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DISCOURSES

CONCERNING

Earth and Water,

Fire and Air,

As they relate to the

GROWTH *of* PLANTS.

WITH

A Collection of New Discoveries for the
Improvement of Land, either in the
FARM OR GARDEN.

By R. *B R A D L E T*,
Professor of Botany in the University of
Cambridge, and F. R. S.

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T H E
P R E F A C E.



Concerning the Growth and Management of Plants, and the Improvement of Land, we have already many Pieces which have been made publick; but still I find that the Business of Gardening admits of more Reasoning than has yet been publish'd. Botany is a vast Field, which affords every Day new Matter for Contemplation; and the more curious we are in that Study, the more Variety we find

The P R E F A C E.

in it: The Knowledge of Plants is, and always has been thought worthy the Regard of the greatest Philosophers, and when that Knowledge began to be well enough understood to improve Land and Estates by it, what Esteem, and what Honours did the first Improvers gain by their Skill.

The Names alone of those Men who are famous in History on Account of their Excellency in this Study, would fill a Volume; we may trace them to the first of Times, when Knowledge was confin'd to a small Part of the World; and we are oblig'd to the Greeks and Romans, for distributing to us their learned Remarks and Observations upon it, and from whence indeed is derived the Taste, which

The P R E F A C E.

which now most of our Gentry fall into of Agriculture and Horticulture, Studies so profitable and useful as these are, surely cannot employ too much of our Time, since Wealth and Health are the Consequences: 'Tis therefore I have design'd the following Sheets to instruct such as bend their Mind towards these profitable Diversions in the Principles of them, and have taken care that nothing should be wanting to render those Arts easy and familiar to the meanest Capacity.



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DISCOURSE

THE UNIVERSITY OF CHICAGO

PHYSICS DEPARTMENT

RESEARCH REPORT

NO. 100

BY

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CHICAGO, ILLINOIS

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DISCOURSE I.

Of the IMPROVEMENT of LAND in General.



Altho' the Arts of Husbandry and Gardening have been accounted in all Ages worthy the Study of the greatest Philosophers, yet we do not find any of the Writers of those Subjects have given themselves the Trouble of laying before us the Principles or Rudiments upon which those great and beneficial Works are founded, for want of which, I conceive the false Reasonings and Acting in these Particulars has proceeded,

and the many Miscarriages which we daily observe are owing.

In Order therefore to act with some Certainty in our Undertakings of this Nature, it will be necessary to consider the Use of Earth in general, with Regard to Vegetation ; and set forth the several Sorts of Earths, which are most common with us in *England* : From whence it will follow, That I treat of the Enriching or Improving one Soil by another, or by such Composts or Manures, as are used by the most expert Husbandmen or Gardeners.

The Use of Water likewise, as far as it relates to Vegetation, will not be unworthy our Regard : To which I shall add some practical Observations concerning the raising and forcing of Water to such Places or Eminences where it is wanting.

I shall in the next Place, treat of such Lands as are drown'd, or lye continually under Water : To which I shall add an Account of the most approv'd Methods for draining off the Waters, and bringing such Land into a fruitful State.

I shall

I shall then proceed to explain the Uses of the several Parts of Plants, and lay down some Proofs of the Sap's Circulation, and also explain the Manner how Plants generate: From whence it will naturally follow, that I mention the various Methods of Encreasing Plants by Seeds, Layers, and Cuttings, and then shall prescribe the Manner of making Plantations either for Pleasure or Profit.

To which I shall add the Advantages of Pruning Wall-Trees, Dwarfs, Espaliers, &c. from which I shall proceed to treat of the Dispositions of a Kitchen-Garden, and lay down proper Rules for the Culture and Improvement of Flowers, and shall conclude with proper Directions for the Culture of Exotic Trees and Flowers, with some Considerations concerning the building of Green-houses, Stoves and other Conservations, in which Work will be contain'd all the Principles upon which both the Arts of Husbandry and Gardening are founded.

According to these Propositions, I am first to enter upon the Subject of Soyles, that we may

know the Use of Earth in Vegetation, as the Foundation of all our Work ; for unless we can judge rightly of this, we cannot have any Certainty of what we undertake, either in the Field or Garden.

In this Case it will be necessary to enquire into the Particulars; first to examine into the Nature of the Soil, whether it be heavy or light, close or open ; and secondly, to know the Depth of it.

As to the first Point which we are to enquire into, *viz.* the Nature of the Soyle, whether it be heavy or light, close or open : I mean whether it be heavy or close as Clay, or light and open as Sand ; for upon one or other of these depend the Sorts of Soyl that have hitherto been observed.

Sand is the Principle of every Soyl, which seems to vary only as the Sand is more or less mix'd with the Parts of decay'd Vegetables or Animals, from whence it is render'd fruitful in several Proportions, and has its Parts more closely united, as the Parts which are mix'd with it, abound in viscus or oily Juices.

Again

Again we may observe, That Sand is of two Sorts ; either consisting of round Parts or angular Parts : We may also take Notice, that Sand is of various Colours, as grey, white, yellow, orange or red, blue, and black, and if any of these Sands, supposing them to consist of round-Parts, happen to be mix'd with a due Proportion of the Parts of Vegetables and Animals, they produce a fertile Soyl, which is more or less pinguid as the viscous or the oily Matter abounds in them, thus have we Earths of all these Colours, and of various Degrees of Fertility, Strength and Stiffness ; those which have their Parts the most closely united by this means we call Clay, and those Earths which are less binding, and are in the Middle Degree between Sand and Clay, we call Loam ; and from these we may reason upon all the rest.

As a Demonstration of what I lay down, if we take Clay of different Kinds, and lay every Sort in so many different Pans of Water, till they dissolve, either of themselves or by Force, we shall find, either a viscous or oily Matter swimming upon the Surface of the Water; and upon examining the Earthy Parts, we shall find its Principle Sand connex'd with such dusty Parts as I have

B 3

mention'd,

mention'd, as will appear by the Microscope ; which will plainly discover them to be broken Parts, either of Vegetables or of such Things as have had proper Vessels for their Juices to move in, such as cannot be found in Sand or any kind of Stone.

It is observable in Clay-Lands which lye upon a Descent, that by great Rains some of the Parts of the Clay lying next the Surface, are frequently carried by Drifts into Hollows, which by a violent dashing of the Waters, loose the viscous or the oily Matter which bound the Parts together ; so that when this is dry'd it will become like Dust, open in its Parts, but without such washing would become hard by drying, as all Clays or Bodies, consisting of fine parts, of Vegetables or Animals mix'd with oily or viscous Matters will do by Insolation. This we may observe in Meal and Water when they are mix'd together in Paste, where the Parts of the Vegetable being viscous, they bind closely when the Water is put to them, and become of an extraordinary Hardness, when the Mass is thoroughly dry, and if we mix Flower or Whiting with Oyl, and let such Mixtures remain till they are dry, they become hard as Stone.

Again,

Again, if we put Oyl or any viscous Matter to Sand, which has been wash'd clean from the Vegetab^l or Animal Parts, we shall find that this Mass, when it is dry, may be freely broken; but if we mix such Mould with it as proceeds only from rotted Leaves, it will become of a very binding Nature, even as tough as any of that Soyl which we call natural Clay.

The Soyl which we esteem the most, is that which we call Loam, because its Parts are not too much restrain'd or bound together like Clay; nor are so open and forcible as Sand, this Soyl is pleasant to the Husbandman, for that it does not want so much Force to turn it up as is required in the ploughing of Clay-Land; and in the next Place, in once ploughing, the Loam I speak of will break and fall fine, when a strong Clay must be plough'd three or four times before it will be mellow and even, then the viscous Juices abounding in it will occasion it to bind as hard as it did before, unless we overpower those Juices, by mixing a good Quantity of such Sand as is sharp and consists of angular Parts, which one may find on the sides of Rivers, and on the Sea shoar, or in Ditches, by the sides of great Roads that are gravelly.

If we undertake to reduce Clay to this middle-stated Soyl, which I call Loam, it is the cheapest Way to do it at once; for considering how laborious it is to plough a stubborn Clay, as it should be, and how much more at Liberty such Land will be to dispence its Riches, when its Parts are open'd by a due Quantity of sharp Sand, we shall presently find our Account.

The best Rule I can lay down for this Manuring of Clay with Sand, is to let the Sand be spread upon the Ground two Inches thick, provided we do not plough all together above six Inches deep, which will be enough for any Annual Crop; but this should have two Ploughings before we sow upon it, in order to mix the Sand and the Clay together.

Or, *Secondly*, we may reduce our Clay-Ground to the Temper of the Loam I mention, by spreading such black sandy Soil upon it as is commonly found in Heath-Ground, wherein are many woody Parts of the Heath and stringey Roots, which will very much help to open the Parts of the Clay, and being mix'd with it will become a fruitful Soil.

Thirdly

Thirdly, we may reduce our stubborn Clay by Sea-Coal Ashes, such as we may make out of waste of Coal-Pitts, lay'd in little Heaps upon the Ground, and burnt with Furze.

Fourthly, our Clays may be open'd and fertiliz'd by Lime, especially such as is call'd Stone-Lime; this is frequently practis'd.

Fifthly, by Lime and Dung mix'd, when it has been lay'd some time together, S. S. S. we may use with this rotted Wood, and rotted Leaves, which will still help our Design; for Wood, Leaves and Roots have seldom any viscous Matter in them.

Sixthly, the burning of stiff Clay is a great Help to cold Clay Grounds; by burning it in little Heaps and spreading the burnt Parts upon the unburnt Ground; for this becomes, by burning, sharp as drift Sand, and so keeps the Parts of Clay open, so as to suffer the Richness of the Clay to help in Vegetation; whereas, when the Land is overbound or stiff, the Vegetable Quality is so much confin'd, that the tender-rooted Plants, which happen to be station'd in it, cannot receive sufficient Nourishment from it, otherwise it is certain, there is no
richer

richer Ground in the World than Clay, if its Parts can be laid open enough for them to distribute their Riches; for we see plainly, that if we, by transplanting a young Timber Tree upon such a Soil, can but preserve it a few Years, till it can gain Strength in its Roots to penetrate such stiff Soil, and make its Way to its Nourishment, it will flourish extremely, the Oak especially; but if small tender Plants which are not of a robust Nature, be set upon such stiff Land, we may expect a very poor Account of them.

Virgil, when he speaks of the Richness of Soil to be chosen by the Husbandman, observes, with a great deal of Justness, that a pinguid Soil is the most profitable; but by no means can I agree with him in despising a light Soil, and making it barren: Indeed as the Case was with him, in a Climate which had as much Share of Heat in the Summer, such as about *Naples*, as any Part of *Europe*, so no light Land could be very profitable there, because such Earth has not Tenacity enough to hold Moisture, sufficient for the Nourishment of Plants, and in that Sense may be said to be unprofitable; but in such a Climate as ours, which is not expos'd to such violent Heats, we find the
light

light Soil preferable, upon many Accounts ; but it must be observ'd, that when I speak of light Soil, I do not mean simple Sand, but such as partakes of Vegetable or Animal Parts, as I have mention'd above : But then they must not be too much impregnated with viscus or oily Parts, for when we come to consider the several Degrees of Growth and Strength of Plants, we find that some Plants grow best in a very light Soil, others delight in Soil somewhat heavier and closer in its Parts, and the more robust Plants rejoice in the more pinguid Soils ; so that we must be always careful to give every respective Plant its proper Soil, that is, when we have Soils of different Sorts, we must contrive to cultivate such Plants upon every one as are most natural to each Soil.

But as it is impossible to find every Variety of Soil upon one Estate, so it will be best to bring our Grounds into such a Posture, as to imitate the middle-stated Soil, which I call Loam, for both the tenderest and the most robust Plants will prosper in a Soil of that kind.

So if we have sandy Ground, which we account too light, we must give it Strength by a Manure of
Clay

Clay or some rich Marl, or by sowing it with such Plants as are of a viscid Nature, and making a Manure of them, for the same Ground they grow upon. *Columella* gives us a Chapter upon this Subject, where he recommends the Lupine for a great Improver of light Land, as it abounds in viscid Juices, he directs us to cut the Stalk of the Lupines in Pieces, and plough them in about 2 or 3 Inches deep, and I have found that a Crop of Turnips sown pretty thick to be fed with Sheep, or only to be mow'd down, and after a Week or ten Days to be plough'd in, will be of extraordinary service to such Land.

Or if such sandy Land happens to lye near the Sea, it is a common Custom to manure it with Fish, and Sea-Weed of any Sort, which brings the Farmer extraordinary Profit.

It is practic'd about *Dunstable*, to manure their Clay Grounds with Woolen Raggs chopt small; and in other Places, to lay the Hair of Animals upon such Ground, both which proves advantageous to the Farmer.

It is necessary however, to make a general Compost of every waste Thing about a Farm, *viz.* the Dung of Poultry, the Dung of Sheep, the Dung of Horses and of Kine, Ashes, rotted Wood, Leaves, Litter, Straw, Grains if they happen to be spoil'd, and such like, to be lay'd together in a Pitt, and mix'd with Earth, and it may be so contriv'd, that the Drain of the whole Yard may run into it: We may also add Fern and Weeds if we have not suffer'd them to Flower; all this when it is well mix'd will make an excellent Compost for any Ground.

About the Isle of *Esly* the Farmers use Abundance of Pidgeons Dung, which they sow upon the Ground; it is full of Salt, and is of a very hot Nature, but their Land is cold and stiff; so that it is mended by this Manure.

But if it should happen, that we have a Tract of simple Sand, which is accounted unprofitable, let us not despair, since it may be cultivated for Liquorice, Carrots, Parsnips, Turnips, and Potatoes; and such Ground, will, without any Manure, bring these Crops to great perfection; or if we desire a more durable Crop upon it, the Firr-
Tree

Tree may be sown or planted there, with great Advantage.

