeu unifolius, vel *Polypetalos* ſeu multifolius: uterque per accidens plenus ſeu multiplex eſt.

Monopetalos eſt qui unico petalo continuo conſtat, quod plerunque cavum aut ſiſtuloſum eſt.

Polypetalos qui pluribus foliis in una ſerie aut circulo diſpolitis componitur. Eſtque vel *dipetalos* ſeu *biſolius*, ut in *Circæa Lutetiana*, *Hypocoo Cluſii*, *Alſines facie nova planta* Columnæ: vel *tripetalos*, ut in *Plantagine aquatica*, *Sagittaria*, *Militari Aizoide*, *Nymphæa alba minima*: vel *tetrapetalos*, ut in *Leucoio*, *Braſſica* & congeneribus aliiſque plurimis: vel *pentapetalos*, ut in *Alſine*, *Lychnide*, *Caryophyllis*, &c. vel *hexapetalos*, ut in *Bulbaceis* & congeneribus. Columna Flores nullos naturaliter heptapetalos obſervavit. Trifolium hepaticum florem octapetalon proferre obſervavit F. Columna; Florem Africanum enneapetalon; Granadillam Mexicanam decapetalon. Verùm in hujuſmodi polypetalis quorum petala ſenarium numerum excedunt dubitamus an Natura certum numerum obſervet.

Flos uterque tam monopetalos quàm polypetalos vel *uniformis* eſt vel *diſformis*.

Monopetalon uniformem cum Jungio voco qui terminos duarum dimenſionum inter ſe ſimiles habet, ſive qui dextrum ſiniſtro & anterius poſteriori ſimile, ſuperius inferiori diſſimile obtinet, ſive figuræ quaſi tornatilis eſt.

Tornatilis autem figura eſt quæ oritur planâ figurâ ſuper uno latere rectilineo quieſcente in orbem motâ, ſive rectilinea ſit mota figura ſive mixtilinea.

Dixi quaſi tornatilis figuræ, quia ſi plicæ, ſtriæ & fiſſuræ accedant tornatilis figura eſſe deſinit.

Monopetali flores uniformes ſunt in *Convolvulo*, *Campanula*, *Bugloſſo*, *Hyoſcyamo*, *Tabaco*, &c.

Flos monopet. uniformis margine ſuperiore vel *integro* eſt, vel in *lacinias fiſſo*: *integro* ut in *Convolvulo*; *fiſſo* ut in *Bugloſſo*, &c.

Si profundæ ſint ſciſſuræ ſæpe compoſitum florem ſimulat; ſed diſcernitur ab eo, quòd totus [ſeu integer] decidat; uti flores *Boraginis*, *Bugloſſi*, *Sambuci*, *Cyclamini*.

Fiſſi flores vel *numero* laciniarum differunt, vel *figurâ*.

Numero, ut vel tribus in *Caſia Poetica*, *Phalangio Virginiano* & paucis admodum aliis, vel quatuor; vel quinque; vel ſex; ut in plurimis.

Figurâ

Figurâ, vel *angulosâ*, angulo *acuto* ut in *Boragine*; *obtuso* ut in *Hyoscyamo*: vel *rotundâ* seu *sinuata*, ut in *Primula veris*, seu *simpliciter rotundâ* & *convexâ* ut in *Buglosso*.

Porrò flos uniformis tunicâ est vel uniformiter teretî; vel plicis, ut in Convolvulo; aut striis, ut in Campanula, variatâ.

Monopetalos difformis est qui unius tantùm dimensionis terminos inter se similes habet, *h. e.* cujus non superiora tantùm ab inferioribus, sed & anteriora à posticis discrepant, uti sunt Labiati, & reliquarum verticillatarum. Estque vel 1. *Semifistularis*, qui fistulâ superiùs obliquè resectâ constat, ut in Aristolochia: vel 2. *Labiatus*, idque vel unico labio, eóque vel superiore seu interiore, ut in Acantho sativo; vel inferiore seu exteriore ut in Scordio, Teucrio communi & Bætico, *&c.* vel duobus, ut major pars florum labiatorum, in quibus labium superius vel repandum est sive sursùm reflexum, convexam faciem alteri labio obvertens, ut in Chamæcisso *&c.* vel convexum sive deorsum reflexum, cavitatem inferiori labio obvertens, quod frequentius est; unde Labium hujusmodi Galea, Cucullus, Galericulus; & flos ipse galeatus, cucullatus & galericulatus dicitur. Est & labium aliud integrum, aliud scissum in lacinias, *&c.* vel 3. Flos monopetalos difformis *cornutatus* est. Corniculum in flore vocat Jungius quod alii Calcar seu Calcaneum. Est ergo, eodem definente, Corniculatus flos flos cavus qui partem aliquam corniculo similem superiori sui parti connexam habet, *h. e.* cavam & rotundam partem, quæ in cuspidem non perviam desinat, ut in Linaria, Delphinio, *&c.*

Flos multifolius seu polypetalos *uniformis* est, cujus petala figurâ & situ conveniunt, licet magnitudine interdum differant, ut in Umbelliferis. *Difformis* est cujus petala figurâ, aut situ, aut utroque differunt, ut *v. g.* Iridis, & Leguminum, licet fortasse horum flos, potiùs monopetalos profundè laciniatus sit.

Superiùs diximus florem simplicem tam monopetalon, quàm polypetalon per accidens interdum plenum esse seu multiplicem. [Simplicem florem appello qui ex floseulis Compositò opponitur, non qui multiplici.]

Flos per accidens plenus est cujus pars foliacea ob culturam, ubertatem soli, aliúdve accidens multiplicata est. Quod si laminâ unicâ flos non plenus constet, in pleno laminâ aliquoties iteratâ, prima secundam, secunda tertiam includit, ut in *Stramonia*, *Aquilegia*, &c. Sin ex pluribus foliis compositus sit floris ambitus, gyri foliorum repetuntur, ut in *Rosa*, *Ranunculo*, *Anemone*, *Papavere*, *Caryophyllo*, *Leucoio*, *Pæonia*, *Colchico*, *Croco*, *Caltha*, *Melanthio*.

Quidam flores ad plenitudinem culturâ perduci nequeunt, ut Galeati & Papilionacei, *&c.*

Superest ut Floris compositi superiùs descripti differentias adferamus.

Flos ergo compositus vel est discoides, vel planifolius naturâ plenus, vel fistularis.

Discus est quod ex plurimis compressis & confertis floseulis ità componitur, ut unam quasi apparentem superficiem constituant.

Flos *discoides* est vel disco *radiato*, vel disco *nudo*.

[Flos discoides disco radiato, interdum per accidens plenus est multiplicatis foliis marginalibus, ut in Matricaria & Chamæmelo cernitur: interdum etiam prolifer, ut in Calendula, Bellide, *&c.*]

Disco *radiato* est cujus exteriora folia quæ marginem quasi floris constituunt prolixiora & dispersiora sunt reliquis quæ discum efformant, & quasi plana.

Folia illa vel sunt frontata & quasi parallelogramma, vel cuspidata; ut in Ptarmica Austriaca *Clus.* Flore Solis *&c.* frontata sunt vel integrâ, vel crenatâ fronte, ut in Caltha vulgari. Disco *nudo* est qui floseulis marginalibus caret, ut in Tanaceto, *&c.*

Flos planifolius, naturâ plenus, seu secundum speciem plenus est qui ex floseulis quasi planis, in aliquot gyros dispositis confarctus est.

Frons autem horum foliorum plerunque crenata est, ut in Taraxaco, Sonchis, Cichoreis, Hieraciis, Scorzonera, Tragopogone.

Flos fistularis est qui plurimis concavis oblongis floseulis, ad margines in longas lacinias dissectis compositus est. Est etiam in hoc genus floribus differentia. Nonnulli floseulos marginales cæteris productiores & majores obtinent; alii omnes æquales.

Not. In floribus compositis floseuli illi, qui à nonnullis perperam Stamina dicuntur, inferiori parte in prolixum candidum, quasi pediculum desinunt, quo seminibus singulis cohærent, habéntque plerumque oram supremam sive craterem in lacinias aliquot sectum: è singulis quoque prominet stylus aliquis (bifidus plerunque) qui peculiari fistulâ coloratâ usque ad apicem sive cornua vestitus est.

Perfectus,

Flos est vel

- *Perfectus*, qui petalis, stylo & staminibus constat; estque vel
  - *Simplex*, qui in flosculos non dividitur, isque vel
    - *Monopetalos*, qui unico petalo sive laminâ continuâ constat, ut in *Convolvulo*, *Campanula*, &c. éstque vel
      - *Uniformis*, qui dextram partem sinistræ, & anteriorem posteriori similem, inferiorem superiori dissimilem obtinet, ut in *Convolvulo*. Estque margine vel
        - *Integro*, ut in *Convolvulo*.
        - *In laciniis fisso*, differentes
          - *Numero*, in nonnullis sci. tres, in aliis quatuor, vel quinque, vel sex laciniæ sunt.
          - *Figurâ*, vel angulosâ, vel rotundâ.
      - *Difformis*, cujus non tantùm superiora ab inferioribus, sed & anteriora à posticis differunt, éstque vel
        - *Semifistularis*, ut in *Aristolochia*.
        - *Labiatus*, labio
          - *Unico*, cóque vel *superiore*, ut in *Acantho sativo*; vel *inferiore*, ut in *Scordio*, &c.
          - *Duobus*, superiore vel
            - *Reflexo* sursum, ut in *Chamæcisso*.
            - *Convexo* sive deorsum reflexo, sive galeato, ut in *Lamio* & plerisque Verticillatis.
        - *Corniculatus* corniculo seu calcaneo concavo & impervio retrorsum extenso, ut in *Delphinio*, *Linaria*, &c.
    - *Polypetalos* sive multifolius est qui pluribus petalis in unica serie aut circulo dispositis componitur; éstque vel
      - *Uniformis*, in quo petala, figurâ & situ conveniunt, quamvis magnitudine interdum differant; éstque vel
        - *Dipetalos*, ut in *Circæa Lutetiana*.
        - *Tripetalos*, ut in *Plantagine aquatica*.
        - *Tetrapetalos*, ut in *Leucoio*, *Brassica*, *Thlaspi*, &c.
        - *Pentapetalos*, ut in *Lychnide*, *Caryophyllo*, *Alsine*, &c.
        - *Hexapetalos*, ut in Bulbosis. *Polypetalos* in aliis.
      - *Difformis*, ut in *Viola*, *Papilionaceis*, &c.
  - *Compositus*, qui ex pluribus flosculis, quorum singuli singulis insident seminibus, in unum totalem florem cocunubus constat; éstque vel
    - *Discoides*, in quo flosculi breves, arctè compressi unam quasi planam superficiem componunt, ut in *Calendula*, &c. est vel
      - *Radiatus*, limbo vel margine foliorum planorum discum cingente; foliis marginalibus vel *frontalis*, fronte *crenatâ*, ut in *Calendula* & papposis lactescentibus, *æqualis*: vel *cuspidatis*, ut *Ptarmica Austriaca* Clus.
      - *Nudus*, qui petalis illis seu flosculis marginalibus caret, ut in *Tanaceto*, &c.
    - *Naturâ plenus*, ut in Papposis lactescentibus.
    - *Fistularis*, ut in Capitatis dictis, *Jacea*, *Carduo*, &c.
- *Imperfectus*, qui harum partium aliqua caret.

Usus floris est ad tenellos fructus tegendos: priusquam enim explicantur, aut insident ipsis fructibus, aut illos undique circumplectuntur: crescente autem fructu jam flores aperiuntur, ac paulo post, tanquam in futurum inutiles, decidunt arefacti. *Cæsalp.* D.* *Malpighius* interdum florum petala in suis utriculis succum excoquere, quem introrsum refluentem tenello utero & seminis inchoamento effunderent opinatus est: quandoque petalorum ministerium in loco grui potius humoris depuratione versari existimavit. Verùm cùm avulsis sæpius floris petalis antequam hiarent (in Tulipa præcipuè) interdum styli seu uteri incrementa remorari observavit, quandoque quædam

* *Anat. Plant. p.* 55. 56.

morari obſervavit, quandoque quædam ſemina abſque nova debitam magnitudinem ſortita eſſe, ſe adhuc dubium reſtare ait, an floris folia tenello utero à Solis & externi aeris injuriis tutando duntaxat inſerviant; an ulteriùs etiam depurando præparent auctivam ſeminis materiam.

Floris folia ſi plus juſto luxurient multiplicatis exortibus, vel ſemina manca redduntur, vel deficiunt & nullus plerunque uterus adeſt, ut in plenis floribus obſervatur. An quia ſinguli fiſtularum faſciculi in folia elongentur & abſumantur? nullæque ligneæ fibræ uteri ſtructuræ & colliquamenti veſiculæ relinquantur? & ità infœcundi contingunt flores.

Quamvis autem plerique flores naturâ pleni ſteriles & infœcundi ſint, hoc tamen perpetuum non eſt in omnibus plantarum generibus: Caryophylli enim pleno flore nihilominus fœcundi ſunt. Idem etiam obſervatur in floribus compoſitis planifolio margine, per accidens plenis, ut v. g. *Matricaria* & *Chamæmelo*; nimirum hujuſmodi etiam fœcundos eſſe.

Aliæ adhuc florum Differentiæ à ſitu ſumi poſſunt, idque vel reſpectu caulis, vel reſpectu fructûs. Caulis reſpectu flos aut ſolitarius eſt, aut coacervatus.

Solitarius eſt qui ità in caule diſpoſitus eſt ut alium proximè non tangat.

Coacervatus, qui vel in ſpicam, vel verticillum, vel corollam ut in Trifolio corniculato *Dod.* vel umbellam, vel corymbum, vel paniculam, vel racemum diſpoſitus eſt.

De Spica, Umbella, Corymbo, Panicula, in differentiis caulis ſuperiùs diximus.

Verticilli in plantis dicuntur flores & ſemina caules ad nodos in orbem cingentes, ad ſimilitudinem inſtrumentorum illorum quæ fuſis adhibere ſolent mulieres, ut facilius vertantur.

Solitarius flos aut ſigillatim, aut ſociatim cauli adhæret.

Sigillatim ſi unus ex una caulis aut rami diſtinctione prodeat.

Socialiter ſi aut bini ut in multis, aut tergemini ut in Sagittali, aut ſeni ut in Viola aquatica.

Reſpectu fructûs aut rudimenti fructûs Flos aut inſidet ſummo fructui, aut ſedi fructûs cohæret.

Qui ſummo fructui inſidet, aut nudo ſemini inſidet, ut in *Veleriana*; aut pericarpio ſive folliculo ſeminis, ut in *Cucurbita, Melone* reliquiſque Pomiferis, *Bryonia, Periclymeno, Ariſtolochia, Liguſtro, Roſa, Pruno, Pomo, Pyro, Groſſularia &c.* Siliquæ in *Lyſimachia Siliquoſa.*

Flos ſedi fructûs cohæret, ideóque fructûs rudimentum quaſi includit & protegit in *Solanis, Capſico, Geraniis, Papavere, Leguminibus* & ſiliquoſis omnibus (excepta *Lyſimachia ſiliquoſa*) *Lychnide, Ranunculo, Nymphæa, Arbuto, Tulipa, &c.*

Supereſt ut Calycis etiam ſeu Perianthii differentias ex ejuſdem Jungii * Iſagoge Phytoſcopica adjiciamus. * *Iſagog. Phytoſcop. cap.* 24.

Perianthium ergo aliud ab initio *clauſum* eſt, quod florem nondum explicatum totum involvit, & dehiſcens deinde eundem retegit, ut in Papavere omni, Capparide, Palmâ dactylifera, Lauro, Pæonia: Aliud ſemper *apertum*, ut in pleriſque aliis.

Perianthium plerunque ſuum cuique flori proprium eſt; interdum etiam pluribus commune, videlicet nondum explicatis, ut in *Palma dactyliſera* & *Lauro.*

Perianthium aliud flori cum fructu commune eſt, aliud flori proprium. Commune in iis omnibus plantis in quibus flos fructum complectitur, ſive quarum flos ſedi fructûs affigitur, ut in Spergula, item *cavis floribus*, quibus *nuda ſubſunt ſemina*, ſive labiatis, ut in Salvia, Marrubio aliiſque Verticillatis, ſive uniformibus, ut in Bugloſſo, Lithoſpermo, &c.

Perianthium deinde vel ſimplex eſt, vel compoſitum.

Simplex quod utriculus eſt ſolâ laminâ conſtans; ut in *Salvia* aliiſque Verticillatis, Nicotiana, Lychnidibus, Caryophyllis &c.

Compoſitum, quod vel foliis pluribus juxta ſe poſitis conſtat, ut in Eupatorio cannabino, & Scabioſis: vel ex foliis aut ſquamis ſibi invicem arctè & imbricatim inſidentibus, ut in Jacea, Cinara, & aliis Carduis.

Perianthium ſimplex plerunque in margine in lacinias ſectum eſt; vel acutas ut in *Salvia, Lamio*, vel obtuſas, ut in *Priapeia*; item vel profundè in lacinias prolixas, vel minus profundè in breviculas, ut in Othonna.

Perianthium plerunque inferiore parte ſtrictius eſt, interdum tamen ventrioſum quaſi & turgidum, ut in *Geraniis, Ocymoide, Vaccaria, Ben albo &c.*

Perianthium aliud rotundum & teres eſt, ut in Caryophyllis; aliud ſtriatum ſive ſulcatum, ut in Othonna.

Inter nudos & Perianthio veſtitos flores ambigunt flores Cucurbitæ & Peponum: Viridibus enim quibuſdam ſive nervis, ſive dorſis, ſive ſtrigibus à fundo ad marginem tendentibus variantur, quorum nonnulli [nervi] intra mediam floris partem à flore quaſi avulſi ſpeciem perianthii anguſtifolii exhibent.

Peculiare etiam quid in iiſdem floribus obſervatur, quòd inferiores partes aliquid inter ſtamen & ſtylum ambigens, vel ex ſtamine & ſtylo conflatum obtinent.

CAP.

CAP. XII.

De Fructibus & Seminibus Plantarum.

FRuctus à fruendo dicitur, éſtque pars ea Plantæ quâ in cibis fruimur, ſive Pericarpium ſit, ſive Semen. Nomen autem fructus per analogiam ad omnium plantarum partes ſimiles, quamvis nullum nobis uſum præſtent, nec in cibis neque in medicina, extendi poteſt.

Fructus ergo (deſcribente Jungio) dicitur Pars Plantæ annua, flori cohærens & ſuccedens, qui ubi maturuerit, i. e. ad perfectionem ſuam pervenerit, ſponte à Plantâ abſcedit, & terrâ, aliâve commodâ matrice excepta, novæ plantæ fit initium.

Succedere dicitur flori fructus, quòd floris inchoatio, perfectio, defluxio, fructûs inchoationem, perfectionem, defluxionem antecedat. Fructus igitur à reliquis plantæ annuis partibus differt, quòd cùm primùm abſolutus eſt, ſive ad perfectionem devenit, pars eſſe deſinit, cùm reliquæ (uti folia & flores) tum demum ubi marceſcere, putreſcere, alitérve corrumpi incipiunt, à plantâ ſuâ ſeparantur.

Fructus vel ſemen eſt, vel Seminis conceptaculum, [vaſculum, folliculus, capſula, theca, involucrum.]

Conceptaculum eſt quod ſemini ad tempus undique tegendo [alitérve continendo] peculiariter deſtinatum eſt.

Excluduntur ab hujus appellationis ambitu perianthia illa in quibus flore delapſo ſemina latitant, uti ſit in Salvia reliquiſque Verticillatis plantis: nam nec undique tegunt ſemina, cùm ſuperiore parte hiant, neque peculiariter ſeminis tutelæ inſerviunt; ſed flori potiſſimùm muniendo deſtinata ſunt. *Hactenus Jungius.*

Semina vel *duplici* conceptaculo ſeu involucro, altero alterum ambiente teguntur, vel *ſimplici* & unico; *Duplici* in Prunis & Ceraſis, nimirum Pericarpio & Oſſiculo; in Malis & Pyris, nimirum Pericarpio & Cartilagine; in Nucibus Avellanis, nimirum Folliculo membranaceo & Oſſiculo; in Pinu, nimirum Cortice ligneſo & Oſſiculo, ut alia plurima omittam. *Simplici*, in Faba, Piſo, aliiſque Leguminibus, in Leucoio, Braſſica, Thlaſpi, aliiſque ſiliquoſis & capſulatis tetrapetalis, &c.

Seminum conceptacula ſunt vel *ſolitaria*, ſeu *ſimplicia* unicâ intus cavitate, ut in Faba, Piſo, aliiſque leguminibus, in quibus ſemina ſiliquæ dorſo adnectuntur; item in Lychnide, Caryophyllo, Primula &c. in quibus ſeminis ſedes eſt in medio, exteriùs protegente vaſculo: vel in *plures cellulas* ſeu loculamenta *diviſa*, eáſque vel *diſjunctas*, ut in Aconito, Aquilegia, Delphinio: vel *conjunctas*; ſeu 1. *binas*, vel cum *ſolitariis* ſeminibus in ſingulis alveolis, ut in Xanthio, Mercuriali &c. vel cum *pluribus* in ſingulis alveolis, ut in ſiliquoſis, *Braſſica*, *Leucoio*, &c. in capſularibus, *Verbaſco*, *Thlaſpi*, &c.

2. *Ternas*, ſeminibus intus vel *ſolitariis* in ſingulis alveolis, ut in Ricino, Tithymalo, Heliotropio tricocco, vel *pluribus* in ſingulis alveolis, ut in Convolvulo, Viola, Hyperico, Aſaro &c.

3. Multas, incerto numero, ut in *Papavere*, *Lino*, &c.

Unus fructus quis. Cæſalpinus rectè meo judicio unum fructum eſſe ſtatuit qui uno tegmine continetur externo, quamvis interna divila ſint, ut in Pæonia, Aconito tres ſiliquæ aut plures in eodem exortu, ſub eodem flore continentur, quæ enim ſub eodem flore ſunt, ſunt etiam ſub eodem floris tegmine, quod externum eſt. Plures verò qui nullo communi tegmine teguntur, licet ex ejuſdem ſedis diviſione oriantur, ut Uvarum acini, ſinguli enim ſub ſingulis floribus ſunt, licet racemus unus ſit.

Semina nuda voco quæ nullo præter perianthium vaſculo aut tegmine donantur, ut *Valerianæ*, &c.

Pro ſeminibus etiam nudis in hoc opere habemus quæcunque pericarpio non incluſa, ſolitarie & ſingulatim decidentia, ſiliquas ſuas ſponte non exuunt, verùm ſis induta à planta matre abſcedunt. Sic Malvæ, v. g. ſemina, ut & umbelliferarum omnium, nobis nuda cenſentur.

Semina ſunt vel
- *Nuda*, nullo præter perianthium vaſculo aut tegmine donata, ut *Valerianæ*, *Thalictri*, Umbelliferarum & Verticillatarum.
- *Conceptaculis* incluſa,
  - *Simplicibus* unicam intus cavitatem habentibus, ut in Leguminibus aliiſque plurimis,
  - *In plures cellulas ſeu loculamenta diviſis*,
    - *Diſjuncta*, ut in *Aconito*, *Aquilegia*, *Delphinio*, &c.
    - *Conjuncta*, ſimul, vel
      - *Bina*, cum ſeminibus in ſingulis alveolis
        - *Solitariis*, ut in *Xanthio*, *Mercuriali*, &c.
        - *Pluribus*, ut in Siliquoſis, *Braſſica*, *Leucoio*, &c. inque capſularibus, *Verbaſco*, *Thlaſpi*, &c.
      - *Terna*, ſeminibus itidem in ſingulis alveolis
        - *Solitariis*, ut in *Tithymalo*, *Ricino*, *Heliotropio tricocco*, &c.
        - *Pluribus*, ut in *Convolvulo*, *Hyperico*, *Aſaro*, *Viola*, & Bulboſis omnibus.
      - *Multa*, incerto numero, ut in *Papavere*, &c.

De-

De processu Naturæ in generatione seminum è D. Malpighii Plantarum Anatome.

Stylus in plantis utero in Animalibus respondet. Nam sicut in oviparis unica est concameratio, in solitariam tubam desinens: in viviparis verò uterus geminis ovariis totidemque tubis [seu cornibus] componitur: ità in plantis uterus seu ovarium unicum quandoque est, cujus tuba hiatu patet, quandoque multiplex, totidemque exporriguntur tubæ.

Not. *Conceptaculum seu vasculum seminale nobis Uteris potiùs plantæ videtur dicendum: quod quidem interdum stylus est, ut in Tulipa, Papavere, &c. interdum corpus à stylo distinctum ut, in Caryophyllis inque Pomo & Pyro aliisque, in quibus flori subest, cùm Stylus pars floris censetur: in his tamen aliisque stylus conceptaculi apici insidet. Verùm quem nos stylum dicimus* D. Malpighius *styli tunicam seu appendicem appellat. Non est ergo cur de nominibus litigemus, siquidem Uterus plantæ vel est stylus ipse, vel basis styli, seu corpus cui stylus insidet, quod Malpighius stylum facit.*

Uterus igitur plantarum, seu conceptaculum seminis, in aliquibus solo membraneo graciliquè corpore, concavo & tubuloso, vesiculæ instar, constat, hocque ligneis fibris, tracheis & utriculis contexto; in cujus centro semina seu fœtus gignuntur & adolescunt. In aliis vegetantium ordinibus, ut in siliquosis, crassiori substantiâ, quasi pericarpio, constare videtur: In quibusdam oblongæ quædam appendices adduntur, quæ semina stipant & fovent, & crassius pariter obducitur pericarpium, elongatis fibrarum & trachearum fasciculis, à quibus utriculi succo turgidi pendent, adeóque uteri substantia conflatur è fasciculis jam dictis & utriculorum striis in commune corpus quod fructus dicitur, conglobatis; non dispari ritu ac in Fœminis accidit, quarum uteri substantia contento sanguine ità tumet, ut solitam crassitiem triplo excedat. In aliquibus pericarpii hæc moles, turgidi uteri vices supplens, ambiente interiùs corpore obvelatur, quod plerunque cartilagineum est, ut *pomis pyrisque* accidit; in aliis autem osseam substantiam sortitur, hujusque structura in tenellis adhuc è pericarpio uteri cavitatem cribratum extillat humorem.

Pericarpium, in iis quibus datur, concoctum fortassè succum contento fœtui subministrat, vel saltem externi caloris vim obtundit, nè solaribus radiis contabescat. Quoniam tamen plures uteri pericarpio vel ejus analogo destituuntur, ideo fas est credere, succum qui à pericarpio percolatur in semen, non omnino productioni ejusdem conducere; sed materiam à fibris derivatis immediatè à petiolo & secundinis excerni, pericarpii verò succum tutari potiùs quàm componere. Quòd verò pericarpia nonnulla nobis aliisque animantibus gratum cibum ministrent, non est ex primaria naturæ intentione, quæ pericarpium ad seminis tutelam destinavit, sed ex secundaria.

Seminis integumenta seu membranæ semen involventes Secundinis analoga sunt; quorum ope diu custodiuntur & terræ concredita pro germinatione juvantur.

Ossicula in Ceralis, malis Perlicis & Mespilis, quibus semen custoditur, pro uteris habet D. Malpighius, non pro secundinis. Nunc licet crassioribus constent parietibus, pericarpio tamen continuantur, & per ipsos humor fortassè in contentum semen percolatur. Secundinæ autem proprie sunt quæ hiante utero unà cum semine excidunt.

At pace tanti viri nullam video rationem cur Avellanarum & Juglandium putaminia secundinæ censenda sint, Cerasorum autem & Persicorum ossicula minimè; cùm tamen si secundinam rectè definiat, *quæ hiante utero una cum semine excidet*, necessariò ita se res habebit, cùm illarum putaminia, utero se aperiente, unà cum semine excidant, horum autem ossicula minimé.

In plerisque Secundinis, ut v. g. *Pyri & Pomi*, hiatus aperitur arctiori in cacumine, ubi scil. plantulæ conus latitat, in aliis verò fenestra occurrit patenti cum hiatu. Quis hujus fenestellæ seu foraminis usus sit ambigitur, an ut externus aer admittatur ad fermentationem excitandam aut promovendam; an ut incongrua eliminentur evidenti transpiratu; an potiùs ad humorem nutritium excipiendum. Quod nobis magis probatur: Foramen isthoc ovi in Animalibus respondere existimat *Malpighius*. Sicut enim (inquit) in Animalibus fœtus non tantùm per umbilicum nutritur, recepto sanguine alimentitio succo commixto, sed etiam per os, derivato scilicet chylo in ventriculum, indeque solutis viis in cavam, ut sensim instituatur hæc alimenti via, quæ in edito fœtu durante vita manuteneri debet, ità probabiliter contingere reor in seminalibus plantulis: Siphones [qui in plurimorum seminum secundinis horizontaliter ordine collocati sunt] alimentum foliis plantulæ ministrant, quod præexistenti in propriis utriculis succo commixtum, per propria vasa gemmam versùs intro deducitur, & ità plantula quasi per umbilicum augeri videtur. Et quoniam hiatus in *Pomis, Pyris*, & lini fenestella in *Ciceribus, Fabis, &c.* aperitur sub quibus extremum conici corporis, radicum scil. inchoamenta, conduntur, & eisdem externum ministratur alimentum, ut regia nutritionis via instituatur, ab extremis videlicet radicibus in caulem vel caudicem, & ab his in ramos & folia, ideò hanc nutritionis viam analogam ei puto quæ per os celebratur in Animalium fœtu. His accedat radicis truncum vaginâ, copiosis utriculis compaginatâ condi, quorum ope extremo caudici debitum auctivum subrogatur alimentum.

Notandum autem naturam non in omnibus Pericarpium exteriùs collocâsse, & fructui seu semini circumposuisse, quamvis nomen Pericarpii id videtur indicare & exigere, sed in aliquibus inversâ viâ, à pericarpio in globosum corpus coagmentato emergere voluit uteros & semina, ut in Fragis præcipue cernitur.

Seminis autem seu potiùs plantulæ seminalis intra secundinas generatio viventium productionibus analoga est. Primò enim umbilicus occurrit qui manifestè perforatus est, & sensim in extremitate laxatus seu dilatatus, colliquamenti ichore (qui in Fabis fluidus est, in reliquis utriculis, coercitus) repletus, in molem diversæ [in diversis seminibus] figuræ intumescit. Tractu temporis semen seu fœtus emergere incipit, in apice scil. amnii, supereminentibus binis foliolis, alarum instar apertis, & frequentissimè diductis, ità ut angularis amnii apex fissuram impleat: à foliis verò seu alis acuminatum minimúmque consimilis substantiæ corpus (quod gemma est) assurgit. Successivo incremento auctior reddita amnii moles fœtum quoque seu plantulam auget & fovet. Amnio in plurimis plantis utriculorum ordines chorii instar circumaffunduntur; Chorium autem in quibus adest à primordiis turget, sensimque adaucto amnio exinanitur, & postremo à plantula amnion, in quod perco-

percolantur omnia, absumitur. Quare probabiliter seminalis humor primo ex secundinis in umbilicum, & sensim in laxatum amnion derivatur; unde prima plantulæ delineatio. Verùm hæc omnia exemplo & iconibus appositis clariùs intelligentur.

Augetur autem probabiliter amnion, non tantùm submini-strato succo ab umbilico, sed & transudante humore à chorio, cùm tractu temporis obliteretur umbilicus. Et cùm plantula seminalis peculiari umbilico destituatur, quo exterius advenens alimentum altè ipsam penetrans, in singulas diffusus partes eas augeat & alat: sed ut plurimùm contiguus amnii humor foliorum hiatum repleat, ipsisque hæreat, non incongruum fortassè rationi erit censere, filtratione transductum chorii humorem in amnion, tandem plantulæ folia, inversâ nutritionis subingredi, ex his in caulem & gemmam derivari.

Mira autem est Plantarum nonnullarum fœcunditas seminis respectu, ut v. g. Verbasci, Digitalis, Papaveris, Hyoscyami, Nicotianæ. In uno Helenii flore (inquit P. Laurembergius) numeravi ultra 3000 semina, neque tamen perveni ad finem. Helenium autem in eodem caule multos producit & gestat flores. Ex uno grano ℞ *Mayz*, seu Frumenti Turcici iterum 1050; in Virginia 2000 colliguntur, seritúrque bis quotannis Martio & Junio. Ex uno flore Solis majore, prognata ex uno semine eodem anno Camerarius exemit circiter 4000 semina: ego 3000 & paulò amplius. Sed hæc nihil sunt si cum Tabaci veri fœcunditate conferantur. *Ego curiositati meæ indulgens*, numerare aliquando cœpi, quot granula seminum Nicotianæ ponderent drachmam unam, & expertus sum ponderi unius grani medici (quæ est minima mensura) respondere grana Tabaci 1012. Jam verò ex una planta collegi seminum maturorum drachmas circiter sex, quæ faciunt medica grana 360 hæc multiplicata per 1000 (omissis 12) largiuntur grana 360000, quorum ferax fuit una planta Tabaci nata ex uno granulo.

* *Horticulturæ, l. 1. c. 17.*

Papaver album (supputante D. Grevio) semina 32000 annuatim producit, quam summam ità colligit: Quatuor plurimùm planta hæc capicula matura profert, in quorum unoquoque denæ minimum membranæ seu parietes, totidem cellulas disterminantes sunt. Harum unusquisque alterutri lateri semina adnascuntur circiter 800, quibus in 10, numerum membranarum, ductis, exurgit summa 8000, quâ iterum 4 pro capitulorum numero multiplicatâ efficitur numerus prædictus 32000.

Not. *Planta hæc, si cælum & solum faveat, non dico quatuor capitula, sed duplo triplóve plura producit.*

Typha major (eodem observante) ultra 120000 quotannis semina perficit, quod ità demonstrat. Semina enim unà cum lanugine spicam seu clavam cylindriacam efficient 6 uncias longam, diametro $\frac{1}{8}$ unciæ æquali circumferentiâ $1\frac{1}{4}$ unciæ. Horum autem seminum 9, latere ad latus juncto, ut in spica collocantur, $\frac{1}{8}$ duntaxat unciæ partem efficiunt, adeò ut 72 lineam uncialem expleant. Verùm quoniam in spica pili seminibus interpositi sunt, 10 detractis, 62 tantùm supputabimus; quibus si addamus $\frac{1}{4}$ numeri 62, hoc est 46, exurgit pro circuitu cylindri summa seminum 108, cumque cylindrus 6 uncias longus sit sexies 62, hoc est 372, semina unam longitudinis lineam component. Quo numero in 108 ducto producitur summa 40176, pro numero seminum unius clavæ; próque trium quas planta illa singulis annis plurimùm profert, 120000.

Verùm numerosissima omnium semina producunt herbæ capillares dictæ. Unius *Linguæ cervinæ* plantæ annuus proventus ad decies centena millia seminum ascendit. Vide Caput de Phyllitide.