We are also to observe, that Gravel and Sand are nearly the same in Nature, and what will grow in one will commonly grow in the other. These are both subject to Springs, and when they happen to be so, they are then only proper for such Plants as are natural Inhabitants of the Waters, such as Alders, Willows, Osiers, &c. but when they lye dry, they may be improv'd both by the same Means.

But I come now to consider the Depth of the Soil, and how far it is necessary to observe that, before we begin to set it in Action.

When we find our upper *Stratum* of Earth, but two Inches deep of a stiff Earth, and the *Stratum* below it Gravel, we may then, by Plowing, make a Coat of tolerable Soil four Inches deep, to which if we add some of such Compost as I have directed, it will bring Corn, and after that Turnips and Peas and Beans, or any Thing which takes a shallow Root in the Ground.

2d. If we find a tolerable Mould, about three Inches upon a Clay, we may work thofe together about fix or feven Inches deep, if we have the Benefit of the Ingredients which I have mention'd as Manures for Clay Ground; and this will bring good Corn or Pulfe; but generally where the Surface is very fhallow, that Ground is beft for Grafs, Clover, St. Foyer, and fuch holding Crops.

If our Bottom be Clay of a great depth, and we have a fhallow Surface, it may ferve to make a Seminary of young Oaks, or any Timber Trees, with Taproots, or to be fown with Afh, Keys, Hazle, &c. for Coppice Wood, but where the Clay is fo near the Top, it is hazardous to plant Trees in it of any confiderable Magnitude, efpecially the common way which is practic'd by moft Gardeners when they make Plantations in Clay Grounds, the superficial *Stratum* of Earth or Mould perhaps not being more than three Inches deep, they look'd upon it to be of fo little Value, that 'tis generally loft or thrown away, and the fecond *Stratum* of Clay not being thought good neither, the Places where the Borders are to be, or the Trees are to ftand are Trench'd, and the
Clay

Clay taken out two or three Foot deep, which Trenches are to be replenish'd with fine Mould, brought thither at great Expence, the Consequence is, that upon the first great Fall of Rain, the fine Mould lodg'd in these Clay Trenches, becomes Mud, and chills the Roots of the Trees, there being no Way for the Water to run off, which brings the Canker first, and then Death to the Trees ; but to avoid this Inconvenience, and save Expence, let the superficial *Stratum* of Mould be par'd off the Clay, especially where the Walks are to be, and let that Molud be lay'd upon the Borders, to raise them to a convenient Height, without digging at all into the Clay, the Walks or Spaces between the Trees may be fill'd up to them with Rubbish, or any ordinary Soil ; with this Management Trees will prosper, their Roots are at Liberty to seek Nourishment where they can best find it.





DISCOURSE II.

Of the PRINCIPLES of WATER,
and the Necessity of it in Vegeta-
tion:



THE Discourse I am now upon has no need of a Preamble, to set forth the several Opinions concerning Water as an Element; or is it necessary I observe any more of it Philosophically, than barely taking Notice, That it is generally allow'd to consist of Globular Parts; from whence proceeds its Fluedity, as appears by its Currency, when it is put upon any smooth Surface which has the least Declension:

And Sphærical Parts, of which all Water is compos'd, are capable of being render'd more light or volatile, or of being more rarify'd by a greater Share of Heat, so as to swim in the Air; or, as one may say, mix it self with it; or of becoming more Dewe, even to be fixt as Marble by a greater Degree of Cold, such as it is in Ice: This is chiefly what I shall have Occasion to touch upon concerning the Principles of Water, in this Discourse.

The Use of Water in the Education or Nourishment of Vegetables, seems from Experience to have a much greater Share than Earth it self; because we find, that besides the Advantage it is of to Plants when it is thrown near the Roots of Vegetables, which those Roots imbibe with the Salts or nourishable Parts of the Earth, the Vapour arising from it assists the Plants in so great a Degree, as to give them a double Vigour; as may be observ'd by setting a Quantity of Plants in Pots upon a Stone Pavement, and keeping them duly water'd; these will scarce have half the Strength of Growth in a Summer, that Pots with the same Sorts of Plants will have, that have stood upon the naked Ground, where the Earth
about

about them has had Opportunity of Discharging its watry Parts in Vapour ; for the Leaves, Bark, Flowers and Fruit of every Plant receives Nourishment from such Effluvia, very near as much as the Plants do by their Nourishment drawn in by the Roots. But this is in General, for some Plants which are very succulent, will endure many Years in a State of Life without either Earth or Water, feeding upon the watry Parts only which swim in the Air ; such as the *Sedum-arborescens*, and several other Sorts of Sedums or Cotyledons, when they lay them up in the House, will even put forth Roots when the Air becomes moist ; but these have very few of those Sap-Vessels which draw Nourishment from the Root, and therefore if we give them much Water, when there is not Heat enough to exhale it, quickly it fragnates about the Roots and rots them : Therefore, where this is the Case, never give such Plants Water, but when you are sure of Sun or Heat enough to evaporate it quickly. But Trees which have many Sap-Vessels, which are fed by the Roots, require more constant Waterings, as I shall have Occasion to explain in another Place. We may observe too, That the more succulent a Plant is, the fewer Roots it has in Proportion ; and so it is a certain

Rule, That the more succulent Plants must have the least Share of Water.

We are in the next Place to consider, How Plants in General are affected by Water, and what are the visible Signs of their want of it.

Every Plant, whether it has a bulbous, tuberous or fibrous Root, receives its Nourishment by means of the watery Parts in the Earth, at the Extremities of its Fibers; for all Bulbs are nourish'd, as well as tuberous Roots, by the Mouths of their Fibers; as will be describ'd in the Account of the Structure of Plants.

For this Reason, it is necessary when there is an Occasion for watering a Plant, that we pour the Water where we can reasonably suppose the extreme Parts of the Fibers lie, which in large Trees may happen to be at a considerable Distance, even six or eight Foot from the Body or Stem of the Tree: But if we water such Trees, as is the common Practice, close to the Stem, the most of the Fibers are not benefited by such Waterings, and the Tree still suffers: Neither should we alone consider the Necessity of watering immediately,
where

where we may judge the Mouths of the Fibers are situated, but refresh the Ground plentifully a Foot or two beyond that Place, that the Water may not be too soon exhaled, but have Time to lie and nourish the Tree as well by the Roots, as by continuing its humid Vapour about the Stem, Leaves and Fruit, to nourish the more spongy Parts of them, while the Roots are gathering convenient Subsistence for their Offices.

The Signs of a Plant's Want of Water are many, but it is dangerous to wait till they appear, for our Remedy may come too late. We are acquainted with the Distress of Plants by the Shrinking of the Leaves, by their turning yellow, by their flagging or hanging down; and by the dropping of the green Fruit in Trees: So that when ever any of these Tokens declare their Wants, we must not delay to give them good Waterings, as I have before mention'd. A Day or two, if the Weather be very hot (as one may reasonable suppose it must be, when this happens) is likely to occasion the Death of the Tree; or if it be a small Plant, we may be sure of its Destruction by a Day's Neglect.

We ought in this Case to confider our Soil, whether it be Sand or Clay, or light open Ground, or strong stiff Land ; if it is the former, watering of our Fruit-trees will be necessary more frequently than in the strong holding Soil ; a Fort-night or three Weeks dry Weather in Sandy Land is enough to trust a Fruit-tree without Water, especially if it happens to be in a warm Situation ; but if it be a stiff Soil, a Month's Drought will do it no Harm, but longer than that it will hardly do well without watering : At the same time we should stir the Surface of the Earth we design to water, which will keep it from binding too hard ; which it will be apt to do, if it is tending to a Clay.

I cannot help observing, that it is an Error to lay the Flower-beds in Partere-works high in the Middle, or round, as the Gardeners call it ; I would rather advise that such Beds be made concave, so as to lie hollow in the Middle, for as these should chiefly be furnish'd with annual Flowers in the Summer, and the most fiberous rooted Plants, and perhaps Ever-green likewise, by this Means the Watering they may require in
the

the scorching Seasons, will be effectual to them ; whereas if they were to lie in a Convex Manner, the Water would run off, and these Plants receive little or no Benefit from it.

When I speak of the Concavity of these Beds, I mean only, that there should be a very gentle Declension from the Sides to the Middle, as much only as will keep the Water from running off.

There is indeed some Beauty in the Roundness of a Bed, and that Roundness is necessary when we design a Bed only for our finest Bulbous-roots, because their chiefest Growing-time is in the moister Seasons of the Year ; and therefore this Convexity is a necessary Provision to carry off the Water, and thereby preserving our Bulbs from rotting : And as these have done their Office before the extreme Droughts begin, so this Fashion is proper enough for such Kinds of Roots.

In watering of Plants we are to observe, that the Evening in the hotter Season is the most proper Time for that Operation, because that the Water will then have Time enough to mix it self with the Earth, before the too scorching Heat of

the Sun can exhale it, or occasion it to scald the Roots of the Plants; which will be the Case if we water Plants in the Heat of the Day.

I am to be understood thus far only of watering Trees, and such Plants as are growing in the natural Ground; but the watering of Pots requires some further Consideration.

The Earth in every Pot ought to be rising a little about the Stem of the Plant, and fall gently to the Edges, that so the Water may rather fall to the Parts of the Pot among the fine Fibers of the Plant, than lye soaking about the Stem.

At every 3d or 4th watering of a Pot, the Surface of the Earth ought to be stirr'd; which otherwise would bind too hard about the Plant, and not admit the Water equally to the Roots of the Plant: Or else, we may lay on an Inch thick of fresh Cow Dung upon the Surface of the Pot when the Heats begin, which will prevent the Sun's scorching of the Roots, which otherwise frequently happens.

When we have Trees or Plants in Pots that require a great Share of Water, they should be set in shady Places during the great Heats of the Summer ; or else the Bottom of their Pots may be set two Inches in Pans of Water ; from whence, through the Holes at the Bottoms of the Pots, the Plants would draw what Water they require, and so will remain in good Condition a Fortnight in the hottest Weather with supplying the Water-Pans : This is much the best Way of treating Myrtles in the Summer, as well as other vigorous shooting Plants, which are not succulent.

It is also of great Advantage to all Sorts of Plants in Pots, to set Tubs of Water, or Tubs or Cafes of Water among them in the hotter Seasons, because there is continually exhaling such Vapour from those Bodies of Water, as the Leaves, Bark, and spongy Parts of the potted Plants imbibe and are assisted by.

I have also found it beneficial to Orange-trees, and other Green-house Plants, to set Pans and Cafes of Water among them when they were in the Conservatory ; and especially when the Weather is

too severe to open the House, or let in fresh Air amongst the Plants: For these Cases of Water, by their continual Exhalation, keep the Air of the House from growing stagnant, and consequently preserve the Plants from growing mouldy; besides it keeps the Bark and spongy Parts of the Trees full, and prevents the Trees from that dangerous Distemper of being Hide-bound: Such Pans and Cases I also find necessary to be placed in forcing Frames for forward Fruits; the Water in them nourishes both the Trees and the Fruit, especially if the Season be too brisk to allow them much Air: And I am of Opinion, when the Summer is very dry, Pans of Water would very much help our Wall-fruit-trees to be set near them; for the Fruit of every Plant consisting chiefly of spongy Parts, is chiefly nourish'd by the Moisture in the Air, the Sap-Vessels being very few in Number, which conveys the Nourishment from the Root to the Fruit.

In *Holland* they have a particular Way of watering Melons, by placing Pans of Water near the Plants, and having dipp'd a Yard of the Lift of Woolen Cloath in Water, they lay Part of the Lift in the Pan of Water, and the other End of
it

it is laid over the Root of the Melons, by which Means the Melon-plants draw to themselves the Quantity of Moisture which is necessary for their Support, and in 3 or 4 Days the Pans will have lost all their Water, tho' one of them which has not had a Lift in it, will not be dry'd up in three Weeks, so that we cannot say the Water is exhal'd by the Sun.

But as I have directed the Time of watering in the Summer to be in the Evening, so on the other Hand our Potted-plants which are preserv'd in the Conservatories during the Winter, must at that Season be water'd when they possess the greatest Share of Sun, or rather about Noon than in the Evening; that the warm Air in the House may prevent the Water's chilling the Roots of the Plants: For I find, that the Air in a Green-house, whether the Sun shines or not, will be warmer in the Day-time by several Degrees of the *Thermometer*, than the Air of the Night.

When I direct Tubs and Pans of Water to be set among Plants, there is an Advantage we may receive from it, which I have not yet taken Notice off, That this Water, when it has stood a
Day

Day or two, will be equally warm with the Air of the Houſe; but to keep it from Putrifaction, put ſome Earth at the Bottom of the Tubs, and when we uſe any of it, fill up the Tubs with freſh Water, the Earth will enrich it and ſoften it, and its Situation for a Day or two will temper it ſo as to aſſiſt the Vegetation of the Plants in the ſame Climate with it.

But the Uſe of Crude-water to Plants is rejected with as good Reaſon as the ſowing Seeds upon Crude-Earth; which is ſuch Ground as has been taken from ſome hidden Part, where the Air has not had any Opportunity of Freedom with it, both the Water, and the Earth I ſpeak of, muſt have Time to mellow or mix with the free Air, before we find them qualify'd for Vegetation; ſo that Pump-water from a deep Well is not proper for Plants, till it has been expoſ'd ſome Time to the Air and Sun, or elſe has had a little Earth, ſuch as the lighteſt Loam, thrown into it, which will correct its Rawnneſs, ſo as to ſoften it, and render it mellow enough to be uſed with Soap: So we find River-water and Pond-water much more aſſiſting in Vegetation, and more generally uſeful than our common
Pump-

Pump-water ; and it is the earthy Parts, as well as the Air that make them so, for all Rivers come from Springs which are hard and crude, if we were to use the Water at the Spring-Head, but their Passage thro' Earth and Air renders them soft, and capable of mixing with the oily Parts of Soap ; and such Water is to be coveted for Plants : For in such Waters great Variety of Plants will grow, as is evident in every River and Pond, but seldom any Plant of more worth than Moss, is found about a Spring-Head.

In the Education of Water-plants in Tubs, Cafes or Pots, I have try'd both River-water and Pump-water, and I found that such Plants as were raised in Pump-water were smaller than those that were fed by River-water, and were the aptest to blossom. Our Pots, Cafes, or Tubs, must be made very light, so that none of the Water can run out, and each of them must be fill'd so full of Earth, as to leave Room enough for a Depth of Water, according to the Height which the several Plants may require which we shall plant in them : And as there will be a great Exhalation of Vapour from these Water-tubs in the Summer, we must be mindful to fill them up with fresh
Water

Water from Time to Time, as the Water in them decreases.

And as I have set forth the Use of Water in the Education of Vegetables, so in the next Place I shall mention the most practical Methods of conveying it from one Place to another, where Forcing is required, so as to raise it from Tops of Hills, or such Eminences where it is wanting.

In every Undertaking of this Nature, we should first duly consider what Force is required to carry a Column of Water to a certain Height, and then what Powers are capable of being employ'd in such Force, and particularly, to contrive that all the Parts be of sufficient Strength to hold out against the required Force.

These are Considerations absolutely necessary in every Undertaking of this Kind; for I have too often seen very ingenious Contrivances set on Foot, which have miscarried in some Branch or other, as soon as they were set to work. As for Example, When the Force had answer'd the End it was design'd for, the Pipes of Conveyance have been so little consider'd, that they have burst and
given

given way, at the first setting the Machine to work. In other Cafes, fuch Pipes have been well guarded, and the Engine has done its Office for fome Time, but thro' the Multiplicity of Parts which compos'd it, the Friction has been fo great, that fome one Part or other has been out of Order, and the whole has flood still. Others again, where the Motion has depended upon Tides, have at first done their Duty, but for want of a fufficient Guard againft higher Tides than ordinary, have been blown up, as they call it. In this Cafe therefore; I am of Opinion, That where our Movement depends upon the Current of a River or upon Tides, we ought not only to know how high fuch Waters has been known to rife, but provide againft its rife, 3, 4 or 5 Foot higher than ever it was known to do; for unlefs we could command the Tides, the Rains and the Fountains, we can have no Certainty: Therefore the faying that the Waters of fuch a River were never higher than fuch a Point, is nothing to the Purpofe. And we find that many great Works have been deftroy'd for want of this neceffary Caution.

Again, tho' we have Mathematical Demonftrations, that fuch a Force will raife fuch a Weight of Water to a certain Heighth, yet I am not for trufting to the Extreme in Praétice ; becaufe in Praétice there are, for the moft part, fome unforefeen Accidents which were not provided againft in the Theory, and oftentimes occasions a Mifcarriage, even in the beft laid Defigns. It is much fafer and furer, if a Man is to remove a great Weight, which, perhaps, may put him to the utmoft of his Strength, rather to move it at twice than at once ; the firft is at the Hazard of his Health, the other without any at all : So if I was to force Water two or three hundred Foot high, and I could have a Force that would do it, confidering the vaft Friction and Wear of all the Parts (for there will be fome Obftruction, do what we can to the contrary, and perhaps fuch, as by this extraordinary Force may break and demolifh our Works when we leaft expect it) it is my Opinion, that in fuch Cafes it is far more reasonable to raife the Water at twice than at once ; there will be lefs Strength requir'd, and lefs Hazard in every Refpect ; and if our Engines are not too much crouded with Contrivance, we may expect

expect to find our Account in the Undertaking ; but where an Engine consists of a great Number of Parts, we must expect it to be frequently out of Order.

This particularly I observ'd in the Attempt of raising Water at *York-buildings*, by the Engine for raising Water by Fire ; where Captain *Savory* the Inventor of it, was concern'd in the setting of it up. That Gentleman, tho' he had before set up his Engines with good Success in several Places, especially at *Cambden-house*, near *Kensington*, was not content with the Plainness of them, when he undertook so great a Work as furnishing the Publick with Water, but doubled every Part in the *York-buildings* Engine, and by that made it impracticable for one Man to work it ; and it was liable to so many Disorders, if a single Mistake happen'd in the working of it, that at length it was look'd upon as an useless Piece of Work, and rejected. And after this it had as bad Success from others who endeavour'd to mend it, or improve it, as they call'd it, by altering the Captain's first Methods ; so that these, in some Measure, lost the Credit which his first Engines had got him : His first Sort, indeed, was not with-

out a few Inconveniencies, such as, That the Instrument, or Regulator of the whole Motion, depended upon several Parts; and in case that happen'd to be out of Order, the Engine was liable to blow up: But considering to how great Perfection he brought it, when he had the greatest Difficulties to reconcile, it is admirable that it answer'd the Design so well, as his first Works demonstrate: But as, always, the Stander-by may see more than the Gamster himself, I did not think it impossible to mend this Engine, by still making it more simple; and therefore directed in the Place of his Regulator, which consisted of many Parts, such an one as was plain, and could not by any common Accident be render'd incapable of Service, till it had done Business enough to be worn out; and even then, should not have any Danger attend it. This was done to the Purpose, as I have hinted in my *New Improvements of Gardening*, where I have given a Figure, with an Explanation of the several Parts of the Engine; from whence it will appear, That an Engine so order'd, without making any Variation, will be of real Use. But I must take Notice, That the Pipes thro' which the Water is forced, must be of Elm, as well as what is there call'd

call'd the Engine-tree, for neither Copper nor any other Metall will do, as too many have experienc'd, and is easy to be demonstrated.

In great Works, two or three such Engines should be employ'd at once ; which will not only raisè a greater Quantity of Water with Salety than a large double Engine (if it could be brought to Use) but if, thro' constant Use, one happens to want Repair, the whole Work need not stop, which it must do, if any Part of a double Engine be out of Order.

But to explain this more fully, Let us suppose that we are to raisè Water from the River of *Thames* at *Chelsea*, to the highest Part of *Oxford-Square* near *St. Mary-le-bone*, which at an Hazard one may guess, lies above 100 Foot higher than the Level of the River, and near three Miles from *Chelsea*: Now, as there is no Ground at *Chelsea* which is high enough to make a Reservoir upon the same Level of *Oxford-square*, then must either a Reservoir rais'd by Art at *Chelsea*, of 100 Foot high, to feed the Pipes which must be laid from thence to *Oxford-square*, or else there must be a Force sufficient to draw the Water from the Ri-

ver to the said Square : Both which may be done, but the Expence will never countervail ; as to the first, the raising an artificial Reservoir of the Height before-mentioned ; there is an Instance of it at *Versailles*, joining to the Gardens : And that it is possible to drive Water up a Hill, whose Perpendicular is more than 500 Foot, we see it done at *Marly*, by continued Chains of Pumps, which are always working, by Means of large undershot Wheels, which are set in Motion by the River from whence they draw the Water : There are very good Prints of these among the Prospects of the King of *France's* Palaces ; but this would be a prodigious Expence : Therefore let us suppose we employ some other Means, such as the Machine which flings up Water from the River of *Thames* to the Top of *Windsor-Castle* ; the first Mover is turn'd by the Stream of the River, by which the Water is forc'd about half the required Height, and lodg'd in a Well ; and from thence by Cyphons, which are work'd by a Man, it is convey'd to a Cistern, which is plac'd near as high as the Castle. There is also an Instance of an undershot Wheel, which by working throws up Water to an Eminence of 70 Foot Perpendicular, at Mr. *Stafford's* Seat at
Pynes

Pynes near *Exeter* ; but the Distance from the River to the Reservoir is not above half a Quarter of a Mile. These I bring as Instances of what can be done, and to shew the Necessity, where the Length and Height of the Way is considerable, of making proper Stops ; for I find in the last mention'd Work at Mr. *Stafford's*, it was with some Difficulty the Undertaker could get Pipes that were strong enough to resist the Force and Weight of the Water : And in the great Work at *Marly*, nothing less than Pipes of Cast-Iron were found capable of conveying the Water from thence to the Reservoir at *Versailles*, and those too of a very considerable Substance. For these Reasons, I think it would be adviseable in such an Undertaking, as that for raising Water from the River of *Thames* at *Chelsea* to *Oxford-square*, That first there be a Reservoir made or built near the River, so that its Bottom may lie between 40 and 50 Foot above the Sides, or rather be kept by Tan Wheels, which should continually lie under Water, which would be influenc'd by the decreasing as well as the increasing Tides, and could never be put out of Order by any great Flood, the Figure of which I have publish'd in my Monthly Writings.

By this Means our first Reservoir being full, we have no reason to doubt but that the Water in it will rise thro' the Pipes of Conveyance to its Level, at a remote place, which we will suppose may be about some of the higher Grounds in *St. James's-Park*; where, if the Ground happens not to be sandy or gravelly, a Reservoir may be made without much Trouble, from whence, either by a Chain of Buckets, or two or three of Captain *Savory's* Fire Engines, the Water may be thrown up into a Reservoir 40 or 50 Foot higher, into a small Reservoir, which would carry it to some Eminence of the same Height, such as seems to be the highest Ground about *St. Mary-le-bone*, or vulgarly, *Mary-bone*, where should be the grand Reservoir, which I suppose might be made at little Expence, the Ground thereabout being for the most part a strong Clay; by which Method I conceive such an Undertaking may be composed at no great Expence, and be free from the Hazards which too frequently attend such large Works.

But in Affairs of a higher Nature than this, where Water is only to be rais'd ten, twenty or thirty

thirty Foot, if we have a River, we may do this with either one of the *Persian* Wheels, which at the same Time it is turning by the Stream, the Buckets or Troughs with which its Circle is dress'd will be filling, and emptying themselves continually, the full ones discharging themselves at the Top of the Wheel; which Wheel may be 20 Foot Diameter, and consequently the Buckets may discharge the Water at 10, 12, 16 or 18 Foot above the River, according as the Axis of the Wheel is plac'd, higher or lower; or else a common undershot or overshot Wheel may work a Chain of Buckets so as to lift the Water 30 or 40 Foot high upon a Frame, and discharge themselves that Height above the River or Pond, into a Receiver: Such a Wheel may be made to work Pumps to fling Water near twice that Height, but if a Stream is wanting, these Movements may be made by Horses; but these Devices must have Cisterns or Reservoirs near at Hand, to render them useful. Where a Canal or Pond happens to lie higher than a River 8, 12 or 16 Foot, and is in want sometimes of fresh Water, the Stream of the River may set one of the *Persian* Wheels at work, and by having only a Trough for the Buckets to empty their Water into, which

by Pipes has a Communication to some Part of the Canal or Pond, to be discharged above the Surface of such Canal or Pond, and an Outlet for the Pond-water to run out, directed to a certain Height, in a Week or Fortnight's Time, according to the Bigness of the Pond, we shall find our Pond which was muddy before, become clear and pleasant, by Means of the continual Flowing of the River-water into it, by the Wheels constant Supply.





DISCOURSE III.

Various METHODS relating to the DRAINING of LANDS.



AS in the last Discourse I treated of the Necessity of Water in Vegetation, and of the several ways of supplying such Places with it as are wanting of it ; so I shall now explain the several Methods which are used for draining off the Water from such Lands as are render'd useles by too great a Quantity of it.

In the Prosecution of this Discourse, it will be necessary that I consider two Things, *viz.* Whether our Lands are overflow'd by Fresh-water or by Salt-water, by Rivers or by the Sea; for the Management of such Lands, when they are discover'd, is very different one from the other; for the Ground which has been overflow'd with the Fresh-water, may be much sooner brought into a State of Fertility than a Piece of Land which has been overflow'd by the Salt-water; but both of these, when they have had sufficient Time to mellow, are not only extremely vigorous in their Productions, but such Land also serves as an extraordinary Manure for scaley or gravelly Ground, one Load being worth two Loads of Dung.

The overflowing of Land by Rivers, proceeds either from some Breach in the Banks of the Rivers, or from Land-waters, which fall in Abundance from the Hills after great Rains, which joining with the River-waters, cause them to overflow their Banks; or else, such an Overflux may happen by extraordinary Tides.

From whence one may judge how necessary it is in the disposing of Rivers, to make them navigable ; that particular Provisions may be made to secure the Banks, in such Manner, that they may have Strength enough to resist any extraordinary Torrent ; and that they may be high enough to prevent any sudden Gush of Land-Waters from overflowing them, or to be above the Reach of extraordinary Tides.

As to the First, We are to observe particularly where the Ground of which the extraordinary Banks of the River is the most loose or tender ; and in such Parts, to line them well with Chalk or Clay, and to allow the Base of the Slope next the Water to be broader than in other Places, and plant such Slopes with a double Row of Willow-Piles or Stakes, so that their Tops may appear only a Foot out of the Ground : These Stakes may be from ten to twenty Foot long, according as the Height of the Bank requires : These Stakes may be planted about 8 or 10 Inches apart, and will in a few Years (tho' they lie for the most Part under Ground) grow to that Thickness, as almost to touch one another, while their Fibers
will

will be entangled to that Degree, that they will be capable of resisting the greatest Force of the Waters. But these Stakes I rather advise to be planted in an oblique Manner, than upright; the first Row leaning one Way, and the second Row leaning the direct contrary Way; so that by crossing one another, the Spaces will be of the Figure of a *Lozenge*: By this Means the Stakes will support one another.