CAP. XIII.

De Plantarum Seminibus observationes quædam generales.

I. NAtura non observat magnitudinis proportionem inter semina & plantas ab iisdem ortas; ità ut majus semen majorem semper producat plantam, minus minorem. Sunt enim in genere herbarum non pauca, quarum semina arborum nonnullarum seminibus non dico æqualia sunt, sed multo majora, Sic v. g. semina *Fabæ, Pisi, Vicia, Lupini, Peponis, Melonis, Cucurbitæ*, ut alias innumeras omittam, semina *Ulmi, Populi, Salicis, Betulæ, Ficûs, &c.* multis vicibus magnitudine superant.

Atque hoc non in plantis duntaxat diversorum generum observari potest, sed interdum etiam in ejusdem generis speciebus. Sic in genere arborum glandiferarum *Ilex* coccifera dicta, quæ fruticis modum vix unquam excedit, glandem edit *Quercûs* vulgaris parem: *Cerrus* arbor *Quercûs* nostrati magnitudine cedit, glandem tamen duplo majorem producit. *Cerinthe* purpurea annua *montanæ perenni* minor est, semen tamen illius hujus semine majus. Eadem differentia magnitudinis respectu observari potest inter semina *Rapistri* & *Sinapeos*, plantarum productricium proportioni contraria: nam semen *Rapistri Sinapeos* semine majus est, cùm *Rapistrum* ipsum *Sinapi* minus sit. At neque Natura in animalibus oviparis eandem perpetuò magnitudinis differentiam observat inter ova quæ est inter animalia quæ ea ponunt. Quamvis enim inter *Locustas* & *Astacos*, magnitudine excepta qua *Locusta Astacum* excedit, indifereta ferè similitudo sit, ova tamen *Astaci Locustæ* ovis multò majora sunt; Sic in Avium genere ova *Anatis Arcticæ* Clusii *Alkæ* Hoieri, ejusdémque *Lomviæ* tanto Anatum domesticarum ovis majora sunt, quanto *Aves* ipsæ *Anatibus* minores. Notandum tamen, Aves hasce palmipedes esse & tridactylas & unicum tantùm ovum una vice ponere antequam incubent, adeóque unum duntaxat pullum excludere. Notatu autem dignissimum est, quò minora sunt eò esse fœcundiora: Fœcundissima enim sunt Papaver, Nicotiana, Digitalis, & capillares omnes, Sinapi, Typha, ut alia omittam, quæ semina minutissima proferunt.

II. De Herbarum annuarum seminibus nota, 1. Ea omnium longè maxima esse, ut in *faba, pisa, lupino, cicere, melone, pepone, cucurbita, flore solis, Phaseolo*, aliisque patet. 2. In iis etiam generibus

in

in quibus aliæ ſpecies annuæ ſunt, aliæ perennes; annuarum ſemina ſeminibus perennium majora eſſe, magnitudinis plantarum ratione habita. Sic v. g. *Piſa* vulgaria majora ſunt ſeminibus *Lathyri* majoris perennis: Sic *Triticum, Secale, Hordeum, Oriza, Avena, Maiz ſeu Frumentum Indicum*; quæ nihil aliud ſunt quàm Graminum annuorum ſemina, majora ſunt ſeminibus cujuſcunque Graminis perennis nobis cogniti, Arundinibus etiam maximis non exceptis. 3. Semina omnia quæ hominibus in cibum veniunt herbarum annuarum genimina eſſe: ſive frumenta ſint, ut v. g. *Secale, Triticum, Oriza, Sorghum, Frumentum Indicum, Milium, Panicum, Avena, Hordeum, &c.* ſive Legumina, ut *Fabæ, Piſa, Lentes, Viciæ, &c.* Cujus ratio eſſe videtur, quia ex ſeminibus ſaporis grati & nutrimenti ſalubris ea maxima ſunt, adeóque eorum purgatio facilior, proventus uberior & farinæ ad ſurfures proportio major.

III. Quamvis in plantis nonnullis, quæ flagellis radices ſubinde agentibus ſe propagant, aut quæ radicibus proliferis vel reptatricibus ſe multiplicant, ut in *Vinca Pervinca, Colocaſia, Battata Canadenſi, Raphano ruſticano, &c.* verum ſit quod à nonnullis obſervatur, eas ſcilicet ſemen rariùs perficere & ad maturitatem perducere, quoniam natura his propagationis modis intenta eum qui eſt per ſemen negligit: Quamvis inquam hoc in nonnullis verum ſit, procul tamen abeſt à regula generali, cùm ſtirpes non paucæ reperiantur quæ aut radicibus reptant, aut flagellis ſe propagant, & tamen ſemen copioſum idémque fœcundum gignunt. Prioris generis ſunt *Herba Gerardi, Solanum halicacabum, &c.* Poſterioris *Fragaria & Ranunculus repens.* Verùm ex altera parte in genere & ſine exceptione verum exiſtimo, quòd quæ plantæ ſemen paucum perficiunt eædem modis ſuperius tactis ſe propagant: aliàs enim natura, quæ in neceſſariis non deficit, talium ſpecierum conſervationi & perpetuitati non ſatis caviſſe videretur.

IV. Plinius aliique rei naturalis ſcriptores dudum de Animalibus obſervârunt, quòd, diutiùs geſtantur quibus ſunt longiora vitæ ſpatia: Hanc obſervationem ſi plantis accommodare velis minimè veram invenies. Nam ex ſpatio temporis breviore aut productiore, quod intercedit inter eruptionem floris & ſeminis perfectionem, de vita ſeu durâtione iſtius plantæ nihil certi colligi poteſt. Videmus enim *Ulmum*, cujus ſemen primo vere ſtatim à flore edito perficitur, atque etiam deſluit ante quam folia explicantur, arborem eſſe ſatis longævam.

V. Semina plantarum oleo copioſiore ſcatent quàm quævis alia earum pars; quod prælo ſubjectæ & tortæ fatentur, magna ejus quantitate fusâ. Oleum autem cùm corpus ſit viſcidum, nec facilè evaporet, ſeminali ſpiritui continendo idoneum eſt vehiculum. Hinc ſit quod ſemina per multos etiam annos fœcunda manent, & ſata germinant. Quin & copioſum ſalem volatilem continent, ut luculenter demonſtrat *Wedelius* in *Experimento novo chymico de ſale volatili plantarum.* Verùm de chymica ſeminum analyſi agere in præſentiarum noſtri non eſt inſtituti.

VI. Quot annos ſemina plantarum fœcunda durabunt, difficilis admodum quæſtio eſt: Veterum nonnulli vel 40 prodidere: D. *Morriſonus* non ultra decennium aſſirmat; alii fœcunditatis ſpatium quinquennio circumſcribunt. Proculdubio autem magna hoc reſpectu inter ſemina eſt differentia; alia enim diutiùs fœcunditatem ſuam cuſtodiunt, alia eam citiùs amittunt & ſterileſcunt, ut verisimile ſit nonnulla fœcunditatem ſuam ultra decennium prorogare, alia ante quinquennium eam amittere. Oſtendit mihi olim D. *Toll* curioſus florum cultor *Lenuæ Norfolciæ* fimetum, in quod ante aliquot annos projectæ fuiſſent uvæ paſſæ corruptæ, ut ibidem computreſcerent; ex earum autem vinaceis quotannis, ſtercore moto, vites aliquam multæ enaſcebantur, & novæ poſt 4. minimùm annos. Ego (ut verum fatear) in nullo adhuc ſemine, 5. annis vetuſtiore experimentum feci, quinquennia autem germinare compertum habeo. Multum autem conducit ad fœcunditatem prorogandam ſeminum conſervatio; cavendum enim eſt nè humorem nimium bibant indeque ſitum & putredinem contrahant, neve nimium calefiant & exareſcant; nonnulla etiam frigus vehementius urit & corrumpit. Quicquid ſit, in terræ gremio latitantia, quamvis tot caloris, frigoris, humoris & ſiccitatis varietatibus ibidem obnoxia, diutiùs tamen (ut puto) fertilitatem ſuam tuentur, quàm ab hominibus diligentiſſimè cuſtodita; nam & ego & alii ante me multi obſervarunt *Sinapeos* vim magnam enatam in aggeribus foſſarum recens factis, inque areis gramineis oſſoſis, ubi poſt hominum memoriam nulla unquam *Sinapeos* ſeges ſuccreverat. Quam tamen non ſponte ortam ſuſpicor, ſed è ſeminibus in terra per tot annos reſiduis etiam prolificis.

VII. Semina omnia ſeu ab hominibus ſata, ſeu ſponte è conceptaculis ſuis in terram delapſa, primum ſuum alimentum per poros tegumentorum hauriunt; aut (ut veriùs & magis Philoſophicè loquar) primum ſeminum ſatorum alimentum per tunicarum ſeu tegumentorum poros ſe inſinuat. In pleriſque autem ſeminibus foraminulum quoddam ſeu feneſtella patentior obſervatur, quâ humor alimentaris primitus ſubintrat: quo ſemel admiſſo, ſpiritus vitalis intus hoſpitans plantulam ſeminalem ejuſque involucra fermenti in modum inflat & extendit, unde etiam humor terreſtris copioſe in eam irruat neceſſe eſt, quo nutritur & augetur.

VIII. Magna eſt analogia & ſimilitudo inter vegetationem & augmentum ſeminum ſeu ovorum plantarum in terra, & viviparorum animalium in utero. Quemadmodum enim ſemen plantæ plenam maturitatem adeptum in terram decidit, ibidemque liberum & ſolutum jacens alimentum (ut dixi) primitus per poros tegumentorum ſuorum attrahit imbibitve; poſtmodum radices in terram agit; ſic pariter ovum Animalis vivipari, maris ſemine fœcundatum, & quaſi ad maturitatem perductum ab ovario velut arbore in uterum ceu terram delabitur, ubi aliquandiu liberum & ſolutum permanens, abſque ullâ cum utero cohæſione, primum ſuum alimentum per membranas involventes ſeu ſecundas attrahit. Aliquanto autem poſt, velut radicibus actis utero ſe affigens, aliquam ſaltem nutrimenti portionem inde exugere videtur. Ovaria voco corpora illa, teſtes fœmineos vulgo dicta, quæ qui diligenter inſpexerit, oculorum teſtimonio victus nihil aliud eſſe quam congeries ſeu racemos ovorum neceſſario confitebitur. Cùm ſemen humorem imbibere aſſero, aut fœtum alimentum attrahere, vulgari & uſitato loquendi modo utor, nec aliud intellectum vellem, propriè & Philoſophice accipiendo, quàm humorem per poros ſe inſinuare, aut influere per venas & vaſa: nec enim attractionem propriè dictam in natura dari ullatenus conceſſerim. Neque verò ſemina dun-

taxat plantarum verùm & earundem radices maximam alimenti sui partem per poros tegumentorum attrahere existimo, minimam autem per capillarium fibrarum extremitates, quas nonnulli pro totidem osculis habent. Quòd plantæ per corticum poros alimentum hauriant à modo ramulos & ἀποσπάσματα depangendi quem memorat *P. Lauremberginus* Horticult. *cap.* 21. §. 1, clarissimè evincitur. *Nulla* (inquit ille) *ferè stirps est quæ non queat propagari per ramulos anniculos, modo* 1. *inferior extremitas abscissa oblinatur emplastro sequenti:* ℞ *ceræ* ℥i *terebinth.* ℥i *resinæ communis* ℥ii *commixtis.* 2. *Non directè infigas terræ ramulum sic oblitum, sed incurvo arcu, ut suprema pars promineat è terra, media tangat imum, infima, quam oblinendam dixi sursum nonnihil vergat,* ità tamen ut delitescat. In hoc casu non alia patet via qua succus alimentaris subintret, quam corticis pori.

Quoniam autem mentio incidit hujus arboris ramulis seu taleolis depactis serendi methodi, operæ pretium fore putem eam in omne genus Pomiferis experiri; cùm si succedat facillima omnium erit & fructuosissima propagandi ratio. Quamvis enim surculus insitus eodem pariter anno fructum producat, truncus tamen seu stipes aliquot annos à satione exigit antequam insitioni idoneus sit. Quin & ramulus cum multo major sit quam surculus & uberius crescat, fructus longe plures eodem temporis spatio producit. His adde, quod si planta quævis non comprehendat, facilè extirpari aliaque ejus loco depangi potest. Quod vero hic plantandi modus in cujuscunque generis pomiferis arboribus succedet verisimillimum judico, cum nulla mihi sufficiens ratio reddi posse videtur, cur in eodem Arboris genere alia species ramulo sata comprehendat, ut v. g. Codlings & Mopis nostratibus dictæ; aliæ minimè. Qua in sententia valdè confirmabar à *D. Josselino*, qui in sua *Novæ Angliæ* descriptione hunc apud indigenas ramulis avulsis plantandi modum in omne genus Malis & Pyris cum successu frequentari scribit.

CAP. XIV.

De foliis Plantarum Seminalibus dictis.

SEminum satorum pars maxima binis primulum foliis è terra exoritur, quæ quoniam multiplici respectu succedentibus dissimilia sunt, hortulanis nostris non ineptè, *folia seminalia* appellantur.

1. *Folia* hæc *seminalia* à succedentibus differunt, primò Parvitate, ut quæ in omne genus plantis illis minora sint.

2. Figurâ, ut quæ integra sint & indivisa iis etiam plantis quibus subsequentia multifariam dissecta sunt, ut v. g. *Umbelliferis*, circum oras æqualia iis quibus reliqua crenata aut dentata; in plerisque plantis à sequentibus foliis circumscriptione diversa. Hic tamen notandum est, quòd quamvis *folia seminalia* in plerisque plantis integra sint absque ulla omnino crena, sectione aut divisione, non tamen hoc in omnibus constans est & perpetuum, siquidem *nasturtii hortensis* folia seminalia in tres lobos dividuntur quæ totidem folia mentiuntur; *Brassicæ, Raphani, Sinapeos, Rapæ* frondes unicâ crenâ incisas obtinent, *Nasturtii Indici* duplici crena in tres dentes divisas: *Geranii moschati* pinnata sunt ad modum ferè subsequentium. Verùm nullam hactenus plantam novi cujus folia seminalia circum oras undique crenata aut dentata sint, *Urticæ* aut *Betonicæ* modo.

3. Differunt Superficie, lævi v. g. iis etiam plantis quarum folia hirsuta sunt aut pilosa; non tamen omnibus, nam folia seminalia *Boraginis, Buglossi* aliorumque quotquot observavi ex Asperifoliis dictis hirsuta seu pilosa sunt.

4. Differunt insuper Situ & nascendi modo, cùm bina opposita nascantur, non in iis duntaxat plantis quarum folia in caulibus conjugatim dispolita sunt, verùm etiam quibus singulatim & alternatim oriuntur, ad inferiorem articulum ex hoc latere, ad superiorem proximè ex adverso, vel 2. stellatim plura caules ad nodos ambiunt, ut in *Asperula, Aparine*, &c. vel 3. crebra in caule confusè & nullo ordine nascuntur, ut in *Lino, Linaria, Tithymalo.*

5. Folia seminalia totáque in universum seminalis plantula ante germinationem, dum adhuc tegumentis suis includitur, pulposa est & fragilis, ut tota fere carne constare videatur, fibræ autem minimum continere.

CAP. XV.

De Plantula seminali reliquisque semine contentis.

IN omnibus quæ unquam dissecui idoneæ magnitudinis seminibus plantulam seminalem semper inveni, in nonnullis perfectè efformatam, ut partes ejus omnes nudis etiam oculis possent discerni, & digitis à se invicem diduci, in aliis minùs perfectam, certè partes ejus non ità facile à me potuerunt discerni.

1. Plantula hæc seminalis in plerisque seminum generibus *binis foliis seminalibus* constat, aut saltem gemino lobo foliis seminalibus respondente; *Radicula* & *Gemmâ*. Gemino dixi lobo foliis seminalibus respondente, quia sunt ex hoc seminum genere quæ lobos suos supra terram foliorum formâ non exserunt, unde nonnulli fortasse foliorum titulum iis minimè tribuendum censeant. Verùm quoniam ejusdem omnino naturæ sunt, eundémque proculdubio usum obtinent, nullam video rationem cur eodem etiam nomine non possint insigniri.

2. In nonnullis seminum generibus plantula seminalis non conficitur ex *binis foliis seminalibus, Radiculâ & Gemmâ*: sed vel solo trunco absque foliis constat, vel trunco *foliolo*, vel *folio* solo absque

que trunco, nudo saltem oculo visibili. Ex hac seminum divisione sumi potest generalis plantarum distinctio, eáque meo judicio omnium prima & longe optima, in eas scil. quæ plantula seminali sunt bisolia aut ἄνοβα, & quæ plantulâ seminali adultæ analogâ.

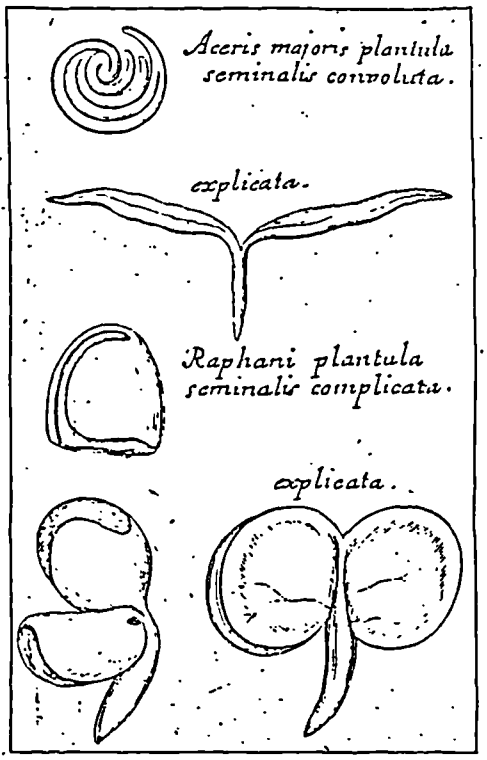
3. E primi generis seminibus (in quibus plantula seminalis binis foliis seminalibus, gemmâ & radiculâ constat) sunt in quibus præter plantulam seminalem nihil omnino pulpæ aut medullæ continetur; sunt etiam in quibus præter plantulam alia etiam continentur, seu in quibus plantula pars tantum est pulpæ seu medullæ.

Semina illa quæ nihil aliud continent præter plantulam seminalem in duplici itidem sunt differentia, 1. In nonnullis plantula seminalis plana est & extensa absque ulla plica, ruga aut convolutione; 2. In aliis folia seminalia cum radicula variè complicata sunt aut convoluta. In primo genere folia seminalia nihil aliud sunt quàm seminis lobi planis suis superficiebus coaptati, ut in *Avellana* nuce videre est. Gibba seu exterua lobi alterutrius superficies eidem est figurâ cum medietate seminis secundùm longitudinem per medium sitti. Hujus generis sunt *Fabæ, Pisa, Phaseoli, Viciæ, Amygdalæ, Pruna, Glandes, &c.*

Hic obiter notare possumus unionem hanc seu connexionem radiculæ cum lobis non semper seu in omni plantarum genere ex ea parte esse qua semen fructui aut vasculo seminali cohæret; unde nec in omnibus speciebus germinatio à puncto cohæsionis incipit, ut nonnulli tradiderunt; sed in aliquibus ad distantiam notabilem à loco cohæsionis, ut in *Fabis, Lupinis, &c.* in aliis ad extremum oppositum, ut in *Glandibus, Juglandi* nuce, *Amygdalis, Prunis, Boragine, Bugloſſo, & Aſperifoliis reliquis.* Jam vero in seminibus oblongis aut acuminatis radiculam ad acutiorem extremitatem sitam observavi, sive extremitas illa vasculo cohæret, sive eidem è diametro opposita sit. Sic v. g. in seminibus *Pomi, Pyri, Floris Solis, Melonis, Peponis, Cucumeris & Verticillatarum* omnium, cum acutior extremitas eadem sit quæ vasculo seminali contigua est, radiculæ etiam apex cohæsionis punctum respicit: in seminibus autem *Glandis, Amygdali, Boraginis, Bugloſſi, &c.* in quibus acutior seminis extremitas cohæsionis puncto è diametro opponitur, radicula quoque eundem situm obtinet. In quibus seminibus medullæ cum lobis connexio vel loco cohæsionis seminis ipsius, vel eidem oppoſito adjacet, hoc est, in seminibus productioribus in quibus alterutram extremitatem occupat, radicula necessario brevis est, in quibus verò connexionis locus à seminis cum planta cohæsione distat, radicula aliquanto longior est; & juxta marginem loborum producitur, donec apice suo ad cohæsionis locum terminetur.

Hæc observatio nonnullius usûs esse potest in serendis seminibus saltem grandioribus, nam eorundem germinationem procuddubio nonnihil promovebit, ità ea serere ut plantulæ radicis apex deorsum spectet; ut vice versâ necessariò vegetationem & augmentum impediet, eo situ serere ut ejusdem apex sursum tendat. Radix enim in hoc casu integrum semicirculum seu duos angulos rectos inflectatur oportet antequam deorsum descendat, & ex altera parte similiter gemma tantundem incurvanda est antequam sursum erigatur, ita ut succus nutritius bis reflectatur necesse est antequam è radice in caulem derivetur.

Secundi seminum generis in quo plantula seminalis convoluta seu complicata est multæ sunt varietates, cùm complicatio foliorum seminalium & radiculæ in variis generibus admodum variet. Exempla aliquot proponam seminum majusculorum in quibus tegumentis detractis complicationis modus clarè apparet, *ut quivis facilè* cum oculis discernere queat, & plantulam inclusam propriis digitis extendere aut explicare. 1. In Raphano & ut verisimilè est in aliis omnibus quæ foliis seminalibus similibus è terra exeunt, ut v. g. *Brassicis, Rapis, Sinapi, Rapistro, Erucæ, &c.* Plantula seminalis in figuram globosam elegantissimè convolvitur hoc modo. Foliis seminalibus sibi mutuò admotis seu appressis ut in aliis plerisque, primò radicula inflexa iis superimponitur, deinde foliorum eorundem partes dextra & sinistra versus se mutuò incurvatæ supra radiculam, & tandem occurrentes eam sinu suo amplectuntur; cujus sic convolutæ & explicatæ plantulæ icones exhibemus è *Malpighii Plantarum Anatome desumptas, Tab. 53. Fig. 319.* 2. In *Acere* majore *Sycomoro* falsò dicta, folia seminalia sibi mutuò admota, ut in priore, ambo simul paulò supra mediam longitudinis partem incurvantur, donec sibi mutuo dimidiæ earum partes contiguæ fiant, deinde unà cum radicula in globulum convolvuntur, ut siquis angustam laciniam bis replicaret, deinde à flexuræ loco incipiendo convolveret. Apposita icon rem illustrabit. 3. In *Nasturtii* hortensis semine lateralia duo segmenta utriusque folii seminalis parti posticæ medii seu præcipui segmenti adplicata (quæ simul ejusdem cum illo exactè la-



titudinis sunt) tegumentis includuntur, radiculâ non nudâ in folia reflexâ, sed velut si prius extensa tegumentis involuta fuisset, postmodum autem una cum tegumentis ad folia seminalia inflexa, ut semen ipsum contemplanti manifestè patebit.* 4. In seminibus *Convolvulorum* omnium, sed præcipuè marinæ seu *Soldanellæ*, folia seminalia multis plicis seu flexuris corrugantur, adeò ut è tegumentis exempta facillimè possint expandi & erugari, cum tenuiora sint minúsque fragilia quam in plerisque aliis, quin & viridescunt nonnihil; adeo ut ex omnibus quæ hactenus observavi hujus generis seminibus huic usui commodissima sint, nimirum demonstrando naturæ artificio in complicando intra membranas involventes plantulam seminalem, quod sanè valde admirabile est & spectatu jucundissimum.

Hactenus de Seminibus quorum pulpa seu medulla tota nihil aliud est quàm plantula seminalis seu extensa, seu complicata, sequitur ut de iis agam in quibus præter plantulam seminalem aliud etiam corpus continetur, seu plantulæ seminali alendæ seu defendendæ inserviat. Hæc etiam consimiliter in duo genera dividi possunt. Primum est eorum in quibus plantula seminalis plana est & extensa absque ulla plica aut flexura. Hujusmodi sunt Fraxini semina & Umbelliferarum nonnullarum. Secundum est eorum in quibus eadem plantula inflexa complicata aut convoluta existit; cujusmodi sunt semina Malvæ, Stramonii, Atriplicis, Spinachiæ, aliarumque plurimarum, in quibus pulpa residua seminali plantulæ dum adhuc tenella est alendæ aut (ut diximus) fovendæ inservire videtur.

In primo genere caro seu pulpa foliorum seminalium seu loborum primum radici nutrimentum, cujus primulum germinat suppeditare videtur; quæ post productior facta, & in terram descendens nova alimenta tum sibi exugit, tum foliis vicissim rependit. Folia enim seu lobi seminales in id genus seminibus dum adhuc tegumentis inclusa latent, crassi sunt (ut ante diximus) carnosi & fragiles, [illegible] multum alimento; idcircoque ordo seu processus germinationis in eis hujusmodi esse videtur. Semine terræ commisso humor seu succus nutriens duplici filtratione per seminis tegumenta & plantulæ ipsius membranulam depuratus à foliorum pulpa imbibitur, eamque [illegible] particulis commixtus alendæ radiculæ nutrimentum suppeditat. Hæc autem primum germinans tunicas disrumpit & producta in terram descendit, indidemque nutrimentum & sibi haurit, & foliis seminalibus reddit, quæ deinde aucta & explicata è terra erumpunt, tegumenta dilacerata exuunt, inque longitudinem & latitudinem extenduntur, rariores tamen magisque spongiosæ, lentæ quoque & fibrosæ evadunt. Verùm in seminibus quorum folia seu lobi seminales supra terram non exurgunt; ut v. g. Fabis, Pisis, Viciis reliquisque leguminibus radicula (quantum quidem ego observare potui) lobis alimentum non suppeditat, qui idcirco crescere & augere propriè non sunt dicendi, quamvis intumescant admodum ratione humoris in eorum poros se insinuantis, spongiæ in modum. Lobi ut & folia seminalia aliquandiu post plantæ germinationem turgida & extensa durant, postea paulatim extenuantur & flaccescunt, tandemque exiccata decidunt. An nutrimentum aliquod plantæ post emersionem è terra subministrent & quandiu turgidæ maneant, mihi non constare fateor. Experimentum autem facilè fieri posset folia seu lobos abscindendo quamprimum plantula è terra prodierit, eámque cum altera coæva cui maneant comparando. Si enim mutila integram vigore & augmento æquat, manifestum est nullum folia nutrimentum plantulæ saltem necessarium suppeditare.

Ex quo hæc primum scripsi ad manus meas venit sagacissimi & verè incomparabilis Philosophi, naturæ ipsi à secretis *Marcelli Malpighii Anatomes Plantarum pars altera*, in qua experimentum hoc à summo viro factum invenio in variis seminum generibus tam ante quam post germinationem inchoatam: quo successu ipsum referentem attende. Primo, inquit, vere *Fabarum* plurimas plantulas sevi, detractis prius cotyledonibus seu farinaceo pericarpio. Ex his binæ tantum plantulæ, reliquis corruptis, parum vegetârunt, gemma scilicet sursum excreverat immota hærente conica radice. Circa undecimam diem gemma non expandebatur: sed foliola in extremitate arescebant: caulisque non elongabatur; sed maculis in atrum tendentibus inficiebatur. Translactâ vigesimâ primâ totus caulis minimus nigrefactus tandem contabuit: corrupta priùs radice, quæ nullum augmentum omnino erat experta. Mense quoque *Maii* alias seminales plantulas *Fabarum & Phaseolorum* ablatis pariter binis seminalibus foliis seu cotyledonibus incubandas posui; è quibus unica *Fabæ* plantula vegetavit, elatâ supra terram minimâ gemmâ, productâque parum infra radice, ità ut tota plantulæ longitudo semidigitum non excederet. Hæc translactâ vigesimâ primâ nigrefacta radice & exiccatis foliis gemmæ seu futuri caulis contabuit. Alias denuo plures seminales *Fabarum* plantulas detractis omnino cotyledonibus plantavi, quarum nullæ penitus vegetarunt. Idem expertus sum in plantulis *Cucurbitæ, Peponum, Lupinorum & Phaseolorum*: qui insigni pollent trunco & gemma.

Hanc eandem observationem progrediente in cubatu & post inchoatam vegetationem tentavi, dum scilicet cotyledones sub specie seminalium foliorum supra terram emergebant. In *Cucurbitæ* itaque plantulis vegetantibus discusso cortice, ablatis binis seminalibus foliis, protrahebatur quidem vegetatio, sed gemma seu relictus caulis nullum ferè augmentum capiebat, hocque sæpius mihi accidebat. Idem contingebat in *Lupinis*, quorum cotyledones in ampla & crassa extuberabant folia. In *Peponibus* quoque, in *Lattuca, Endivia, Raphano* & Rapis; quorum plantulæ cotyledonibus orbatæ, vegetationis incrementa non sortiebantur; sed vel citò extinguebantur, vel minima absque vegetatione tâbida subsistebant. Plantulis verò à primordiis vegetantibus, unico detracto folio, altero autem superstite, germinatio producebatur, non tanta tamen felicitate qualis in non mutilatis observatur.

Vegetantium cotyledonum vim & durationem exploraturus, plura sevi *Lupinorum, Cucurbitæ & Fabarum* ova: à quibus plantulis, dum supra terram erumpebant singulo die seminalia folia abstuli. In *Lupinis*, quarta die è terra emergentibus laceravi folia; in *Cucurbita* pariter, quinta die primò apparente planta, idem molitus sum, & septima die in *Faba* vegetante cotyledones abstuli, & in subsequentibus diebus idem tentavi in consimilibus plantis per spatium dierum decem, Lupinorum igitur tres primæ plantulæ, cotyledonibus orbatæ, nullum ferè sortitæ incrementum post mensem conta-

contabuerunt; reliquæ verò longè minores perduraruntę. Cucurbitæ verò quatuor primæ reliquis vegetantibus extinctæ sunt. Fabarum plantæ cotyledonibus orbatæ, plures quidem vegetarunt sed gracillimæ & minimæ.

Ex his igitur conjectari licet, bina illa, utplurimum crassa, folia quæ plantulæ seminali hærent uterinæ placentæ vel cotyledonum vices explere. Hæc autem humorem exposcunt à terreno utero emanantem, quo soluti fermentativi & spermatici eorum succi per propria umbilicalia vascula quotidianam plantulæ alimoniam & auctivam materiam suppeditant: unde plantulæ fœtus è fermentatis & in motum actis particulis, in placentis scilicet seu seminalibus foliis jam concretis, non solum laxatis meatulis augetur; sed ad vegetandum excitatur. Hactenus *Malpighius*.

Quòd folia seminalia ad primam vegetationem seu germinationem plantulæ necessaria sint, experimenta allata evincunt; seu quia humor terrenus minimè idoneus est plantulæ dum adhuc tenella est alendæ, nisi præparetur per admixtionem succi foliorum seminalium fermentativi, ut *Malpighius* conjectatur, & rationi consonum est, seu quia tenella & imbellis plantula è terra nondum haurire valeat quantum sibi alendæ sufficiat, sed supplemento adhuc egeat à foliis subministrato, ut pullo recens excluso alendo vitellus necessarius est, quantumvis cibum ore capessat; seu ob utramque rationem.

Quòd folia hæc ad vegetationem prosperam faciant aliquamdiu etiam postquàm planta è terrâ emersérit experimenta itidem probant.

Quod verò non semper necessaria sint, neque etiam utilia; manifestum est, quia post aliquod tempus paulatim marcescunt & intereunt; radice totum suum nutrimentum plantæ subministrante.

Notandum quoque est, quòd post vegetationem inchoatam plantula tenella recens nata partem saltem aliquam nutrimenti sui radice attrahit, ut patet à celeri auctu & extensione foliorum seminalium. Sic in Animalibus videmus quòd Embryo partem aliquam nutrimenti è cotyledonibus seu placenta uterina exugunt, partem ore admittunt, dum adhuc in utero sunt: siquidem in ventriculo dissecto idem planè humor invenitur qui in amnio cernitur; & in intestinis etiam excrementa, post ejusmodi humoris coctionem & distributionem reliqua, observantur.

Ex his omnibus colligere licet primum plantulæ seminalis alimentum, & (ut verisimile est) fœtus etiam in utero à cotyledonibus seu placentis uterinis, hoc est in plantis à foliis seminalibus præparari & præberi; postmodum succo nutritio partim ore seu radice hausto, partim à cotyledonibus subministrato aluntur, adeóque paulatim indies ore seu radice plus assumentes, à cotyledonum succo velut ablactantur, eóque tandem prorsus deficiente, animalia ore, plantæ radicibus integrum suum alimentum hauriunt aut capessunt.

Supereſt jam ut de iis seminibus dicamus, in quibus plantula seminalis non binis seminalibus foliis, radice & gemmâ constat, sed cujus folia primùm apparentia subsequentibus similia sunt.

Horum duo genera observavimus. Primum est eorum in quibus plantula seminalis alteri seminis extremitati, ei nimirum quæ vasculo seminali contigua est, exteriùs affigitur, figurâ ferè gemmæ cum scuto suo in emplastratione arboris alicujus trunco aut ramo appositæ. Secundum est eorum iis quibus plantula seminalis media seminis pulpa velut medulla includitur.