But when we are to consider the Height of the Banks, in order to prevent an Overflux of the River upon sudden Gushes of Rain or Land-waters, it will be necessary to satisfy our selves what Quantity of Ground has been laid under Water by Overflux of the River, and what Depth of Water such Land has had upon it; that so when we make any of our new Cuts, we may allow Space enough in them to command such an extraordinary Quantity of Water, when it may happen to come a second Time: And in this we ought likewise to allow still more Space than appears necessary from our Calculation, in case greater Floods may happen, or that Tides may flow higher than they have done before: For it is not enough to say, That the greatest Floods that
 have

have been known in the Memory of Man, or the highest Tides, never exceeded such a Height ; because we find every Day produces something new, and the highest Rise of Waters that have been known, were not expected or thought possible till they happen'd ; and therefore Provisions were not made against them. 'Tis therefore necessary that in all Works of this Nature we arm against Accidents ; and in making of our Banks, tho' we can be certain that the Waters we are to fence against, never exceed five Foot high, yet it is Prudence to suppose, that they may rise upon some new extraordinary Occasion, a Foot or two higher than what has been observ'd before, which accordingly should be guarded against. Then may we enjoy Tranquility of Mind, when we have so well consider'd our Undertakings ; that according to the Rules of Reason we have made sufficient Defence against such Accidents as may happen : And I am persuaded, that the Want of Thought this Way, has not only been the Occasion of many Miscarriages in great Works, but has been the Ruin of many Families.

I come next to consider the Losses which we may sustain by the Erruption of Rivers or of the
Sea,

Sea, when ever this rude Element is not discreetly guarded against, and gains an Advantage over us, by breaking thro' our Works. All the level Grounds, as well as those which lie below it, must consequently be lost or bury'd in Water: Such was the Case at *Dagenham* in *Essex*, when the Breach was made there by the River *Thames*, and many thousand Acres of good Land were drown'd, by which those Gentlemen, which the Minute before enjoy'd all the Affluence of Fortune, were in an Instant reduc'd to Beggery; for upon the first breaking in of the Water, when the Breach was small, and it might have been easily stopt, the Confusion among them was so great, and at the same Time it was the Business of so many, that no Body undertook to put a Stop to it; so that it grew wider by Degrees, till at last it over-power'd the Skill of the best Artists; till Captain *Parry* took it in Hand, by whose Skill it was at length stopt; and the Land is now for the most Part recover'd. We are to Note, That in such a Work of raising a Dam against the River that has broken its Way thro' its Banks, one must have Regard to the Back-waters, which in such a Case, are of a Weight, at least, equal, if not superiour to the Pressure of the River; so that

one

one must not only have Regard to keep out the River at high Tides, but to have Strength enough in our Works to withstand the Back-waters, till they are all run out thro' the Flood Gates, which should be provided for that Purpose at Low-tides. In this Case we are also to observe, that the Ground was overflow'd by such Water as one may rather call Salt than Fresh-water.

In *Holland*, where the Country generally lies lower than the Sea, and when the Sea is only kept from overflowing it, by Means of strong Banks or Dams, there is great Care taken in such Places, where the Sea drives in an extraordinary Manner against them, to keep off the Force of the Surges by large Piles of Timber, which they drive a convenient Depth into the Sands ; so that the Tops stand several Foot above the highest Tides, by which Means the Violence of the Sea is broken before it can reach the Banks : But yet sometimes the Tides are so high, and the Sea so strong, that neither the Piles nor the Banks are able to resist the Fury of the Waves, but they are forced to submit, and the Country is overflow'd, to the Loss of many Lives : But always upon the Fall of such a Tide every Man within Reach of the Place attends,

to repair the Damage ; and in a Tide or two the Breach is repair'd, by driving down Piles of Timber, and filling up the Vacancies between them with Carts or Carriages fill'd with Stones, or such like heavy Bodies.

But when this is done, we are to consider that the Country still remains overflow'd, and therefore our next Business is to drain off the Water, which may be done several Ways. The first Method which is most generally practis'd, is by a Wheel, which is set to Work with a Wind-mill : This Wheel is about 13 Foot diameter, resembling a Wheel with Spokes only ; but in lieu of Spokes they are Boards of 14 or 16 Inches wide : This Wheel turns between two upright Plains of Boards, so that there is not an Inch Space on either Side between the Wheel and the Plains of Boards ; so that as the Wheel turns in the Water, the flat Boards which stand in the Room of Spokes, bring up the Water as high as the Axle-tree, and discharge it over the Banks ; so that whenever the Mill goes, it carries off a large Stream of Water without Intermiſſion : This Engine is chiefly in Use among the *Hollanders*, and I have also seen the same in the *Lincolnshire Fens*.

Or

Or, if the Banks are very high, the Wind-mills may work either Pumps or Chains of Buckets, to discharge the Water.

But let us suppose our Case to be the most difficult that can be, such as having a great Quantity of overflow'd Land encompass'd with Hills, so that our Wind-mills can be of no Use; nor Pumps, nor Chains of Buckets can reach to discharge the Waters over the Hills: In this Case, I know no better way than to use the Crane, which is infallible, if we can find a lower Ground on the Out-side of the Hills; for if our Hills were never so broad, we might bring a Crane to act so as to discharge the Water over them. For this End we may use either Elm or Fir Pipes, of three or four Inches Bore; placing at the very highest Part of them a Turn-Cock, by Means of which, the Range of Pipes which make up the Crane, may be fill'd with Water; first stopping them at each End. When this Range of Pipes is once full, and the Turn-Cock shut close, we must first unstop that End of the Crane which lies in the

E. Water,

Water, and then the other; so will the Water flow in a continued Stream from the Crane, as long as it has any Water to discharge.

But let us consider in the next Place, that, tho' by Flood-Gates, or Mills, or Cranes one may lay dry an overflow'd Ground in some Sort, yet perhaps some of the lower Parts of such Land may hold a standing Water; so that we must go another Way to Work to bring the Ground to Use; which must be done by cutting of Canals, Dykes or Ditches of such a Depth, Length, and Breadth, as may contain the Water, and give an easy Communication to every Part of the Ground. In this Work we shall find, that besides the Room which we make to hold Water in such Canals or Dykes, the Earth which we take out of them will raise the other Land in such Proportion, as yet to give more Room for the Water, as it is the Case in *Holland* and other Parts, where Water is in too great Abundance.

Our Land being once drain'd, we come next to consider what Methods ought to be taken to
improve

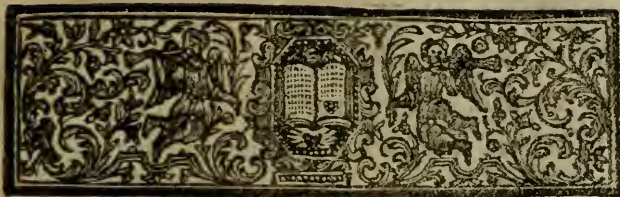
improve such Ground, and make it produce profitable Crops.

I observe, that when we first discover Land which has been overflow'd for a great Number of Years, it is generally black for a good Depth, and consisting of very fine Parts, which being turn'd up, and lying expos'd to the Air and Sun for some Time, it becomes mellow and fit for Action : But if it has been overflow'd with Salt-Water, the Salts will rise to the Surface by the Heat of the Sun ; and then we may pare off the Surface when it is thoroughly dry : This Surface will be well worth our while, to be carted to some of our Ground which is the least fertile : It is excellent upon a Clay or upon a Scaley Ground ; but should be always more moderately used upon light, than stiff Soil : But the Ground, where this is put, must be plow'd twice or thrice, in order to mix the natural Soil and the drown'd Earth together. When this is done, we may sow it first with Turneps, and it will afterwards bring excellent Corn. But our new drain'd Land will be much too luxuriant for Corn, till it

has had Time to fallow, and has brought a Crop
of Cole or Rape, or such like strong growing
Vegetable.



DIS-



DISCOURSE IV.

Of the several PARTS of PLANTS
and their Respective OFFICES,
with Regard to Vegetation.

IT is necessary, in the first Place, to consider that every Tree consists of two principal Parts, *viz.* The Root, and the Body: The Business of the Root is to act in the Ground, while the other is to act in the Air: And both these Parts are capable of being alter'd and chang'd, by shifting their Stations. The Roots being expos'd to the

Air, will produce Buds, Leaves, Flowers and Fruit ; and the Branches, which are now enjoying the Air, being bury'd or lay'd into the Ground, will divert themselves from their present Method of Growth, and produce Roots and Fibers : This is Evident from the Experiment I have publish'd several Years ago, relating to the reverfing of a Tree ; by first laying down the Head of a Tree in the Ground, and letting it fo remain till it has taken Root ; and then digging up the original Root, and expofing it to the Air, while the Head, which has now taken Root, is capable of nourifhing the whole Plant.

This Experiment fhews us, That the fame Principles of Vegetation are in the Roots and in the Branches, and that their different Manner of Acting proceeds only from their different Situations, the one being govern'd by a Body, light as Air ; the other by a Body denfe as Water or Earth.

Every Root, as well as every Branch of a Tree, confifts of two principal Parts, *viz.* Sap-Veffels, which extend themfelves through the whole Body ; and fpongey Parts, which enclofe the Sap-Veffels : Thefe in the Trunk, or Branch, or Root of a
Tree

Tare, are ſo diſpos'd, as if one was to ſtick Quills or Straws in a Sponge, the Quills or Straws repreſenting the Sap-Veſſels, thro' which the Vegetable Nouriſhment circulates, when it is taken in by the Root from the Earth, or from the Leaves by the Air. The ſpungey Parts have alſo a Communication with theſe Veſſels, ſo as to keep them open in ſuch a Manner, as to continue them in a Capacity of receiving the Sap; for without theſe ſpungey Parts, the Sap-Veſſels would ſhrink and dry up; ſo that no Juices could move in them: The one is neceſſary to maintain the other, as the ſeveral Coverings are neceſſary in Animals, to ſupport and defend the Blood Veſſels.

The ſpungey Parts of Plants are moſt aparent in the Pith and Bark of Trees; the Bark, by being of this Texture, is capable of receiving its Nouriſhment from the Air, as well as of diſcharging ſuch ſuperfluous Moiſture or excrementitious Juices as are neceſſary to be voided, to keep the Plant in Health; and as the Bark has a cloſe Communication with the Pith of a Tree, ſo ſuch Juices as are naturally requir'd to be diſcharged from the Pith, have a Freedom of Paſſage thro'

the Bark ; or the Benefit which the Bark receives from the Air, is communicated to the Pith.

The Bark and the Pith are so much of the same Nature, that while the Bark is tender and full of Juices, so is the Pith ; and when the Bark grows hard and woody, so does the Pith likewise ; so that we never find the Pith of any Moment or Use, but in young Shoots, where the Bark is tender ; and we seldom can observe any Pith, but what is tending to Rottenness, in a Shoot of three Years old.

+ The Buds of Trees have their first Rise in the Pith ; they are there fram'd, and as they become fit for Action, by being furnish'd with every necessary Part for Vegetation, they are forced along certain regular Channels, till they meet the Air at the tender Bark, thro' which they make their Way ; and would drop to the Ground, if they were not restrain'd by a Number of Sap-Vessels, which serve as so many Roots to nourish them from the Body of the Tree. The Buds ~~are~~ ^{are} in every Respect, as perfect as a Seed, or rather more so ; for a Bud contains a whole Plant roll'd up in it, and has, for the most Part, its

Juices

Juices so well digested, as to come sooner to bear Fruit, than that Plant which is wrap'd up in a Seed. We are to observe, that the Difference between a Bud and a Seed is, that a Seed consists of Lobes or Ear-Leaves, which include the young Plants, and serve to give the little Plant, they inclose, the first Stamp; by teaching it what Kinds of Juices it ought to draw from the Earth for its Nourishment: But a Bud has no Occasion of such Ear-Leaves, because it takes Root immediately in the Body of the Tree, where the Juices are already fit for it: So a Seed takes Root in the Earth, and a Bud takes Root in the Tree, and both these are produc'd by the same Tree, but in different Manners. As they are to be of Different Uses, Seeds are to multiply the Species, and within the Compass of certain Laws of Nature, have Liberty to sport, and produce their own Species with Variety of Completions; while Buds are constant to the Mother-Tree, and are exact Representatives of the Plant that produc'd them. ✕ This seems absolutely necessary in Nature, as well when we consider the Offspring of Plants from Seeds, as when we have Regard to Animals, that they should not all have exactly the same Faces: For as the Faces are so made,

as

as to be capable of being touch'd with Variety, so are they recreated and refresh'd by it, and remain longer perfect, than if each of them was continually to be employ'd upon a single Object. As for such Plants as are produc'd from Seeds, they are all of them some Way different from one another, either by some little Variation in the Colour of the Flower, the Taste, or Time of ripening of their Fruit, the Flower or Figure of it, or some Difference in the Shape and Colour of the Leaves: So in Animals, we find that the same Female will produce great Variety, her Offspring differing from one another, either in Colour or Marks, and some more tractable than others, some more lively and brisk, &c. But none of this Offspring will bear exactly the Face of the Mother, or be exactly like the Sire: But the Reason of this we shall examine in another Place.

~~But as I have~~^{ing} said thus much of the Seed,^{we are} I am next to set forth the Benefit Nature has given to Plants, to make up their Deficiency in the Want of local Motion: And this is particularly instanc'd as in the Production of Buds in Trees, which may be transferr'd from one Tree to another; and by Inoculation will take Root in the Tree
they

they are fixt upon ; and still the Shoots of the Buds will produce the same Fruit as the Mother-Tree which they sprung from : So that what ~~we~~ ^{is} have before observ'd, of the Creation of Buds, and Difference between them and Seeds, is here confirm'd ; and shews us, that they were made on Purpose to suport the Reputation of the Mother-Plant, any Where, and every Place, possessing still the same Qualities : So that one might say, the same Plant may be every where at the same Time. ~~For~~ For if we bring an Example from the Golden-Pipin, which is a Plant well known, the Seeds of it will bring Trees, that will produce different Sorts of Apples,; but the Buds of the same Tree, if they are grafted upon either a wild Crab, or any other Sort of Apple, these Buds will still produce the same Sort of Fruit with the Tree they were taken from. And so the *Newington-Peach*, or any other good Peach, is budded or inoculated either upon an other Peach, or upon a Plumb, or such other Plant whose Juices are natural enough to it, to feed it well, it will preserve its original Virtue. ^{is} What ~~is~~ ^{we} shall remark from these Observations is, That a Bud of a Tree is the Means by which a particular Fruit, or Tree of Merit, may come to possess the whole

whole World at one Time, which is a sufficient Recompence for its Deficiency in the want of Liberty of moving from Place to Place, as Animals do.

But Buds are of several Sorts, and are such, as are either immediately profitable, or unprofitable, *i. e.* Either Leaf-Buds, or Blossom-Buds. We may know the Difference between these Buds in most Sorts of Fruits, before they open, by observing that the Leaf-Buds are long, thin, and pointed; but the Blossom-Buds are short and turgid: The Juices in the first are more fluid and aqueous; and the latter are more digested and gummy: But both these Sorts of Buds proceed from the Pith of the young Wood, and are dispos'd for different Offices, as the Plant or the Branches which produce them, are more or less vigorous: It is observable, that the most Vigorous bring Leaf-Buds; and those that are smaller, and seem to be less nourish'd, produce Blossom-Buds.

The Buds of Trees are put into Action, and are explain'd into Branches, when the Temper of the Air is such, as to render the Sap or Juices of the Plant, of such a Degree of Fluidity, as that

it may pass through the Vessels without Interruption; And this Sap, in different Plants, is of very different Kinds; in some it is set at Work with a very small Share of Warmth; in others, 'tis of that Nature, as to require extraordinary Heat to put in Motion: The Consequence however is, when the Sap is sufficiently fluent, that it fills the Buds, and by Degrees are explain'd into Shoots and Branches; every one of which is properly a Tree growing upon an other Tree; which makes it practicable to cut off Branches from any Tree, where we please, without destroying the Tree: But if a Tree was one entire Body, as the Body of an Animal, the cutting of the Branch would endanger the whole.

All Buds of Trees are guarded with Leaves, which are useful to help the Bud in its Germination; for we find that if we strip a Shoot of its Leaves, the Buds will not grow; the Leaves of a Plant are poreous and spongey, and imbibes a Moisture from the Air, which helps to nourish both the Buds, and the Plants, they grow upon: In some Plants, those Leaves are Annual, in other Perennial; in those Plants where the Leaves are Perennial, the Juices are of that Nature, as

even to aſt upon their Plants in the colder Seaſons, and occaſion them to grow in Winter : But where the Leaves are Annual, they fall from the Plants aſſoon as the Juices of ſuch Plants are conduced by Cold, and have finiſhed their ſeaſonable Shooting. The Account we have of the Tree in the *Madera* Iſlands, which has Water continually droping from its Leaves, even in ſo great a Quantity as to furniſh the Inhabitants with Water, ſeems to determine, that the Uſe of the Leaves of Plants is to conduce the Air ; and perhaps this Tree, in a particular Manner, may be of a colder Nature than other Plants, and therefore the Air about it may be condenſed much quicker than that about other Trées. It is remarkable, that Countries which abound in Wood, are more ſubject to Rains than bare plain Countries ; and that Leaves ſerve to nourish the Tree they grow upon, is certain, becauſe we may kill the moſt vigorous Tree, if we ſtrip it of its Leaves while it is growing ; for the Leaves help to keep up the Circulation of the Tree ; they are like Feathers to Fowls, and Hair or Wool to Cattle, which if we were to ſtrip them off entirely, we ſhould certainly deſtroy them.

† But as it has been observed, that Buds are the Occasion of increasing the Parts of the Tree under Ground; they are fram'd in the Pith of the Root, as well as in the Pith which we find in the Parts of a Plant above Ground; those that are form'd in the Root, are impress'd with the Form of the Root when they are put in Action; and so those Buds which are form'd in the Branches are also model'd for Branches, when they begin to act, but in their Principles are both the same: For if we expose the Roots of a Tree to the Air, after allowing it some little Time to be acquainted with the Element, it will put out its Buds in such Sort, as they will produce Leaves: And if we lay down a Branch of a Tree in the Earth, after it has had a due Time to reconcile it self to that Station, those Buds form'd in the Pith, when they begin to move, will, instead of Leaves, or Flowers, or Fruit, which they would have produc'd if they had rais'd in the Air, will now bring forth Roots, and from them others. Now, as I have observ'd before, that Pith, of Consequence, is only found in the younger Shoots; so, if we would increase a Tree by Layers, those Layers must be of the young
 Shoots,

Shoots, where this Pith is perfect; or else there will be wanting those Seeds or Buds which are so necessary to produce Roots; and not only our Labour will be to no Purpose, but our Time will be lost in the Disappointment. †

When our Roots are fram'd, we find them to consist of two principal Parts, as I have mention'd, *viz.* The Sap-Vessels, and the Spungy-Parts. These Roots, like the Branches above Ground, branch themselves in the Earth: And 'tis my Opinion, that every Tree has the like Quantity of Roots, that it has Branches; and that every Root has a particular Branch, which has Connection with it. The extream Parts of the Roots are not much unlike Earth-Worms in their Make; they are always smaller than the rest, and are distinguish'd by the Name of *Fibres*: These are the Mouths by which every Plant is fed, and receives Nourishment from the Earth. And in every Plant, which is in a natural State of Growth, it is observable, the Roots always shoot before the Buds above Ground; and in the time of their Growth, draw in Nourishment for the Plant they are to maintain.

As I have now fet forth the ſeveral Parts of a Plant, with regard to its Increaſe of Stature ; ſo it would be neceſſary I ſhould ſay ſomething concerning its Circulation of Juices ; which in General I ſhall hint at in this Diſcourſe, and leave the particular Inſtances of it to the next, where I ſhall ſhew the Uſe of that Doctrinẽ. As I have already deſcrib'd the principal Parts of a Tree, it appears, That the Fibres of the Roots draw ſuch Nouriſhment from the Earth, as is afterwards diſtributed to the lower Parts, through the Sap-Veſſels ; which are ſo many Arteries and Veins thro' which the Blood is circulated in Animals : But theſe Veſſels are ſo fine, that nothing which is ſo denſe as Water, can paſs thro' them, unleſs ſuch watery Parts as are receiv'd by the ſpongy Body which encloſe them, and have a Communication with them, are rarify'd to a very fine Degree ; and then the Tree is render'd capable of Growth, and is in Action every where : For we find by Experience, that if we take a Tree in the coldeſt Part of Winter, and lay its Branches cloſe to a Wall which is artificially warm'd, the Parts which lie cloſe to that artificial Heat,

will begin to open and explain themselves in a few Days, and by their Motion will set the Juices of the whole Tree in Motion : Which, particularly, I shall explain in the Discourse where I treat of artificial Heats.

It remains, however, that I speak of the Flowers and Fruit of a Tree in this Discourse, in order to describe all its Parts. The Flowers or Blossoms, I have said before, are form'd in the Buds, while they are in the Pith ; and consequently, so is the Fruit or Seed : The Flower which includes the Fruit, is a Plant growing upon another Plant ; for whether a Flower be Male or Female, or Androgenous, it is sure to fall from the Tree when it has done its Office, as a Male, by impregnating the Female Parts ; or, as a Female, by producing a Fruit with Seeds.

What I call Male Flowers, are such as the Catkins upon the Hazel, &c. which only bring Stamina with their Apices ; and whose Apices, when they open, discharge a Dust or Powder,
which

which serves to fecundate the Female Flowers, and when that Office is perform'd, drop from the Tree.

What I call Female Blossoms, are such as contain the Ovaries or Egg-Nests, or Seed-Nests, which, when they are impregnated by the aforesaid Dust or Powder, bring perfect Fruit: These Female-Parts are, for the most part, more adorn'd than the Male-Blossoms: Both these, as far as I have observ'd, are always to be found upon the same Tree.

Those Flowers, which I call Androgynous, are partaking of Male and Female Parts; each Flower contains both those Parts which are Male and Female, and have a proper Defence from the Weather, while the Female is perfectly impregnated; and then all the Parts which have finished their Office drop off: Such a Flower we suppose a Lilly or a Tulip, it consists of Petalls or Flower Leaves, which are to shelter the more nice Parts; they have visible Roots, which take hold, or take Root, on the Summit of the Foot-Stalk,

and upon them the Stamina take Root, and the Result or Sum of the Stamina, are the Apices which produce the Male-Dust ; all which Parts, drop assoon as they have perform'd their Office of Generation : In the Center of these is plac'd, either the *Pistillum* or *Stylus*.





DISCOURSE V.

Of the ANATOMY and MOTION of JUICES in PLANTS.



AS the preceding Discourse treated of the several Parts of Plants, and their respective Offices, with regard to Vegetation, so it will be my Business, in this, to explain the Use of that Knowledge.

We have observed, that every Plant has a Continuity of Vessels throughout the whole Body, as well adapted to the Circulation of
F 3
Juices,

Juices, as any Animal whatever ; and that all Plants have Juices which flow in them, when they are duly rarify'd by a proper Degree of Warmth, is beyond Contradiction ; and therefore the Observation I have offer'd concerning the Reversing a Tree, and making the Branches become Roots, and changing the Roots into Branches, is a capital Evidence, that the Sap does circulate : As also confirm'd in another Experiment I made nine Years ago, by inarching four Branches of an old Dwarf Pear-Tree, into four young Pear-Stocks, which being well join'd and united, I saw'd off the old Tree near the Root, and supported it by Wedges for a Year or more, and by these Means, every Part of my old Tree, which before was so sickly as to bring its Fruit little larger than Hazel-Nuts, had now gather'd so much Strength from the young Pear-Stocks, as to shoot freely and bear large Fruit ; thus by the Circulation of the vigorous Juices of the young Pear-Stocks, through the whole great Pear-Tree which was decay'd, it recover'd its full Strength and Vigour, notwithstanding I had disengag'd the old Tree from its own Root. Thus, without more Instances, we are sure of the Sap's Circulation ; unless I may observe enpassant,

that

that the Distemper which shews itself in the yellow and white Variegations of the Leaves of the common white Jessamine, and several other Plants, may be communicated to every Plant of the same Tribe, by inoculating only a single Bud of the other variegated Kind into the others, which have plain green Leaves; and tho' the Bud does not live yet barely by the Application of it to the healthful Tree, we shall find the yellow Blotches, or Variegations of the unhealthy Bud, communicated to every Part of the healthful Plant. Just as it happens, when a Man has had the Small-Pox inoculated upon him, his whole Mass of Blood will become infected with the Poison. The Circulation of the Sap being thus certain, as the Circulation of the Blood, it next follows, that I observe, That some Plants which are ever-green in the Winter, are Analogous to those Animals which enjoy all their Faculties the whole Year about; and those which die down to the Ground, or drop their Leaves at the Approach of the Winter-Season, and revive again in the Spring, are like those Animals which sleep during the Winter; but yet there is Life in all these throughout the whole Course of the Year tho' not the same Degree of Active

Life; and it is even to be understood by the Touch, when the Leaves are fallen from a Tree, whether it is Alive or Dead; the live Tree will feel cold and smoth in the young Shoots, and the dead Tree will be rough to the Touch. In such Plants where the Juices are the most condens'd in cold Weather, the Sap becomes Glutinous, or of a Gummy Nature, in such Sort, as to preserve the Plants from Putrifaction, and so is seeming Analogous to the Juices in those Animals which sleep in the Winter, which are not subject to putrify: For I have had an Opportunity of making the Experiment with the Halcion or King-Fisher, in the hottest Weather in the Summer, which for a Week after it was dead, had not the least Sign of Putrifaction, or any ill Scent, tho' it was difficult at that time, to keep any kind of Flesh among the Butchers, or Poultry 24 Hours, without becoming rancid: And as the King-fisher is asleep, as well as the Plants I speak of, so I suppose its Juices, as well as those of all such Creatures, as are lay'd up in the Winter, are in a particular Manner dispos'd, to preserve them from putrifying, while they are at Rest; which Rest, is so like Death, that one must have good Judgment to distinguish between one and the other:

And

And it is with theſe Animals as it is with Plants, that if, in the cold Seafon when they are lay'd up, we bring them near a Fire, or put them into ſome warm Place, the Heat will put their Juices in Action, as they are naturally in the Summer-Seafon : This we find in the Snake, the Batt, the Urchin or Hedghog, and the Tortoiſe. But we have ſome Plants, whoſe Juices are flowing as well in Winter as in Summer; the Ever-greens eſpecially, are growing, and flowering, and ripening their Fruit even in the coldeſt Time of the Winter, and are the neareſt at a Stand about Mid-ſummer; and, indeed, ſo are moſt Plants. What I mean by this Stand, is, that they have about Mid-ſummer finiſh'd their firſt Shoot, or Summer-Shoot; that is to ſay, the Fund and Nouriſhment which the Root had collected from the Earth in the preceding Autumn and Spring, is now expended in the new Shoots; and ſo the Roots are now encreaſing themſelves, and are preparing to take in freſh Supply from the Earth, in order to ſhoot a freſh in the Autumn. At this Stand, it is much the beſt Time to remove Trees; becauſe they will then ſtrike freſh Roots in two or three Days; whereas if we tranſplant them late in the Autumn, when the Juices are thicken'd, they

they will not make any new Roots till the Spring following ; and then the Plant is employ'd in making new Roots, when such Roots should be already made and stored with a Fund of Nourishment to feed the Shoots which are to be made above Ground : When this is the Case, the Shoots of that Summer are always poor and weak ; but by Summer-planting, our Trees presently take hold of the Ground, and their Roots are plentifully furnish'd before Winter, and so are capable of producing strong Shoots the Spring following.