Prioris generis sunt frumenta omnia & gramina quæ fibrosas obtinent radices; plurimis minutis fibrillis è fundo plantæ unà erumpentibus, non autem simplici trunco qui postmodum in surculos & fibras spargitur. Sic in grano *Hordei* v. g. observavi sex ejusmodi fibrillas enatas, antequam folium germinare inciperet. Plantula seminalis in his vix decimam partem pulpæ seu medullæ seminalis magnitudine æquat. Reliqua pulpa seu farina plantulæ dum adhuc tenella est nutriendæ inservit, etiam postquàm radices egerit; quemadmodum in Animalibus oviparis ovi vitellus pullo alendo aliquandiu etiam postquam excluditur, quamvis interim ipse cibum roſtro capessat. Pulpam hanc seu carnem seminis in hoc genere folium conglobatum appellat vir nunquam satis laudatus *Marcellus Malpighius*, in *Plantarum Anatomes parte prima, pag.* 77. qua occasione in hanc opinionem inductus est ipse declarat. In *tritico* (inquit) & *avenaceis* videtur plantula seminalis unico hóque obscuro folio præditа. Huic meditationi lucem tulit seminum *pomi Armeniaci* frequens inspectio: semel enim incidi in seminalem plantulam folio destitutam, & hujus gemma cum radice non parum luxuriabat: aderat autem intra eundem nucleum alterum semen seu plantula, in cujus auctionem primò conspiraverat natura. Ex hoc itaque monstro interdum credidi frumenti & consimilium seminales plantulas unico pollere folio, cui hæret gemma cum cauliculi inchoamento & radicibus. Sic in *Avena* præcipuum corpus seu seminis caro in ovale & oblongum configuratur corpus, quod in sui medio excurrentem exhibet foveam. Namque est veluti cratis lamina sua extremo in medium reflexis & convolutis cujus summitati plantula seminalis appenditur seu inseritur. Hactenus *Malpighius*. Verum hæc medulla seu caro farinacea seminis, seu folium convolutum conglobatimve dicenda sit live minus, certè plantulæ recens satæ alimentum suppeditat, ut in *tritico*, v. g. evidentissimè apparet. Si enim cùm primùm exorta fuerit plantula, eam extirpes, pulpam in grano ferè integram invenies; quod si de die in diem plantulas simul satas extirpare pergas, pulpam seu farinam sensim quotidie minui observabis, donec tandem nihil reliquum sit præter vacuum folliculum plantæ fundo adhærentem. Pulpa autem seminis seu farina post germinationem terræ humore per poros tegumentorum percolato commixta in cremorem facessit chylo non dissimilem. In iis autem frumentorum generibus quorum grana membranâ tenui vestiuntur, ut v. g. *tritico* & *secali*, foliuni tegumenta dirumpit, & ab eadem cum radicibus extremitate egreditur. In quibus verò grana cortice crassiore obteguntur, ut *Hordeo* & *Avena*, folium sub crassiori cortice reptans è seminis summitate exit, quamvis gemma seu plantula seminalis eidem seminis inferiori extremo adnascatur, primáque tum folii tum radicis germinatio ab eodem puncto incipiat tam in hoc genere quam in illo.

Secundi generis semina, h. e. in quibus plantula seminalis mediâ seminis pulpâ includitur nonnihil variant. In nonnullis enim tum truncus tum folia perfectè formantur. Sic v. g. in nucleis *pinus* (& ut verisimile est, aliarum omnium conferarum & relinferarum arborum seminibus) *Pinum*

pusillum perfectè effigiatam truncóque & foliis suis discretam, prout apparet cùm primum fata è terra emerserit, si eos dilsecueris facilè invenies. Pulpa exterior, cujus medium occupat plantula seminalis, eidem alendo non videtur inservire, saltem maxima ejus pars. Observavi enim à germinatione post plantulam enatam totam ferè pulpam exteriorem in cortice residuam. Si conjecturas sequi licet, verisimile nobis videtur, pulpam inservire semini partim protegendo nè arescat nimis & humidum ejus radicale evaporet, partim succo nutritio per filtrationem depurando, partim denique ut tenuior ejus pars cum humore commixta in nutritionem plantulæ tenellæ faciat.

2. In aliis plantula seminalis nihil aliud esse videtur quàm cylindrus aut bacillus quidam, in nonnullis acuminatus, in aliis in capitellum extuberans. Plantula hæc cylindroides in nonnullis seminibus incurvatur, in aliis rectà extenditur, in omnibus eam seminis partem occupat, quæ matri adnascitur, & ad molem pulpæ seminalis minimam obtinet proportionem: reliqua autem pulpa corpus est durum & cartilagineum; quod plantulæ seminali partim alendæ, partim protegendæ inservire videtur. Hujus generis sunt semina bulbosarum omnium, *Iridum, Ari, Asparagi*, & (ut puto) *Pæoniæ* & *Cyclamini*. Aliquam etiam inter hæc semina differentiam observavi. Nam in seminibus *Cepæ* & *Porri* exterior terminus cylindrici stipitis seu plantulæ seminalis, primùm germinans, deorsum rectà descendit in terram, & fit radix, pulpâ seminali alimentum eidem suppeditante, & eam velut protrudente. Radix deinde terram apprehendens alimentum inde attrahit, & vicissim trunco reddit, qui in longum extensus supra terram assurgit inflexus, cum alteri extremo radix alteri autem semen alimentum subministret. Verum cum radix copiosius præbeat quàm semen, hinc fieri videtur, quòd à flexura trunci medietas illa quæ radici continuatur, celeriùs crescens & productior facta, alteram medietatem unà cum semine adhærente è terra extrahat & sursum rapiat.

Siquis autem plantulam seminalem videre desiderat, semen quodvis ex majusculis (quæ huic usui aptiora sunt) adultum quidem, dum tamen adhuc viride est & humore turget, dissecandum sumat; quòd si exiccatum offeratur, aquâ tepidâ prius infundat donec intumescat & germinare incipiat. Tunc enim plantulam tunicis exutam facile explicabit, omnesque ejus partes, folia seminalia, radiculam & gemmam, clare discernet. Quod si fecerit, non poterit non naturæ artificium in plantis seminalibus tam curiosè complicandis summopere admirari, & tam amœno spectaculo vehementer capi & delectari.

CAP. XVI.

De Partibus Plantarum secundariis seu auxiliaribus, Capreolis, Spinis, &c.

CUM Plantarum nonnullarum eximiæ etiam magnitudinis Caules infirmiores sint quàm ut per se subsistant, quin humi provolvantur, necesse est in alienis adminiculis sustententur: harum securitati solicita partes aliquas secundarias & auxiliares ingeniosa excogitavit Natura, quarum ope vicinis stirpibus aliisve fulcimentis sese implicantes adhærentésve firmentur & in altum enitantur, adeóque & seipsas tutentur, & fructus suos ad maturitatem felicius perducant. Aliis enim Capreolos concessit seu claviculos, quibus (ut Cæsalpini verbis utar) tanquam manibus vicinas plantas apprehendant, & velut funiculo circumducto amplexentur, ut *Viti, Cucurbitæ, Piso*, aliisque leguminibus. Oriuntur autem Capreoli vel in ipsis foliorum alis, vel à latere, vel ex adverso, vel etiam in summis foliis, ut Leguminibus quibusdam contingit. Hujusmodi capreoli styliformes appendices seu flagella exserunt, modò tria, frequenter quatuor, & non rarò etiam sex. Hæc à primordiis tenella, & parùm obliqua (verba sunt Malpighii) producuntur; temporis tractu solidiora reddita in spiram contorquentur, unde occurrentes plantarum ramos arctè amplexantur. Capreolorum color viridis est, & fistulis, tracheis, & interpolitis utriculorum ordinibus compaginantur. Aliis eadem polydædala natura aliud vinculorum genus machinata est. Sic *Hederæ* vulgari cirros quosdam seu radiculas pilosas indulsit per totam caulem frequentes hinc indè, velut Millepedum pedes, qui, observante sagacissimo *Malpighio*, glutinosum fundunt humorem seu terebinthinam, quâ arboribus aut parietibus occurrentibus pertinaciter adhærescunt & agglutinantur. Sic Hederæ Canadensi quinquefoliæ quasi manus quasdam elargita est, velut in digitos divisas, qui diuturnitate temporis cincinni instar in spiram contorquentur. Horum extremitates (eodem observante) dum tenelli sunt acuminatæ extant, tandem verò laxantur in corpus crassiusculum, quod papillis seu minimis siphonibus refertum, terebinthinam fundit, unde parietibus hærens concretum quasi cuticulam efformat, quæ nisi summâ vi à muro vel subjecto ligno avelli nequit.

Aliis autem plantis infirmis (ut id obiter notemus) vel caules volubiles concessit, ut *Convolvulo, Lupulo, Phaseolis, Helxine, &c.* quibus vicinas stirpes aut pedamenta amplexentur, serpentum modo iis se circumvolventes; vel foliorum pediculos tortiles, quibus sese iis adnectant, ut in *Clematide, Fumaria, Nasturtio Indico* cernitur.

Alias præterea Plantis partes minùs principales aut forte excrementitias donavit natura, pilos & aculeos. Illos vel ornamenti vel tutelæ causâ, vel (quod opinatur Malpighius) ut turgentis alimoniæ sub harum forma incongrua portio erumpat & digeratur; de quibus ipsum erudite & subtiliter, ut solet, philosophantem consulas: hos ad arcendas injurias aut etiam inferendas, nunc in caulibus, ut Rubo; nunc in foliis, ut Agrifolio; nunc in fructu, ut *Tribulo*; nunc sub solis tantum, ut Ononi; nunc ubique, ut in plurimis Acanaceis *Cæs.* In his ipsis plantis nonnullis elargiendis providentiam naturæ satis admirari ampleétique non est (inquit Plinius.) Naturæ autem consilium in hujusmodi aculeatis efformandis ingeniosè simul & succinctè explicat, pro more suo, verbis sequentibus. Inde excogitavit aliquas aspectu hispidas, tactu truces, ut tantum non vocem ipsius naturæ fingentis illas rationémque reddentis exaudire videamur, nè se depascat avida Quadrupes, ne protaces manus rapiant, nè neglecta vestigia obterant, ne infidens ales infringat, his muniendo aculeis

aculeis teliſquo armando, [proviſum] remediis ut tuta ac ſalva ſint. Ità hoc quoque quod in iis odimus hominum causâ excogitatum eſt.

Cap. XVII.

De Nutritione Plantarum.

Nutritio dicitur alimenti intus ſuſcepti & alterati in omnes Plantæ partes diſtributio, ſinque earundem ſubſtantiam tranſmutatio, ad ſupplendum id quod continuè caloris ſeu inſiti, ſeu adventitii vi abſumitur & evaporat. Partes enim humidiores tam Plantarum, quàm Animalium in perpetuo fluxu ſunt: id quod ex foliis & floribus decerptis evidentiſſimè apparet. Hæc enim flacceſcunt illico & contrahuntur, ob ſucci eorum vaſa & veſiculas repletis & diſtendentis fugam. Eadem autem ſucci evaporatio partibus hiſce accidit dum adhuc plantæ matri cohærent, nec tamen ſentitur, foliis conſiſtentiam & extenſionem ſuam nihilominus retinentibus, ob novi ſcilicet humoris à radice ſubminiſtrati jugem efluxum. Plantarum autem nutritio à nutritione Animalium in eo differt, quòd hæc cibum ore aſſumptum in ventriculo concoquant, adeóque comminuunt & partium ejus unionem laxant, ut ſponte ferè ab invicem ſecedant, ſaltem purum ab impuro, clarum à fæculento, alimento idoneum ab excrementitio haud difficulter poſſit ſecerni, adeóque illud vaſorum meſentericorum (quæ plantarum radicibus reſpondent) ſeu poros, ſeu orificia ſubire, hoc per partes & meatus ad id officium deſtinatos expelli: Plantæ autem ſuccum nutritium non præparant; nullus enim in iis ad hoc præſtandum partium apparatus, nullum os, nullus ventriculus, nullæ primæ viæ, ſed quem in terra inveniunt ſuccum radicibus excipiunt & aſſimilant.

An Plantæ electione quadam in alimento attrahendo utantur, ut quod congruum eſt & nutritioni idoneum imbibant, incongruum repudient; an verò quodcunque ſe offert indiſcriminatim admittant, ambigitur. Nonnulli attractionem electivam aſſerunt: quæ tamen nobis non probatur. Primò enim attractionem propriè dictam in rerum natura dari, imò poſſibilem eſſe, vix concedimus: Fieri tamen poteſt ut radicum pori taliter figurati ſint, ut particulas amicas & plantæ alendæ aptas intromittant, alienas & incommodas excludant; quomodo Hepar bilem, Renes urinam tranſmittentes à ſanguine intus cohibito ſecernunt. Verùm id non fieri multis experimentis probatur.

Aqua enim vulgaris, fibrarum cava facilè ſubintrat, eáque liberè permeat, ut ſuperiùs oſtendimus. Deinde verno tempore qui factâ inciſione effluit liquor, pruinoſa præſertim tempeſtate; ab aqua communi guſtu vix poteſt diſcerni. Probabilius ergo nobis videtur, ſtirpes omnes ſuccum quemcunque in terra invenerint intus ſuſcipere, qui in vaſis cum ſuccis uniuſcujuſque propriis permixtus concoquitur & aſſimilatur, ſuperfluo & ad nutriendum inutili rejecto & evaporato; ad eundem modum quo tertia (ut vocant) concoctio in Animalibus peragitur, quæ ex chylo in ſanguinem recepto partem aliquam aſſimilant, reliquum qui nutritioni ſupereſt, per tranſpirationem inſenſibilem evacuant, qui ſanè longe maxima ejus pars eſt. Animal enim plus excrementorum hoc modo expellit quàm omnibus aliis viis ſimul ſumptis, ut * *Sanctorius* demonſtrat.

* *Lib. de Medicina Statica.*

Plantas aquâ ſolâ nutriri poſſe & augeri tum noſtra, tum aliorum experientiâ conſtat: † D. *Sharrocus* Catalogum nobis exhibet herbarum quarum ſurculi in phialas vitreas aquâ oppletas à ſe immiſſi germinârunt, quem non pigebit huc tranſcribere. *Balſamita fœmina, Menthæ quæcunque, Pulegium, Sedum multifidum, Prunella, Naſturtium aquaticum, Bugula, Trifolium purpureum, Clematis daphnoides, Herba Doria, Ranunculus, Becabunga, Althæa, Lauro-ceraſus, Scordium, Tripolium, Polygonum, Nummularia, Panax coloni, Matricaria,* aliæque quarum non meminit. Nec dubium eſt, quin & aliæ multæ quas ille expertus non eſt pariter germinarent & radices agerent. Aqua enim non eſt ſimplex & purum elementum, ſed multas heterogeneas particulas, præſertim ſalinas, in ſe continet.

† *Lib. de propagat. Vegetabilium.*

Quomodo autem Aer hujuſmodi Plantarum radices intret, non ità perſpicuum eſt, cùm enim vitri poros non permeet, oportet ut per phialæ orificium ingrediatur & per aquæ poros ſe inſinuet. Aquæ autem pori admodum ſtricti ſunt, nec aerem niſi parvâ admodum quantitate, & in minimas particulas diviſum admittunt. Et tamen (quod mirum) particulæ hæ quas Aer aquæ communicat non ſolùm plantarum vegetationi ſed & piſcium reſpirationi ſufficiunt. Quandiu enim Aer aquæ ſuperficiem lambit, tandiu piſces in vaſe vitreo incarcerati bene ſe habent: quamprimum verò Aer externus excluditur, ejus inopiâ laborant, & in ſuperficiem aquæ confeſtim enatant, ut eo liberiore fruantur. Sive ergo Aer præcipitet nitrolas particulas in aquam (ut nonnulli volunt) ſive ſubtilius aliquod corpus, certum eſt continuè & non interrupto tenore ab aere decedere hujus particulas, & per aquam diffundi: nam ſi perexiguo tempore, aer (ut diximus) intercludatur, piſces concluſi ejus abſentiam ſentiunt, & ægrè ſe habere incipiunt, quod & patiuntur in ſtagnis & piſcinis ampliſſimis, cùm per hyemem aquæ ſuperficies congelatur. Quòd ſi nitrum eſſet ab aqua ſolutum & præcipitatum cujus particulæ piſcibus pro reſpiratione inſerviunt, adeóque aqua perpetuo nitrolas particulas ab aere imbibat, quomodo fit ut aqua omnis jamdudum tantâ nitri copiâ impregnata non ſit, quantam ſuſtentare potis eſt, ut ſalſedo vel guſtui perceptibilis fiat? ſaltem in ſtagnis immenſis & piſcinis: aquæ enim fluentes & per terram multam percolatæ facilè in eam particulas haſce iterum deponere poſſunt.

Quomodo ſuccus nutritius per fibrarum poros arborum etiam altiſſimarum ſummâ faſtigia conſcendat mihi non penitus perſpectum fateor. Aquam in tenues tubulos utrinque apertos, perpendiculariter etiam erectos aliquouſque aſcendere experientiâ conſtat, cóque altiùs quò anguſtiores ſunt tubi. Quis verò iſtius aſcenſûs terminus ſit, certúſne an incertus, & pro anguſtia tuborum in tantum altior, ut in anguſtiſſimis ad excelſarum etiam arborum ſummos apices evadat, me latet.

Contra-

Contrarium tamen videtur cùm, annotante nobilissimo Boylio, satis difficulter ad tres quatuorve uncias ascendat. Quo impulsore hoc fiat, difficile est investigare. Aquam equidem in angustiores meatus quàm aerem, vel sponte se insinuare, vel vi compelli posse, adeóque tubulorum angustias aeri impervias subire, experimenta evincunt, quia scilicet aqua minoribus particulis componitur quàm aer. Cùm ergo fibrarum cava ob angustias suas aerem excludant, aquam admittant, externi autem aeris gravitas effectum suum sortiatur, quidni humorem in fibras sursum compellet, ad eam scilicet altitudinem, donec ad æquilibrium cum aere externo veniat, hoc est, ad triginta duorum plus minus pedum? Hæc quamvis ratiocinanti verisimilia videantur, si tamen experientiam consulas longè aliter rem se habere deprehendes; siquidem nobilissimus Boylius aquam in istiusmodi tubulis filtrive non minùs intra Recipiens seu vas magnum aere exhaustum suspendi quàm extra in Aere libero & aperto, experiundo didicit & nos docuit.

Verum (ut id concedatur) arbores altissimæ duplo triplóve hanc mensuram excedunt. Alia ergo adhuc ascensûs causa, saltem adjuvans, quærenda est. Experientiâ constat aquam in vaporem resolutam, & in minima divisam, gravitatem suam amittere, & per aerem medium ascendere, quæcunque tandem gravitatis causa sit. Videtur ergo ut gravitas suum sortiri possit effectum, requiri ut corpus grave aliquam habeat molem & magnitudinem; aliàs enim (ut vidimus) si in minima dividatur, fieri potest ut à fluido cui innatant ejus particulæ vel sustentari possit, ut metalla etiam ponderosissima in menstruis eadem in minima solventibus, vel etiam sursum compelli, ut aqua in vaporem resoluta in aere. Fortè ergo succi in angustissimis fibrarum canaliculis in tenuissima filamenta divisio ad ascensum ejus promovendum concurrere potest.

Lib. de Anatome truncorum.

D. *Grew* ascensum succi in plantarum vasis, partim vasorum angustiæ, partim parenchymatis vasa ambientis, ex innumeris vesiculis compositi pressuræ attribuit. Hæ enim vesiculæ ad ingressum alicujus liquoris naturali quadam propensione se dilatant, ut in Spongiis apparet, quarum textura plantarum parenchymati non adeò dissimilis est. Parenchyma ergo succo repletum & intumescens continuum sese dilatandi & extendendi conatum exserit, unde & vasa unà comprimat & coarctet necesse est, adeóque & succum sursum compellat. Verùm cum compressio utrinque tam deorsum, quàm sursum effectum suum sortiatur, non video quin ascensum succi initio impediat, nisi valvulæ obstent, quas neque nos, neque D. *Grew*, ob rationes superiùs dictas admittimus. Adde quòd unde oriatur hæc sese dilatandi propensio in parenchymate plantarum, explicatione ulteriori indiget.

Nos equidem succum eodem ferè modo plantarum fibras subire & conscendere, quo aqua panis aut spongiæ poros, pannique lineive lacinias aut aliud filtrum solet, concedimus. Fibrarum etiam structura & conformatio (ut observat D. Malpighius) liquoris ascensum adjuvat. Sunt enim fibræ tubulosa corpora, è corpusculis plurimis concavis, quadratis, aut interdum orbicularibus, aliisve figuræ, invicem hiantibus, composita. Subintrans itaque humor (D. Malpighii verba sunt) sursum ascendit & quasi suspenditur. Singula namque portio quæ fibrarum fistula unit, cùm parum interiùs emineat, valvulæ vices supplet, & ità minima quælibet guttula veluti per funem, seu per gradus ad ingens deducitur fastigium. Quænam autem ascensûs hujusce causa efficiens seu impulsiva sit, quæ succum sursum adigat & compellat, nos hactenus latet; nec enim in causis assignatis nobis hactenus satisfecimus.

* *Anat. plant. part. 1. pag. 5.*

CAP. XVIII.

De Satione & Propagatione Plantarum.

SAtionis & propagationis Plantarum varii modi sunt. Veteribus usitati fuere *Semine, ramo, surculo, talea, malleolo, gemma, stolone, viviradice.*

Semen quid sit notius est quàm ut definiri debeat: Ramus pariter, & Surculus.

Talea nonnullis est Surculus utrinque præcisus. Varro lib. 1. de Re Rustica cap. xi. Denum in oleaginis seminibus arbores videndum, ut sit de tenero ramo, æquabiliter præcisum, quas alii clavolas, alii taleas appellant, ac faciunt circiter pedales.

Plinius Taleam à Ramo atque etiam Surculo distinguit, Ramum facit majorem Talea, Taleam Surculo. Ejus verba sunt, [lib. 1. cap. 17.] *Multa sic feruntur* (ramis scilicet) *ac imprimis Ficus, omnibus quidem aliis modis nascens, præterquam talea. Optimè quidem si vastiore ramo pali modo exacuto adigatur altè, exiguo supra terram relicto capite, eóque ipso harenâ coperto. Ramo feruntur & Punica, palis laxato prius meatu: item Myrtus: omnium horum longitudine trium pedum, crassitudine minùs brachiali, cortice diligenter servato, trunco exacuto. Myrtus & taleis feritur: morus taleâ tantùm, quoniam ramis eam seri religio fulgurum prohibet. Quapropter de talearum satu nunc dicendum est: Cavendum in eo ante omnia, ut taleæ ex feracibus fiant arboribus, nè scabræ aut bifurcæ, néve tenuiores quàm ut manum impleant, nè minores pedalibus, ut illibato cortice, atque ut sectura inferior ponatur semper & quod erat ab radice, accumuletúrque germinatio terrâ, donec robur planta capiat.*

Palladius Clavolam à Talea diversum facit, quam Varro (ut vidimus) cum eadem confundit. *Martiè* (inquit) *Martio Citri arbor 4 modis seritur, semine, ramo, talea, clava: & paulò post, Clava seri commodius est, quæ sit manubrii crassitudine, longitudine cubitali, ex utraque parte lævigata, nodis & aculeis recisis, sed relicta summitate gemmarum, per quas spes futuri germinis intumescat, &c. Talea & gracilior & brevior esse potest, quæ similiter ut clava mergatur. Sed talea palmis duobus superstet; clava cunctis obruatur.*

Malleolus à Columella de Re Rust. l. 3. c. 5. sic definitur. Malleolus novellus est palmes, innatus priori anni flagello, cognominatúsque à similitudine rei, quòd in ea parte, quæ deciditur ex vetere sarmento prominens utrinque malleoli speciem præbet: & Plinius *l.* 17. c. 21. Solebat capitulatus utrinq; è duro surculus seri, eóq; argumento malleolus vocatur etiam nunc: & Columella, c. 17. Malleolis autem sic ab iisdem [agricolis antiquis] pangebatur, ut novello sarmento pars aliqua veteris hæreret:

ret: Sed hanc positionem damnavit usus. Nam quicquid ex vetere materiâ relictum erat depressum atque obrutum celeriter humore putrescebat, proximásque radices teneras & vixdum prorumpentes vitio suo enecabat: quod cùm acciderat superior pars seminis retorrescebat. Secuti ergo quicquid residui fuit ex vetere palma, per ipsam commissurani, quâ nascitur materia nova, resecuerunt, atque ita cum suo capitulo sarmentum depresserunt.

Et ad faciendum malleolum supremam flagelli partem resecuerunt, solúmque eam quæ est juncta cum vetere sarmento probaverunt. Longitudo quæ debeat esse partium certa est (inquit idem) quoniam sive crebras gemmas habeat, brevior faciendus est: seu raras longior: attamen nec major pede, nec dodrante minor esse debet.

Superior pars surculi seu flagelli Sagitta rusticis vocabatur, eodem autore, sive quia longiùs recessit à matre & quasi micuit atque prosiluit; sive quia cacumine attenuata prædicti teli speciem gerit. Hanc prudentissimi agricolæ negaverunt conseri debere: nec immerito: Omnis enim secundus pampinus intra quintam aut sextam gemmam fructu exuberat, reliqua parte, quamvis longissima, vel cessat, vel perexiguos ostendit racemos. Quam ob causam sterilitas cacuminis jure ab Antiquis accusata est. *Sagitta quid.*

Stolo à Stolone viro qui propter diligentiam culturæ Stolonum confirmavit cognomen dictus est; quòd scilicet nullus in ejus fundo reperiri poterat Stolo, quod effodiebat circum arbores è radicibus quæ nascerentur è solo quas Stolones appellabant. Stolo ergo *J. Bodæo à Stapel* est qui nascitur circa stipites & avellitur cum radice & corporis parte & sic scribitur: quo à Viviradice differt, quæ integra ex arboribus è longinquo extrahitur. *Plin.* lib. 17. cap. 10. Et aliud genus simile natura monstravit, avulsíque arboribus stolones vixere. Quo in genere & cum perna sua avelluntur, partémque aliquam à matris quoque corpore auferunt secum, limbriato corpore. Hoc sensu si accipiatur non video quid differat avulsio à Stolone. Nobis tamen Viviradix dicta videtur vel soboles quæcunque à radice, jam ablactata à matre, & suis radicibus sibi sufficiens; vel alia quævis propago quæ jam radices egit. *Stolo quid & unde dictus.* *Viviradix.*

Antequam exponamus quot modis arte propagentur plantæ, inquirendum videtur quot quibúsque modis sponte naturæ se propagant: Ii autem sunt vel 1. *Semine*: vel 2. *Flagellis* seu funiculis emissis; ad nodos radices agentibus & sursum germinantibus: quæ flagella ad plantam propagandam nata videntur. Nam germina illa ad nodos radices agentia, cùm invalescunt, funiculis exarescentibus à matribus suis sponte separantur, & novæ plantæ fiunt: ut in *Fragaria, Pentaphyllo*, &c. videre est. 3. *Sobolibus* ex radice, illíque vel surculorum seu virgarum specie è radice transversim acta seu reptante succrescentibus; vel gemmarum seu bulbillorum specie; idque vel ex radicis fundo vel ex fibris in bulbulos intumescentibus, ortis. Quæ ex tuberibus sponte propagantur plantæ ad alterum genus, ex radicibus transversis in tubercula extumescentibus referendæ sunt. 4. *Caulibus* ipsis, humi procumbentibus, & ad nodos radices agentibus, quod plurimis plantis contingit.

Dantur & alii modi peculiares quibus plantæ nonnullæ se propagant, ut v. g. Ficus Indica gemmi è ramis in terram usque demisso funiculi specie. Allii quædam genera bulbulis seu spicis in summo caule consertim enascentibus. Chelidonium minus tuberibus in alis imorum foliorum ortis: Moly Homericum dictum bulbo in summo folio excrescente: Opuntia foliis depactis. Verum quoniam paucarum admodum specierum sunt, non est cur eorum rationem habeamus.

Superest jam ut exponamus quot modis plantæ arte propagari possint, aut soleant. Ii autem ad duos reduci possunt, *Sationem* nimirum & *insitionem*. Quod ad primum attinet, Plantæ seruntur vel 1. *Semine*, vel 2. *Ramo* [Sub ramo comprehendo etiam *taleam, clavolam, malleolum, surculum*] eoque vel decisо, seu avulso à caule antequam radices egerit, & in terram depacto; vel terræ submerso, nec à matre separato antequam radices egerit: vel 3. *Sobole* seu ex flagello, ut in Fragaria; seu ex radice sub terra reptante, surculi specie assurgente, quæ vel Stolo vel Viviradix dicitur, seu è radicis fundo exeunte, Gemmæ specie, ut in Bulbosis. Bulbus enim (ut diximus) nihil aliud esse videtur quàm Gemma grandior subterranea. In bulbosis autem soboles non semper è bulbi parentis fundo exit, sed interdum è fibra crassiore in bulbum extuberante, seu denique è radicum tuberibus in iis quæ radicibus tuberosis sunt. Potest etiam propagari planta radice divisâ in tot sol. partes si placet quot ex ejus capite gemmæ exeunt; gemmâ cum parte aliqua radicis adhærente decisâ. *De Satione.* *Propagatio per Semen.*

Plantæ autem inseruntur multis modis, de quibus postea breviter agemus, cùm varios sationis modos expediverimus: Primò ergo plantæ seruntur *Semine*.

Antequam autem Semina terræ mandentur, oportet ut solum debito modo præparetur, nimirum ut aratro sæpius vertatur, ligone fodiatur, surculo findatur, bipalio subigatur, occa & rastro in minutias dividatur. Hoc autem fieri convenit, partim ut inutilibus herbis eradicatis & submersis, aut ejectis liberetur: partim ut solum laxius & levius, mollius & tenerius reddatur, quo sit tum ut satorum radices facilius illud penetrent, adeóque fibras undique spargentes latiùs se diffundant, & copiosius alimentum attrahant, unde plantæ lætiores & vegetiores fiant: tum ut particulæ aeris nitrosæ, quibus præcipuè vegetatio promovetur, in terreni interstitia liberiùs & copiosiùs se insinuantes, ibidem præcipitentur & terreno adhærescant. Quin & aquæ pluviæ fortasse ad salium solutionem conducunt, quos secum unà in radicum poros convehunt. Præterea in terra laxa & soluta aquæ promptiùs subsidunt, adeóque nec humore nimio radices suffocant, nec frigore corrumpunt. Præterea terra laxa & soluta ad hoc conducit ut Aer copiosior radicum tracheas subeat ad respirationis usum, quam Plantis non minùs necessarium esse quàm Animalibus superiùs ostendimus.

Commodissimum serendi tempus Natura indicat, nimirum quando semina jam plenam maturitatem adepta vel dehiscentibus conceptaculis in terram decidunt, vel contrahentibus se valvulis excutiuntur, vel lanugine innascente alatâ ventorum arbitrio huc illuc feruntur & latè disseminantur.

Harum nonnulla Autumno plantas producunt totâ hyeme virentes: aliæ per hyemem in terra restant, nec ante ver proximum ex involucris erumpunt. Ex iis quæ Autumno exeunt alia, ut v. g. *Angelicæ*, ex observatione nostra & aliorum, collecta & asservata vere serentem plerunque frustrantur, sponte delapsa & terræ gremio excepta, vel etiam à satore eidem mox concredita haud dubiè

dubie germinabunt nisi tempestas admodum sicca & æstuosa fuerit, quo in casu per hyemem in terra quiescentia, sequenti tamen vere in lucem exibunt; cùm tamen si à colligente repolita vere satâ fuissent nequaquam germinâssent. Alia quamvis vere etiam sata haud infeliciter proveniant; fideliùs tamen & latiùs Autumno, firmiores etiam fiunt plantæ inde enatæ adversùs injurias cœli, & sequenti æstate uberiore quam vernales proventu, cæteris paribus, Agricolam aut Hortulanum locupletant, grano quoque turgidiore, solidioréque fœtæ. Nam ex observatione prudentissimi agricolæ, Amici nostri plurimùm honorandi, quò planta aliqua ex semine nata diutius duraverit antequam in semen abierit, hoc est, quo maturiùs sata fuerit, eo semen copiosius, plenius, ponderosius, cæteris paribus producit. Sic Triticum & Avena hyberna seu autumno sata, vere editis, firmiora solidioráque sunt.

Reliqua quæ per hyemem in terra restant, proculdubio vel terreni vapore macerata, vel salinis quas imbibunt particulis imprægnatâ ad germinandum præparantur: & securiùs interim latitant, tempestatúmque omnes mutationes constantiùs tolerant, quàm in Apothecis recondita, & quam diligentissimè adservata.

Exoticas tamen plantas & regionum calidiorum alumnas si habere velimus, oportet ut eorum semina vere seramus, quandoquidem illæ hyemes nostras non tolerant, sed à frigore facilè corrumpuntur.

Quinimo si præcoces fructus è tenerioribus desideramus, sive rariores & delicatiores omnino ad maturitatem perducere cupimus; oportet ut pulvino calenti, è fimo equino recenti paleis permixto extructo, deinde terra pingui cribrata, ad trium quatuórve digitorum altitudinem instrato, & operculo è storeis superinducto tecto, semina committamus.

Quocunque autem tempore seras Semina eligantur recentia, æstatis proximè præteritæ, si haberi possunt. Quamvis enim Plantæ nonnullæ ad decennium & ultra fœcunditatem suam custodiant, alia tamen eam citiùs amittunt: omnia autem quò vetustiora eò difficiliùs & parciùs germinant.

Quæ in aquâ subsidunt firmiora sunt, & ad serendum fideliora, quæ fluitant languidiora & propagationi inepta.

In siliquis & spicis media potiùs quàm ima aut summa nobis probantur, quamvis Ferrarius ima in Caryophyllis commendet.

Quòd si flores multiplices aut variegatos desideras, præstat semina colligere è siliquis aut conceptaculis ejusmodi floribus succedentibus. Sive enim varietates illæ morborum symptomata sint, sive naturæ errores, sive ejusdem lascivientis lusus, proinor certè erit natura in his ad ità iterum deerrandum aut lasciviendum: quemadmodum videmus in Animalibus parentes morbo aliquo aut corporis vitio, membro v. g. deficiente aut redundante, laborantes sobolem non rarò procreare iisdem vitiis affectam, & morbis obnoxiam. Hoc autem præcipuè in *Mirabili Peruviana* servandum si floribus striatis insignem plantam obtinere cupias.

Semina omnia sicca tempestate serenda sunt, tertio quartóve die à pluvia largiore. *Nec tamen* (inquit * Ferrarius) *simul ac magnis imbribus terra permaduit seres, sed tamtisper exspectabis dum pluvius ille mador modicè exsiccetur, nè madenti limoſóque solo statutæ radices exputrescant.* Hoc autem in seminibus quæ humore nimio in mucilaginem facilè solvuntur, ut v. g. *Myrrhide, Ocymo, Scorzonera*, præcipuè servandum est nè solo madido serantur, néve recens sata irrigentur.

* *Horticult. lib. 3. c. 1.*

Cavendum etiam est, nè recens sata quæcunque tempestate frigidâ irrigentur, néve aquâ gelidâ fontanâ aut puteali, nisi prius probè insolata fuerit.

Nonnulli Semina aquæ seu simplici, seu nitratæ, vino, aliive alicui liquori priùs infundunt quàm terræ committunt ad germinationem promovendum: quod tamen non necessarium esse puto in seminibus recentibus & indigenis, fortè etiam nocivum in aliquibus. Verùm in vetustis & aridioribus, aut exoticis *Hen. Corvini* Romani praxin non improbo cujus meminit * *Ferrarius* his verbis. *Antequam contumacis lentæque duritiæ semina solo committat, aquam defundit in catinum, nitri modicum superfundit ac distabescere sinit: in eam nitratam aquam semina immittit: duodenas horas pro variâ duritie plus minúsve macerari & medicari patitur, exinde serit: eandem aquam inspergit, ut nitrum ex igneo terræ halitu concretum seminalem contumaciam ad uberem germinationem proritet.*

* *Hortic. l. 3.*

Generale est in omni satione ut semina terrâ operiantur; non quod exposita & intecta minimè germinent, sponte enim decidentia non minùs feliciter pullulant, sed nè avibus spermologis prædâ fiant. Seruntur autem & conteguntur variis modis, nimirum vel in sulco terrâ aratro superinjectâ, vel in superficie terræ occâ aut rastro inhumata, vel in area coæquata, pulvere aut velut farina terræ manu aut incerniculo insperſa, vel denique seorsim singula in foraminulis pastino factis sepulta.