We may learn also, by the Knowledge of the Sap's Circulation, in the Manner I have set down, that no Time is so proper to transplant any Tree, as when its Juices are active, and have a Tendency to act particularly in the Root ; but then we must take especial Care to preserve the Roots from drying, while we remove our Plants from one Place to another ; and likewise we must observe, that the Earth we plant them in, be closely fix'd to the Roots at the Time of Transplanting ; for otherwise, the Air, which will get into the Crevices of the Earth, will dry and harden them ;

to

to prevent this, see the Discourse concerning the transplanting of Trees.

Another Thing, which we may learn from the System of the Sap's Circulation, is, that when we remove any Tree, we are not immediately to rob it of its Head and Branches, as is commonly practis'd; for while a Tree with its Branches consists of spongy Parts, which imbibe Moisture from the Air and Dews; the Moisture and Nourishment which the Tree receives by those Means, is assisting to the Support of the Tree, and to the framing of new Roots; and when that Work is over, after transplanting them, it is necessary we may thin the Head, or lop off some of its Branches, that the rest may be better nourish'd. In this Operation we must have regard to what I have mention'd concerning the Buds of Trees, that they are, as it were, so many Seeds which are to grow upon the Trunk or Body of the Tree; and the Case is much the same, as if we were to sow Seeds upon a Piece of Ground; that is, if we suffer the Ground to be overstock'd with Seeds, the Plants will be weak thro' the Want of Nourishment; but if we sow the Seeds at a due Distance from one another, they will
then

then have a sufficient Share of Nourishment, to make them strong Plants. So the Buds of a Tree, if they are too many in Number, will, for want of Nourishment, become weak : But when the Judgment of a Gardener can prune a Plant, so as to leave a proportionable Number of Buds upon it, to be well fed by it, they will then be vigorous in their Growth : Which in Forrest-Trees is to be desired, but in Fruit-Trees it is otherwise ; for, as I have observ'd before, the luxuriant Shoots are fed by the more watery Parts of the Tree, and such indigested Juices are unfruitful, and by pruning, many of those watery Juices are lost, and the Remainder is useful in the Production of smaller Branches, but then they are such as bear Fruit. We are to observe, all this while, that the cutting off a Branch from a Tree, while its Juices are in vigorous Action, does not hinder the Circulation of Juices in the other Parts, no more than the cutting off a Leg or an Arm from a Man would prevent the Circulation of the Blood in the other Parts of the Body. But I have, in the former Discourse, given some Account of the Difference between Animals and Vegetables in this Respect. I may observe however, in this Place, that we have some Shell-Fish
 which

which have the Power of renewing a lost Limb, as well as Vegetables ; I mean the Lobster, and Sea-Crab, which, according to the Accounts in the Memoirs of the Royal Accademy at *Paris*, will, in a few Weeks after they have lost one of their great Claws, renew it again ; which is the reason (those Gentlemen tell us) that we so frequently find the large Claws of Lobsters unequal in their Size and Figure. But the transplanting of Wall-Fruit-Trees, without pruning off their Tops till they have struck Root, is yet a common Practice among Gardeners, and they find their Account in that Way of planting ; but yet when they make Plantations of Forrest-Trees, they as surely cut off their Heads at the Time of transplanting : And tho' they are almost as frequently convinc'd of their Error in the Death, or languishing Condition of such Trees, yet they proceed on in their Way, without considering how much their Practice is contradictory one Part to the other. If they find a Benefit, by planting Wall-Fruit-Trees with their Tops on, why should they not expect the same Advantage in planting Standards with their Heads on ? By the one Way we have rarely a Miscarriage, and by the other we scarcely meet with any thing else :

For

For if ſuch lopp'd Trees happen to live, they are ſo long before they recover themſelves to ſhoot vigorously, that to ſow Seeds at the Time when ſuch Plantations are made, the Seedling-Plants will outſtrip them in ſeven Years Time, or ſome Sorts of Trees in five Years, as I have experienc'd : But it is quite different with thoſe Plants which are tranſplanted in the Summer with the Heads on, which flourish the following Year, as if they had not been remov'd at all, and in the hotteſt Weather have no more need of watering than Trees that have been planted three or four Years ; for while the Sap is fluent, the whole of it which is in the Body, as well as in the Branches of the Tree, is turn'd to the framing of new Roots, to ſupply the Deficiencies of thoſe which are loſt by the taking up of the Tree, all which while the Buds above Ground ſtand ſtill, and only have bare Subſiſtence to keep them alive till the Roots are ſufficiently ſtrengthen'd, and are in a Capacity of filling themſelves with ſuch a Fund of Nouriſhment, as is convenient to furniſh them with full Allowance. Thus the Autumn-Shoot is generally prevented, and ſo the Tree is in a Capacity of ſhooting ſtrong in the Spring.

But

But suppose these Trees I speak of, are such as I may compare to the Animals which sleep in the Winter, then one would suppose, that the pruning of them is best at such a Season when their Juices are most at rest; and it certainly is so, if we can guard the wounded Parts from the Frosts; for tho' the Juices at that Time are thicken'd in Plants in some Degree or other, yet their Coverings are such, as will prevent their receiving Injury from the Frost; but when they are laid open by pruning, and become subject to the Frost, such a Branch or Limb as is wounded, is always subject to decay by Severity of Weather; therefore it is necessary where the Wound is great, to plaster it with such Gums as I shall speak of in the Discourse of Pruning. 'Tis observable, that such Trees as are Natives of *England*, or were brought to us from Countries which were not of the warmest Latitudes, such as Pears and Apples, are commonly prun'd in the Winter; but those Fruits which come from the warmer Climate, such as the Stone-Fruits, which are subject to Gum by wounding, are left unprun'd by our Gardeners, till just before their Sap begins to move towards Germination in the Spring, so that Frosts may not have

Power

Power over them, and the Flux of the Sap immediately following, may heal their Wounds: We must observe too, that the Reason why Apples and Pears are not so subject to mortify by Winter Pruning, as the Stone-Fruit, is, because their Juices are not so unactive in the Winter; for it is common to see them fling out their Blossoms in the colder Seasons, but we never see this in the Stone-Fruits, unless they have artificial Heats.

Upon the Foot of what I have said concerning the Buds of Trees in my former Discourse, I now come to speak of Inoculation which may be perform'd either in *March*, *April*, or *July*, in such Plants where the Bark will rise, and the Sap is fluent at those Times; but while the Stock which we are to inoculate upon is making its Shoots, it is by no Means proper, because the Shoots which have already begun to grow, draw away all the Sap from the Strange Bud, and so it cannot be supported till it can join with, or take Root in the Stock. Thus the Motion of the Juices in the Stock is to be consider'd, when we design to inoculate a Bud into it.

In Grafting, it is necessary to perform that Operation a little before the Juices in the Stock are beginning to move fluently, that the Buds in the Cion, and those in the Stock, may be working together ; for the same Reason that I have given in the Article of Inoculation. And we must remark, that those Plants which abound in Aqueous Juices, and consequently have their Sap constantly, in some Degree of Fluidity, such as Apples and Pears, will best bear Grafting early, and the Stone-Fruit, which have more Gummy Juices, will best prosper by Inoculation.

It is likewise to be remark'd, that all Cuttings of Plants, which abound in Aqueous Juices, will sooner strike Root in the Ground, than the Cuttings of such Plants, as have their Sap of a more Gummy or Rosinous Nature. I have observ'd before, that when a Plant abounds in Watry Juices, its Shoots, will be Luxuriant ; and, on the contrary, when the Juices are Gummy, it will produce such Shoots, which, tho' they are small, will be fruitful : This is remarkable in many kinds of Fruit-Trees ; Apples and Pears, for Example,

for the most Part, must have Shoots of one Year, before such Shoots can form their Buds for Blossoms or Fruit ; but Peaches, Apricocks, and Plumbs, bring their Fruit upon the Shoots of the last Summer, through the Gumminess of their Juices. So that it is difficult to raise Cuttings of such Trees, whose Juices abound in Gum ; but the Cuttings of such Trees, as consist chiefly of Watry Juices, strike Root presently, and put forth their first Fibres, for the most Part, at those Places where the Buds are which we bury in the Ground, provided they are Leaf-Buds ; but where such Buds are ripen'd into Blossom-Buds, there is no altering of them, and the Cuttings will not strike Root ; for they are too much perfected, in every Respect, to alter their Property ; the Pith, as I have observ'd in the former Discourse, has done its Duty, and is incapable of altering its Work.

But we have yet this Advantage, where the Juices of Plants are more inclining to be Gummy, we may lay the young Shoots into the Earth, where, after a due Course of Time, the Moisture of the Earth will alter their Property, and dispose them to strike Root ; the Mother
Plant,

Plant, all the while, keeping them alive, 'till they can undergo this great Change. This is another Consequence of the Circulation of Sap.

The Season of planting Cuttings of Trees, or of making Layers from them, which bring the hardest young Wood, is always when the Juices are most at Rest; because the Buds, which we bury in the Ground, being then unactive, have Time to be prepar'd by the Moisture of the Earth, and to be chang'd insensibly, *v. g.* before the Sap is fluent, and those Parts which acted before as Roots to the Buds in the Tree, are reconcil'd, upon the first Motion of the Sap, to do their Office as Roots in the Earth, the Spongy or Fungous Part of the Cuttings, supplying the Office of the Lobes or Ear-Leaves of the Seed, *viz.* to feed them 'till they can be wean'd to receive a Nourishment from the Earth; and the Parts which are under Ground, may be the first in Action, because they are shelter'd from the cold Winds, which often happen when the State of the Air is warm; and consequently, when the Body of Air is warm, the Earth, which consists of Parts contiguous, must be warm likewise; which one may best judge by the following Experiment;

periment. In *Germany*, there is a large Room warm'd, by having the Vault, underneath it, lin'd with Pieces of Iron, which are so laid together, that every one touches another ; some of these are Pieces of broken Cannon, which are pretty large, others are as small as Hob-Nails or Horse-Nails : At one End of these, is a Fire, which by heating the Irons next to it, the Heat is communicated to all the rest, which, in a Body, hold the Heat for a long Time, which is communicated to the upper Room : So when the Surface of the Earth is heated, we suppose the next Parts below it are concern'd, and the next below them, and so on, in some Degree or other.

But we say, the Buds of a Plant will preserve its first Qualities, tho' it is apply'd to a Tree of different Qualities ; that is, that the Bud taken from a Golden Pippin-Tree will produce a Branch which shall bear Golden-Pippins, tho' it be inoculated upon a wild Crab-Stock, whose Juices are sower and harsh, and far different from those of the Golden-Pippin, which are sweet and high flavour'd. This is no more strange, than that several Off-Sets from the same Auricula, or Ranunculus, or Tulip, shall bring the same Flower in
all

all its Properties, tho' they are planted in different Soils : For I have observ'd before, that every Bud, of a particular Tree, has the particular Stamp of that Tree in it, which is unalterable ; and this Bud, whether it is growing on the Mother-Tree, or is join'd with a Crab of the same Tribe, has its Vessels, which act as Roots, inoculated into the Vessels of the Stock it grows upon ; so that when the Sap of one is set to work, the Sap in the other must necessarily be moving at the same Time ; and, one may say, there is a general Circulation of the Juices in the Stock and the Bud of the same Sort, as in Animals, where the finer Juices are separated from the Blood, such as Urine, Milk, &c. which only change their Colour, Flavour, and Use ; as the Vessels, thro' which they pass, happens to be differently form'd, so the Bud, which encloses the Hereditary Virtue of the Golden-Pippin, will still be the same, tho' it receives its Nourishment from a harsher Apple, its Parts are made to filter its Nourishments in such a Manner, and no other. But when these Juices are once receiv'd by the Bud, they cannot be return'd again into the Body of Sap, from whence they were first drawn, no more than the finer Juices, in some Parts of Ani-

mals, can be return'd back into the Blood, but must circulate in those Bodies which have receiv'd them ; and, without they can discharge themselves some Way or other, will occasion the Parts, which contain them, to swell and grow larger, from the continual Addition they receive from the great Body of Juices, which is the Occasion of a Bud's swelling into a Branch, and the Reason why a Bud, of any particular Tree, preserves its original Virtue, tho' it be made to grow upon a different sort of Tree.

While I am speaking of Buds, I cannot help observing, that all Bulbs are improperly call'd Roots ; for, in Reality, they are only Buds, which include the Image of the Mother Plant, which they spring from Fibers, which they produce when they are put into the Ground, are the Roots which properly nourish such Bulbs.

But I am, in the next Place, to speak of the Multiplication of Plants by Seeds, and to account for the Varieties which the Seeds that are gather'd from one Plant will produce.