Summopere autem cavendum est nè semina altè demergantur aut nimiâ terrâ obruantur, adeóque sine ulla resurrectionis spe sepeliantur. Plurimos enim hac in parte errare video. Nam quamvis Triticum aliáque Cerealia quorum spiritus vegetiores leni etiam colore excitantur, germináque validiora gravem terræ incumbentis molem haud difficulter penetrent, ideóque ut hyemem facilius tolerent altius inhumari solent, nè scilicet radices immodico frigore perurantur; non tamen omnium, imò paucorum seminum eadem conditio est. Pleraque enim ad vegetandum segniora blando solarium radiorum tepore fovenda & ad pariendum invitanda sunt, ideóque in summa tellure modico insperſo pulvere exponenda.

Quo Semina maturiùs seruntur vere, eò plantulæ indè enatæ diligentiùs à frigore defendendæ sunt; quò seriùs, eò largiùs irrigandæ & inumbrandæ.

An Plantæ sponte oriantur.

An Plantæ aliquæ nullo semine prævio sponte è terra oriantur difficilis quæstio est.

Qui affirmativam tuentur rationibus & experimentis sustragantibus non destituuntur. Cùm enim nulla non regio peculiares suas stirpes obtineat, verisimile videtur terram ipsam nullo imprægnatam semine familiares regionibus plantas producere.

Deinde in aggeribus fossarum derivandis aquis ad paludes exsiccandas ductarum in insula *Elienſi* ingentem Sinapeos vim enatam, & alibi etiam in areis gramineis effossis, mirati sumus: quam Sinapeos seminibus in terra reſiduis ortum suum debere verisimile non est, cùm nullum unquam Sinapi post hominum memoriam ibidem nascens observatum fuerat. In ruderibus etiam Urbis *Londinensis*

dimensis post deflagrationem illam funestissimam quæ anno 1666. accidit, non minorem copiam *Eryſimi angustifolii Neapolitani* fuecrevisse Autores fide dignos habemus, partim etiam ipsi vidimus; cùm loca illa per multas annorum centurias ædificiis occupata fuissent, nec ullus ibi auditus Eryſimi proventus. Oportet ergo ut vel sponte ortum sit, vel ex seminibus per tot annos in terrâ latentibus: nisi fortè suspicari velimus malè feriatum aliquem plantæ istius semina de industria sparsisse ut curiosis illuderet & admirationem excitaret. Non est autem cur quis miretur, ubi tantam seminis copiam, quæ ducentis agri jugeribus conserendis sufficeret, colligere potuisset. Plantam enim illam ad vias inter urbem & *Kensington* vicum, & alibi circa urbem copiosissimè provenientem observavimus: semina autem minutissima & numerosissima profert.

Tertio, Plantas imperfectas, *Fungos, Tubera, Muscos* & id genus ex semine non nasci manifestum est, cùm nullum (quantum hactenus observatum est) gignant: quin & Submarinas omnes, *Algas, Fucos, Corallia, Alcyonia, &c.* ob eandem rationem sponte oriri arbitramur, quod scilicet, nullum hactenus semen in iis animadversum fuerit, quod tamen satis mirari nequimus in tanta specierum multitudine, & uberrimo omnium proventu. Alii fortasse post nos diligentiores aut feliciores harum etiam semina detegent, aut propagandi modum invenient.

Vulgò receptum est, & experientiâ (ut aiunt) quotidianâ confirmatum, quòd si aqua in quâ Fungi aliquandiu infusi distabuerint, vel etiam abluti fuerint, veteri pulvillo calenti, qualem modò descripsimus, affundatur, vel etiam Fungorum frustulatim divisorum particulæ minimæ eidem inspergantur, magnam indè Fungorum vim illico exorituram; unoquoque nimirum frustulo seu ramento imperfectæ istius plantæ prolifico & fœcundo, seminali vi potiùs dotari credito, ut in * *Mali Cydoniæ* v. g. ramis cernitur, quàm ut Natura semen aliquod visum fugiens, certè nondum detectum, in aliqua ejus parte occultaverit. † *Sharroc. de Propag. Vegetab. c. 3. n. 5.*

Quartò & ultimò, Perfectiores etiam plantas interdum sponte oriri, aut ex alieno succo germinare magnum nobis argumentum Viscus suppeditat, arboribus innatus, etiam in prona seu aversâ ramorum parte. Unde omnino fabulosum esse constat, quod de ejus exortu Veteres prodidere, quodque Proverbio illi *Turdus malum ipse sibi cacat* originem dedisse perhibetur. Quanto rectiùs Maro : *Viscum*

Fronde virere novâ cecinit, *quam non sua seminat arbos.*

Ex altera tamen parte satis mirari nequimus, Naturam *quæ nihil facit frustrà*, semen alicui plantæ dedisse absque effectu, sed tota specie ad generandum inutile.

His omnibus rationibus & experimentis contrariam opponimus Clarissimi Viri Marc. Malpighii experientiam. Is enim ut exploraret an Terra nullo semine fœcundata plantas aliquas sponte produceret, terram è profundo erutam vitreo vase concluſit, cujus orificio multiplex Sericum velum super extendit, ut Aer & affusa aqua admitteretur, exclusis minimis seminibus, quæ vento rapiuntur: In hâc autem, inquit, nulla omnino planta vegetavit.

Ego equidem sententiam opinantium nullam dari in plantis generationem spontaneam libenter amplecterer, si experimenta permitterent. Verùm quæ adduximus contrarium suadent, necdum satis perspicio quomodo iis responderi possit. Temerarium enim nimis esset asserere, Plantas etiam imperfectas vulgò creditas semen gignere, cùm nullum in iis ostendere possimus.

Notandum tamen fieri posse ut plantulæ è radicum aut ramorum frustulis enatæ pro spontaneis fallant. Radicum autem frustula germinare ipse expertus sum in *Raphano rusticano* & *Scorzonera*: Ramorum minimas particulas J. Bodæus à Stapel, in *Salice* & *Rosa centifolia* ut apud ipsum videre licet, *Comment.* in *Theophr. hist.* lib. 2. cap. 1. pag. 73. D. Sharrocus in malo cydonia. *Lib. de propag. Plant. cap. 3. n. 5.*

Cæterùm Semina rariora in fictilibus serere convenit, ut Plantæ indè enatæ commodiùs transferri, & per hyemem, si opus sit, in hypocausta subduci possint. Oportet autem ut fictilium fundi foraminibus pertundantur, ut Plinius olim monuit, nè humor in fundo stagnans diutinâ morâ putresceret, & plantarum radices seu vapore, seu frigore suo corrumperet: fortè etiam nè respirationis inopia eædem suffocentur: quam rationem Plinius etiam ipse eleganter pro more suo innuit, *Per foramina* (inquiens) *inserne dato radicibus spiramento.*

Secundò, Plantæ seruntur ramo aut surculo, vel avulso decisóve & terræ impacto, vel dum adhuc matri hæret depresso & eidem immerso tantisper donec radices egerit. *Propagatio ex Surculo sato.*

Surculi hi majores minorésve esse possunt pro natura plantæ serendæ. Aliæ enim seruntur ramo majore, aliæ talcâ, aliæ malleolo, aliæ sagitta, quas voces superiùs exposuimus.

Talcæ surculive serendi recentes sint oportet, Oleæ tamen rami etiam sicci germinant, Veteribus id attestantibus, ut v. g. Virgilio, *Truditur è sicco radix oleagina ligno.* Quod quamvis Recentioribus nonnullis videtur, Fortunii tamen Liceti autoritas me movit ut Veteribus assentiar, Recentiorésque eos dum temere rident seipsos deridendos propinâsse putem. Scribit autem Licetus se vidisse Rechi in horto patrui sui stipitem Oleæ sativæ aridum ferè ac levem, per decennium & ultra à trunco separatum, neque posthac unquam terræ implantatum, ad alterius ligni fulcrum in terram demissum, & ligno cui fulcimentum præstabat clavis ferreis affixum, pullulâsse germinâsséque eodem anno plures Olivarum novellas, foliis ac fructibus onustas, atque in posterum etiam per plures annos protulisse. Hinc virga illa arida, quam monachus à superiore suo, ut obedientiam ejus probaret, jussus assiduè irrigavit, si fortè oleaginæ fuit, potuit sine miraculo radices agere & germinare.

Quò teneriores sunt plantæ eò surculi earum serùs pangendi sunt; adulto scilicet vere in frigidioribus hisce regionibus. Oportet etiam si tempestas permittat satos irrigare; si tempestas, inquam, permittat, nam si Aer paulò frigidior sit, nimius humor recens plantatos facilè corrumpit: quin & sereno cœlo radii Solares umbraculo oppositò solicitè arcendi sunt, nè surculos depactos confestim urant & exsiccent.

Observandum etiam in plantis quarum caules nodis intercepti sunt, ut surculus serendus vel in ipso nodo, vel proximè infra nodum decidatur. Cùm enim radices ex nodis tantùm pullulent, si quid internodii relinquatur, necessariò putrescet & corrumpetur, adeóque vitio serpente periculum est nè proximum nodum veneno suo inficiat & surculum perimat.

Arbores

Arbores ſurculis ſeu ramulis propagandi modum docet P. Laurembergius his verbis, Ramulum elegantem non tortuoſum aut eroſum, vegetum, anniculum (relinqui illi poterit portio exigua adhærescentis rami bimi.) Hujuſmodi igitur ramum præciſum ab arbore, utraque extremitate mutilatum terræ fœcundæ ad profunditatem dimidiæ ulnæ arcuatim impone, ſubſtrato ſimo, bubulo aut ovillo. Foſſam terrâ conculcatâ reple.

Fruticum herbarumque taleolis vel ramulis pangendis alteram extremitatem malleo priùs conculca, ut ſilamenta ducat: Tum aqua irriga, non ſimo, quem nullâ ratione ferunt: poſtea terrâ operi.

Nulla (pergit ille) ferè ſtirps eſt quæ non queat propagari per ramulos anniculos, modo 1. Inferior extremitas abſciſſa oblinatur emplaſtro ſequenti vel ſimili, Rx Ceræ, Terebinthinæ ana ℥i. Reſinæ communis ℥ii. commiſceantur. Sic naturalis ſuccus non exſudabit, nec inutilis humor ſubibit, qui alioqui putredinem inferre ſolet. 2. Non directè infigas terræ ramulum ſic oblitum, ſed incurvo arcu, ut ſuprema pars promineat è terra, media tangat imum, infima, quam oblinendam dixi, ſurſum nonnihil vergat, ità tamen ut deliteſcat. E medio illo ramuli dorſo innumeras videbis radices pullulare.

Alium adhuc modum proponit Snapelius. Ramus ab arbore avellitur ſuperne deorſum, ut quaſi pes illi adhæreſcat. Hinc pedunculus aut appendix undique perforatur ſubulâ: ad dimidiam ulnam defoditur in terra fertili, ſæpiuſque irrigatur.

Submerſio. Propagationem illam quæ fit ramulorum ſubmerſione ipſa etiam natura docuit, plantarum plurimarum ramulis quamprimum reclinati terram attigerint radices ſponte agentibus. Ramuli autem ſubmerſi non priùs ablactandi ſeu à matre ſeparandi ſunt, quàm radicibus multis in profundum actis terram firmiter apprehenderint: quâ autem parte matri hærent tranſverſim initio ad medium ferè incidendi ſunt, ut ſucco à matre parcè ſubminiſtrato ei è terra exugendo aſſueſcant adeóque faciliùs & tutiùs cùm res poſtulat ablactentur.

In Caryophyllis (monente D. Sharroco) ſurculi ſubmergendi ſcapum ſub infimo ſeu radicis capiti proximo, aut ſaltem ſecundo geniculo tranſverſim imâ parte ad medium ferè incidito, deinde ab inciſione facta ſurſum ad ſecundum (ſeu ab imo juxta quem inciſio ſit proximum) internodium findito, folii particula in ſiſſuram immiſſa ut aperta teneatur, quamvis id non ſit omnino neceſſarium: cùm enim inciſio, ex ima (ut diximus) ſeu terram ſpectante parte fiat, ſurculus autem leniter primo à radicis capite reclinetur ſeu deprimatur, ut moris eſt, deinde ſumma ejus pars terra ſubſtrata erigatur mediâ in arcum flexâ, ſiſſura ſponte ſua aperietur & hiabit, ſi omnia ritè peragantur. Nonnulli uncinulo ligneo in terram adacto ſurculum apprehenſum detinent nè reſiliat, ſed in eodem ſitu in quo primò depoſitus fuit perſeveret. Tandem ſurculi arcum ſeu partem inflexam terrâ pingui operias eámque frequenter irriges.

Aliarum etiam plantarum, exceptis iis quæ quoquo modo depoſitæ comprehendunt, ut Vitis, &c. ſurculos flagellave ſubmergenda pari modo incidere utiliſſimum erit, nè dicam neceſſarium. Tempeſtate etiam ſicca ſurculi ſubmerſi aſſidue irrigandi ſunt, aliàs enim radices non facilè emittent.

Tempeſtates autem huic operationi cum ſucceſſu exercendæ commodiſſima ſunt Veris initium, aut Æſtas caloribus remiſſis in Autumnum declinans.

Circumpoſitio. Circumpoſitio non differt à ſubmerſione, niſi quòd in hac ramulus deprimitur ad terram, in illa terra vaſe idoneo vimineo ligneóve excepta attollatur ad ramulum, eique circumponatur, ramulo ſcilicet per vas recipiens ſeu terram continens foraminibus ad id factis trajecto. Locum autem habet ubi ramulus ob altitudinem ſuam & diſtantiam à terra eo uſque non poteſt deprimi. Solent autem nonnulli ramulum eâ parte quâ terrâ circumpoſitâ latitat, vel aliquantulum delibrare, vel corticem ejus ſuperne ſubulâ perforare.

Itali utuntur ciſtulis ligneis quadratis, quæ ità confectæ ſunt, ut non ſolùm foramen habeant in fundo, ſed & compactæ ſint ex duabus medietatibus, pro libitu ſeparandis, vel iterum conjungendis: ut ità commodiùs ramis circumponi, & poſtmodum his in terram deponendis ſegregari iterum poſſint. * P. Lauremberg.

* *Horticult. lib. 1. cap. 22.*

Huc ſpectant hæc Plinii, lib. 17. cap. 13. *Alterum genus luxurioſius radices in ipſa arbore ſollicitandi, trajectis per vaſa fictilia vel qualos ramis, terráque circumpoſitis: atque hoc blandimento impetratis radicibus inter poma ipſa & cacumina, audaci ingenio aliam arborem longè à tellure faciendi.*

Tertiò, Plantæ propagantur ſobole, eáque vel

1. Ex flagellis ſeu cauliculis funiculorum ſpecie ſerpentibus, & radices ſubinde agentibus, ut in *Fragaria, Pentaphyllo, Ranunculo, &c.*

2. Ex radicibus tranſverſis, flagelliformibus, ſub terra reptantibus, obiter germinantibus & ſurculos emittentibus: ut in *Ulmo, Prano ſylveſtri, Ceraſo, &c.* Atque hoc genus Soboles propriè *Viviradices* appellantur. *Stolones* enim dicuntur, qui è majoribus radicum truncis propè ipſum matris corpus ſeu ex imo ipſius caudice oriuntur, autore *J. Bodæo à Stapel.*

3. In herbis radicibus tuberoſis donatis ex ipſis radicum tuberibus, ut in *Chelidonia minore, Flore Solis pyramidali, Croco.*

4. In bulboſis, ex ipſo bulbi fundo aut fibra aliqua craſſiore propè bulbum, bulbillorum ſeu nucleorum ſpecie egerminante, ut in *Tulipa, Narciſſo, Allio, &c.*

De his nihil præcipiendum habemus, niſi ut opportuno tempore tranſferantur, éque ſolo ſteriliore in fertilius & pinguius; nec antequam firmitatem aliquam & robur contraxerint a matribus ablactentur.

CAP.

Cap. XIX.

De Insitione.

INsitio, voce latissimo sensu acceptâ, est ejusmodi applicatio surculi seu gemmæ ad truncum ramúmve, vel suum, vel alienum, ut tandem uniantur & coalescant. *Insitio quid.*

Cùm autem potissima succi nutritii pars inter libram & lignum ascendat, totum inserendi artificium in eo consistit, ut in trunco & surculo libra libræ, lignum ligno continua sint, & in eandem superficiem disposita; vel ut surculus gemmáve stipiti seu ramo ità applicentur, ut interstitium libræ & corticis in utroque [trunco & insito] ferè continuum sit, & unam quasi superficiem componat, unde è trunco in insitum [surculum gemmámve] facilis & expeditus succi transitus fiat.

Insitio est vel *surculi* vel *gemmæ*. Gemma autem à surculo non aliter differt quàm infans ab adulto. Gemma enim nihil aliud est quàm velut embryon surculi, perfectè quidem effornatum, omnibúsque suis partibus distinctum, tegumentis tamen velut secundis obvolutum & per Hyemem latitans, Vere sequenti in lucem edendum, & in surculum paulatim extendendum: *Insitio quotuplex. Gemma & Surculus quid differant.*

Surculus inseritur vel applicatione externa seu coaptatione, vel insitione strictè dicta. *Surculum inserendi modi.*

Applicatio externa seu coaptatio est vel

1. Quando virgæ minori transversim obliquè dissectæ surculus paris crassitiei, pari obliquitate excisus, ità applicatur, ut interstitium libræ & corticis in utroque (ut diximus) ferè continuum sit; deinde vinculo seu fasciâ circumductâ firmiter adalligatur, ut in situ contineatur. Obliqua sectio uncialis minimùm aut longior esse debet. Hic modus inserendi nostratibus *Whipgrafting* dicitur, & ob difficultatem surculum virgæ, sectionem sectioni coæquandi, ut exactè congruant, minùs frequentatur. *Primus coaptandi modus.*

2. Vel secundò coaptatio fit, cùm surculus obliquè ut prior dissectus, ità tamen ut in suprema obliquæ sectionis parte cultello perpendiculariter adacto cortex cum tantillo ligni auferatur, truncо transversim primò seu horizontaliter dissecto, deinde ab uno latere [Austro-occidentali] cortice obliqua sectione eousque denudato, ut plano sectionis in surculo exactè respondeat, ità applicetur, ut angulus ejus seu projectura plano horizontalis trunci sectionis innitatur: adeóque vinculo adalligetur, & luto oblinatur. Hic modus inserendi *Shoulder-grafting* nostratibus appellatur. *Secundus modus.*

Insitio propriè dicta duplex iterum est, vel

1. Inter corticem & lignum. Timebant scilicet Prisci, referente Plinio, truncum findere, ideóque inter corticem & lignum inserebant. Hic modus à * nonnullis nunc dierum in usum revocatur, & in arboribus quarum cortex à ligno ob ascensum succi priùs separabilis est quàm surculi ob gemmas nimis explicitas insitioni inepti (hujusmodi autem è frugiferis solæ Mali sunt) omnium optimus habetur. *Insitio inter corticem & lignum.* * *D. Langford.*

Trunco ergo & surculo ut in secundo coaptationis modo præparatis corticem nè auferas, sed duntaxat findas seu secundùm longitudinem incidas, à capite deorsum ad longitudinem ferè obliquæ surculi sectionis, ab Austro-occidentali trunci latere. Deinde cortice à ligno primò cultello, deinde instrumento ex ebore, osse, aut ligno aliquo solido, figurâ obliquæ surculi sectionis sed minore, ad id facto, immisso, leniter separato & elato, inter corticem & lignum surculum intrudas, ablato prius à tenui extrema surculi acie cortice, nè inter demittendum replicetur. Deinde quoniam surculus insitus corticem à trunco elevans, & ad utramque cuspidis suæ aciem cavitatem relinquens, influxum succi interrumpit, cortex trunci ad utrunque surculi latus incidendus est, nè à trunco abscedat, & ut ejus oræ cum corticis surculi marginibus concurrant & coaptentur, ad tranitum succo à trunco in surculum dandum. Quibus peractis vinculo obligandus & luto muniendus est, ut in præcedentibus operationibus.

2. In fissuram ipsius ligni: quam Plinii verbis exsequar. Auferatur, inquit, serrâ æqualiter superficies, lævigatur falce truncus: deinde eodem per media leniter fisso, cuneóque tenui fissuram custodiente, donec cuspidatim decisus descendat in ramum calamus, operatio absolvitur. Surculi inserendi cuspis ità solet incidi ut cum basi ejusdem utrinque extante angulos efficiat, quò basis summo trunco firmiùs innitatur. Nonnulli tamen hanc praxin improbant, quia cuspis indè infirmior fit. *Insitio in fissura.*

Verùm quoniam hæc inserendi ratio omnium longè usitatissima est, descriptio autem Plinitna nimis fortasse concisa & obscura alicui videatur, pleniorem & explicatiorem è Petri Laurembergii Horticulturæ, lib. 1. cap. 24. mutuatam dabimus.

Elige (inquit) verno tempore arbusculam crassitie trium circiter pollicum, cui deme partem superiorem serrâ, relicta unius ulnæ altitudine, operámque dato nè librum, id est, corticem saucies. Siquid inæquale relictum à serra, id cultro abscinde, & conforma in æqualitatem. Stipitem ita dispositum molli cultri ictu leviter finde per medullium, cavendo summâ diligentiâ nè fissuras ducat fissura. Hanc fissuram cuneolo eburneo aut buxeo servabis apertam, ut eò promptiùs recipiat hospitem venientem surculum; sed neque illud negliges circumligandum esse stipitem funi aut vimine, eo loco quousque terminatam iri fissuram reberis, quæ si profundiùs penetrabit emorietur stipes, túque omnem perdes operam. His sic paratis sume surculum inserendum, quem in summitate præfectum altera crassiore parte, proximè sub nodo vel tumore, (qui omnibus bonis surculis inest, unde incipit quod unius anni ætatem gerit) scalpello conformabis in triangularem formam, cunei instar, non præfecto cortice ab uno loco, * integráque servatâ quantum fieri potest, medullâ. Jam hunc surculum apice cuneato insere in stipitis ante præparati fissuram, eâ lege ut cortex surculi cortici stipitis respondeat, totúsque surculus firmiter fissurâ comprehendatur, subtracto iterum cuneo. Denique fissuram supernè & ad latera arctissimè obtura ac obline emplastro emphyteutico, mox argillâ aut limo circumda, & linteolo invesli aut cannabino vinculo obliga fortiter. * *Hanc observationem nihili esse puto.*

Emplastrum hoc emphyteuticum non necessarium ducimus fortè etiam nocivum; siquis autem illud experiri velit ita præparet.

℞. Resinæ commun. ℥i. Ceræ ℥ß. Viscì ℥ij. Butyri antiq. q. s. ad form. empl.

Quæ arborum species sibi mutuò insitæ coalescunt.

1. Multa in hoc genus insitione servanda sunt. Primùm omnium quæ patiatur coitum talem arbor, & cujus arboris calamus. Facillimè coalescunt quibus eadem corticis natura, quæque pariter florentia ejusdem horæ germinationem succorúmque societatem habent. *Plin.* Oportet certè ut surculi truncis cognati & congeneres sint, aliter non coalescunt. Hinc mirum nobis non videtur, *Pyrum* vel *Cydoniæ*, vel *Oxyacanthæ*, huic *Mespilum*, *Pruno Armeniacam* insitam comprehendere, & vice versâ. Quid enim est Malus Cydonia dicta quàm Pyrus fructu tomentoso? Malus Armeniaca quàm Pruni genus? nec fructus Oxyacanthæ à parvo Pyro vel figura, vel qualitate multum abludit. *Pyrus* & *Malus* ob dissimilitudinem non coeunt, uti nec *Malus* & *Oxyacantha*, nec (observante D. *Sharroco*) *Pyrus* & *Sorbus*. Hæ tamen (ut ex ejusdem observatione habeo) ut & aliæ diversi generis, sibi mutuo insitæ non mòd comprehendunt: post perfectam tamen (ut videtur) unionem, & germina productiora edita, surculi paulatim, quamcunque curam adhibueris, languescunt & tandem intereunt, ob succum vel deficientem, vel incongruum.

Fissura qualis esse debet.

2. Alia observatio est, nè fissura in nodo fiat. Repudiat quippe advenam inhospitalis duritia, ut in parte nitidissima, nè longior multo tribus digitis, nè obliqua, nè translucens, nè hiscat nimium rima laxéque capiat, aut nè parùm & exprimat, aut expressum necet. *Plin.* Hinc si truncus crassior sit monent hortulani, ut cuspidis surculi interior pars, quæ aliàs in aciem tenuari solet paulò crassior relinquatur, nè exterior adeò comprimatur, ut cortex laxetur aut corrugetur, adeóque succi influxus impediatur aut interrumpatur. Alii in hujusmodi truncis fissuram cuneo ligneo tenui adacto apertam tenendam malunt.

Electio surculorum.

3. Certum est (inquit Plinius) ab humeris arborum Orientem æstivum spectantibus surculos petendos, & è feracibus, & è germine novello; nisi vetustæ arbori inserantur; ii enim robustiores esse debent. Præterea ut prægnantes, hoc est, germinatione turgentes, & qui parere illo speraverint anno; denique ut è pulcherrimis & robustissimis ramis eligantur: ante omnia gemmantes nitere convenit, nihil usquam ulcerosum esse aut retorridum. Hortulani nostri præcipiunt, ut aliquid (uncia saltem) veteris, i. e. bimi ligni surculo superstet, ità ut surculi cuspis fiat paulo infra articulum seu commissuram veteris ligni cum novello. Ità enim & ad resistendum injuriis cœli firmiorem, & durabiliorem & feraciorem futurum. Surculum nimis gracilem & è germine tantum novello, contra præceptum Plinii, inseri vetant ob contrarias rationes. Monent etiam ut surculi cùm inseritur summitas præcidatur.

Surculi longitudo & gemmæ quot.

4. Quod ad longitudinem surculorum & numerum gemmarum attinet, ità præcipiunt, Si trunci cortex viridanti nitore se succo turgere prodat, ut largum insito alimentum se ministraturum spondeat, plures in surculo gemmæ relinquantur, sufficiunt plurimùm tres quatuórve ad exitum succo dandum. Præferuntur autem surculi quorum gemmæ crebriores sunt, nec nimis distent vel à se invicem vel à surculi sui pede. Si arborem * patulam desideras, surculum longum inseras, qui supra trunci caput ad 5, vel 6 digitos extet, ut crebriores ramos emittat: si arborem rectà assurgentem & proceram; brevem adhibeas, qui non ultra 4 digitos supra stipitem abscissum emineat, duabus gemmis supra lutum relictis; vel si placet, unicam tantùm gemmam adolescere sinas. Quò enim longior est surculus eò languidiùs succum attrahit, eóque magis & ventorum concussionibus, & avium injuriis opportunus est.

* *Plinius surculum inversum inseri jubet, cùm id agatur ut inior altitudo in latitudinem se diffundat.*

Surculi quandiu & quomodo si opus sit, asservandi.

5. Surculos decisos duas trésve septimanas antequam inserantur servare expedit; ut trunci succo magis turgeant, surculi exhauriantur, adeóque siribundi avidiùs novum combibant. Non oportet autem eos terrâ humidâ obruere, nè ad præproperè germinandum invitentur, adeóque cùm inserantur aeri frigido expositi perurantur & exarescant. Sub arbore aut tecto, alióve loco frigido reponere sufficit, aut si à gelu periculum sit, terrâ siccâ aut arenâ operire. Si longiùs asservantur surculi rapo infixos optimè custodire succum arbitrabantur, inquit Plinius. Nonnulli è nostris imam partem luto madido inligere, reliquum musco aut palea obvolvere jubent; verùm sufficit vasculo inclusos, tempestate præsertim tepidiore, musco madido circumpositio, aut terrâ cribratâ munire.

Quâ parte trunci inserere conveniat.

6. Inserere aptissimum quamproximum terræ, si patiatur nodorum truncique ratio. *Plin.* Præsertim si surculum arboris naturâ crassioris & grandioris gracilioris trunco inseras ut *Pyrum*, *Cydoniæ* aut *Oxyacanthæ*. Item à parte trunci vento occidentali aut Libonoto opposita (hic enim apud nos omnium vehementissimè spirat) ut *vi venti* ad truncum potiùs cui pede *suo innitatur*; quàm à trunco impellatur: indè enim periculum est nè abrumpatur aut luxetur.

7. Si fructum copiosum ab insito quamprimum desideras, adultiorem truncum decapites, eique calamos inseras.

Quot surculi inserendi.

8. Eidem trunco plures inserere surculos expedit, ut mortalitati ex numero succurras. *Plin.* & nè si fortè unus deliciat, truncus ipse periclitetur. Cautiores tamen Agricolæ verant truncum transversim seu in crucem findere, quoniam nimia indè trunco injuria sit, & vulnera agrè consolidantur. Optimum virgæ minori, & quæ unum tantùm calamum admittat, inserere.

Cur stipiti cicuri potiùs quàm sylvestri.

9. Si miteni & generosum succum desideras, trunco sylvestri aut spontaneo nè inseras, sed potiùs cicuri & culto. Hinc enim fructus mitior & delicatior evadit, ut qui alimento mitiore & meliùs præparato utitur, quamvis arbor ipsa ad durandum minùs firma, & brevioris ævi, esse credatur. Surculus decisus arbori sùæ iterum insitus, meliorem dabit fructum quàm arbori etiamnum hærens.

Tempus inserendo aptissimum.

10. Tempus inserendo aptissimum censetur veris initium, aut ver proximè antecedens, antequam gemmæ explicari incipiunt: quamvis per totam hyemem insitio satis feliciter plerumque succedat; & D. *Sharrocus* asserit se observasse surculos *Malo* insitos Novembri mense & circa Natalitia Christi comprehendisse. Pyrum vel Florentem inserere licet, autore Plinio, & in Maium quoque mensem protendere insitionem. Verùm ex recentiore observatione, surculus cujus gemmæ jam explicantur ægrè coalescet: unioni non repugnat quòd truncus germinaverit.

Lutum ad insitum muniendum quale.

11. Ad insitum muniendum contra injurias cœli & bestiolarum, Cato olim argillæ vel cretæ hircinam simúmque bubulum admisceri, atque ità ad lenorem subigi jubet, idque interponi & circumlini.

cimilini. Plinii ætate abundè arbitrabantur paleato luto libros farcire, duos digitos infito exante. Hortulani aliqui nunc dierum fimum bubulum luto tenfaci probè admiftum & in mallam fubactum illinunt. Non multum intereft utrum adhibeas. P. Laurembergius emplaftrum emphyteuticum commendat, de quo fupra.

Novæ fructuum fpecies ab inſitione fruſtra ſperantur. Eſt enim regula generalis & perpetua in Horticultura, *Fructum ſemper ſurculi naturam ſequi.* *Inſitio fructum non mutat.*

Aiunt tamen tranſitarinos quoſdam Horticultores ſurculorum vel gemmarum ſpecie diverſarum, per mediam longitudinem ſeu medullam ſiſſarum medietates diſparatas tam dextrè coaptare & inter ſe componere, ac deinde inſerere nôſſe, ut & coaleſcant & comprehendant, & fructus ex utrâque ſpecie mixtas producant.

Nonnulli truncum non findunt ſed rimam ſeu ſulcum in ejus latere cultello excavant, & ſurculum eidem adaptatum dextrè immittunt, & vinculo alligant.

Dantur & alii ſurculum ad trunci minimè decapitati latus applicandi modi, quos vide apud D. *Langford* in libro de Arborum frugiferarum ſatu & cultura.

Non inmeritò autem quæritur quinam ex his inſerendi modis præſtabilior ſit. Longus omnium ſeculorum uſus cum qui fit in fiſſura approbavit. At verò Auctor mox laudatus tertium omnibus aliis præfert, & poſt eum ſecundum reliquis, ob has rationes. *Quinam inſerendi modus præſtantior.*

1. Quia trunci hujuſmodi operationum capaces ſunt aliquot annis antequam ad calamum admittendum findi apti.

2. Quia ab illis minùs læduntur quàm ab hoc genere. Fiſſura enim humorem facilè admittit, qui arbores corrumpit, unde trunci inſitioni iteratæ minùs idonei fiunt, ſi fortè ſurculi prima vice non comprehendant, aut alio quovis modo corrumpantur.

3. Surculus multò expeditiùs trunci amputati caput cortice & ligno obducet & integet, quod ad firmitatem, ſalubritatem & celeriorem auctum arboris magnopere conducit.

4. Hæ operationes faciliores ſunt, citiùs perficiuntur & feliciùs plerunque ſuccedunt.

Datur adhuc & alia inſerendi ratio, quam *Ablactationem* vocant, cùm ſurculus alicujus arboris ab uno latere delibratus, matri adhuc hærens, arboris vicinæ ramo pariter delibrato applicatur & alligatur donec coaluerit, deinde à ſuo ſtipite ſeparatus alieno duntaxat ſucco ali permittitur. Plinius in *Vite* hanc operationem ſic breviter præcipiendo è Catone deſcribit. Si inter ſe Vites contingant, in obliquum latere contrario adraſo junctis medullis colligari. Notandum autem plantas nonnullas hoc modo ſibi invicem implantari & concreſcere quæ prædictis inſitionum rationibus in ſocietatem trahi non poſſunt, ut v. g. Vites diverſarum ſpecierum, Mali *Armeniacæ* & *Perſicæ*. *Ablactatio quid.*

Hactenus de inſitione quæ ſurculo fit. Gemmâ inſerendi ratio duplex eſt, altera *Inoculatio* dicitur, altera, quæ ſola nunc dierum in uſu eſt, *Emplaſtratio*. *Gemmæ inſerendi ratio duplex.*

Inoculatio Antiquis uſitata, deſcribente Plinio, fiebat ſutoriæ ſimili fiſtulâ aperiendo in arbore oculum cortice exciſo, ſeménque includendo eâdem fiſtulâ ſublatum ex alia. *Inoculatio.*

Emplaſtratio, eodem Plinio auctore, ex inoculatione nata videri poteſt. Ergo (inquit) amputatis omnibus ramis, nè ſuccum avocent, nitidiſſima in parte, quâque præcipua cernitur hilaritas, exemptâ ſcutulâ (ne deſcendat ultra ferrum) cortici imprimitur ex alia arbore cortex par cum ſua germinis manima, ſic compage denſata, cicatrici ut locus non ſit, & ſtatim unitas fiat, non humorem, non afflatum recipiens; nihilominùs tamen & luto munire & vinculo melius. *Emplaſtratio.*

Alii non eximunt corticem, ſed duntaxat incidunt, primò rectè deorſum, perpendiculari inciſione, digitum longâ, deinde in ſumma hujus parte lineâ tranſverſâ cuſque utrinque extenſâ, ut corticis anguli commodè elevari poſſint, & ſcutum (quod ima parte in angulum exacuari debet) ligno applicandum ſinu ſuo excipere, tandem cortices angulis ſeu labiis ſcuto appreſſis & vinculo ligatis in ſitu omnia contineantur.