What I have remark'd in my former Discourse concerning the Generation of Plants, may give us to understand, that the *Farina fecundans*, or Male Dust of a Flower, may be convey'd from one Flower to another, by Means of the Wind ; and if the Flower be a Yellow Tulip, for Example, from whence the Male Dust is blown, and the Flower, which it is blown upon, be a Red Tulip, so that the Ovary of the Red Tulip be impregnated with the Dust of the Yellow Tulip, then the Grain, or Seed, which is so impregnated, will produce a Tulip, which shall partake of both the Colours, Red and Yellow, and not be strictly like either the Mother-Flower or the Sire : This we find certain from Experience. So if we plant a White Cabbage near a Red one, the Seed of each of them will produce Varieties partaking of both Colours, some quarter'd with Red and White, some vein'd with Red, &c. which I have also experienc'd. As likewise the sowing the Seeds of a particular Sort of Fruit, which, by growing among Varieties in a Garden, such Seed has brought almost as many Varieties as there were Seeds put into the Ground ; so that where we have many Varieties of the same

Tribe of Flowers, or Fruits, or Herbs, growing in one Garden, the Seed of any one of them will produce Plants, which will be different, in something or other, from the Mother-Plant, they were gather'd from. And this, I suppose, gave the Ancients Room to believe, that Corn would degenerate in Three or Four Years, because it is almost impossible to sow a Bushel of any Corn, which shall be all of one Sort of Grain. Again we observe, that when we have a Flower of a simple Colour, such as a Black *Auricula*, for Example, and that we keep this Flower remote from others of the same Tribe, which are of different Colours, then the Seeds, which we gather from the Black *Auricula* will bring Plants that shall only produce Black Flowers. So if we have a Breed of White Cattle, their Offspring will be White, 'till we mix them with Cattle of another Colour, and then we shall have a Py'd Breed; but in the Affair of Generation, Nature will, in some Cases, permit of the Production of suffering of Plants or Animals to Couple with such as are not directly of the same Species. So the Afs and the Mare produce a Mule; but then to prevent the Increase of such monstrous Productions, Mules, whether Male or Female, are not capable

capable of continuing their Species by Generation. The same is the Case among Vegetables, as we find in the several Plants, which have been rais'd from such Carnation-Seeds, which have happen'd to be impregnated by the Farina of the Flower call'd the Carnation and Sweet-William but the Seeds of such Plants, tho' these will sometimes seem perfect, yet will not grow no more than a Male and Female Mule can produce any Offspring, tho' no Creatures are more addicted to Venery.

There seems to be the same Difference, in Nature, between the Carnation and Sweet-William, which produce a Third Sort of Plant, as there is between the Horse and the Ass, which produce the Mule.

From hence we may learn, that when we have a Mind to preserve any particular Quality in a Plant that we design to increase by Seed, we should never suffer any Plant to grow near the Plant we propose to save the Seed from, which may have Power of debasing or adulterating the Seed, and then we may expect such Seed to be good, or to inherit the Virtues and Qualities of
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the Mother-Plant ; which is a very necessary Observation in the saving of the Seeds of Annual Plants, because there is no other Way of raising Annual Plants, but by Seeds.

On the other Hand, if we have a Mind to produce Variety by Seed, such as one would wish for in the Production of Flowers, our Hopes will depend upon the Number of different colour'd Flowers of the same Tribe which are growing together, for then there will be an Opportunity of the Farina, or Male-Dust, of one Sort, to impregnate the Egg, or Seed-nest, of another : And it would be well worth our Care to make our Experiments with that Exactness, that one may come to know what Properties are preserv'd of the Mother, and what of the Sire, whether those of the Male, or of the Female, are predominant. There are yet many particular Observations relating to the Generation of Plants which I have mention'd in my printed Works of Husbandry and Gardening, which may be consider'd ; but I judge, that the Instances I have here produc'd may be sufficient to render that System intelligible.

It remains now, that I speak of the Seed of a Plant, and what ought principally to be observ'd in its Management.

All Seeds whatever, which have been perfectly impregnated, contain the Image of the Plant in Miniature, from whence they spring. This Image is the Consequence of the Impregnation, which is absolutely necessary for the Multiplication of the Species in Plants; as the Cock's Tread is necessary in the Egg, to render it prolifick by Incubation. The Incubation of Birds, or Fowls, is Analogous to the Burying the Seed of Plants in the Earth, that it may hatch into a Plant: The Ostrich, as a Fowl, and the Tortoise, and many other Creatures besides, which are Oviparous, take the same Way of Hatching their Young; that is, they bury their Eggs in the Sand or Earth, where they happen to be when they lay their Eggs.

In all Seeds or Eggs, we find such Parts as are proper to nourish the little Plant 'till it can shift for itself, and draw its Nourishment from the Earth; such Parts are the Lobes, or Ear-
Leaves,

Leaves, which join with the young Plant and inclose it: They are Spongiſious or Fungous Bodies, which, by gentle Degrees, receive Nouriſhment from the Juices of the Earth, and after they have filter'd, and alter'd them, according to the different Textures they may happen to be of, the little Plant, which is lodg'd within them, receives its firſt Nouriſhment from them, and their Juices begin to circulate in the little Plant they contain; 'till, at length, the Radicle becoming, by Degrees, more acquainted with the Diet it can receive from the Earth, begins to ſhift for itſelf, without feeding any longer from the Lobes or Ear-Leaves, from whence it firſt receiv'd its Support; and then, as conſtantly the Ear-Leaves fall from the Plant, as they are then of no further Uſe to it. I might add, that all Seeds are cover'd with Coats, which are finely and cloſely wrought, the better to keep the Moiſture of the Earth from coming too ſuddenly upon the Lobes, or the little Plant, which might occaſion their rotting; and we find, that almoſt every Sort of Seed, by Means of theſe Coverings, muſt paſs different Lengths of Time in the Earth, before they begin to Germinate: Some will not ſpring in the Ground 'till the Se-

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cond Year after they are bury'd, while others will begin to shoot in Three Days after sowing.

This being consider'd, we are next to observe, that Seeds, as they are of different Textures, of different Modes, and of different Sizes, they require to be sown in different Depths of Earth; and, considering their Tenderneſs at their first ſprouting, it is alſo neceſſary to prepare the Earth very fine and light where we ſow any Seed; but the moſt robuſt Seeds may be ſown in the heavier Land. The Seeds which are the longeſt coming up, ſuch, I mean, as will lie without Motion a Year in the Ground, may be ſown full Two Inches deep in light Soil, or of a proportionable Depth, as the Soil is heavier; and the ſmaller and lighter the Seed is, ſo it muſt be ſown ſhallower, and in lighter Earth, than other Seed. We are forc'd, in ſome Caſes, to ſow the very lighteſt of Seeds in rotted Earth of Willows, or other light Woods, and then only to rake that Earth finely, ſo that it may lie looſe, and ſowing them upon the Surface, preſs it down, or flat it, with a ſmooth Board. This is the Method of ſowing Auricala Seeds, and the Seeds of Ranunculus, are not to be cover'd much deeper.

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From these Observations, we may know how to regulate any Seminary; either if we have a Mind to preserve the particular Virtues in any Annual Plant or Flower, or to produce Varieties, or to raise any Plant from Seed, with good Success.

I shall conclude with remarking, that what we call Corn, or Grain, is not properly a Seed, because no Sort of Corn brings Ear-Leaves, but sprouts directly with a Leaf at its first Germination; which Leaf, Dr. Grew, in his *Anatomy of Plants*, calls an *Acrospire*. This is like what we call, commonly, a Bulb, which is, properly, a Bud; as I have accounted for in this Discourse.



DISCOURSE VI.

Of the different Ways of propagating of PLANTS, by SEEDS, CUTTINGS, &c.



THE Contents of this Discourse, as they relate to the different Ways of propagating of Plants, so are they depending upon the former Chapters, which treat of the Anatomy of Plants, and of the Motion of Juices in Plants; to which we must have a strict Regard in the Practice of every Lesson I shall here set down,

I shall begin with increasing of Plants by Cuttings: By a Cutting, I mean a young tender Twig, of the last Growth, to be cut from a Plant, in order to make it strike Root, by burying Part of it in the Earth, by which Way many Sorts of Plants may be increas'd; especially those whose Shoots are the most Juicy, or Succulent, or contain the most watry Juices: For, as I have observ'd before, such Plants as are fill'd with Gummy or Rozinous Sap, will rarely take Root from a Cutting.

When we find such as are for our Turn, we must cut them from the Mother-Plant, either in the Spring, just as the Sap is beginning to move in them, or else about Midsummer, when they have just finish'd their first Shoot; always observing that they are tender. For an Example, we shall propose the Myrtle, whose Cuttings, at these Seasons, are tender, and little inclining to be Woody. The Cuttings of this Sort may be about Four Inches long, because there will be as many Buds in that Length of a Myrtle-Shoot, as one may find in a Shoot of a Vine, and other such like Plants of a Yard long; and the more
Buds

Buds we bury, so the more Roots we shall have, and the greater Number of Roots will gather a greater Quantity of Nourishment; and, consequently, the Buds above Ground will be better fed, and be more vigorous in their Growth. The Myrtle Cuttings will presently strike Root, if the Earth we plant them in be made very fine, and well clos'd about them, both by the Hand and by watering; but it must be observ'd, that the Leaves must be taken off with a Knife carefully, from that Part of the Cutting which is to be bury'd in the Ground, which, in a Myrtle Cutting of Four Inches long, should be near Three Inches, that we may leave little more than an Inch above the Surface of the Earth.

In planting of Vine-Cuttings, I prefer the *French* Way before the common Method practis'd by our *English* Gardeners. The *French* never plant Vine-Cuttings less than a Yard in Length, and then leave only Two or Three Buds out of the Ground, so that the first Shoots are always strong. Their Way is to open a Trench about *October*, and set their Cuttings in it about a Foot distant from one another, and then fill in the Earth, and tread it down hard; of these Cuttings,

perhaps Nine or Ten Buds of each may only be bury'd for making Roots ; but in *England*, our Vine-Cuttings are seldom longer than a Foot, and, perhaps, not above Two or Three Buds of each are cover'd with the Earth ; so that the first Shoots are weak, and will require several Years to gain Strength enough for bearing.

In making Cuttings also of Jessamin, and the Honyfuckle, whose Wood is tough and hard, it is the common Practice to let their Leaves drop before we prepare them for Planting. In these the Buds stand wide asunder, and therefore their Cuttings should be of such a Length, that we may bury them a Foot in the Ground, at the least : But I find, that if we plant our Cuttings in the Summer, as soon as they have finish'd the first Shoot, they will answer our End much better ; but then they must be well follow'd with Water, and be set in a shady Place : Or, to save that Trouble, we may open a Trench, and fill it with fresh Cow-dung, and, upon that lay Three or Four Inches of good sifted Mould ; in this prepar'd Bed our Cuttings will prosper exceedingly, for the Cow-dung will keep them constantly moist, and keep the Air from them, and
nourish

nourish them. It is also to be observ'd, that all hardy Ever-greens will do best from Cuttings, if we plant them about *October* or *November*, for then their Juices are in Motion. Again, we must remark, that when we collect Cuttings of those Plants which are very succulent, such as the several Sorts of *Cerens*, *Ficoides*, *Sedums*, *Indian Figs*, and such like, we must, in Proportion to the Succulency of such Cuttings, let them lie some Days expos'd to the Sun before we plant them, that the wounded Parts may be thoroughly dry, for otherwise, their own Moisture mixing with the Moisture of the Earth; would rot them. The Time of making Cuttings of these is always when we find them inclinable to grow, which is at different Seasons, as the natural Springs of their several native Countries happen to fall out; for Plants of every Country in the World will always preserve their natural Time of shooting, wherever they happen to be station'd. The great Point to be consider'd in planting of Cuttings is, that we keep the Air from drying the Parts under Ground as much as possible; and, in such as are very succulent, to plant them rather upon the natural Earth than in Pots, for from the whole Body of Earth there will exhale continually a

Vapour gently moist, which will dispose them for drawing Root ; but in Pots we must be oblig'd to water them frequently, which often occasions them to rot, and if we give them too little Water, then the Earth in the Pot will become so dry at particular Times, that the Cutting will be put aside from the drawing of Roots, tho' by the Moisture it had at other Times, it was dispos'd to make Roots : For, according to the following Experiment, it is a continued gentle Distribution of Moisture to a Cutting, which will occasion it to strike Root, and when it is once in that Method, if we suffer it to dry, the Intent of making Roots is stopt. The Experiment I mean is, that if we take a Branch of the *Sedum Arborefcens*, or Tree Houfleeck, and hang it up in the House, we shall see it put out Roots when the Air comes to be of a certain Density or Thickness, and as soon as the Air becomes dry, and more rarified, these Roots grow dry, and shrink away ; but if we keep this Plant in some Place where the Air is continually moist, the Roots will be constantly growing as long as there is any Moisture in the Plant ; but the Head, or Top Bud of the Plant, will not grow at all, for that the Roots cannot draw Nourishment enough from the Air to feed it

it. What I have remark'd concerning the planting of Cuttings of Ficoides, Geraniums, Cæreas, *Indian Figs*, Aloes, and such like, in the natural Ground, I have experienc'd to be much the best Way; they will soon draw Root, and make good Plants, so that we may Pot them about the Middle of *August* of the same Summer, in order for the Green-house.