Alii perpendiculari inciſione facta, media ejus parte tranſverſam lineam imprimunt, & cultello vel calamo elatis, ut priùs quatuor angulis ſeu labiis corticis, ſcutum cum gemma ſua inſerunt & vinciunt, ut in præcedente ſectione.

Alii quadrata inciſione ſcuto æquali in cortice facta ut in primo modo, totum tamen corticem non auferunt, ſed inferiore medietate relicta & elata ſcutum ſub ea ligno applicant & vinculo ligant.

Optima ratio gemmam à ſurculo integram & illæſam auferendi eſt lineis ſcutum ſimientibus cultello per corticem adacto ductis, reliquum lignum decorticare, ſcuto ſolo cum gemma intacto; deinde è pennæ anſerinæ calamo per medium ſiſſo imbrice facto, acie ejus extrema (quæ acuta eſſe debet) ſub cortice immiſſa gemmam exſcindere ſeu extirpare. *Optimo gemma à ſurculo exſcindenda.*

Ut loco denudato ſcutum exactè congruat neceſſe eſt, ideóque tum longitudo tum latitudo ſcuti circino ſumptæ in ramulo denudando ſignentur; vel ſurculo unde ſcutum ſumitur utrinque ad longitudinem ejus deciſo, & ad latitudinem per medium ſiſſo, applicetur ſcutum cum fruſtulo ligni adhuc adhærente ſurculo delibrando, & lineæ circumducantur.

Antequam ſcutum cum gemma eximitur, locus in quem tranſferendus eſt ritè præparetur, ut quàm ocyſſimè poſſit inſeri: aliàs gemma aeri expoſita vitium contrahet aut exareſcet. Vincula hanc ex materia extendi apta, v. g. Juncis lævibus, filo lineo lanéove, ut trunci ſcutique cortici intumeſcenti cedant. Vincula enim non ſolvi antequam gemmæ explicentur melius. *Gemma exempta ſtatim inſerenda.*

Tempus inſerendi gemmâ à primo vere cùm pruinæ ceſſaverint tandiu durat, donec tantùm ſpatii ſuperſit ad reditum pruinarum, quantum ſufficiat gemmæ cum trunco cui applicatur conglutinandæ & conſolidandæ, omnium aptiſſimum cenſetur media æſtas circa feſtum S. Joannis Baptiſtæ. *Tempus complexationi aptiſſimum.*

Quod ad electionem gemmarum attinet eadem obſerventur quæ de ſurculis præcepimus.

Si gemma comprehendat, ſequente Martio quæ ſupra eam ſunt omnia amputentur, & gemmæ in parte reliqua, una exceptâ (quam nonnulli ad ſuccum deducendum hauriendum neceſſariam arbitrantur) omnes detergantur.

Quæ arbores emplastra admittunt. Quæcunque arbor surculo insito eadem & emplastratione propagari potest, nisi obstet tenuitas & imbecillitas scuti. *Vitis non recipit emplastra, nec quibus tenuis ac caducus rimosusque cortex. Fertilissima omnium inoculatio, eadem tamen infirmissima: Et quæ cortice nituntur tantùm vel levi aurâ ocyssime deplantantur. Inserere firmissimum & fœcundius quàm serere.* Plin.

Emplastrationem insitio præferendam probatur. Mali Persicæ & Armeniacæ rarò & difficulter insitione, emplastratione facilè propagantur.

Emplastrationem in quibus succedit insitioni longè præferendam esse multis probare nititur D. Langfordus.

1. Quia stipes seu truncus duobus tribúsve annis citiùs magnitudinem emplastrationi quàm insitioni idoneam assequitur: unde & tempus lucrefit; & arbor multò celeriùs augetur post naturam immutatam quàm antea.

2. Arbor indè sanior efficitur quàm ab insito, quia stipitem decisum citiùs & securiùs obducit & investit gemma cum scuto quàm surculus.

3. Arborem minùs lædit quàm insitio, & si fortè gemma non comprehendat, potest arbor vel proximo anno, vel interdum etiam eodem, denuò emplastrari.

4. Praxis ejus facilior est, expeditior & delectabilior quàm insitionis: mediâ enim æstate peragitur, quando nullum à frigore periculum imminet, quod persæpe vehemens est, & vix sine injuria aut valetudinis detrimento delicatioribus tolerabile, Februario & Martio mensibus, tempestate insitioni aptissima.

CAP. XX.

De specifica (ut vocant) Plantarum differentia.

UT Plantarum numerus iniri possit, & earundem divisio rectè institui, oportet ut notas aliquas seu indicia specificæ (ut vocant) distinctionis investigemus. Nobis autem diu multúmque indagantibus nulla certior occurrit quàm distinctæ propagatio ex semine. Quæcunque ergo Differentiæ ex ejusdem seu in individuo, seu specie plantæ semine oriuntur, accidentales sunt, non specificæ. Hæ enim speciem suam satione iterum non propagant: Sic v. g. *Caryophyllos* flore pleno seu multiplici pro specie distinctis à Caryophyllis flore simplici non habemus, quia ab horum semine ortum suum ducunt, & semina sati Caryophyllos simplices iterum edunt. At quæ ex eodem specie semine nunquam proveniunt eæ demum specificæ censendæ sunt: aut si inter duas aliquas comparatio instituatur, quæ plantæ ex alterutrius semine non proveniunt, nec unquam seminè satæ transmutantur in se invicem, eæ demum specie distinctæ sunt.

Sicut enim in Animalibus sexuum distinctio non sufficit ad speciei diversitatem arguendam, quia sexus uterque ex eodem specie semine, eidémque non rarò parentibus oritur, quamvis multis & insignibus Accidentibus inter se differant; nec Taurum cum Vacca, Virum cum Muliere specie convenire aliud requiritur argumentum, quàm utrosque iisdem persæpe parentibus eadémve matre ortos esse: sic pariter in plantis convenientiæ specificæ non aliud certius indicium est quàm ex semine ejusdem plantæ seu in specie seu in individuo oriri. Nam quæ specie differunt speciem suam perpetuò servant, neque hæc ab illius semine oritur, aut vice versâ.

Hinc pro distinctis plantarum speciebus non habendas censeo,

1. Quæ solo floris colore, geminatione aut multiplicitate differunt.

Genes. 2. Cùm enim specierum numerus in natura certus & determinatus sit: cum * *Deus sexto die ab omni opere suo*, hoc est, à novarum specierum creatione, requievit: floris autem colore & multiplicitate variantium plantarum numerus, novis quotannis exorientibus, infinitus sit, meritò eas à specierum gradu & dignitate dejicimus & excludimus.

Deinde, si hæc sufficerent ad specificam distinctionem inferendam, Æthiops quoque pari ratione ab Europæo, Juvencus niger ab albo, rubro, variove specie differret; quod nemo, ut opinor, sanæ mentis unquam concesserit.

Quinimo hæ varietates cœli, aut soli, alimentíve differentiis debentur: quæ quantam vim habeant ad hæc & similia effecta producenda in domesticis & mansuetis animalibus patet. Cùm enim fera in plerisque speciebus eosdem colores servent, mansueta & domestica coloribus infinitùm variant, nec coloribus tantùm, sed & carnis sapore, aliisque accidentibus à feris differunt, ut à palato non admodum sagaci haud difficulter gustu possint distingui.

Præterea hæ varietates seminio non propagantur, sed vel ramulis avulsis, vel sobole, vel stolonibus.

Denique arte & mangonio induci possunt, nimirum translatione iterata de loco in locum, & irrigatione aquâ colore aliquo imbutâ. Nam P. *Laurembergius*, vir fide dignus, Horticult. cap. 28. Sect. 3. se in Caryophyllis sæpius expertum scribit, *Caryophyllos quos simplices Vere primùm, deinde Autumno, iterum Vere sequenti transposuerat, (neque interim florere passus erat) Æstate omnes flores multiplices protulisse. Deinde ad mutationem coloris in flore inducendam variis in locis hæc repetit. Terrâ pinguissimâ in Sole exsiccatâ aut cribratâ reple vas aliquod. Ei implanta germen florum candidorum (nam hi soli tingi possunt) ad irrigandum non utere aliâ aquâ quàm rubefactâ si flores rubeos desideras, virides si virides, &c. Tali aqua de die plantam irriga manè & vesperi, noctu transfer in ædes, nè nocturnum aut matutinum bibat rorem per tres septimanas. Produci flores experieris tinctos non prorsus eo colore quem effudisti, sed partim eo, partim naturali.* Hæc quamvis à nonnullis rideantur, Laurembergio tamen Autori ἀξιοπίστῳ in iis quæ sibi comperta tradit fidem derogare non audemus. Quid quod plantæ florum coloribus aut multiplicitate spectabiles in eodem loco sine cultura diutiùs relictæ & neglectæ colorum delicias amittant paulatim, petalorum comam exuant, & ad sylvestrium ingenium redeant.

Idem

Idem esto judicium de floribus nudis in *iis* plantis quæ radiatos plerunque proferunt, ut *Chamæmelo, Cotula, Parthenio*: *proliferis* dictis, in *Bellide, Calendula,* aliisque nonnullis Corymbiferis: petalis fistulosis donatis, in iis quibus naturaliter plana sunt, ut *Bellide* & *Flore Africano*, & siquæ præterea sunt hujusmodi florum differentiæ.

Quoniam verò varietates hæ floribus plenis aut variegatis insignes ob pulchritudinem & elegantiam raritatémque suam à Florum cultoribus magni æstimantur, & non rarò insanis pretiis redimuntur; non ab re fuerit quibus illæ mediis obtineri possint ostendere.

Et quod ad Caryophyllos attinet, eos è simplicibus multiplices fieri translatione iterata de loco in locum Laurembergio aliisque expertis credimus: nec dubitamus quin & aliis plantis flores plenos producere aptis pariter translatis idem eveniret.

Quin & unica sola translatione in plantis nonnullis flores è simplicibus in plenos evectos legimus. D. *Sharrocus* se novisse ait qui *Anemonas nemorum & Colchica flore multiplici* in hortis habuerint, qui asserebant se eosdem simplici flore sylvestres ex agris in hortos transtulisse, soli luxurie, & culturâ diligenti mutatione illâ inductâ. * *Lib. de propag. Vegetabilium.*

Verùm quicquid sit de translatione, varietates prædictas certissimè & facillimè satione obtinebis. Si enim plantæ cujuscunque florem mutare aptæ semen solo læto & opulento largâ manu severis, inter multas flore simplici, nulla colorum varietate spectabiles paucæ enascentur flore pleno, & nonnullæ etiam variegato insignes. Cujus generis ut plures obtineas ex sententia Hortulanorum seminum serendorum electio fieri debet. Sic v. g. ex florum Caryophylleorum Aurantii mali colore tinctorum, tam purorum quam variegatorum seminibus satis plurimæ & pulcherrimæ habentur varietates. * Ferrario autore, ex albi Caryophilli semine multiplex varietas provenire solet: item ex fuscis maculis distincti. * *Horticult. lib. 3. cap. 15.*

Observatio nonnullorum ad obtinenda Leucoia flore pleno ut semina colligantur ex siliqua flori succedente per luxuriam pentapetalo, experientiâ nostrâ frivola est & falsa.

In Tulipis præcocibus ad producendas varietates purpureæ aut purpurea marginibus albis semina omnium optima esse observavit Parkinsonus: in mediis quæ coloribus lucidioribus sunt reliquis præferuntur.

2. Plantas sola magnitudine differentes. Quamvis enim dentur certi magnitudinis termini in unaquâque specie, quos neque excedere, neque ab iis deficere possunt individua: neque enim Grossularia v. g. Quercûs staturam & dimensiones unquam assequetur, quamcunque *culturam* adhibueris; magna tamen inter hos terminos latitudo est, & maxima fortasse ad minimum decupla proportio. Quæ tamen differentiæ vel soli ubertati aut sterilitati, vel regionis temperiei caloris aut frigoris respectu, vel tempestati siccæ aut pluviæ, vel alii cuipiam accidenti debetur, non specificæ plantæ naturæ. Si enim Plantæ, culturæ patientis, in suo genere minimæ & pauperrimæ semen accipias, idque læto & pingui solo, loco Soli exposito & ab aeris injuriis tuto severis, brevi sobolem matre planta decuplo fortè majorem obtinebis; immo verò si plantæ alicujus perennis & culturæ patientis radicem à monte sterili & aprico, ventis expositò, quem *per hyemem Boreæ penetrabile frigus adurit*, in hortum pinguem & tepidum transtuleris, mirum quantum luxuriabit & magnitudine proficiet, ut vix pro eadem agnoscas. Nec minor hoc respectu differentia invenitur in Animalibus inter individua ejusdem speciei: siquidem in Anglia nostra oves quæ in montosis & sterilioribus frigidis degunt quintuplo ferè minores sunt iis quæ in pinguibus & temperatis pascuntur, adeò ut illæ vix quinque solidis nostræ monetæ singulæ vendant, cùm hæ interdum duas libras, i. e. octuplum illarum pretii, valeant. Equi etiam qui in montibus Cambricis immodico frigore perustis educantur & aluntur, adeo pumili fiunt & contemptæ parvitatis, ut canem Molossum magnitudine & staturâ non multùm superent. Vidimus enim Cestriæ qui quatuor aut quinque solidis emi possent.

Excipiendæ tamen hic videntur species plantarum nonnullæ à nobis & aliis inventæ, quæ quantum hactenus observavimus, non alia in re quàm magnitudine differunt; suspicamur tamen & alias inter eas intercedere differentias, rémque ulteriori observationi committimus. Has species diversas esse opinamur quia simul in eodem loco nascentes nos & alii observavimus, & tamen major minorem triplo quadruplove magnitudine superabat. Tales sunt Hyssopifolia major & minor à nobis; Alchimilla major & minor à *Morisono*; Heliotropium majus Siculum & majus vulgare à *P. Boccone*, Millefolium aquaticum flore luteo galericulato majus & minus à *D. Dent* Cantabrigiensi unà nascentes observatæ. Vidimus etiam in horto Nobilissimi viri D. *Caroli Hatton* Astrantiæ nigræ speciem minorem, quæ non aliâ in re quàm parvitate sua à vulgari differre nobis visa est. Alias etiam non paucas invenies apud D. Morisonum in *Historia Plant. univers.*

3. Foliorum variegatio, qualis in Alaterno, Buxo, Rosmarino, Dulcamara, &c. cernitur, tantum abest ut sit specificæ distinctionis nota; ut sit potiùs symptoma morbidæ constitutionis in Planta aliqua, quæ vel calce radici supposita, vel pari mixtura calcis cum terra ruderata induci potest; unde in ramis depactis durat, in plantis è semine ortis evanescit. An floris petalorum variegatio morbi etiam symptoma sit inquirendum.

An planta foliorum marginibus crispis à congeneribus foliis planis specie differant ambigo. Quantum enim hactenus observavi, quæ hujusmodi sunt speciem suam satione semper propagant, nec unquam plantas planifolias producunt. Quin & Nasturtii hortensis crispi folia seminalia ab hortensis vulgaris seminalibus figurâ suâ & incisuris differunt, cùm hæc tripartita seu in tres lobos divisa sint, illa unica duntaxat hinc inde incisione secta: quod argumento est eas specie differre.

At † Quæ radicis colore solo differunt, cujusmodi sunt Pastinacæ tenuifoliæ radice lutea, alba, atro-rubente; Rapæ radice alba & lutea pro specie distinctis non habendas censeo: nec magis quæ radicis tantùm figurâ differunt, ut Rapæ radice longa & rotunda.

Denique 5. Quæ Fructûs seu Pericarpii magnitudine, sapore, figurâ, colore differunt ut Pomorum & Pyrorum infinitæ ferè varietates: Cæterum (observante * D. *Sharroco*) Arbores è Mali & Pyri hortensium & cultarum seminibus satis ortæ non semper degenerant in naturam sylvestrium; sed interdum sapidiores & mitiores generosioréve fructus edunt, quàm earundem matres seu productrices; contra quàm vulgo creditum & receptum est. * *Lib. de propag. Vegetab.*

Quæ item seminis colore ludunt, ut Phaseoli, Fabæ vulgares, Frumentum Indicum, ob rationes superiùs allatas specie distare non concedimus. Quin de industria experiundi causâ Fabas rubras plures unà aliquando sevimus; quæ tamen indè enatæ sunt plantæ pleræque Fabas albas dederunt. Notandum tamen distinctam propagationem ex semine non esse illud ipsum quod constituit differentiam essentialem seu specificam, sive in quo illa consistit, sed ejus signum seu indicium tantùm.

Deinde cum dicimus in Plantis specie distinctis hanc ab illius semine non oriri, de eo quod plerunque & naturaliter contingit loquimur, non de eo quod rarò & inusitatè extra ordinem naturæ. Nam ut inferiùs ostendemus, Plantarum nonnullarum semina degenerem & diversæ speciei sobolem interdum producunt; unde colligimus dari in plantis veram specierum transmutationem.

CAP. XXI.

De Specierum in Plantis transmutatione.

PLantas quæ ex eodem semine ortum ducunt, & speciem suam satione iterum propagant, specie convenire superiùs docuimus; adeóque varietates illas in florum colore, geminatione & multiplicitate, in foliorum variegatione, radicis colore, fructûs seminisve sapore aut etiam colore, specificæ quam vocant diversitatis notas aut indicia non esse, concludimus.

Verùm nota hæc quamvis satis constans sit specificæ convenientiæ signum, non tamen perpetuum est & infallibile. Semina enim nonnulla degenerare, & diversæ à matre speciei plantas interdum licèt rariùs producere, adeóque dari in plantis transmutationem specierum, experimenta evincunt.

Hypomn. 5. cap. 2. Triticum, referente Sennerto, degenerat in Lolium; Rapum in Rhaphanum; Sisymbrium in Mentham; Ocimum in Serpyllum: Vitis nigra in albam, alba in nigram mutatur: Zea in Triticum, & è contra Triticum in Zeam. Si in Ungaria Secale Germaniæ seratur, generatur indè Triticum. Si ager paulò sterilior sit, Avena nostra alba quam appellant in nigrum degenerat. Si idem semen eodem in agro aliquot annis seratur in vilius degenerat. Galeni pater Triticum & Hordeum aliquando sevit, omnibus diversi generis seminibus quæ ipsis erant admista, selectis, quo certò cognosceret num ex eorum mutatione Lolium & Ægilops nascerentur, an proprium hæc *quoque semen haberent.* Cùm autem fortè unà cum puris seminibus, in Tritico quidem frequens Lolium, in Hordeo autem magnam Ægilopis vim, natam conspiceret, in aliis quoque seminibus idem est aggressus. Reperit igitur in Lente durum quoque rotundúmque Aracum & Securinum, præterea Aparinem enatam.

Hæc experimenta ex variis Autoribus collecta Veteribus & Recentioribus, quamvis eorum nonnulla verisimilia nobis videntur, partim tamen quia vulgo per errorem non causam pro causa accipienti, partim quia Philosophis vel nimis credulis, vel minùs circumspectis in causis phænomenon assignandis, & receptis opinionibus addictis, originem suam debent, pro incertis & suspectis habemus, nec sufficere putamus sententiæ adeò ancipiti & controversæ stabiliendæ.

Sic Galeni patrem in ratione phænomeni modò dicti reddenda deceptum putamus. Nec enim sequitur quia frequens Lolium in Tritico nasceretur, Triticum in Lolium mutatum fuisse, seu ex Lolii semine Triticum enatum; potuit enim ex Lolii semine in agro superiore anno residuo Lolium oriri. Et quod ad Ægilopem attinet, ipse olim observavi in agro quodam ubi Triticum purum satum fuerat magnam Ægilopis vim enatam, idque sæpius, etiam postquam intermissâ satione, ut mos est, ager ille annum integrum requieverat: quæ tamen ipsius Ægilopis non Tritici semini originem suam debuit. Cùm enim Ægilops citiùs matureat & semen suum perficiat quàm Triticum, cúmque semen ipsius per maturitatem facilè defluat, vel vento, & inter metendum manu decutiatur in terram, ibi relictum, quamvis ager non seratur sequenti anno, per integrum biennium durabit, & cum frumento postmodum sato succrescet. Nec dubium est quin semina plantarum, non dico per biennium, sed per decennium & amplius in terra non rarò fœcunda restent, ut superiùs ostendimus.

Verùm quamvis experimenta allata incerta nobisque suspecta sint, non desunt tamen alia certiora, idoneis testibus confirmata, quæ rem planè conficiunt & extra omnem dubitationis aleam ponunt.

E Brassicæ floridæ semine sato Brassicam capitatam sæpius enatam hortulanis apud nos plurimis affirmantibus credimus, imò Brassicæ species omnes satione in se invicem transmutari affirmat R. Morisonus, & experimentis probat. Brassicæ tophosæ semina ex Italia ad Reverendissimum Episcopum Londinensem D. *Hen. Compton* transmissa Brassicam produxere tophosam, sed hujus semen denuò satum degeneravit in vulgarem apertam lævem Brassicam. Idem decendum de Brassica florida botryte, nimirum ex semine plantarum in Anglia nascentium & cultarum sato Brassicam longifoliam apertam oriri: quod *Richardus Baal* hortulanus Brainfordensis multorum experimentis damno suo didicit. Hic enim ingentem copiam seminis Brassicæ floridæ in horto suo collectam, hortulanis quamplurimis in suburbanis *Londini* locis, vulgò dictis the Neat-Houses degentibus vendidit: atque hi cum summa cura & industria eadem semina terræ pingui à multis annis bene stercoratæ commiserunt, quæ Brassicas satis magnas, longifolias apertas ipsis produxere. Quare prædicti hortulani animadvertentes se oleum & operam perdidisse, & in rem nihili labores & sumptus impendisse, se fraudatos queruntur, & prædicto *Richardo Baal* litem intendunt in foro Westmonasterienti: qui ex sententia Judicum illic sedentium condemnatus est, non solùm ut ipsis pecunias quas accepisset restitueret, sed ut jacturam temporis & amissum terræ usum fructum resarciret.

Idem

Idem accidit Brassicæ Sabaudæ tam hybernæ, quàm æstivæ, cujus semina recenter ex Italia ad nos transmissa, feliciter hîc proveniunt [in Anglia] verùm semina ejusdem hîc ortæ collecta & sata degenerant in Brassicam apertam. Oportet ergo si species has habere velimus, ut nova quotannis semina è transmarinis regionibus petamus.

Nec Brassicæ tantùm semina sata degenerem prolem producunt, sed & Primulæ veris seu Paralyseos. Affirmavit nobis, Oxonii cùm essemus, *Jacobus Bobertus* Horti publici Academici custos, è semine Primulæ veris majoris sibi enatas Primulam vulgarem & Primulam pratensem inodoram luteam.

Olaus Wormius *Musei, lib. 2. cap. 7. pag.* mihi 150. asserit se habere Hordeum quod Hermaphroditicum vocat, quia in una spica & Hordeum & Secale contineret, cujus descriptionem videsis loco citato. *Johnsonus* quoque apud *Gerardum emac. lib. 1. cap. 46. pag.* 65. sibi ostensam refert à *D. Goodyer* spicam Tritici albi, circa cujus mediam partem tria aut quatuor grana Avenacea undique perfecta enata sunt.

Hæc si vera sunt, ut à fide dignis narrantur, negativam sententiam, in quam proniores sumus, deserere nos cogunt, & vel invitos concedere, dari in plantis specierum transmutationem.

Observandum tamen transmutationem hanc dari tantùm inter species cognatas & ejusdem generis participes; quasque nonnulli fortasse specie differre non concedent.

Quòd vero plantæ nonnullæ bulbosæ diuturniore in eodem loco morâ absque translatione, mirabili metamorphosi in alias species vel degenerent vel transmutentur, ut v. g. *Crocum* in *Gladiolum*, *Leucoium* in *Hyacinthum* & vice versâ, utrique *Boberto*, nè juratis quidem crederem. * *Sharroc. de propagat. Plant. cap. 1. n. 4.*

Cap. XXII.

De Statura & Magnitudine Plantarum.

DE magnitudine Plantarum nihil notatu dignum habeo quod adjiciam iis quæ ab Historiæ naturalis conditoribus traduntur.

Dari in unaquaque specie certos dimensionum terminos, quos neque excedere, neque ab iisdem deficere possunt individua, opinamur: Magna tamen inter hosce latitudo existit, & maximi ad minimum decupla, ferè proportio. Arbores Animalia, saltem terrestria, (Belluæ enim marinæ excipiendæ videntur) staturâ & magnitudine tantùm excedunt quantum herbulæ minutissimæ parvitate ab iisdem vincuntur. Dantur enim Animalcula quæ oculorum etiam lynceorum aciem fugiunt.

Arbores omnium maximas & altissimas India utraque aliæque regiones fervidæ producunt: quâ calor maximè viget,

Quaque dies medius flagrantibus æstuat horis.

Ibidem & animalia visendæ magnitudinis: in Quadrupedibus, Elephas, Rhinoceros, Hippopotamus; in Avibus Struthio & Emeu; in Serpentino genere, Crocodilus aliique stupendæ longitudinis & crassitiei, in Exangubus aquaticis testaceis Murices, Buccina aliique portentosæ molis innumera nascuntur.

Mira sunt & fidem penè superantia, quæ de arborum nonnullarum crassitudine & proceritate feruntur. Plinium attendamus, Volum. 16. cap. 40. exempla producentem. Amplissima arborum ad hoc ævi existimatur Romæ visa, quam propter miraculum Tiberius Cæsar in ponte naumachiario exposuerat, advectum cum reliqua materie. Fuit autem trabs è Larice, longa pedes 120, bipedalis crassitudinis, æqualis. Quo intelligitur vix credibilis reliqua magnitudo fastigium ad cacumen æstimantibus. Fuit memoria nostra & in porticibus septorum à M. Agrippa relicta, æquè miraculi causâ, 20 pedibus brevior, sesquipedali crassitudine. Abies admirationis præcipuæ in nave, quæ ex Ægypto Caii principis jussu obeliscum in Vaticano circo statutum, quatuorque truncos lapidis ejusdem ad sustinendum eum advexit. Arboris ejus crassitudo quatuor hominum ulnas complectentium implebat. Cedrus maxima in Cypro traditur ad undecimemem Demetrii succisa centum triginta pedum; crassitudinis verò ad trium hominum complexum. Germaniæ prædones singulis arboribus cavatis navigant, quarum quædam & triginta homines ferunt. Quid hoc ad Congenes arbores, è quarum singulis pariter excavatis Canoæ (ità vocant hoc genus cymbas monoxylas) ducentorum hominum capaces fieri possunt. *Pontis è Rhetia.*

In Indiæ Orientalis Regno Malabarico stupendæ magnitudinis Arbor enascitur, *Atti-meer-alat* Indigenis dicta, caudice quinquaginta plerunque pedum ambitu: cujus generis in provincia Cochinensi prope templum *Beykam* habetur, quæ bis mille annos vixisse dicitur. *Hort. Malab.*

Hic tamen obiter monere convenit falsum omnino esse quod Plinius aliique de magnitudine Ficus Indicæ prodidere, nimirum vasto matrem corpore esse, ut 60 pedes pleræque orbe colligunt. Celeberrimus enim Vir, idemque fide dignissimus D. *Gualterus Raleghe* eques auratus, qui vicies mille minimum hujus generis arbores in quadam valle non procul Paria Americæ nascentes vidit, nec pauciores in insulis *Trinidado*, & alibi 12 etiam milliarium iter sub earum umbra se confecisse scribit, magnitudinem mediocrem earum truncis attribuit, & inter decies mille unam aliquam reliquis majorem invenire perdifficile esse ait.

Quæ sequuntur exempla arborum maximarum è celeberrimi viri D. *Joannis Evelyn* Sylva, ut labori nostro parceremus, pleraque transtulimus.

Quod ad staturam attinet, Arborum in Fortunatis insulis proceritatem ad 144. pedes adolescere prodidit Sebosus. *Plin.* lib. 6. cap. 31. Idem in India arbores quasdam tantæ proceritatis invenisse refert, ut sagittis superari nequeant, lib. 7. cap. 3. Et quod omnia miracula excedit in insula *Barbades* Antillarum una Palmitas regales dictas sesquipedali non majore trunci diametro ad trecentorum pedum altitudinem adolescere non solùm Ligonus scriptit, sed & testes αὐτόπται nobis confirmarunt.

Matthiolus

Matthiolus arboris in insulâ Cypro natæ meminit, quæ ad 144 pedum altitudinem materiem produxit.

Quod ad magnitudinem, referente Plinio, sylvestris circa Memphin regio tam vastas arbores producit, ut terni nequirent vel circumplecti. Arborum ad Gambræ fluvium nascentium 37 pedum diametro meminit Jul. Scaliger. Alii in Nicaragua & Gambra arbores tantæ crassitudinis nasci referunt, ut 17 homines ulnis extentis eas ægrè complecti possint, nec minores in Bratilia, in quibus una ab Indigenis religioni habita, 120 pedum erat ambitu. In Historia Chinensi non ità pridem edita leginus arborem quandam *Ciennich*, [i. e. Arbor mille annorum] dictam in Provincia *Suchu* propè urbem *Kien* reperiri, adeò portentosæ magnitudinis, ut sub unico solo ramo ducentas oves adeò integat & occultet, ut ab appropinquantibus discerni non possint: & aliud etiam monstrum & miraculum potiùs arboris quàm arborem in Provincia *Chekiang*, adeò stupendæ amplitudinis, ut 80 etiam homines vix truncum ejus complecti possent.

Verùm ut exotica mittamus, Arborum nonnullarum ex domesticis & Europæis in specie exempla proponemus.

Pyrus. Pyrum propè Rosslam in Herefordia 18 pedum ambitu meminit Autor noster quæ septem quotannis dolia majora Pyracei exhibuit.

Castaneæ. In Siciliæ monte Ætna ad locum *gli Castayne* inde dictum trium Castanearum meminit Kircherus, quarum unius cortex tantæ amplitudinis erat, ut intra eam integer pecorum grex à pastoribus tanquam in cauda commodissima noctu includeretur. *Chinæ illustr.* p. 185.

Tiliæ. Tiliam visendæ magnitudinis & staturæ Depehamiæ in Norfolcia à se visam & mensam-literis ad D. *Evelyn* datis describit celeberrimus & eruditissimus Vir D. *Thomas Brown* Norwicensis, cujus hæ *dimensiones* erant. Trunci ambitus gracillima sui parte, duobus supra terram ulnis, 8½ minimùm ulnarum nostræ mensuræ, i. e. 24 pedum erat: ima parte terræ & radici proximâ 16 ulnarum: superius ad cubiti distantiam 12 fere ulnarum: Altitudo ad summos ramos 30. Tiliam illam famosam Tiguri in Helvetia omnibus dimensionibus superans: an à quaquam in externis Tiliceis hoc genus arbore excedatur incertum. Nam prodigiosa illa Neostadii in Ducatu Wirtembergensi conspicienda Tilia, ob enormem magnitudinem tantopere celebrata ut urbi ipsæ cognomentum dederit, Germanis *Nieustadt ander grossen Linden* indè dictæ, humilior fuit, ut cujus trunci circumferentia non plus 27 pedum, & 4 digitorum erat; ramorum extensorum ambitus 403, ejusque diameter à Meridie ad Septentrionem 145, ab Oriente ad Occidentem 119.

Platanus. Platani ingentis duodecimo volumine Plinius meminit his verbis, Nunc est clara in Lycia gelidi fontis socia amœnitate, itineri apposita, domicilii modo cava 80 atque unius pedis specu, nemoroso vertice, & se vastis protegens ramis arborum instar, agros longis obtinens umbris: ac nequid desit speluncæ imagini, saxeâ intus crepidinis coronâ, muscosos complexa pumices: tam digna miraculo ut Licinius Mutianus ter Consul, & nuper provinciæ ejus legatus prodendum etiam posteris putavit, epulatum intra eam se cum duodevicesimo comite, largè ipsâ toros præbente fronde, ab omni afflatu securam, optantem imbrium per folia crepitus, latiorem quàm marmorum nitore, picturæ varietate, laquearium auro cubuisse in eadem.

Ulmus. In manerio de Horton in Parœcia de Ellham in Surreia, cujus Dominus Autoris nostri frater, Ulmi etiamnum restant in sepibus bene multi, truncis trium in quadrum pedum ad 40 plus pedum altitudinem. Ulmus folio lævi intra tres quatuorve annos in D. Gualteri Bagoti Parco in Comitatu Staffordiæ dejecta, ad 40 ulnas extensa 48 ligni ad focum vehes in summo capite seu coma gestabat, ejusque truncus ad sedem 17 pedum diametro præter 8 modiolorum pana 8660 pedes tabularum seu asserum præbuit. Tota materies ad 97 tonnas æstimabatur. Eruditissimus Vir D. Rob. Plot, in Hist. Nat. Oxoniensi Ulmi cujusdam meminit, quæ pauperculæ cuidam gravidæ ab inhospitali vicinia exclusæ receptum & hospitium præbuit, quæ in ejus cavo puerum enixa est, marem adhuc viventem adultum & robustum juvenem.

Fraxinus. Fraxinos in Essexia 132 pedes longas nuper venundatas audivimus.

Taxus. His adde Taxum ingentem in Cœmeterio Ecclesiæ de *Crowherst* in Surreia decem ulnarum ambitu: & aliam annosam visendæ magnitudinis in cœmeterio Brabournensi in Cantio, cujus truncus 58 pedum & 11 insuper unciarum erat in circuitu, unde colligitur diametrum 20 ferè pedum fuisse.

Salix. Dantur etiam & Salices enormis crassitiei. D. Plot è Joan. Ferdinandi de Hortoda cujusdam in *Moravan* Moraviæ pago crescentis meminit, intus concavæ 27 pedum ambitu.

Quercus. Sed ad Quercus transeamus, Hujus generis arborem memorat idem celeberrimus Vir, in vireto de *Kidlington* Comitatûs Oxoniensis adhuc stantem, cujus interior cavitas carceris extemporanei usum præstat. Ei etenim incarcerandos tantisper includere solebant donec ad carcerem publicum commodè transmitti possent. Quercuum nonnullarum in Westphalia non ità pridem stantium & florentium incredibilis vastitas, quarum altera Arcis & Propugnaculi loco munita, altera 130 pedes alta, 30 pedum diametro fuisse fertur.

Silentio transmittendæ non sunt arbores illæ imprimis memorabiles quas Galfridus Chaucerus poeta ævo suo celeberrimus in Parco *Denningtonensi* plantâsse fertur, tanto satore dignæ, quarum una Regis, altera Reginæ, tertia ipsius Chauceri dicebatur. Harum prima, quæ Regis, ad 50 pedum altitudinem ἄκρων & cnodis erat, ad imum quinque in quadrum pedum, tota firma & solida, optimâ materie: Secunda, quæ Reginæ, ad 40 pedum altitudinem rectus & cnodis, præstantissimâ materie, imâ parte 4 in quadrum pedum, summa propè trium erat. Tertia, quæ Chauceri, staturâ & magnitudine inferior, pulchra tamen & ipsa erat. Hinc, si vera sunt quæ feruntur de harum arborum satione, colligi potest ad quantam altitudinem & crassitiem intra 300 annos (nec enim antiquior est Chaucerus) Quercus excrescere potest. *Ingens nobilis imprimis arbor* erat ex qua trabes transversæ ad navem illam longè maximam & pulcherrimam the Royal Sovereign dictam, ab optimo Principe Carolo primo exædificatam, factæ fuere; diametro 4 pedum & 9 insuper unciarum, in 4 tigna, singula 44 pedes longa, dissecta. Nec prætercunda, quamvis alterius ge-

neris

neris, arbor illa prægrandis & procera, quæ navigio prædicto mali usum præstitit, 99 pedes longa, diametro 35 pedum.

Ingeniosissimus Vir D. Rob. Plot in laudatissimâ sua Historia Nat. Oxon. Quercum meminit inter *Newenham-Courtney* & *Clifton* crescentem, cujus diameter ab extremo ad extremum ramorum extensorum pedum erat 81, aream 560 ulnarum quadratarum inumbrans, in qua 2420 homines commodè consistere possent: Et aliam adhuc majorem propè januam Ambulacrorum Collegii Magdalenensis Oxonii, cujus rami à caudice ad 16 ulnas extenduntur: aliam denique Ricori in Parco nobilissimi Baronis Dom. *Norreys*; cujus rami à trunco ad 54 pedes porrecti, 304 equitibus, peditibus 4374 opacandis sufficiunt.

D. Rob. Harley literis superiùs memoratis, Quercûs in ædium suarum vicinia non ità pridem dejectæ meminit, cujus crassitudo 5 in quadrum pedum erat ad 40 usque pedum altitudinem, in cujus unoquoque pede (omnibus utique simul sumptis divisione facta) dimidia tonna materiei erat. Rami præterea 25 ligni chordas suppeditabant in focum.

Multa adhuc exempla adducit Autor quem sequimur ingeniosissimus, Quercuum enormis magnitudinis & crassitiei vel etiamnum stantium, vel non ità pridem dejectarum, in Sheffeldensi Eboracensis comitatûs præcipuè agro & locis vicinis, scitu non indigna, & idoneis testibus comprobata, quæ omnia huc transcribere longum & operosum nimis foret. Qui plura desiderat librum ipsum adeat, cap. 30.

Cap. XXIII.

De Ætate & Duratione Plantarum.

Plantæ durationis respectu immensum distant. Aliæ brevis admodum ævi sunt, aliæ admodum longævæ.

Aliæ Æstivæ sunt, quæ Vere oriuntur, Autumno intereunt, & sequenti iterum Vere ex semine in terra relicto se renovant. Hujusmodi sunt *Atriplices, Blita, Sonchi, &c.*

Aliæ anno spatio ætatem circumscribunt. Hæ Autumno exeunt, per hyemem virent, æstate sequenti excaulescunt, florent, & demum semine ad maturitatem perducto radicitus exarescunt. Hæ tamen etiam Vere satæ Autumno insequenti perficiuntur.

Aliæ biennes aut triennes sunt, aut plurium etiam annorum, ut v. g. *Petroselinum vulgare, Angelica, &c.* Hæ primo aut secundo postquam satæ sunt anno in caulem non abeunt, imo earum nonnullæ quinquennium interdum & amplius excaules durant, at caule semel edito & seminibus perfectis funditus marcescunt.

Aliæ denique perpetuæ sunt, nec certum durationis terminum obtinent.

Hæ autem vel radice tantùm sunt perpetua vel etiam superficie.

Quæ radice tantùm sunt perpetua *restibiles* appellantur, quæ etiam superficie *perennes*.

Quæ radice perpetuæ censentur non eandem omnes perpetuò radicem individuam servant, nisi impropriè & (ut Philosophi loqui amant) per æquivalentiam; novâ aggeneratione annua radicis damna reparantes, ut superiùs in capite de Radicibus Plantarum ostendimus.

Arbores admodum longævas esse plurimis exemplis allatis volumine xvi. cap. 48. probat Plinius: *Vita arborum quarundam immensa credi potest* (inquit) *siquis profunda mundi & saltus inaccessos cogitet. Verùm ex his quas memoria hominum custodit, durant in Liternino Africani prioris manu satæ Olivæ, item Myrtus eodem loco conspicuæ magnitudinis. Romæ verò Lotos in Lucinæ area, Anno qui fuit sine Magistratibus 369 Urbis æde condita: incertum quantum ipsa vetustior. Esse quidem vetustiorem non est dubium, cùm ab eo luco Lucina nominetur. Hæc nunc circiter annum 450. habet. Antiquior illa est sed incerta ejus ætas quæ capillata dicitur, quoniam Vestalium Virginum capillus ad eam defertur. Verùm altera Lotos in Vulcanali, quod Romulus constituit ex victoria de decimis, æquæva Urbi intelligitur, ut autor est Massarius. Radices ejus in forum usque Cæsaris per stationes municipiorum penetrant. Fuit cum ea Cupressus æqualis circa suprema Neronis Principis prolapsa atque neglecta. Vetustior autem Urbe in Vaticano Ilex, in qua titulus æreis literis Hetruscis religione arborem jam tum dignam fuisse significat.* Reliqua quia incerta & fabulosa nobis videntur, omittimus: Videat qui volet apud Plinium loco citato.

Idem celeberrimus autor lib. xvi. cap. 2. Hercyniæ, inquit, Sylvæ arborum vastitas, invicta ævis & congenita mundo, propè immortali sorte miracula excedit. Ut alia omittamus fide caritura, constat attolli colles concursantium inter se radicum repercussu, aut ubi secuta tellus non sit arcus ad ramos usque, & ipsos inter se rixantes, curvati portarum patentium modo, ut turmas equitum transmittant. Josephus de Bello Judaico lib. 5. cap. 31. Sexto ab urbe Hebron stadio Terebinthum cerni refert, ἥ φασι ἀπὸ κτίσεως μέχρι τοῦ διαμένειν

Lawsonus nostras Horticulturæ scriptor non incelebris arbores etiam frugiferas, *Malos* & *Pyros* ad nongentos usque annos vitam producere non contemnendis rationibus probare nititur. Habere se in horto arbores, quas ante octoginta annos satas fuisse seniorum testimonio constat. Has tamen aliis congeneribus (quas noverat) nec commodiùs sitis, nec diligentiùs cultis, quin potiùs neglectis & malè tractatis, necdum plenè adultis triplo minimùm magnitudine & perfectione inferiores fuisse. Unde colligit hoc genus arbores trecentos circiter annos augmento impendere antequam ad ἀκμὴν perveniant. Cùmque in animalibus status & declinationis spatia incrementi minimum dupla sint; quanto magis in Arboribus quarum substantia solida, ad durandum firma, cœli injuriarum patiens: victus naturalis & purus, nullis fæcibus aut περιττώμασι contaminatus? Quòd si arbores frugiferæ, tot injuriis obnoxiæ ex iterata translatione, putatoris falce, aliisque accidentibus, quin & ex prodiga succi nutritii in tot annuos fructus impensa vigore exhaustæ, tot annos durent quanto

quanto magis longævas esse credi par est arbores illas statura & magnitudine excellentes, materie firma & invicta, locis natalibus adolescentes, nec succi in siccis prodigas, quibus terra mater est non noverca, alimentum idoneum, nec vires cultu aut marcgonio labefactatæ.

Verùm facessant rationes quantumvis speciosæ; experimenta quærimus non argumenta. Quæ de arborum longævitate feruntur apud nos non facilè fidem inveniunt. Cùm enim temporum quibus arbores primùm satæ sunt nulla aut perquam rara fide digna testimonia, literis consignata extant; quæ de earum vetustate traduntur, incertis & male fundatis rumoribus & opinionibus constant, ideóque vel omnino falsa & fabulosa nobis videntur, vel incerta & conjecturis plena. Quercum certè longævitati repugnare quæ *D. Rob. Harley* ad *D. Rob. Murray* literis ante decennium datis perscripsit: Nimirum se ex inquisitione 200 circiter abinde retro annis capta certiorem factum, in Parco quodam suo (sic vocant vivaria ferarum sæptis circundata) & sylvis adjacentibus nè unam quidem Quercum tunc temporis per ætatem glandibus ferendis parem extitisse, in quibus cùm hæc scriberet, se observâsse plurimas eximiæ magnitudinis & proceras, intérque eas nonnullas jamdudum *Senio* & vigore defectas, in extremo senii & marasmi declivio constitutas.

CAP. XXIV.

De Viribus & Usibus Plantarum in Cibo & Medicina.

PLantarum usus latissimè patet, & in omni vitæ parte occurrit. Sine illis lautè, sine illis commodè non vivitur, at nec vivitur omnino: Quæcunque ad victum necessaria sunt, quæcunque ad delicias faciunt, è locupletissimo suo penu abunde subministrant. Quanto ex iis mensa innocentior, mundior, salubrior quàm ex Animalium cæde & laniena? Homo certè naturâ Animal carnivorum non est, nullis ad prædam & rapinam armis instructum, non dentibus exertis & serratis, non unguibus aduncis. Manus ad fructus colligendos, dentes ad mandendos comparati. Nec legimus ei ante diluvium carnes ad esum concessas. At non victum tantùm nobis suppeditant, sed & vestitum, & medicinam, & domicilia aliáque ædificia, & navigia, & supellectilem, & focum, & oblectamenta sensuum animique: Ex his naribus odoramenta & suffumigia parantur. Horum flores inenarrabili colorum & Schematum varietate & elegantia oculos exhilarant, suavissima odorum quos expirant fragrantia spiritus recreant. Horum fructus gulæ illecebræ mensas secundas instruunt, & languentem appetitum excitant. Tacco virorem amœnissimum oculis amicum, quem per prata pascua, agros, sylvas spatiantibus objiciunt, & Umbras quas contra æstum & solis ardores præbent. Verùm, his missis, de earum tantum viribus seu usibus in Medicina verba faciam, quæque dicenda habeo in pauca contraham. Medici tum Antiqui, tum Recentiores de Plantarum temperamentis, Qualitatum primarum quas vocant, *caloris, frigoris, humiditatis & siccitatis* respectu, fuse differunt. Singulas enim qualitates in quatuor gradus, & unumquemq; gradum in tres manliones subtiliter nimis distinguunt. Verùm quoniam doctrina hæc argutior nobis quàm utilis videtur, neque de qualitatum gradibus in plerisque plantis autores consentiunt, atque ex saporum differentiis & gradibus de temperamentis judicium faciunt, hujusmodi minutiis immorari non necessarium ducimus: qui iis delectantur Institutionum Medicarum Scriptores adeant. Magis adrem foret Odorum sed præcipuè Saporum differentias, causas, effectus indagare: ex his enim vires plantarum & usus in Medicina certiùs colligi possè quàm ex aliis quibuscunque notis signisve omnes consentiunt. Quæcunque enim plantæ saporibus *conveniunt*, facultatibus quoque *consentire* verisimillimum est. *Verùm antequam* de saporibus in specie agamus, alios plantarum Vires indagandi modos excutiemus, quorum primus est ex signaturis dictis. Signaturam vocant Plantæ alicujus ejúsve partis, radicis puta, caulis, folii aut fructûs, cum parte aliqua corporis, aut morbo ejúsve symptomate, similitudo aut convenientia in figura, colore, textura, alióve accidente, unde eam tali corporis parti amicam & salutarem, talive morbo utilem esse conjiciunt. Ejusmodi enim similitudinem talis proprietatis signum seu notam à natura impressam arbitrantur. Signaturas præcipuè crepant Chymistæ. Chymicum autem dudum definivit Davisonus ut memini (quàm rectè ipse viderit) *Animal credulum & mendax.*

Nos alibi Signaturas rejecimus, nec ullas notas naturæ consilio plantis impressas ut naturalium facultatum indices essent, demonstravimus, nec dum sententiam mutamus, ob rationes ibi adductas, quas hic repetemus.

1. E plantis specificis dictis, quæ scilicet cuivis parti aut membro corporis, aut morbo, ut propriæ & salutares dicantur, *numerus earum quæ Signaturis carent longè major* est, ut in Cardiacis, Thoracicis, Cephalicis, Hepaticis, &c. facilè esset ostendere.

2. Diversæ partes ejusdem plantæ diversas, imò nonnunquam contrarias exhibent Signaturas.

3. Plurimæ plantæ rerum naturalium & artificialium imagines exprimunt, ad quas tamen nullum habent respectum; ut flores quarundam Orchidum, Muscarum, Apum, Papilionum, hominis nudi, &c. [inter quas tanta (ut id obiter notem) intercedit similitudo, ut nemo non flatum illam agnoscat, nec facilè sibi persuadeat in tot præsertim speciebus casu evenisse, sed potius naturæ ludentis consilium arguere:] Bursæ pastoris vascula seminalia saeculi: Thlaspeos biscutati elypei: Antirrhini vulgaris capitis vitulini; Phaseoli semina renum: Tragopogon Barbæ hircinæ: radix Terræ glandium muris; Gladiolus gladii; Fœnugræci siliquæ cornuum; folia Medicæ cochleatæ vulgatissimæ cordis: cujus etiam imaginem expressam gestat Pilum cordatum dictum; ad quæ tamen referri nullatenus aut debent aut possunt.

4. Partes plantarum quarundam eas interdum partes corporis repræsentant quibus quam maximè adversantur. Sic Anacardii fructus cor repræsentat, est tamen venenatus. Fungi arborei pulmones figurâ, colore & spongiosa mollitie referunt; Fungus phalloides membrum virile; Utrique tamen maligni sunt & pernicioli. Tithymalorum succus acerrimus lacti simillis est, nemo tamen illum

lum nutricibus propinat ad lac augendum, Meſpilorum caro ſtercori colore & conſiſtentia reſpondet, alvum tamen non ſubducit, ſed adſtringit & conſtipat.

5. Eædem corporis partes diverſis & non rarò contrariis morbis aſſiciuntur, qui diverſa & qualitatibus diſcrepantia remedia expoſcunt.

6. In diverſis plantis partes ejuſdem ſpeciei & figuræ vires diverſas aut etiam contrarias obtinent, ut in bulboſis radicibus conſtat, quarum aliæ vomitum cient, ut Narciſſi, aliæ cibum præbent gratiſſimum ut Tulipæ, Cepe, Allium, &c.

7. Signaturarum paucitas, & aſſignatarum obſcura nec cuivis facilè obſervabilis cum rebus quas repræſentare dicuntur ſimilitudo nullum naturæ intendentis conſilium arguunt, ſed potiùs humani ingenii obſervantis & accommodantis ſubtilitatem. Utcunque tamen memoriæ juvandæ inſerviunt, & efficiunt ut facilius recordemur facultatum earum plantarum, quæ hujuſmodi notam velut frontis impreſſam geſtant. Alia ratio Plantarum vires inveſtigandi eſt Inſectorum eaſdem depaſcentium obſervatio; quæ revera nonnullius uſus eſſe poteſt. Et primò quas nullum animal, nedum inſecta attingant, eas venenatas eſſe extra dubium eſt. Et hoc indicium habuerunt Europæi, cùm Americæ ſylvas oberrarent, fructus aliquos edules eſſe, aut ſaltem impunè guſtari poſſe, ſi nimirum ab Avibus decerptos aut admorſos viderent.

Veriſimile etiam eſt viribus convenire quas eadem inſecta arrodunt. Ipſi ſæpiùs obſervavimus Scarabæi genus parvum, nigrum, (quem à parvitate æquali & aliquali ſimilitudinem Pulicem hortenſem hortulani noſtri vocitare ſoliti ſunt) plantas duntaxat acres & calidas, Piperitin, Naſturtium, Iberidem appetere; unde certò colligere licet, quamcunque plantam illud attingat ejuſdem qualitatis participem eſſe. Sic & Erucam quandam annulis nigris & aureis tranſverſis inſignem Jacobæam plerunque, interdum tamen & Senecionem depaſci; unde concludimus plantas illas ut facie ſic viribus affines eſſe.

Quin ſi quod Inſecti genus peculiarem aliquam ſpeciem affectet, reliquis omnibus ſpretis, veriſimile eſt Plantam illam pollere etiam vi aliqua aut proprietate peculiari, quamvis fortè ea ſenſus noſtros non incurrat. Inſecta enim ſubtiliùs quàm nos ſapores diſtinguunt.

Non eſt autem hæc obſervatio certa & univerſalis in omne genus inſectis: dantur enim nonnulla polyphaga & pamphaga, quæ nullum fere eſcæ genus averſantur.

Supereſt tertia & optima initio propoſita Plantarum vires indagandi ratio, nimirum ex ſaporibus.

Medici vetuſtiores novem ſaporum differentias ſeu ſpecies conſtituunt, temperamentorum indices, calidi tres, tres frigidi, & medii ſeu temperati totidem, quas tribus verſiculis complectitur Schola Salernitana,

Hi fervore vigent tres, ſalſus, amarus, acutus:
Algent acetoſus, &c.

Jo. Fernelius Autor imprimis eruditus & elegans pro ſtyptico acerbum ſubſtituit, pro Pontico ſapore auſterum: Saporum autem differentias ſeu ſpecies ſic deſcribit,

Sapor acer eſt, qui linguam & os acrimoniâ ferit atque compungit, ſimúlque calfacit & interdum quaſi exurit: is maximè conſpicuus eſt in Pipere, Pyrethro & Euphorbio.

Acidus ſapor guſtum quoque penetrat & tenuitate ferit, ſed citra ullum ſenſum caloris. Tale maximè in aceto deprehenditur, deinde etiam in ſucco mali cytrii, limonum, &c.

Pinguis ſapor nec calore, nec acrimonia guſtum ſollicitat, ſed linguam oriſque partes lentore quodam oblinit. Is præcipuè animadvertitur in oleo, butyro, adipe, &c.

Salſus ſapor linguam non admodum calfacit, ſed acriter ſiccando corradit. Hic imprimis elucet in ſale communi.

Auſterus ſapor os & linguam moderatè conſtringit & quadam aſperitate coarctat: hinc quadantenus ſiccat & refrigerat. Hic propriè *crudus* appellatur, eſtque immaturis fructibus peculiaris, ut in ſucco uvæ acerbæ, pomorum, pyrorum, meſpilorum immaturorum.

Dulcis ſapor guſtu ſuavis atque jucundus oblectat, nullâque qualitate exuperante nioleſtus eſt. Ejuſmodi conſpicuus eſt in Saccharo, melle, glycyrrhiza, &c.

Amarus ſapor dulci ex adverſo oppoſitus, inſuavis ac triſtis; ſenſum ipſum veluti corradit aut divellit. Eo inſignis eſt Aloe, deinde abſinthium, centaurium minus & colocynthis.

Acerbus ſapor auſtero finitimus, eo tamen gravior moleſtiórque eſt, ac magis linguam omnémque guſtum conſtringit & exaſperat, ac proinde magis tum ſiccat, tum refrigerat. Is luculenter in malicorio, in galla, in rhoe & nucibus cupreſſi conſpicitur.

Inſipidus, ἄγευστος dictus, qui propriè ſapor non eſt, ſed ſaporis privatio, nulla qualitate manifeſta guſtum ferit. Talis eſſe videtur Farris univerſum genus, & cucurbita & citrulus. Hactenus Fernelius, qui & cauſas horum ſaporum aſſignat, in quibus tamen nobis non ſatisficit.

At neque hic, neque alii ſeu Medici, ſeu Phyſici ſaporum differentias ſatis diligenter obſervâſſe videntur; & nonnullos etiam compoſitos pro ſimplicibus habuiſſe, alios gradu tantùm diverſos pro ſpecie diſtinctis. Quocirca Grevius noſter doctrinâ in Scholis traditâ non contentus, rem totam ad examen revocans & curioſiùs expendens ſexdecim minimùm ſimplicium ſaporum ſpecies diverſas animadvertit & diſtinxit. Eæ ſunt,

Primò Sapor *amarus* qualis in *Abſinthio* ſentitur: cui opponitur. 2. *Dulcis*, ut in *Saccharo* 3. *Acidus*, ut in *Aceto*; cui adverſatur, 4. *Salſus*. 5. *Calidus*, ut in *Caryophyllis*; cui opponitur 6. *Frigidus*. Dantur enim corpora quædam quæ frigoris ſenſum linguæ manifeſtè imprimunt, ut v. g. *Sal prunella*, idque quamvis liquor in quo ſolutus fuerit calidus deguſtetur. 7. *Aromaticus*, nec enim minùs ſapori quam odori convenit aromaticum eſſe. Aromaticum autem ſaporem à calido diſtinctum eſſe manifeſtum eſt, cùm plurima obſerventur corpora calido guſtu vel remiſſo vel etiam intenſo, quæ nullatenus aromatica ſunt, ut v. g. Euphorbium. Adeò ut quamvis ſapor Aro-

maticus

maticus cum calido ſæpiſſimè conjunctus ſit, non eſt tamen una eadémque ſaporis ſpecies, ſed diverſa. 8. *Nauſeoſus* ſeu malignus præcedenti contrarius, qualis unà cum adſtringente & amaro in Rhabarbaro ſentitur, cum amaro & dulci in Aloe. Malignus dicitur quia ingratus eſt quamvis vel remiſſo gradu cum aliis ſaporibus miſceatur. 9. *Vapidus*, in albumine ovorum, Amylo, Ptiſanis nonnullis. 10. *Unctuoſus*, qualis in Oleo, Adipe, &c. atque hoſce duos ſapores *molles* vocat Auctor noſter, quemadmodum ſequentes quatuor *duros*. 11. *Penetrans*, qui ſine acrimonia aliqua in linguam ſe inſinuat, quomodo nonnulla inſecta in cutem: qualis in radice & foliis Cucumeris agreſtis ſentitur. 12. *Stupefaciens*, qualis in radice Hellebori nigri percipitur, quæ commanſa, & linguæ aliquandiu impoſita, eam paralytico quodam ſtupore afficit, ac ſi nimis calidum ſorbendo uſtulata fuiſſet. Atque hos duos proximè dictos ſapores vapido contrarios facit; quemadmodùm ſequentes duos 13. *Adſtringentem* ſcilicet, qualis in Gallis ſentitur, & 14. *Pungentem*, qualis in ſpiritu Salis Armoniaci, Unctuoſo ſeu pingui opponit. Deinde Sapores dividit in continuos quales plerique & 15. *Intermittentes*, cujuſmodi obſervatur in radice Dracontii, qui poſtquam planè ſopitus & extinctus videtur, ad intervalla quaſi reviviſcit & renovatur, maximè ex appulſu linguæ ad ſauces aut gingivas. Denique ſapores ſunt vel æquales ut plerique, vel 16. *Tremuli*; ut calor à Pyrethro productus, quem vibratio quædam comitatur. Verùm hæ duæ ultimæ ſpecies nobis potiùs Affectiones ſaporum videntur, cum & multis ſaporibus accidere poſſunt, nec ſeorſim & ab aliis omnibus ſeparati exiſtere.

Sapores compoſiti numeroſiſſimi ſunt, interdum enim bini, interdum terni, quaterni, quini aut etiam plures in eodem ſubjecto concurrunt.

Ex innumeris ferè Saporum conjunctionibus quæ in variis corporibus obſervari poſſent ob linguæ Latinæ egeſtatem & inopiam verborum, ſex tantùm (quod novimus) nomina impoſita ſunt, nimirum *Acerbo*, *Auſtero*, *Aceri*, *Muriatico*, *Lixivo* & *Nitroſo*; quorum plerique ſaporibus ſimplicibus annumerari ſolent, verùm admodum impropriè, cùm omnes compoſiti ſint, aut decompoſiti. Eſt enim

1. *Auſterus* ex adſtringenti & amaro compoſitus; ut in immaturis & mollibus uvarum nucleis ſeu vinaceis.

2. *Acerbus* propriè dictus ex Adſtringente & Acido; ut in Omphacio.

3. *Aceris* ex pungenti & calido, nec enim ſimpliciter calidus eſt, cùm multa corpora calida reperiantur quæ non ſunt acria, ut radices Zedoariæ, Milleſolii, Contrayervæ; nec minùs pungentiæ pariter non acria, cujus generis eſt Ari radix.

4. *Muriaticus* eſt ſalſus cum pungente remiſſo compoſitus; velut Salis communis Sapor.

5. *Lixivus* dicitur Salſus cum pungente & calido.

6. *Nitroſus* vocatur Salſus cum pungenti & frigido concurrens. Differunt præterea Sapores variis modis; 1. Reſpectu graduum: 2. Reſpectu Durationis. 3. Reſpectu ſubjecti quod afficiunt.

1. Differunt ſapores in unaquaque ſpecie reſpectu graduum. In aliis enim corporibus remiſſiores ſunt, in aliis intenſiores, idque eo exceſſu, ut in nonnullis decem gradus poſſint diſtingui. Sic, v. g. Radix Curcumæ primo gradu amara eſt, Gentianæ decimo, Cardui benedicti radix gradu primo calida eſt, Clematidis peregrinæ ſiliquæ decimo. Et quamvis in omnibus ſaporum ſpeciebus tanta graduum latitudo ſeu differentia non inveniatur; plerique tamen quinque ſaltem gradus intenſionis & remiſſionis obſervabiles obtinent.

2. Differunt ſapores reſpectu durationis, & terminorum motûs. Quemadmodum enim morborum ita & Saporum quatuor tempora ſunt, ſeu motûs termini, nimirum *Principium*, *Augmentum*, *Status* & *Declinatio*.

Ad quos rite obſervandos & diſtinguendos oportet ut corpora duriora quorum partes guſtabiles non adeò promptè abſcedunt & guſtui occurrunt, in pulverem tenuiſſimum reducantur. Aliàs de principio nullum poteſt fieri judicium.

Principium voco ſpacium illud temporis quod intercedit inter primum corporis guſtandi contactum, & primam ſaporis manifeſtam perceptionem. Sic ex. gr. corpora *acida* aut *amara*, ut *Acetum* & *Abſinthium* ad primum ſtatim contactum, quatenus acida & amara ſunt, ſenſum afficiunt, & talia eſſe deprehenduntur, adeóque principium habent breviſſimum. *Acria* principium aliquanto longius obtinent. Sic Clematidis peregrinæ folliculi, quamvis acrimoniam vehementiſſimam ad decimum uſque gradum obtineant, ea tamen non ſtatim ſentitur, nec tam citò guſtum afficit quàm Roſarum amaror, qui ſecundum gradum non excedit. Verùm ſaporum calidorum principium longius ſeu tardius plerumque eſt quàm aliorum quorumcunque. Sic *Hellebori nigri* radicum amaror, qui gradum ſecundum non tranſcendit, mox tamen à contactu ſentitur; calor verò quem in linguâ excitant, quamvis uno ſaltem gradu intenſior, non ante duo minuta temporis à primo occurſu exacta omnino percipitur. Conſimiliter Enulæ amaror qui quartum gradum non ſuperat, citius tamen ſentitur quàm ejuſdem calor qui octavum attingit gradum.

Augmentum appello interſtitium illud inter primum ſaporis perceptionem & ſummum quem aſſequitur intenſionis gradum interveniens. Sic calor *Galangæ* non ſolùm ſtatim percipitur, ſed & intra unius minuti dimidium ad ἀκμὴν ſeu ſummum intenſionis gradum aſcendit. At radicis *enulæ* calor ad augmenti terminum non accedit niſi poſt integrum minutum; nec *Hellebori nigri* ante 4 à primo contactu minuta præterita.

Status, ſeu ſpatium quo Sapor in vigore ſuo perſiſtit, in variis ſubſtantiis varius eſt. Sic, v. g. ſiliquarum Helleboraſtri calor, ad ἀκμὴν pervenit & declinare incipit intra dimidium minutum; radicis Naſturtii hortenſis non ante minutum exactum; radicis *Aſari* poſt duo demum minuta completa.

Declinatio, à prima ſaporis remiſſione ad totalem ejus extinctionem extenditur, cujus etiam duratio varia eſt, pro differentia corporum guſtatorum. Sic v. g. Folia *Milleſolii* in quarto gradu amara ſunt, in primo tantùm calida, & tamen calor aliquandiu durat, amaror illico evaneſcit. *Calamus*

mus Aromaticus amarus est in quarto gradu, in primo calidus, in tertio Aromaticus: Amaror tamen illico extinguitur, calor duo minuta durat, Aromaticus sapor 7. aut 8. Calor radicis *Centrayervæ* ad duo propemodum minuta extenditur; pungens sapor *Gialappæ* ad sex ferè: calor *Nasturtii hortensis* ad 7. aut 8. *cucumeris agrestis* amaritudo ad horæ ferè quadrantem: At *Euphorbii* calor, ut & *Hellebori nigri* multò diutiùs, ad dimidiam scilicet plus minùs horam permanet. *Ari* radix vere gustata per 12. etiam horas linguam compungere interdum perseverat.

Adeò ut augmentum rariùs ultra 4. aut sex minuta à contactu primo extenditur, at declinatio ad 30, 40, aut etiam plura.

3. Differunt Sapores respectu *subjecti* seu *sedis* seu partis illius corporis quam præcipuè afficiunt. Atque hoc respectu sunt vel *fixi*, vel *mobiles*.

Fixus sapor dicitur qui ab initio ad terminum intra ejusdem partis limites se continet, ut v.g. apicem radicémve linguæ.

Mobilis est vel *diffusivus*, vel *transitivus*; si ita loqui liceat.

Diffusivum voco qui gradatim in partes vicinas se diffundit & propagat, nec tamen interim partem illam deserit quam initio affecit. Sic amaror radicum exsiccatarum *Hellebori nigri*, qui in linguæ apice primò sentitur, ad ejusdem mediam partem se dilatat; amaror foliorum *Cucumeris agrestis* ab apice ad radices usque linguæ se extendit.

Sapor *transiens* dicitur, qui partem quam initio affecit post moram aliquam penitus deserit, & in aliam se transfert. Sic *Gentianæ* amaror ab apice linguæ ad ejus mediam partem illico transit.

Partes illæ quas modis prædictis sapores afficiunt, quibus etiam respectibus Saporum sedes & organa gustûs dici possunt, sunt *Labia, Lingua, Palatum, Fauces, Gula.*

Labiis radix Hellebori albi, ut & Pyrethri caloris sensum imprimit, qui 9. aut 10. minuta durat; in aliis partibus multo diutiùs.

Linguam tribus præcipuè in locis sapores afficiunt. 1. in *Apice*, ut plerique. 2. Propè basin, ubi *Cucumeris agrestis* foliorum sapor se præcipuè manifestat. 3. Mediâ parte, ubi *Gentianæ, Colocynthidis*, & aliorum plurimorum corporum sapor viget, cùm nec in apice, nec in alia parte omnino sentitur.

Palato radix Solani lethalis (quantum memini) sui sensum præcipuè imprimit, & ad 4. minuta ibidem durat.

Fauces seu Guttur saporum non rarò sedes est. Non pauca etenim corpora quamvis in Lingua reliquisque partibus prædictis saporem nullum manifestent, gutturi tamen & faucibus vehementem satis infligunt. Sic *Bellidis minoris, Chelidonii minoris, &c.* folia, ut & radices *Jalappæ, Mercurialis, Asparagi, &c.* commanducata linguæ exiguum aut nullum saporis sensum imprimunt: at succus eorundem deglutitus guttur quodammodo compungit, & lacessit, catarrhi acris in modum: qui affectus ab aliis acribus & calidis ut v. g. *Pyrethri* & *Gentianæ* succis deglutitis non producitur.

Postremò, Saporis voce latissimè accepta *Gula* quoque seu *Oesophagus* ejusdem *sedes* seu subjectum (ut vocant) esse potest. Sic v. g. calor à radice *Absinthii vulgaris* productus, qui primò in apice linguæ percipitur, inde primo ad radicem ejus transit, deinde in fauces & paulatim in gulam descendit, ut ipsum tandem ventriculum calefacere videatur, caloris sensu ad horæ quadrantem durabili, idque quamvis nihil omnino succi deglutiatur, neque tamen ingratus est aut caput tentat, quemadmodum folia; unde obiter colligi potest, radicem hanc, quæ ab omnibus vulgo ut inutilis rejicitur, præstantissimis stomachicis annumerari debere, prout eam revera esse etiam experientiâ dictici.

Quæ de Saporum causis Autor noster habet apud ipsum quærenda omitto, ne nimium (quod aiunt) extra oleas.

Cæterum Saporum in plantis diligens & curiosa observatio ad nondum cognitarum aut fortè oblatarum vires investigandas eximii usûs esse potest, cùm enim in iis quarum vires traduntur, quæ saporibus conveniunt viribus quoque convenire compertum sit, quidni in nondum traditis aut expertis eadem observatio locum habeat? Sic. v. g. cùm *Jalappa, Mercurialis & Bellis*, quæ eundem fauces exasperantem saporem obtinent, vi cathartica intentiore aut remissiore omnes polleant, colligere licet alias etiam plantas quæ eundem gutturi saporem imprimunt (plures autem ejusmodi sunt) eadem quoque facultate purgatrice dotatas esse, ut alia exempla omittam.

Deinde in plantis ejusdem generis quæ saporibus differunt & facultatibus unà distare verisimillimum est: quemadmodum *Rhabarbarum* à reliquis Lapathis.

Interest quoque plurimùm in diversis ejusdem plantæ partibus saporum differentias observare. Sic v. g. cortex arboris *Sassafras* ejusdem ligno triplo fortior est; quod & in aliis plerisque vulgo cognitis arboribus experimur. Unde verisimile est, *Santali, Ligni Rhodii, Ligni Aloes, &c.* cortices (si haberi possent) eorundem lignis efficaciores futuros & majorum virium. Nonnullarum etiam partium ejusdem plantæ, sapores quàm reliquarum delicatiores sunt & palato gratiores, ut florum v. g. Cardui benedicti quàm foliorum ejusdem. Nos etiam alibi [in catal. plant. Cantabrig.] indicavimus & allatis exemplis confirmavimus, diversas ejusdem plantæ partes diversis interdum imò planè contrariis qualitatibus & viribus instructas esse.

Observatu quoque dignum est quomodo plantarum sapores & facultates conservando, exsiccando aut præparando vel immutentur, vel minuantur, vel planè abolentur & amittantur. Sic v. g. Ari radix recens ellòsa vehementer mordax acris & pungens est, eadem penitus exsiccata, præsertim si diutiùs asservetur, planè insipida evadit, & prorsùs ineffica& & nullarum virium. Idem esto judicium de aliis plantis quarum virtus in parte humida & vaporosâ consistit. Olea multarum plantarum illarum partibus unde eliciuntur plerumque validiora sunt; in nonnullis tamen, ut in *Euphorbio*, imbecilliora.

Tandem ex superiùs de saporibus dictis summâ verisimilitudine colligit Autor noster, Plantis nonnullis vires specificas quas vocant, hoc est, partem aliquam corporis, *Cerebrum, Cor, Hepar, &c.*

respicientes inesse, quas Medici & Philosophi nonnulli pernegant, alii in dubium vocant. Cùm enim una aliqua planta aut plantæ pars uni alicui oris parti privatim saporis sui sensum imprimat, non alii: cur non & eadem vel alia quædam unum aliquod viscus afficiat, aliud non item; præsertim cum oris partes textura & constitutione minùs differre videntur quàm viscera nonnulla inter se.

Horum pleraque è D. Grevii ingeniosissimo libello de saporum causis & differentiis, in Latinum versa huc transferre non piguit, quoniam scitu dignissima sunt, & nonnulli fortassè qui hæc nostra legent, Anglicanum fortassèm in quo conscripta sunt non intelligent.

CAP. XXV.

De loco Plantarum.

PLantæ loci respectu dividi possunt in eas 1. Quæ certo alicui loco aut sedi ità adstrictæ sunt, ut alibi nec durare, nec vivere omnino possint, ejusmodi sunt *Visci arborei*, & *Submarinæ* omnes.

2. Quæ quamvis locum aliquem peculiarem affectent, nec temerè alibi sponte sua ortæ reperiantur, culturam tamen admittunt, & in hortis curâ adhibitâ educari, florere, semen perficere, seque propagare possint.

3. Quæ plurium locorum communes sunt, nec ullum ferè solum aut cœlum refugiunt.

Secundum genus multas admittit subdivisiones cœli, solique respectu: Aliæ enim locis frigidis gaudent, aliæ temperatis, aliæ calidis: Aliæ montanæ sunt, aliæ campestres, aliæ sylvaticæ, aliæ pratenses, aliæ palustres & aquaticæ, aliæ maritimæ, &c.

De loco plantarum cœli respectu observavimus quòd quo ad Meridiem & Solis cursum propiùs accedas eò plures plantarum species sponte oriri deprehendes. Quamvis enim Regiones frigidæ & Septentrionales suas quoque peculiares stirpes obtineant, paucissimæ tamen ex sunt si cum illarum multitudine conferantur quæ in temperatis & calidioribus tantùm proveniunt. Cui accedit, quod juga, *vertices aut etiam latera montium in regionibus calidis cum frigidiorum* depressis, *planis & sylvosis* aeris temperamento quodammodo conveniunt, quo fit ut eadem ferè stirpes producant, adeóque nè plantæ quidem Septentrionales Meridionalibus desint.

Deinde multæ plantæ quæ in frigidis & Septentrionalibus regionibus Fruticum modum non excedunt, in calidioribus Arborum staturam & magnitudinem assequuntur, ut superiùs ostendimus.

Tandem in regionibus calidis multæ observantur herbarum species fruticescentes, ut v. g. *Sempervivi majoris, Althææ, Malvæ, Tithymali, Scabiosæ, &c.*

Respectu situs sublimioris aut humilioris in eadem regione observavimus, Montes excelsos, quorum vertices maximam anni partem nivibus operiuntur, varietate specierum præcipuè abundare. Alpes certè quæ Italiam & Galliam Germaniámque disterminant, inexhausto plantarum penu Botanicorum scrutiniis in hunc usque diem sufficiunt, magnâ adhuc nondum proditarum reliquâ multitudine. Nec ullus ferè vertex excelsior est præsertim salebrosus & præruptus, qui non peculiares aliquas species, nec alibi quàm in paris altitudinis & naturæ verticibus investigandas producat. Quin & altissimos omnium montes & montium vertices & plurimas & rarissimas plantarum species fundere observavimus. Hæc specierum diversitas toh differentia, partim etiam aeris temperamento deberi videtur. Si enim montes terræ motibus originem suam debent, ut Clariss. *Hookii* sententia est, materiam eructatam è visceribus terræ, & in montes aggestam, non in omnibus verticibus imo nec in eodem uniformem esse, ejusdémvè naturæ seu temperamenti certum est, sed diversissimam, unde nil mirum si diversas plantarum species producat.

Observavimus insuper Plantas montanas omnium sui generis plerunque maximas esse, & pulcherrimos flores edere, in partibus montium non nimium apricis & ventis Septentrionalibus expositis. Quod tanta soli fertilitas dicam an luxuria nivibus imputanda sit, nobis equidem visetur; seu quia nix velut vestis superextensa radices foveat, & ab injuriis cœli & frigoris vehementiâ defendat, sive quòd Sale nitroso, quo abundare creditur, terram lætificet & fœcundet: Ob quas rationes agricolæ etiam nostri hybernas nives ad satorum tutelam in terræ superficie aliquandiu restare exoptant. In montibus autem, colliquatis statim nivibus, brevi temporis spatio, celerrimo auctu adeò proficiunt pascua, ut montium juga vernantium pratorum speciem exhibeant.

CAP. XXVI.

De Divisione Plantarum in genere.

PLantarum divisionem instituere, cujus membra seu genera subalterna universas species complectantur, nullâ adhuc anomalâ & sui generis relictâ, quæque singula genera notis suis characteristicis ità circumscribat, ut non communicent invicem, hoc est, ut nulla possit inveniri species incerti (ut ità dicam) laris & ad plura genera revocabilis, difficillimum esset imò planè impossibile.

Nec enim primò id patitur natura rei. Cùm enim *Natura* (ut dici solet) *non faciat saltus, nec ab extremo ad extremum transeat nisi per medium*, inter superiores & inferiores rerum ordines species nonnullas mediæ & ambiguæ conditionis, quæ utrosque velut connectant, producere solet, ut ad

utrum

utrum pertineant omnino incertum sit: ut v. g. inter Plantas & Animalia *Zoophyta* dicta. Deinde in unoquoque etiam ordine non paucas exhibet species singulares & anomalas, sui; ut vocant, generis, tanquam exceptiones à regulis generalibus, ad libertatis scilicet suæ nullis legibus obnoxiæ ostentationem.

At neque secundò, si natura rei id pateretur, humana conditio admitteret. Cùm enim plantarum numerus ingens sit, in his ætatis angustiis, memoriæ imbecillitate, intellectûs inadvertentia & caligine; quis adeò universalem specierum omnium notitiam, adeóque claram & distinctam singularum, se unquam assequi posse sperat, ut tali incepto sufficeret? Quis adeò circumspectus esse potest ut ad omnes omnium convenientias & differentias attendat, eásque sub uno quasi intuitu comprehendat, quod tamen ad eas inter se conferendas necessarium est?

Nos ergo Methodum Plantarum omnibus numeris absolutam non pollicemur, cùm natura (ut diximus) intra limites Methodi cujuscunque coerceri repugnet: at neque quam patitur natura perfectam & elimatam: non enim id unius est hominis aut ætatis; sed quàm potuimus accuratam pro ingenii nostri tenuitate, & modica harum rerum peritiâ.

Methodos autem illas quæ plantas secundùm locos natales, aut florendi tempus, vires & usus disponunt, rejicimus, quoniam omnes illæ cognatas species separant, alienas consociant; eam autem quæ à similitudine & convenientiâ partium præcipuarum, floris scilicet, & calycis, seminis ejúsque conceptaculi notas characteristicas generum sumit, amplectimur & usurpamus.

Cap. XXVII.

De Divisione Plantarum, in Arbores, Frutices; Suffrutices & Herbas; & singulorum in genera sua subordinata.

Planta perfecta à Botanicis vulgò dividi solet in Arborem, Fruticem, Suffruticem & Herbam.

Arbor [Δένδρον] definiente * *Jo. Bodæo à Stapel*, cujus definitionem probamus, est Planta lignosa, crassitudine & altitudine inter omnes maxima, cui caudex pro superficie est, perennis & naturâ simplex, qui in multos ramulos majores, & deinde ramusculos multiplices finditur, ut *Pyrus, Abies, Quercus, &c.* * *Comment. in Theophr. Hist.*

Frutex [θάμνος] eodem definiente, est stirps inter lignosas altitudine & crassitudine mediocris, cui pro superficie stipes perennis, naturâ multiplex, quique facilè in naturam arborum stolonum abscissione transcendit.

Suffrutex [Φρύγανον] eidem ex Antiquorum sententia sic definitur; stirps minimæ inter lignosas & crassitudinis & altitudinis, caule perenni, interdum simplici, interdum multiplici & sarmentaceo, folio minuto & tenui, ut *Rosmarinum, Lavendula, &c. Hæc definitio nullas continet notas quibus Suffrutex à Frutice certò possit distingui; ideóque nos paulò post commodiorem dabimus.*

Herba [Πόα] eodem definiente ex Antiquorum sententia, est stirps cujus superficies est ex foliis tantùm, ut *Phyllitis, &c.* vel etiam ex caule, sed illo annuo, carnoso, & qui diutiùs durare nequit, lignosúsque non est nisi cùm exaruerit.

Divisio hæc quamvis uniciuique è vulgo nota, & populari usu omnibus seculis recepta & frequentata fuit, non tamen accurata & Philosophica censenda est.

Nam primò, Plantæ nonnullæ inter duo genera ambigunt, ut ad utrum pertineant difficile sit judicare, aliis Botanicis uni, aliis alteri eas ascribentibus. Sic v. g. *Vitis* Theophrasto arbor est, reliquis Botanicis frutex, ut alias omittam. Natura enim tam in plantarum, quàm in Animalium genere, inter superiores & inferiores ordines, species nonnullas mediæ & ambiguæ conditionis producere solet, quæ utrosque velut connectant, ut ad utrum pertineant omnino incertum sit.

Secundò, Arbores nonnullæ recisis cymis in frutices; frutices avulsis aut abscissis stolonibus in arbores facilè transeunt. Sic v. g. Lentiscus magnâ solùm ex parte fruticat; multis ab una radice stolonibus & virgultis assurgens; interdum verò quando non cæditur sed negligitur (ut plerisque locis ad Anam fluvium observavi) in arborem justæ magnitudinis excrescit, inquit * Clusius. Juniperus quoque apud nos in ericetis frequentissima, cæsa aut à jumentis depasta plerunque fruticat; sin permittatur nec violetur in arborem adolescit. Idem dicendum est de Buxo, & (ut nonnullis videtur) Ilice coccifera, quæ in Galliæ Narbonensi eisdem de causis in fruticum ordine coercentur. Ex altera parte Myrtus nisi sæpiùs purgetur in fruticem tranſit. Theophrast. Hist. lib. 1. cap. 5. *Comarus* [Arbutus] suâ naturâ pusilla est, sed ramis expurgata in magnam altitudinem assurgit, quemadmodum etiam Malus Punica. Bellon. *de neglect. stirp. cult.* Prob. 12. * *Hist. lib. 1. cap. 16.*

Tertiò, Plantæ nonnullæ in aliquibus regionibus fruticum modùm non excedunt, in aliis arborum staturam & magnitudinem assequuntur. Sic *Ricinus*, quæ Lobelio in *Adversar.* annua nec rediviva planta dicitur, in Creta multos perdurat annos, & in tantam excrescit altitudinem, ut nonnisi scalis admotis conscendi possit, quod * Bellonius tradit. Clusius quoque in maritimis Bæticæ Ricinos crassitudine humana, altitudine trium hominum, multis prægrandibus ramis brachiatos & multos annos durantes observavit, eósque exactissimè congruentes descriptioni Dioscoridis. *Schol. in Matthiol. cap. 4.* Nos quoque in Sicilia Ricinum arbusculam, Sambuci æmulam lignosam & perennem, in sepibus frequentem observavimus. *Rhododendri* nonnullis Cretæ insulæ locis ad ædicularum trabes consciendas aptæ, quæ alibi parvæ sunt. *Bellon. de neglect. stirp. cult.* Probl. 12. Idem *Observ.* lib. 1. cap. 43. Rhododendri rubro flore, inquit, in monte Athos in summam celsitudinem attolluntur, earúmque caudices crassitudine sicubus non cedunt. Arbuti quoque, quæ in aliis locis plerunque duntaxat fruticant, ingentes illuc fiunt arbores. *Bellon. ibid.* Cornus fœmina, quam Galli Latinos imitati Sanguineum fruticem appellant, haud minor in monte *Castagne*, non procul Philippis Macedoniæ * *Observat. lib. 1. cap. 18.*

urbe, naſcitur quàm majores noſtri Corni mares. Idem *Obſervat.* lib. 1. cap. 56. Multis Auſtriæ locis naſcuntur etiam Corni fœminæ arbores mare non minores. *Cluſ. Annot. ad dictum locum Bellon.* Suffrutices quoque alicubi in fruticum aut etiam arborum altitudinem excreſcunt. Joſephus Rutæ cujuſdam Macherunte in ipſâ Regia plantatæ meminit, quæ à nulla Ficu vel cellitudine vel magnitudine vincebatur. Nos quoque vidimus baculum tricubitale ligno ſatis duro & ſolido, è caudice Rutæ cujuſdam in Virginia naſcentis factum, uti retulit generoſus quidam ex amicis noſtris, qui ſecum illud geſtare & circumferre ſolitus erat.

Quartò denique Arbores nonnullæ cum Fruticibus, Frutices & Suffrutices inter ſe & cum Herbis genere proximo conveniunt, eoſdémque characteres ſeu notas genericas & eſſentiales obtinent. Sic in genere *Buxi* alia reperitur arborea, alia pumila; in genere *Amygdali* alia pariter procera, alia nana; necnon in genere Ilicis, ut alias omittam. In *Sambuco* autem, *Hyperico*, *Tithymalo*, *Sempervivo*, *Malva*, *Scabioſa* aliiſque plurimis res eſt manifeſtiſſima. Ebulus enim quæ herba eſt, cujuſque ſuperficies quotannis emoritur, eaſdem omnino cum Sambuco (quæ arbor Botanicis cenſetur) notas genericas & eſſentiales obtinet. Tragium quoque (quod frutex eſt lignoſus) cum Hyperico: Tithymalus dendroides cum vulgaribus herbaceis; Sempervivum arboreſcens, Scabioſa arborea Cretica, Malva arborea, &c. cum cognominibus plantis notis generícis conveniunt, & primo ſtatim aſpectu ad eadem genera pertinere agnoſcuntur.

Verùm his non obſtantibus, quoniam Diviſio hæc paſſim cognita & recepta, omniúmque ferè ſeculorum uſu approbata eſt, nec alia commodior occurrat, nos quoque eam retinebimus, certiores tamen inter *Fruticem*, *Suffruticem* & *Herbam* diſtinctionis notas aſſeremus.

Plantas ergo initio, diviſione dichotomâ, partiemur in eas quæ caule ſunt *annuo*, vel ſi perenni non lignoſo, & quæ caule *perenni* lignoſo. Quarumcunque caules annui ſunt, Herbas appellamus, ſive radices perennent ſive non; nonnullæ, etiam caule perenni non lignoſo herbis accenſendæ videntur, ut v. g. Braſſicæ ſpecies nonnullæ, Nicotiana cujus caulis interdum perennat, Malva arborea marina, &c. Quæ caule ſunt perenni vel *gemmiparæ* ſunt, & ſurculos ſimplices non ramoſos annuatim producunt, vel non *gemmiparæ*, germina producentes eodem anno in ramos & ramulos interdum diviſa. Has Suffrutices appellamus; illas adhuc in Arbores & Frutices ſubdividimus, inter quas hactenus certas & ſtabiles diſtinctionis notas non invenimus, ideóque ſuperiùs in earundem deſinitionibus poſitis contenti ſimus oportet. Gemmas appello Arborum & Fruticum fœtus novellos quos quotannis Autumno, aut interdum etiam Æſtate, concipiunt, ſquamoſis tegumentis velut ſecundis obvolutos, in quibus per totam hyemam latitant, quâ exactâ, vere novo in ſurculos explicari incipiunt, ut ſuperiùs diximus.

Arbores ergo & Frutices à Suffruticibus diſtinguo quòd illæ gemmiparæ ſunt, hæ autem minimè. Eſto ergo Suffrutex nobis definientibus, Planta minimæ inter lignoſas altitudinis & craſſitudinis, non gemmipara, caule perenni. Seu Planta caule perenni, lignoſo, non ſimplices tantùm ſurculos annuatim producens, ſed ramos in ramulos & ſurculos diviſos & ſubdiviſos.

Verùm quoniam Suffrutices plerique cum Herbis notis generícis conveniunt, nec admodum numeroſi ſint, eos Herbis admiſcebimus, adeóque tria duntaxat ſumma Plantarum genera conſtituemus, Arborem, Fruticem, Herbam.

Summis autem generibus conſtitutis ſequitur ut ſubalterna, ſeu horum unicuique ſubordinata exquiramus.

Horum autem notæ characteriſticæ non tantùm à ſemine ejúſque conceptaculo (quanquam ab his præciquè) ſed & à flore ejúſque calice deſumendæ ſunt; non omnino neglectâ Radicis figurâ & conſtitutione, aut foliorum ſitu. Flores enim & perianthia nonnullorum generum certiores & magis conſpicuos characteres exhibent quàm ſemina aut eorundem involucra. Sic v. g. in genere Leguminoſo *Flos papilionaceus* character eſt inſignis, quem ſpecies omnes *Leguminum* velut fronti impreſſum intuentibus oſtentant; cùm ex ſeminum eorúmve conceptaculi numero, figura, ſitu aliiſve accidentibus difficile eſſet notam generis indicem ſumere.

De Arborum & Fruticum diviſione inſtituenda, cùm horum genera non admodum numeroſa ſint, non eſt cur multum laboremus. Herbæ autem cùm numeroſiſſimæ ſint, in iis rité diſtribuendis & ordinandis præcipua eſt difficultas. Nobis diu multúmque conſiderantibus non alia prior aut potior differentia videtur quàm quæ deſumitur à *Plantula ſeminali*. Plantas ergo primo in loco dividemus in eas quæ *Plantulam ſeminalem* habent *biſoliam* aut *bivalvem*, ſeu mavis, binis cotyledonibus inſtructam; & eas quæ eandem obtinent *altero* vel *utroque folio* ſeu cotyledone *carentem*; in his quæ primò è terra exeunt folia ſuccedentibus ſimilia ſunt.

Poſterioris generis omnes, paucis exceptis, *Aſparago*, *Paeoniâ*, *Aro*, *Cyclamino* & ſiqua ſunt ſimilia, foliis ſunt Gramineis. Florum reſpectu dividuntur, in eas quæ floribus ſunt *apetalis* ſeu *ſtamineis*, & eas quæ floribus *petaliferis* ſeu bracteatis. Quæ floribus *ſtamineis* ſunt dividuntur in *Culmiferas*, hoc eſt, quæ caulem teretem, geniculatum & plerunque concavum edunt, ſingulis foliis ad ſingula genicula cum involventibus: & *Graminifolias caule*, geniculis nodoſis non intercepto. Culmiferæ grano majore quarum ſemina hominibus in cibum veniunt *Frumenta* & *Cerealia* vocantur, reliquæ grano minore *Gramina*. Quæ floribus *petaliferis* ſunt, vel conceptaculum ſeminale in terra loculamenta diviſum obtinent, ſeu radice *bulboſâ* propriè dictâ ſint, hoc eſt, vel è pluribus ſquamis invicem incumbentibus, vel è pluribus tunicis exteriore interiorem ambiente contextâ; ſeu radice *tuberoſâ*, ut Crocon Colchicum, Aſphodelus, &c. ſeu radice *fibroſa*, ut Phalangium; vel *baccifiræ* ſunt, ut *Aſparagus*, *Arum*, *Dracontium*, *&c.*

Prioris generis herbæ, quæ ſcilicet plantulam ſeminalem biſoliam aut bivalvem obtinent, à floris conditione commodiſſimè dividi poſſe videntur in eas quæ florem habent *apetalon* ſeu *ſtaminum*, hoc eſt, ſolis ſtaminibus cum Stylo & Calice compoſitum, ſolis illis fugacibus, cinellis, coloratis, petalis nobis cum *Columna* dictis, quæ vel decidunt vel marceſcunt ante ſeminum maturitatem, carentem: & eas quæ florem obtinent πτελέδη ſeu bracteatum, ſolis illis fugacibus coloratis inſtructum.

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Not. Ad petalum conſtituendum duæ conditiones concurrant oportet; 1. Ut ſit tenellum, & colore aliquo præter herbaceum inſigne. 2. Ut ſit fugax aut caducum, hoc eſt ut vel deſluat, vel marceſcat antequam ſemen matureſcat.

Quæ florem habent *petalis inſtructum* ſeu bracteatum, vel ſunt eodem *compoſito*, vel *ſimplici*.

Florem *compoſitum* voco qui ex multis floſculis in unum totalem florem coeuntibus conſtat. Florem hunc unicum compoſitum voco potiùs quàm floſculorum agmen, quia unico pediculo donatur, & unico calice includitur, & id multis ſpeciebus circulum in margine habet foliorum planorum radiatim medium diſcum ambientium, diverſæ à reliquis floſculis figuræ & magnitudinis.

Herbæ flore compoſito vel *lactieſcunt*, ſúntque eodem planifolio plerunque naturâ pleno; vel *ſucco limpido* ſcatent. Hæ autem vel ſunt flore *diſcoide*, h. e. ex pluribus brevibus, compreſſis & conſertis floſculis, in unam quaſi apparentem ſuperficiem digeſtis compoſito; ſuccedente ſemine vel *pappo* innaſcente alato, cujus generis herbæ *Pappoſæ* dicuntur, vel *ſolido* & pappo deſtituto, in *Corymbiferis* dictis; vel flore *fiſtulari*: hoc eſt, ex pluribus concavis oblongis floſculis, ad margines in longas lacinias diſſectis compoſito. In hoc genere floſculi etiam marginales fiſtuloſi ſunt. Hæ *Capitatæ* vulgò dicuntur, quia calyx earum ſquamoſus in ventrem plerunque extumeſcit.

Quæ florem habent *ſimplicem*, h. e. ex petalis, tantùm cum ſtaminibus & ſtylo conſtantem, ſeminum reſpectu dividi poſſunt in duo genera, Primum eſt earum quæ ſeminibus ſunt *nudis* ſeu verè, ſeu apparentur tantùm, h. e. nullo præter Perianthium vaſculo aut tegmine donatis: Alterum earum quæ ſeminibus *conceptaculo* proprio, & à perianthio diſtincto *tectis*.

Quæ ſeminibus ſunt *nudis* pro numero ſeminum ſingulis floribus ſuccedentium dividi poſſunt, in eas quæ ſemina ad ſingulos flores obtinent. 1. *Singula*, 2. *Bina*, 3. *Terna*, 4. *Quaterna*, 5. *Multa* incerto numero. Quæ *bina* ad ſingulos flores ſemina obtinent in duplici ſunt differentia, Alius *flores pentapetali* in umbellas plerunque digeſti, & hæ *Umbelliferæ* dicuntur: aliis flores monopetali, quadripartiti, folia caules ad ſingula genicula ſtellatim ambientia, multa, & hæ *Stellatæ* appellantur.

Quæ itidem *quaterna* producunt ſemina poſt florem unumquemque, duorum ſunt generum: Aliis folia in caulibus ad ſingulos geniculos ex adverſo bina, flores labiati, quæ *Verticillatæ* appellantur: aliis folia alterna, ſeu ſingulatim in caule ſita, quæ *Aſperifoliarum* titulo innoteſcunt.

Verùm quoniam ſemina, quæ videntur in nonnullis hujus generis plantis nuda, reverà non ſint, ſed folliculis ſeu theeis incluſa, ideóque titulum hujus membri diviſionis ſic emendabimus.

Herbæ flore perfecto ſeminibus vel nudis, vel in ſingulis folliculis, à planta matre unà abſcedentibus, ſingulis.

Nos equidem in Methodo plantarum non ità pridem edita pro nudis habuimus Verticillatarum ſemina, prout vulgo habentur, quamvis in nonnullis, ut *Libanotidis cachryophoræ*, dari nucleum, à ſpongioſo cortice diſcretum non neſciremus, quoniam in pleriſque hujus generis cortex nucleo arctè adhæret, & Theophraſtus ipſe ſemina hujuſmodi nonnulla pro nudis habet: idem de reliquis hoc genus ſeminibus, ut v. g. Stellatarum, Aſperifoliarum, & Polyſpermon dicendum, ea à nobis nudis accenſeri quia folliculi quibus includuntur interiori nucleo in multis ſpeciebus adhærent, in omnibus (etiam Malvis ipſis) unà cum ſeminibus incluſis à planta productrice abſcedunt; ideóque videntur & vulgo reputantur non conceptacula ſeu uteri ſeminum, ſed membranæ tantùm involventes, & ſecundinis analogi.

Quæ ſemina ferunt in conceptaculis ſeu vaſculis propriis, à perianthio diſtinctis, diſtingui poſſunt in eas quæ in pericarpio ſeu pulpa humida aut molli ſemina incluſa obtinent: Hæ duûm generum ſunt, nimirum vel 1. *Fructu majore*, corticoſo, cui flos inſidet; quæ *Pomiferæ* dicuntur: vel 2. fructu minore membranâ tenuiore veſtito, quæ *Bacciferæ* appellantur: & eas quæ in *conceptaculis ſiccioribus* ſemina continent. Hæ autem in multa adhuc genera ſubdividuntur. Sunt enim vel *conceptaculis pluribus & diſjunctis* eidem flori ſuccedentibus, quas *Multiſiliquas* dicimus, ut v. g. *Aconitum, Aquilegia, Delphinium, &c.* vel *conceptaculis ſingulis, aut conjunctis*, quas enim nos pro ejuſdem vaſculi cellulis habemus, Cæſalpinus aliique pro conceptaculis diverſis ſed conjunctis. Has autem pro numero foliorum in flore & eorundem figurâ dividimus in 1. *Monopetalas*, quarum ſcilicet flos unico & continuo folio conſtat, eóque vel *Uniformi*, vel *Diſſormi*. Florem uniformem ſuperiùs deſcripſiſſimus, in capite de Floribus plantarum. 2. *Tetrapetalas*, flore pariter vel *Uniformi*; cui ſuccedit vaſculum ſeminale, ſeu *oblongum* ut in *Tetrapetalis ſiliquoſis*, ſeu *breve* & *curtum* in *Tetrapetalis capſulatis*; vel *Diſſormi*, quales ſunt *Papilionaceæ* dictæ, quia earum flos Papilionem alis expanſis quadantenus imitari videtur. 3. *Pentapetalas*, ſeu *veras* quarum flos quinque petalis diſtinctis conſtat; ſive *apparentes*, quarum flos revera monopetalos eſt, cùm lacinæ in quas dividitur ad ungues junctæ ſint, ſed pentapetalum refert ob profundas & ad unguem ferè pertinentes ſciſſuras.

CAP. XXVIII.

De Collectione, exſiccatione, aſſervatione Plantarum, earumque partium.

IN Plantis earúmve partibus colligendis obſervationum cœleſtium, & Aſtrologicarum de partibus Zodiaci, planetarum aſpectibus, configurationibus, influentus, &c. rationem non habendam cenſemus. Quantum enim hactenus obſervare licuit, incertæ & fallaces ſunt, & ſucceſſu carent.

At neque multum referre putamus quâ Lunæ ætate collectæ fuerint plantæ: quin æque durabiles eſſe creſcente & decreſcente ſydere collectas.

Omnes denique de modo colligendi obſervatiunculas ſuperſtitioſæ vanitatis damnamus.

In genere autem colligendas censemus cùm in statu & vigore sunt, cùm succo jam imbi & probè concoctо turgidæ, antequam indurescentibus fibris lignescere incipiant: & quod ad tempus attinet, die sereno, cùm Solaribus radiis matutino rore dissipato penitus exsiccatæ fuerint.

Verùm (ut rectè Schroderus) finem duplicem collectio respicit, asservationem & usurpationem.

Asservationis causâ (ut ille pergit) colligendæ sunt eâ temporis periodo, quâ vigent qualitates ad durationem facientes, ut sunt siccitas, caliditas, vel moderata frigiditas.

Usurpationis ratione colligi requirunt dum qualitates vigent medicationi aptiores.

Sed ut de partibus plantarum in specie agamus,

1. Quod ad Radices attinet nonnulli Vere potiùs quàm Autumno colligendas judicant, quia tum (priusquam succus in folia & fructus absumitur) major iis inest & vegetior vis, humórque abundantior: è contra Autumno parciori polleant succo, siquidem æstatis decursu in caules, folia, flores, fructus omnis facultas insumpta sit, & proinde radix enervata. Alii præstare putant æstate eas colligere, cùm planta in vigore ac maturitate fuerit. Quippe ut integram plantam ità & radicem eum maturitate vigorari censent. Alii denique Autumno colligi latus esse statuunt, cùm folia decidunt, caulesque contabescunt, ob has rationes, 1. Quia omnis humor à stirpe ad radicem recedit. 2. Plurimæ per hyemem in terra relictæ ad ver usque pereunt non rarò frigore, aut gelu constrictæ corrumpuntur, ut v. g. Cichorium, Beta, Carrota, &c. 3. Non habent radices hyeme quod nutriant, adeóque sibi solis alendis vacant, & tunc temporis robustissimæ sint oportet. 4. Accedit frigus Autumni, condensans radicum calorem, omniáque exactius concoquens. 5. Radices Autumno vegetiores esse inde etiam evincitur, quòd Autumno transplantatæ facilius proveniant quàm Vere. Hæc omnia * P. Laurembergius.

* *Horticult. lib. 2. cap. 7. sect. 7.*

Verùm rationes hæ rem non concludunt, Iisque facilè respondetur. Nam 1. Nullus est Autumno humoris à caule in radicem recessus propriè dictus: quod tamen in idem recidit, humor qui in caule erat evaporat; cúmque ascensu à frigore inhibito, novus à radice non subministretur, tum folia defluunt, tum in nonnullis caulis ipse inarescit. Radix autem in terra latitans succo turgeat necesse est, cùm humor semper præsto sit quem è terra combibat, nec ullum in folia & caules impendat. Nec tamen inde sequitur Autumno vegetiorem esse radicem, sed potiùs Vere, postquam succus longa in valis per hyemem digestione & velut circulatione exaltatus fuerit, mitiórque & maturior evaserit.

2. Excipiendas concedimus quæ à brumali frigore vel corrumpuntur, vel etiam damnum & injuriam sentiunt: has enim Autumno colligere præstat.

3. Cùm radices per hyemem non habeant quod nutriant, tunc temporis robustissimas quidem esse convenit, non tamen initio hyemis, sed cùm temporis diuturnitate earum succus (ut diximus) probè concoctus & maturatus fuerit.

4. Quòd frigus Autumni condenset radicum calorem omniáque exactiùs concoquat concedimus. Quo ergo diutiùs insultus ejus senserint, (ni nimis vehemens sit) eò melius concoctо succo mitiores & maturiores sunt; ut in Pastinacis latifoliis experimur, quarum radices tempore Quadragesimali erutæ longè sapidiores & dulciores sentiuntur quam Autumno.

5. Quòd Radices Autumno transplantatæ facilius proveniant, eas tunc temporis vegetiores esse non convincit. Ideò enim facilius comprehendunt, quia cum omnis germinatio sursùm à frigore inhibeatur, nec aliud habeant quod agant, fibris duntaxat agendis vacant; nec ante foliis & caulibus emittendis distrahuntur, quàm diuturnitate temporis solo affixerint, eique firmiter coaluerint. Adde quòd per hyemem terra plerunque humore scatet, ut nullum iis à siti periculum sit, quæ æstate plerunque calore ambientis humorem evocante, permuntur.

Nos ergo herbarum omnium radices colligendas censemus cùm plenam maturitatem adeptæ sunt, antequam caulem emittere incipiunt: atque nonnullas autumno, alias æstate, pleraque vere: Plantarum annuarum æstate: *Biennium*, si periculum sit nè Brumali frigore corrumpantur, aut vitium contrahant, ut *Carotæ*, autumni initio; si hyemem facilè tolerent nec lignescant, primo vere antequam germinent, ut *Pastinacæ latifoliæ*; quòd si ante hyemem exactam lignescere incipiant, ipsâ etiam hyeme, ut *Rapa*: Earum quæ caule edito radicitus intereunt, vere antequam germinent; quo tempore pleræque etiam plantarum perpetuarum radices colligi postulant: nonnullæ tamen, ut *Acetosæ, Althææ, Asari, Buglossi, Cyclamini, Dracunculi, &c.* quovis anni tempore excepta hyeme colligi possunt. Ratio cur radices plerarumque plantarum colligendæ sunt antequam caulem edant vel germinent est, quia cùm caulem emittunt, succus illico radicem destituit & fibræ lignescunt.

Flores (ut rectè Schroderus) colligendi sunt, cùm pulchritudine sua luxuriant, nec tamen marcescunt. Excipe paucas quæ in gemmis colligi volunt, ut *Rosæ, Jasmini*, & sim.

Herbæ & folia cùm odore, colore, sapore, cacumineque superbiunt, & floreſcentiæ appropinquant, ad usum scilicet, medicum, aut ad Herbarium siccum conficiendum, cùm enim nimis teneræ sunt, succus aquosior est, & tota ferè planta in humorem resoluta evaporat. Hinc & gramen non ante demetunt pro fœno quàm in caulem abierit. Nam quamvis ad pabula aptius sit, dum adhuc tenerum & recens est, non tamen ut exsiccetur in fœnum: quia quamvis tunc temporis humore admodum turgeat, postquam tamen exaruerit, succo evaporante parum solidi restat pro pabulo, sed in nihilum ferè contrahitur. Deinde succus minùs exaltatus minùs firmum & solidum nutrimentum præbet. Tandem succus ille specificus, valis propriis contentus, in quo tota vis plantæ quà talis consistit, aliquo tempore indiget, ut ritè præparetur, & maturescat.

Ad usum culinæ sive in acetariis, sive in olere, Herbæ ferè aptiores sunt dum teneræ adhuc & recens natæ, ut in *Asparagis, Lactucis, Portulaca, &c.* cernimus.

Herbæ, utplurimum ad usum medicum cum floribus asservantur, colligendæ itaque hæ erunt quando floribus triumphant; ut *Calamintha, Centaurium, Chamædrys, Chamæpitys, Daucus, Fumaria, Majorana, Origanum, Polium, Pulegium, Serpyllum, Thymus, &c.* Schrod.

Simus

Semina colligenda sunt cùm bene matura fuerint, siccaríque cœperint, nec tamen exciderint: *Idem.*

Fructus ad medicinam cùm bene maturuerunt, ut rectè idem Schroderus: ad asservationem, ut idem è *Bapt. Porta in Mag.* antequam omnino matureſcant, ac neque omnino acerbi sunt, neque ad justam maturitatem pervenerint.

Verùm nos eorum potiùs consilium probamus qui non antè plenam maturitatem fructus colligendos monent. Maturitatis autem indicia sunt quòd sponte defluere incipiunt, vel quòd grana seu semina colorem mutare & nigreſcere cœperint.

Qui enim immaturi decerpti sunt contrahuntur admodum & corrugantur; eorúmque caro sicca & lenta evadit.

De exsiccatione plantarum, earúmque partium ambigitur. *Plerique enim* medici præcipiunt ut in umbra siccentur. Nos potiùs iis assentimur, qui citò & in Sole siccari jubent, quod in Fœno etiam exsiccando commodissimum experimur. Quo enim citiùs exsiccantur eò melius. Nam quæ in umbra siccantur, ni diligens cura adhibeatur, facilè situm & rubiginem contrahunt, & tandem corrumpuntur. Quod si velles ut flores & folia colores nativos diutiùs retineant, in umbra siccare præstat. Cùm autem folia, flores & summitates plantarum in sole siccandos dico, nollem ut singulatim sparsa Solaribus radiis exponantur, sed in acervulos composita sæpiùs verſentur donec probè exsiccata fuerint. EXSICCATIO.

Fructus pulpâ molli constantes quales sunt *Pruna* & *Uvæ* in sole aut in furno exsiccari requirunt: reliqui exsiccari non desiderant.

Pro Herbario sicco efficiendo Plantarum folia & flores diligenter explicata inter chartas siccas reponenda, & moderatè premenda sunt: nam si nimis comprimantur, valis ruptis humoribus consulis, colorem mutant & nigreſcunt. Sæpiùs deinde transferenda sunt in chartas novas & siccas, aliàs facilè mucescunt & corrumpuntur. Cùm penitus sicca evaserint chartis potiùs affluenda quàm agglutinanda statuimus, quoniam agglutinatio minùs firma & durabilis est.

Asservanda sunt herbarum folia, flores & summitates, postquam probè exsiccata fuerint in sacculis chartaceis (alii coriaceos præferunt) iisque pyxidibus ligneis inclusis, inque loco sicco & frigido potiùs quàm calido repositis. Calor enim partes spirituosas & odoriferas (in quibus vis plantæ præcipuè hospitatur) agitando facilè evaporabiles & fugitivas reddit. Conducit certè ad diuturnam asservationem, ut aer sedulò arceatur, qui partes activas ei expositæ plantæ brevi evocat & dissipat. Aeris enim partes in perpetuo motu sunt, movendo autem dividunt & partes volatiliores plantæ secum auferunt, præsertim si sit calidior. Proprium enim caloris est partes agitando à se invicem separare & dividere. Quòd si hoc non esset, & partes plantarum vaporabiles non minùs in vase clauso quàm in aere libero exhalarent; valis tamen latera eos cohibent nè longiùs recedant, sed ad plantam concluſam rursùs reflectantur, & ibidem quandam quasi circulationem efficiant. Hinc morem illum improbamus herbas in fasciculos colligandi, déque Officinarum tectis suspendendi. ASSERVATIO.

Fructus qui exsiccari non desiderant, ut *Mala* & *Pyra*, aeri exposita & in acervos congesta satis commodè servantur, si modò loco sicco & frigido reponantur: nam si locus calidior sit succo exinanitos contrahi & corrugari experientiâ didicimus. Sed nè nimius sim, varios modos servandi fructus vide apud P. Laurembergium *Horticult.* lib. 2. cap. 3. §. v.

Semina in conceptaculis suis optimè servantur loco frigidiore & sicco: satis commodè etiam in sacculis aut involucris chartaceis iisque cistis ligneis inclusis, inque loco sicco non nimis calido repositis. Nam calor immoderatus eo usque exsiccat semina ut germinationi inepta evadant.

Semina nonnulla si probè asservata fuerint per decennium integrum fœcunditatem suam custodiunt & sata germinant. Maximum ab humore damnum sentiunt & ad putredinem disponuntur. Et tamen (quod mirum est) terræ gremio excepta, quantumvis per hyemem perpetuò ferè madeant, secura & illæsa latitant, novoque vere promptiùs & alacriùs germinant quàm quæ diligentissimè custodita fuerunt, ut superiùs innuimus.

Cap. XXIX.

De Chymicâ Plantarum Analysi, & partium resolutarum Usu.

Missâ controversiâ illâ inter Chymicos & Philosophos tantopere celebratâ, an Ignis sit verus corporum Analysta, vulgò notum est, constitutiva vegetabilium principia esse spiritum, sal, phlegma, oleum, & terram.

Spiritus Vegetabiles sunt vel Vinosi, vel Urinosi; illique vel Acetosi vel Sulphurei; hi verò nil aliud sunt quam salia volatilia modico phlegmate soluta. Salia dividantur in volatilia & fixa, illa in Urinosa & Oleosa (Olea enim interdum concrescunt in Salia sui generis) hæc in essentialia, seu marina, & lixivialia, etiam & in saccharina. Phlegma prout magis vel minùs participat de Sale, vel Oleo, varia sortiatur epitheta, ut simplex, insipidum, aqueum, frigidum, albescens, aromaticum, amarum, calidum; phlegma per se proprie loquendo est humiditas elementaris. Olea sunt vel distillata, vel expressa, eáque odorifera, balsamica, fœtida, inodora, inflammabilia, æthera, crassa, &c. terra damnata & insipida audit, licet interdum variis operationibus & usibus inserviat, quod quidam Chymici optimè norunt. Hæc principia Vegetabilium in se invicem transmutentur, sunt enim secundaria elementa.

Modi eliciendi & præparandi hæc principia, seu Membra Vegetabilia è seminibus, frugibus, floribus, foliis, aliisque partibus plantarum, putrefaciendo, fermentando, digerendo, destillando, separando,

parando, rectificando, incinerando, elixiviando, filtrando, evaporando, vel Crystallizando, adeò triti & omnibus familiares sunt, ut hic non opus sit Cramben totiès coctam propinare.

In Scholis Medicis notissimum est, spiritus acetosos vim Bezoardicam habere, volatilem venenatámque acrimoniam domare, ferocientes humores figere, & obtundere; unde apud Chymicos corrigentis Vice admodùm frequenter sunguntur in præparando Antimonio, Saturno, Hellebero, Opio, Aro, &c.

Spiritus sulphurei sunt inflammabiles, inebriant, sanguinem accendunt, ablumunt roridum nectar partium, exiccántque tonum Viscerum, & humores reddunt acres, undè horum potatores sæpissimè evadunt Phthisici, Hectici, vel Hydropici; modicè tamen sumpti sunt Cordiales, & labantes vires sæpè revocant; in externis applicationibus sunt egregii usus contra frigidas intemperies; inserviunt etiam extrahendis tincturis, & resinis.

Spiritus urinosi vegetabiles, & salia volatilia, sunt diaphoretica, diuretica, acidum destruunt, & cum illo se jungunt, undè sal compositum resultat Armoniaco simile; sanguinem torpidum, crassum, vel emortuum, resuscitant, fluidum & volatilem reddunt, & restaurant; spiritibus animalibus, & generi nervoso sunt admodùm amici; undè juvant in Scorbuticis, Cephalicis, & convulsivis affectibus. Notandum tamen est, quòd hæc salia vel spiritus urinosi frequenter vel copiosè propinati appetitum dejiciant, & digestionem impediant, obtundunt enim glandulosum fermentum primarum viarum, & interdum excitant paroxysmos Hypocondriacos, convulsivos & scorbuticos, (licet eosdem eradicent, & tollant,) fermentando cum materiâ morbificâ, quæ sæpenumero habet texturam acidam.

Salia volatilia plantarum rarò in Alembicum ascendunt sub siccâ formâ, aut lateribus vasis adhærent, sed liquore immerguntur, & solvuntur; quod patet ab odore, & mixturâ cum acidis. Hi spiritus urinosi & volatiles reddantur fixi cum spiritu salis, aut vitrioli: affirmant nonnulli omne hoc Sal volatile oriri ex animalculis copiosissimè repertis in plantis putrefactis, sed hi nimis indulgent suæ phantasiæ; multa enim experimenta faciunt ex contrariâ parte. Hi spiritus urinosi seu Salia volatilia non solùm eliciantur è plantis calidis, Aromaticis, aut vulgò dictis antiscorbuticis, cephalicis, & Stomachicis, ut Cinnamomo, Galangâ, Zingibere; Cochleariâ, Aro, Nasturtio, Lepidio, Beccabungâ, Raphano; Rosmarino, Majoranâ, Salviâ, Rutâ, Lavendulâ, Thymo; Menthâ, Absynthio, Chelidonio, &c. Sed etiam è frigidioribus vel insipidis, ut gramine, papavere, lactucâ, portulacâ, endiviâ, acetosâ, sempervivo, melissâ, musco, Nymphæâ, lenticulâ palustri, &c. quod experimenta & argumenta D. *Wedelii*, & *Coxii*, extra dubium posuerunt. Hoc intelligendum est de vegetabilibus dùm recentes & virentes sint; semina dicuntur maximâ ex parte esse fertilissima hoc sale.

Phlegma maximè fungitur officio Vehiculi, & inservit Julapiis: Laudana, Spiritus, tincturæ, & Olea vix adhibeantur absque idoneo Vehiculo.

Olea destillata habent suos Usus tam internos, quam externos; nam rarefaciunt, penetrant, discutiunt, & roborant, attamen cautè & cum judicio internè adhibenda sunt, nè inflammabili suâ facultate febrim sanguini, & ureglinem visceribus inferant, præcipuè in infantibus: verùm Olea expressa & cocta pigriora sunt, lubricant, & laxant, commodèque miscentur cum destillatis, ità enim & horum caliditas & illorum segnities corriguntur, quod rectè monet *Wedelius*: inserviunt etiam variis usibus mechanicis.

Salia fixa videntur differre in suis viribus, saporibus, figuris, aliisque qualitatibus, pro ratione plantæ, vel operationis; omnia tamen obtundunt & destruunt acida, aperiunt & resolvunt coagulationes; undè in cachexia, affectibus Hypochondriacis, Ictericis, & febrilibus juvent. Hæc salia inter se non differre affirmat Clarissimus Coxius noster; attamen illa viribus discrepare ostendit D. *Grevius*; & figuris suis multum variari demonstrat D. *Lewenhoeck*. Inserviunt etiam pro conficiendo Vitro, & Sapone.

Wedelius videtur (meâ saltem opinione) rem acu tetigisse, affirmans Sal Alcali unum ab altero non differre, in genere, formâ externâ, seu affectu generali, attamen figuris, poris, & viribus per omnia non convenire.

Salia essentialia, & marina è lixiviis Crystallisata, quorum præparationes, & figuras vide apud D. *Grevium*, suos habeant usus in Medicinâ, incidendo, & detergendo; nec fermenta viscerum tam facilè obtundunt; & debilitant, ut *volatilia*, & *lixivialia*.

Salia seu concretiones Saccharinæ (qualia fiunt è succis Fraxini, Aceris majoris, Cannæ Indicæ, & Arboris Coco dictæ) inserviunt officinis pro conficiendis syrupis, conservis, electuariis, conditis, &c. variisque usibus domesticis. Attamen Clarissimus *Willisius*, & *S. Paulus* contendunt Scorbutum, tabem, aliosque morbos chronicos ab horum usu generari, & propagari; continent enim particulas acres & corrosivas mixtas cum rotundis & roscidis, palliantibus acrimoniam, quæ distillatione se manifestat.

Decocta plantarum, modò clausè & diligenter fiunt, numerentur inter optimas præparationes; vires enim, & virtutes vegetabilium maximâ ex parte continent, sic etiam & tincturæ, extracta, & pulveres; attamen singulæ partes plantarum chymica analysi solutæ non donantur omnibus specificis virtutibus, quas in ipsis plantis reperiamus; licet sæpissimè id separatim agant, quod conjunctim non agant.

Succi vegetabiles fermentati dant omnia genera Vinorum & liquorum inebriantium, quæ varia induunt nomina & qualitates pro naturis plantarum & regionum, & sunt apprimè utilia necessitatibus humanæ vitæ, modò sobriè utantur secundùm salutiferum naturæ instinctum. Hi succi colliguntur vel incisione, vel maceratione, & expressione. Succi inspissati dicuntur *Rob*, quod hi vel solâ coctione, vel mixtura sacchari seu mellis. *Rob* cum liquoribus diluta essentias efficaces constituunt, vel inserviunt pro fundamento bolorum & pilularum. Gummi seu Resinæ nil aliud esse videntur quam succi vegetabiles magis cocti, digesti, & concreti. Omnia operantur pro ratione plantæ, hinc audiunt diuretica, cathartica, & narcotica, e. g. Terebinthina, Gummi Gutta, Opium, &c.

Meliora

Meliora & nobiliora fiunt medicamenta è ſpiritibus urinoſis, ſalibus, & oleis, inter ſe invicem mixtis, & unitis ſ. a. digerendo, circulando, & deſtillando repetitis vicibus. Balſama, & ſapones componantur è lixiviis, & olois, egregii uſus in pharmaciâ, & mechanicis.

Tincturæ vegetabiles, & extracta optimè eliciantur & præparentur cum ſpiritibus, ſeu menſtruis ab ipſis plantis abſtractis, corpora enim facillimè ſolvuntur à ſuis propriis ſpiritibus, ſeu menſtruis; e. g. tinctura roſarum extrahatur cum ipſo ſpiritu roſarum.

Colores ſeu laccæ eliciantur è floribus cum ſucco limonum percolato, & depurato; vel cum lixivio benè filtrato è calce vivâ & cineribus clavellatis, ſeu ſodâ. Hoc fiat degerendo, decantando, & evaporando. Hi colores ſeu laccæ inſerviant pingendis floribus, aliiſque rebus colorandis, ſeu miniandis, quandò ſolvuntur & parantur in aquâ gummatâ, aut cum albumine Ovi; habeant & ſuos uſus in pharmaciâ.

Caput hoc de Chymicâ Plantarum Analyſi partiumque reſolutarum uſu contribuit ingenioſiſſimus, vir & ſingularis amicus noſter D. Tancredus Robinſon, *M. D.*

Cap. XXX.

De Morbis Plantarum eorumque Remediis.

Quamvis de morbis Plantarum eorúmque remediis multa ab aliis dicta ſunt, & plura adhuc cum fructu dici poſſent iis qui earundem culturæ & obſervationi multùm temporis & operæ impenderunt. Me tamen, cui aliud eſt quod agam, quique ſtirpes ὡς ἐν παρέργῳ & animi duntaxat causâ contemplor, obſervationes & experimenta deſtituunt, nec quicquam ferè dicendum ſuppetit, quod non ab aliis jampridem dictum eſt: ad quos Lectorem remittere mallem, quàm eorum commentarios exſcribendi tædium devorare. Quocirca caput hoc paucis abſolvam, & primo huic libro coronidem imponam.

Morbi Plantarum ſunt vel interni, vel externi.

Internos voco qui à ſucco nutritio intus ſuſcepto originem ducunt. Hic enim ſi vel nimis parcè ſubminiſtretur, vel nimis copiosè irruat, vel nimis frigidus & aqueus ſit, vel maligna aliqua aut noxia qualitate imbuatur, morbos in plantis generat; Fame plantas non minùs quàm animalia tabeſcere & tandem enecari minimè dubium eſt. Nonnullæ ex nimio alimento obeſitate laborant: ut *omnia quæ reſinam ferunt, nimia pinguedine in tædam mutantur; & cum radices quoque pingueſcere cœpere intereunt, ut animalia nimio adipe*, autore Plinio. Eſt & alius ab alimento nimis ubere morbus quem φυλλορροΐαν Græci vocant, cum arbores aut etiam herbæ foliis aut frondibus adeò luxuriant, ut fructum, vel nullum, vel paucum, vel ſtrigoſum edant. * *Luxuria hæc in ſegetibus caſtigatur dente pecoris dum in herba ſunt, & depaſtæ quidem, vel ſæpius nullam in ſpicæ injuriam ſentiunt.* Sed & tonſura prodeſt, quicquid contradicat Plinius. Ab humore nimio radices perpetuò alluente aut inundante pleræque plantæ præcipuè lædunturvel ob frigiditatem, vegetationi maximè inimicam, vel fortè quod humor poros obſtruens aeris ad radices liberum appulſum & influxum prohibet. Hinc in Septentrionalibus montoſis Angliæ & Scotiæ, ubi ſolum paluſtre rarum & fungoſum Spongiæ inſtar aquam imbibit & retinet, Ericæ longè latéque omnia occupant, & pauciſſimæ præterea plantæ proveniunt: hinc in fictilibus fundo impervio latæ ſtirpes languent, & ad frugem non perveniunt: quamvis in his fortaſſe etiam aqua ſtagnans computreſcat, & ad plantas corrumpendas conducat. Hinc, ni fallor, corticis in arboribus nimia conſtrictio & denſitas, quæ ſucci liberum aſcenſum impedit, & truncum in latitudinem extendi & augeri non permittit; cui malo hortulani noſtri ſubveniunt cortice ſecundùm longitudinem lineis aliquot ductis inciſo: hinc denique arbores muſco infeſtantur, qui ab humore crudo & frigido ortum ducit. Uſtilago Frumentorum & graminum nonnullorum morbiſne internis an externis accenſenda ſit dubito. Diſpoſitio certè ad hunc morbum eſt in ipſo ſemine, quamvis fortaſſe detur aliqua cauſa procatarctica ſeu externa quæ in materiam diſpoſitam agens morbum facilè inducat. Verùm de uſtilagine in capite de frumento fuſius agetur.

* *plin. lib.* 18. *cap.* 17.

Externos morbos voco qui ab externa cauſa inducuntur. Cauſæ externæ morbos producentes ſunt vel injuriæ cœli & tempeſtatum, vel inſectorum punctiones, eroſiones aut etiam afflatus malign. Cœleſte malum (ut cum Plinio loquar) & maxima ſegetum peſtis *Rubigo* eſt, Anglice Mildew vocamus. Frequentiſſima hæc in roſcido tractu convallibúſque & perflatum non habentibus: è diverſo carent ea ventoſa & excelſa. Hujus remedium ſuperſtitioſum & magicum proponit Plinius, nimirum Lauri ramos in arvo defixos, in quarum folia vitium ex arvis tranſit. Meliùs probiſſem feriis, feſtóſque dies ſolennes, quos huic peſti averruncandæ inſtituebant, *Robigalia* appellantes, ſi modo vero Numini & non fallis & fictitiis quibuſdam Diis ſacrati fuiſſent.

Inſectorum punctionibus, eroſionibus aut etiam afflatibus noxiis originem debent plerique tumores & excreſcentiæ in plantis, quæ generali Gallarum nomine complectitur ſummus Vir Marcellus Malpighius, quorumque hiſtoriam & Anatomen ſolitâ ſua ſagacitate & ἀκριβείᾳ exſequitur Anatomes Plantarum parte altera. Tractatum autem illum de Gallis ſic concludit, Erunt ergo Gallæ & reliqui plantarum tumores morboſæ excreſcentiæ vi diſpoſiti [ab Inſecto] ovi à turbata plantarum compage & vitiato humorum motu excitatæ, quibus incluſa ova & animalcula, velut in utero foventur & augentur, donec manifeſtatis firmatiſque propriis partibus quaſi exoriantur novam exoptantia auram. Nam ſuperiùs multis adductis exemplis demonſtrarat plantarum tumores reliquaſque ſideratas partes muſcas & diverſa Inſectorum genera fovere & alere donec emancipata viam ſibi faciant. Plura enim (inquit) inſecta ſua edunt ova, omni fere auctivo ſucco deſtituta, quarum aliqua cortice privantur, ità ut mollis primæva partium compages occurrat ſub ſpecie quaſi vermis. Ut igitur incluſum animal debitam acquirat partium manifeſtationem & ſoliditatem, uterum vel

vel saltem vicariam ipsius opem exigit, quam in plantis saga insectorum natura perquirit. Quare ex diversa Ovorum contentorumque Animalium indigentia à parentibus Muscis variè diversis plantarum partibus ova committuntur vel deponuntur. Quæ enim robusto cortice mununtur, & alimoniam unà cum animali claudunt, quacunque arborum parte jam tabefacta opportunè custodiuntur. Quæ verò molliora sunt in foliis ipsis deponuntur, vel si copiosius exigant humidum, majorémque tutelam, intra gemmæ tenellum corpus; intra surculos, flores, amentum, pericarpium, semina, lignum, radices & singulas ferè vegetantium partes conduntur, ope terebræ, qua Gallarum muscæ præ cæteris pollent. Terebræ enim quam diximus radix ovario nectitur, ità ut dispersa per multiplices tubas ova per communem ductum, quasi per uterum seu vaginam foràs à basi terebræ propellantur. His conjecturis sensuum fidem addere liceat. Semel propè Junii finem vidi muscam [qualem alibi delineavit] insidentem Quercinæ gemmæ adhuc germinanti: Hærebat etenim foliolo stabili ab apice hiantis gemmæ erumpenti; & convulso in arcum corpore terebram evaginabat, ipsumque tensam immittebat, & tumefacto ventre circa terebræ radicem tumorem excitabat, quem interpolatis vicibus emittebat. In folio igitur avulsâ muscâ minima & diaphana reperi ejecta ova, simillima iis quæ adhuc in tubis supererant. Tam ferax itaque muscarum familia è Gallis erumpentium, sic dictante natura, terebræ seu duplicis limæ usu vulnerat & persodit molles plantarum partes; ità ut ex diversa ipsarum natura & compage variæ pariter emergant morbosæ excrescentiæ & tumores. Ex infuso namque liquore è terebræ extremo effluente, qui summè activus & fermentativus est, nova in tenellis vegetantibus particulis excitatur fermentatio seu intestinus motus, ita ut appellens nutritivus succus & in transversalibus recollectus utriculis, peregrinâ aurâ inspiratus fermentari incipiat & turgere, ut frequenter in nobis & sanguineis perfectis Animalibus ex apum inflicto vulnere, & subinde infuso ichore experimur. At non ex vulnere tantùm & liquore fermentativo infuso morbi excitantur, sed afflatu ipso ovi aut insecti afficiuntur & contabescunt plantarum partes: Mirabilius est (inquit idem Clariss. Malpighius) quod passim ex relicto uno vel altero muscæ minimo ovo in foliis Vitis, Quercûs & similium accidit: convulsis enim fibris totum folium circa expolitum ovum in spiram contortum contabescit: quin tanta est depositi ovi vis; ut non solùm subjectum folium, sed communicata pediculo labe, indéque continuato surculo & appensis foliis; totus tenellus ramus in spiram contortus summâ colorum jacturâ exarescit. Hæc omnia D. Malpighius.

Notandum autem non omnes Plantarum tumores & excrescentias ab insectorum vulneribus aut afflatibus venenatis excitari, sed quosdam ab interno principio, nimirum succo nutritio quomodocunque alterato, vitiato, & à debita sua crasi & consistentia recedente oriri: interdum etiam ab externo vinculo aut pressura, contusionéve impedito nè per propria vasa liberè fluat: Cum enim à radice semper copiosè subministretur, & à dictis causis impediatur nè cursum continuet, in latus digreditur, & vasis impetu ruptis tumores gignit. Verùm de his consulatur Clariss. Malpighii liber modo laudatus. Nos his contenti hunc librum finiemus.

HISTO-

Herbarum Tabula generalis, summa genera exhibens.

Herbæ sunt vel

- *Imperfectæ*; quæ partibus præcipuis, flore scilicet & semine, sed præcipuè semine, vel carent, vel carere videntur, adeóque ortum habere spontaneum; ut FUNGI, ALGÆ, & MUSCI: species nonnullæ LIBER II.
- *Perfectiores*; quæ flore & semine donantur, saltem semine. Hæ vel sunt semine

  - *Minutissimo*, & nudis oculis inconspicuo; adeò ut earum pleræque ante inventum microscopium à nonnullis etiam magni nominis Botanicis stellites habitæ sint; ut CAPILLARES *herbæ* dictæ, &c. LIB. III.
  - *Majore*; quæ vel sunt Plantulâ seminali

    - *Bifolia*, seu bivalvi, binisve cotyledonibus instructa. Hæ semine satæ binis primò foliis plerunque è terra exeunt, rarius valvas seu cotyledones non efferunt supra terram foliorum specie. Sunt autem vel flore

      - *Imperfecto*, seu stamineo, hoc est foliis staminibus cum stylo & calyce composito, foliis illis tenellis, fugacibus, coloratis, quæ hos Petala dicere solemus, carente. LIB. IV.
      - *Perfecto*, seu petalode aut bracteato, foliis illis fugacibus instructo: Hæ autem vel sunt eodem

        - *Composito*, seu ex pluribus flosculis in unum totalem florem cocuntibus aggregato; qui vel

          - *Plantifolius*, naturâ plerunque plenus, plantâ lactescente. LIB. V.
          - *Discoides*, hoc est, ex plurimis brevibus, compressis & conferris flosculis, in unam, qualis apparentem superficiem digestis compositus, succedente semine, vel

            - *Pappo immarcente alato*, in PAPPOSIS inde dictis. LIB. VI.
            - *Solido & pappo destituto*, in CARYMBIFERIS. LIB. VIII.
          - *Fistularis*, h.e. ex pluribus concavis oblongis flosculis, ad margines in longas lacinias dissectis compositus, flosculis etiam marginalibus fistulosis; quod genus herbæ CAPITATÆ dicuntur. LIB. VII.
          - *Simplici*, seu ex petalis tantùm cum staminibus & stylo constantem. Hæ vel sunt seminibus

            - *Nudum*, hoc est, nullo præter petiantium calyculum aut semine donatis; ad singulos flores, vel

              - *Singulis*, LIB. IX. PAR. I.
              - *Binis*, floribus
            - *Pentapetalis*, in umbellæ formam plerunq; dispositis, UMBELLIFERÆ. LIB. IX. PAR. II.
            - *Monopetalis*, in quatuor lacinias dissectis, foliis caules ad nodos stellatim ambientibus, STELLATÆ. LIB. X. PAR. I.
            - *Terno*, cujus veneris est *Nasturtium Indicum* dictum
            - *Quaterno*; Hæ vel sunt foliis in caule

              - *Ex adverso binis*, floribus labiatis, caules plurimum verticillorum in modum ambientibus, VERTICILLATÆ. LIB. X. PAR. II.
              - *Alterno vel nullo ordine positis*; floribus monopetalis, margine quinquepartito; quæ ob folia in plerisque speciebus aspera ASPERIFOLIÆ denominantur. LIB. X. PAR. II.
            - *Pluribus quatuor*, nullo certo aut definito numero, quas *Gymnospermas polyspermas* vocamus. LIB. XII.
          - *Conceptaculis propriis & à perianthio diversis donatis*, quæ constant vel

Pericarpio

Insero inter pag. 58. & 59.

- *Pericarpio molli*, seu pulpâ per fructûs maturitatem humidâ semina ambiente; Hæ vel sunt fructu
  - *Majore* cortice crassiore tecto, cui flos monopetalos margine quinquepartito insidet, semina etiam majora sunt: POMIFERÆ dictæ. LIB. XIII. PAR. I.
  - *Minore*, membranâ tenui vestito, seminibus etiam minoribus. BACCIFERÆ. LIB. XIII. PAR. II.
- *Materiâ per maturitatem sicciore*, Hæ autem vel in
  - *Conceptaculis pluribus & distinctis* eidem flori succedentibus semina continent, quas MULTISILIQUAS dicimus. LIB. XIV.
  - *Conceptaculis solitariis & singulis*, aut conjunctis, quas florum respectu dividimus in
    - *Monopetalas*, flore vel
      - *Uniformi.*
      - *Difformi.*
    - *Tetrapetalas*, flore itidem
      - *Uniformi* seu
        - SILIQUOSAS, flori succedente vasculo oblongo.
        - SILICULOSAS, capsulatásve, vasculo succedente curto.
      - *Difformi*, papilionem alis expansis quadantenus referente, quas idcirco PAPILIONACEAS vocant.
    - *Pentapetalas* seu
      - *Veras & genuinas*, quarum flos quinque petalis distinctis constat:
      - *Apparentes*, quarum flos revera monopetalos est, cùm laciniæ in quas dividitur ad ungues junctæ sint, sed pentapetalum simulat, ob profundas & ad unguem ferè pertinentes scissuras.
- *Unifoliâ* aut *aphyllo*, i. e. singulis aut nullis cotyledonibus donatâ, idcóque foliis succedentibus similibus, è terra exit. Hæ vel sunt
  - *Flore imperfecto* seu stamineo, seu
    - CULMIFERÆ, hoc est quæ caulem teretem, geniculatum & plerunq; concavum edunt, singulis foliis ad singula genicula eum involventibus, sintque vel grano
      - *Majore*, quarum semina hominibus in cibum veniunt, FRUMENTA & CEREALIA dictæ
      - *Minore*, GRAMINA.
    - *Caule geniculis nodosis non intercepto*, vel non tereti. *Graminifoliæ floribus stamineis.*
  - *Flore perfecto*, seu petalode, quæ vel sunt radice
    - *Bulbosâ*, hoc est ex pluribus tunicis, exteriore interiorem ambiente, contextâ.
    - *Tuberosâ* fibrosâve, in bulbosis affinibus nobis dictis.

His adnumeramus plantas nonnullas quæ semina pulpâ per maturitatem humidâ inclusa obtinent, ut Arum & Dracontium, quas ni obstaret nota generica cum aliis communis ad Bacciferas rectiùs retulissem.

TAB. I.

TAB. I.

Plantæ imperfectæ.

Plantas imperfectas voco quæ flore & semine carent, aut saltem carere videntur, cùm neque flos neque semen in iis hactenus observatum sit, adeóque sponte provenire creduntur. Hæ ex loco natali distingui possunt in

- *Marinæ*, suntque vel consistentiæ
  - 1. *Durioris & lapideæ*, plurimarum specierum; CORALIUM, *Corallina*, *Porus*.
  - 2. *Tenerioris & herbaceæ*; referentes
    - *Herbas*, seu frutices,
      - *majores* & cauliferæ ferè; Fucus.
      - *minores*; ALGA. Utriusque generis species plurimæ observantur.
    - *Muscum seu Fungum*; SPONGIA.
- *Aquarum dulcium alumnæ*; vel foliis
  - *Carentes*, capillaceæ seu filamentosæ; CONFERVA.
  - *Trifidæ*; LENS PALUSTRIS, *Lenticula*.
- *Extra aquas nascentes*, quæ vel sunt substantiæ
  - *Crassioris*, ad carnes aut ligna accedentis. Hæ nihil ferè commune habent cum plantis perfectioribus: nec enim color iis herbaceus, nec textura analoga, neque flos ullus seminve, aut folium proprie dictum adest; FUNGI: qui vel
    - *Arborei*, secundùm arbores quibus innascuntur distinguendi; peculiaria autem nomina sortiti, sunt Fungus Laricis AGARICUM dictus, & Fungus Sambuci *Auricula Judæ*.
    - *Terrestres*, iique vel
      - *Cauliferi*, qui vel
        - *Pileati*, pileo subtus
          - 1. *Lamellato*; quorum species plurimæ esculentæ & noxiæ.
          - 2. *Poroso*; *Fungus* POROSUS.
        - *Non pileati*, qui vel sunt caule
          - *Simplici*; *Fungus* OPHIOGLOSSOIDES, *Digitelli*.
          - *Ramoso*; *Fungus* RAMOSUS.
      - *Caule carentes*, vel
        - *Tenuiores*, membranam seu corium referentes; PEZICÆ *Plinii*.
        - *Crassi* & in formam globosam coacti; *Fungus* PULVERULENTUS, *Crepitus lupi*.
    - *Subterranei*, TUBERA *terræ*.
  - *Tenuioris* & siccioris, ad herbæ naturam propiùs accedentis. Hæ vel sunt
    - *Cauliferæ & ramosæ*, plurimarum specierum; MUSCI.
    - *Caule carentes*, crustæ modo in terræ superficie, aut in arboribus, lignis, lapidibus, &c. reptantes; LICHEN *arboreus & terrestris*.

Herbarii Fuci & Algæ nomina ferè confundunt: & revera admodum est difficile plantas hasce submarinas ad genera aliqua reducere quæ notis certis & essentialibus differant.

Quæ Musci marini Botanicis censentur, nobis Algæ species sunt.

Surpes marinas à maritimis ità distinguimus, ut marinæ dicantur quæ perpetuò aquis innatant, vel singulis saltem æstuum accessibus aquis operiuntur; maritimæ quæ extra aquas in maris litoribus, aut palustribus mari vicinis, alibive in confinio maris oriuntur.

Præter muscos semine viduos de quibus in hac Tabula agimus, est & aliud Plantulæ genus eodem nomine, semine minutissimo prægnans, de quo in sequenti.

Sennertus *Hypomn. Phys.* probabile existimat tubera & fungos omnes è plantis provenire & nasci.

TAB. II.

TAB. II.

Herbæ ſemine minutiſſimo & nudis oculis vix conſpicuo ſunt vel eodem

- *Foliis averſis adnaſcente*: v. Tab. ſequentem.
- *Caulibus ipſis* aut pediculis privatis innaſcente inſidentéve: Hujus generis ſunt vel
  - *Imperfectiores*, ſuperficie perenni
    - *Caule carentes*, foliis in ſuperficie terræ reptatricibus latè ſe diffundentes, pediculis ſemini ſuſtinentibus è foliis enatis; LICHEN *terreſtris*.
    - *Cauliferæ*,
      - *Majores*,
        - *Spicatæ*, & repentes
          - *Abietiformis*; LYCOPODIUM.
          - *Cupreſſiformis*; SABINA SYLVEST.
        - *Non ſpicatæ* & erectæ; *Muſcus* ſeu *abietiformis*, ſeu *Polyſpermos*
      - *Minores*, vaſculis ſeminalibus
        - *Caules terminantibus*; ADIANTHUM AUREUM.
        - *E lateribus caulium egredientibus*; ſeu erectus; *Muscus terreſtris ſive* ceretus.
  - *Perfectiores ſuperficie annua*; ſuntque vel
    - *Monophyllæ*,
      - *Spicatæ*, folio integro ſimplici; OPHIOGLOSSUM.
      - *Paniculatæ*, folio è multis ſegmentis compoſito; LUNARIA.
    - *Polyphyllæ*, foliis teretibus, caules ad nodos in orbem ambientibus multis, radiorum in modum; foliis & caulibus pyxidatim articulatis; EQUISETUM.

Muſcus quamvis ab imperitiſſimo quoque primo ſtatim aſpectu agnoſcatur; cùm latiſſimè pateat id nomen, omnes ejus differentias unica definitione complecti difficillimum eſt.