The Directions I have given for the raising of Plants by Cuttings, may, in a great Measure, serve for the raising of Plants by Layers; that is, we must take Care to bury Buds enough in the Ground when we make Layers, provided they are such as are found upon a tender Shoot of the last Growth; but the old Wood of such Plants, whose Substance is hard, such as Oak, and the like, will not make Roots, tho' we lay them many Years in the Ground. The Season when we commonly make our Layers of Trees is in *September*, *October*, or *November*, because they may have Time enough to be acquainted with the Earth, before the Spring comes on; that is, that their Gummy or Rozinous Juices may be, by Degrees, impregnated with the watry Parts of the Earth, and, by that Means, facilitate their

Change. It is a Practice among the Nurserymen, to cut off the Heads of such Trees as they design to increase by Layers, in order to make them produce young Shoots near the Ground, that they may be bury'd more easily in the Earth. These Mother-Plants they call *Stoles*; signifying a Shoot or Twig of a Tree springing from an old Stock; such as, by some of the Ancients, was call'd an *unprofitable Branch*, because it brought no Fruit, and so, corruptly, the Gardiners use the Word *Stolo*, for the old Stock which produces such Branches: But whatever Layers we make from such Twigs, must, when they are bent to the Ground, be carefully pinn'd down with hook'd Sticks, that when we have once fix'd them, they may not spring or start from their Places. In making of Layers to be taken from the Stocks, and transplanted without losing of Time, I have practis'd the drawing Shoots of Plants thro' the Holes at the Bottoms of Garden-Pots, and then filling the Pots with Earth, they will take Root in the Pots: But in the drawing such Shoots thro' the Holes of the Pots, we must take Care, that we do not break off the Buds from the Shoots. These Layers,
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When they have taken Root in the Pots, may be taken from the Mother-Tree, and, with all their Earth, be turn'd out of the Pots, and set directly in a Place for bearing. Some Sorts, as Vines, for Example, will strike Root in Five or Six Months: We may lay them in *November* or *December*, and we may cut them from the Vine when their Grapes are ripe; but some Sorts of Plants require to be bury'd 'till the second Year before they take Root: And, indeed, Vines may be cut from the Mother-Plant much sooner, but then their Fruit will not be perfectly good, as if we let them feed from the old Stock, 'till their Fruit is ripe, and then we may bring the whole Plant, with its Fruit, upon the Table, before we plant it in the natural Ground. I cannot well pass by an extraordinary Observation of Dr. *Agricola's*, a Physician of *Ratisbone*, who was curious in this Way, relating to the raising of Plants from Cuttings, that our first Regard ought to be how to preserve them from shrinking by the Air; and he even proposes to plant Cuttings, and make Layers of Plants while they are shooting, and are in the most tender State; for which End, he prescribes several Preparations of Gums, to dip that End of the Cutting in, which is to be bury'd

in the Ground ; which, by Experience, I find, will nourish the Cutting, will preserve it from rotting, and keep it from shrinking by the Air, This I have try'd, as also to plaister the Cuttings with Soap, and have found them both successful even in the Cuttings of Peach-Trees, Plumbs, Vines, and several Ever-greens in Summer. The Compositions of Gums, I shall mention in another Discourse.

There is also a Method of encreasing of Plants by the Leaves, but then they must be such as are ever-green, like those of the Holly, Bay, Orange, Lemmon, &c. which being taken from the Plants when they are fully perfected, without any Buds adhering to them, and then immediately dip'd in a Mixture of Gums, as I shall relate hereafter, while the Mixture is Blood-warm, and put into the Earth as deep as the Composition of Gums has cover'd them, which may be about an Inch, the Earth must be press'd close about them, and very well water'd. This I have seen practis'd, and will bring us very fruitful Plants, for out of the extreme Parts of the Foot-stalks of the Leaves, will sprout a Bud that will bring Blossoms and Fruit, if the Leaves are taken from such
Places,

Places where the Buds adjoining to them has produc'd Blossoms. This is one Reason why, I say, that a Leaf is a perfect Plant, which grows upon another Plant.

As to what regards the raising of Plants from the Fruit, concerns only the *Indian Fig*, whose Fruit, while it is green, being separated from the Mother-Plant, and set in the Earth, will grow, as I have experienc'd; that is, after we have given it Time to dry in the Sun, it will produce a Plant as perfect as that we took it from: But it is to be observ'd, that the Fruit of the *Indian Fig* is always in its full Growth before the Blossom is open; and yet this must not be taken as an Instance to contradict the System of the Generation of Plants, because this is yet green, and the Seeds in it are imperfect, so that it has the same Liberty of acting in the Ground as any other Part of a Plant. And it is also observable, that these Sort of Fruit, in our Climate, with the Shelter of a Green-house, will not change its Colour towards Ripening, 'till the Summer after the Blossom: And it is also observable, that this Sort of Fruit, in Summer, is beset with Buds on every Side.

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It next follows, that I mention the Manner of increasing Plants by their Roots, which is the last Way we have Recourſe to, when we are not provided with the Seeds of a Plant. This is done by ſevering, or cutting ſome of the larger Roots, near the Surface, from the Tree, and without diſturb- ing any of the Fibrés which belong to ſuch Roots, to raiſe the wounded End of the Root gently, 'till we can bring Part of it above Ground to ſtand upright, the more of it the better. This, by being expos'd to the Air, will, in Proceſs of Time, be diſpos'd to put forth Buds for Leaves and Shoots, and make a Plant, which may afterwards be remov'd; but ſome Plants are ſo ſtubborn, that after a Year or Two, ſuch Roots will not ſhew any Buds, tho' we may find them then alive. When this happens, we may graft a Cion from the Head of the Tree upon the Root thus prepar'd, and we ſhall preſently have a Plant for our Purpoſe: Or we may graft upon ſuch Roots about Six Months after they have been disciplin'd after the Manner above directed. Thus have I gone thro' the Methods of increaſing of Plants by Cuttings, by Layers, Leaves, Fruit, and Roots: It remains that I ſhould ſay ſome-
thing

thing concerning the increasing of Plants by Off-Sets; but as that Way of Multiplication relates chiefly to the Improvement of Flowers, so I shall rather leave it for that Discourse.

I shall therefore proceed to explain the several Ways of Grafting, by which Trees are improv'd from Wildings to bring good Fruit: In order for which Design, our Garden ought to be stor'd with Stocks of all Sorts; that is, with such as are Pomiferous, or Apple-bearing; Pruniferous, or Plumb-bearing; Bacciferous, or Berry-bearing; Coniferous, or Cone-bearing; Nuciferous, or Nut-bearing; Glandiferous, or Mast-bearing; and Siliquiferous, or Cod-bearing; because we may sometimes meet with a strange Tree, which will only be encreas'd by Grafting: And as all Trees, that I can now think on, are of one or other of these Classes, so our Nurseries should be provided with Stocks of these several Sorts, that we may graft the Apple-bearing upon the Apple-bearing, the Pruniferous upon the Pruniferous, and so on.

The Wilding which we are to graft upon, we call the Stock, and the Twig or Shoot which we
are

are to graft upon the Stock, is call'd the Cion, or Graft: Every Cion, or Graft, when it is rightly dispos'd on the Stock, according to Art, will take Root in the Stock, and retain the Virtues of its Mother-Plant, as I have observ'd before.

Some Sort of Plants will more readily join by Eneying or Inoculating, than by Grafting; and there are others which will not take by either of those Ways, but by Inarching only: Again, there are some which will only join by approaching, all which we shall consider in their Order; observing, by the Way, that Nature gives us large Liberties in Grafting, such as that we may graft Apples upon Pears, or Pears upon Apples, and both these upon the common White-thorn; upon which, likewise, we may graft Medlers, the Lazeroli, and Cervices, and upon the Pear-Grafts we may also graft the Quince: All these may be made to grow upon one Tree, by Whip-grafting, or by Cleft-Grafting, or Stock-grafting, or by Inoculation, Eneying, or Budding.

So the Pruniferous Fruits, such as Peaches, Nectarines, Apricocks, Cherries of all Sorts,
and

and Plumbs of all Sorts, may be budded upon Plumbs, or upon one another: And what seems extraordinary, is, that the *Lauro Cerasus*, which is our common Laurel and Ever-green, may be inoculated upon the Cherry and the Plumb, and be made a Companion for all those of the Pruniferous Race. An Instance of this Sort is now in the Garden of Mr. *Whitmill*, a curious Gardiner of *Hoxton*: By this we may observe, that these Grafts, or Buds, are so many Plants of different Kinds, which grow upon one Plant; which is like one certain Sort of Soil, wherein we find growing many Plants of different Sorts; but we must observe, that one Kind will prosper better than another.

The first Sort of Grafting, which I shall mention, is that Sort which we call Whip-grafting, or Rind-grafting: This is perform'd by paring off Part of the Bark on one Side of the Stock, either after we have cut off the Head of the Stock, or else while the Head remains on the Stock; for it is done both Ways. If we cut off the Head of the Stock, then the Bark we take off must leave the Wood bare, about an Inch and half from the Place where the Head is cut
off

off downwards towards the Root, and as wide as the Cion, which we design to join with it; then we must, with our Knife, slit the Stock down from a little below the Place where the Head is cut off, guiding it with the Grain of the Wood, 'till we have made a Tongue on the Side of the Stock where the Bark is par'd off, about an Inch long. This being done, we are next to pare off the Bark from one Side of the Cion, and then, with our Knife, make a Tongue in the Wood of the Cion, of such a Length as may fit exactly with that in the Stock, which when we have join'd together, so that the Barks of both the Cion and Stock join together, we must tye them fast with Bafs, and cover all the wounded Part with fine Loam, well mix'd with Cow-dung or else we may cover the wounded Part with the following Mixture, *viz.* to Four Ounces of Bees-Wax add as much Tallow, and when these are melted together, add about an Ounce and half of Rosin, which must be used when 'tis Blood-warm, with a soft Brush, and then we need not tye the Cion and the Stock together; for these Coverings are only design'd to keep the Air and the Wet from the wounded Parts, 'till they join together, which they will soon do, if the Tongues of the

Stock

Stock and the Cion are well wedg'd into one another. When we use this Sort of Grafting, without cutting off the Head of the Stock, we then take the Bark from the Stock in any smooth Part of a Shoot, *i. e.* between the Buds, and fitting the Cion to it, as before with Tongues, we then cover the wounded Parts with some of the aforementioned Grafting-Wax. This last Operation may be done when the Sap is in its highest Fluences; but the first must be done just before the Buds begin to shoot.

Cleft-grafting, or Stock-Grafting, is perform'd by cutting off the Head of the Stock, and then, with the Knife, flitting the Stock downwards an Inch or two, in Proportion to the bigness of it, and of the Cion we are to put into it. We then cut the Bottom Part of the Cion Wedge-ways, of the same Length we have made the Slit, and so place the Cion in the opening we have made in the Stock, that the Bark of the Stock and the Cion both join, or match with one another.

If the Stock happens to be very large, as sometimes it is, when we use this Kind of Grafting, such as an old Tree saw'd off, which may, perhaps

haps, measure Three Foot in the Girt, then we must be forc'd to open the Places, where we are to fix our Grafts, with Chizzels, and keep them so open with Wedges, 'till the Grafts are fix'd to our Mind. In such Stocks we may place Three or Four Grafts, but Two are enough, if we could be sure they all would take: In this Case our Cions may be larger than if the Stocks were small. In *Worcestershire*, it is common enough to graft Apples this Way, with Cions, which measure about Five Inches in the Girt, and they prosper very well: But we must observe, that our Cions may be larger, if they are of Trees that have tender Wood, than if they are of a hard Wood; when this is done, lay on some of the Grafting-Wax, as before directed, so as to cover all the wounded Parts of the Stock and Cion. In this Case, where the Stock is large, there is Vegetable Matter enough in it to feed the Cions to good Advantage, so that the Third Year they will produce extraordinary large Fruit, tho' before the old Head was cut from it, the Fruit was hardly bigger than Hazle-Nuts. Here is another Example of a Tree's growing upon a Tree; and as the Clift-grafting is practicable upon the oldest Trees, so is it to be done upon
Plants,

Plants which are not above Three Months old from the Seed: This I learnt from Mr. *Curtis* of *Putney*, a very curious Gentleman in the Knowledge of Plants: His Method is, when he raises Orange-Trees from Seeds, that as soon as he finds they have got a Stalk about Three Quarters of an Inch above the Ear-Leaves, he cuts off the Top, and making an Incision cross that Stalk, bears his Knife downwards, towards the Part where the Ear-Leaves join with it; and then choosing a tender Shoot of a bearing Tree, that will match with the Stock, he cuts the Bottom of it in the Manner of a Wedge, and places it as I have related before, so that the Barks may join; and then applies some of the Grafting-wax warm with a fine Painting-Brush. This Operation may be done all the Summer long, and is particularly explain'd in my Philosophical Account of the Works of Nature:

I am next to speak of Inarching, that is Inlaying the young Shoots of one Tree into another, which is the surest Way of Grafting that I have yet mention'd; for here, if the Part which acts as a Cion does not happen to join with the Stock, it may still remain upon the Tree. To perform this Work, one must have a Collection of Stocks

in Pots, that when we have any particular Tree which we have a Mind to encrease, we may bring the Stock to it, and then cutting off the Head of the Stock, we choose out such a Shoot of the valuable Tree, as may, with the most Ease, be brought down to the Stock, and then we must order both of these with Tongues, as I have directed in the Whip-Grafting, only we must leave that Part which is to act as a Cion to join with the Tree in such a Manner, that it may be well fed with the Juices of the Tree. I commonly, in these Cases, cut the Tongue of the Graft half way only thro' the Shoot: This being thus order'd, we are to tie our Two joining Parts very close, and then cover them with the Mixture of Loam and Cow-dung, also taking especial Care to secure the inlay'd Branch from flying from the Stock, which sometimes it will be apt to do, if it is not well secur'd by Strings or Sticks; for tho' this is not a Work to be done in the Summer, when the Plants have their Sap in the greatest Fluency, yet the mildest Summer is not without its Storms, especially in *June* or *July*. It is to be noted, that some Plants should remain thus join'd 'till the second Year, before we cut them from the Bearing, or the desir'd Plant; especially those whose inarch'd Shoots are of a more hard

or

or Woody Nature : But where we can inarch green Shoots, such as those of Oranges or Lemmons, if we do this Work in *May*, we may cut them off in *August*, if we find they have taken hold of the Stocks:

When we have cut our Plants from the Mother-Tree, set them immediately in some Place of Shelter, where the Winds may not get at them, for else the new Heads, which are tenderly join'd, will be subject to break from the Stocks ; or if the Stock be growing in the natural Ground, then when we cut the young Inarch from the Tree, we must be careful to guard them well with Stakes.

Inoculation is the next Improvement I shall treat of. To Inoculate is the same as to Eneye, or to Bud ; and is nearly the same as the Ancients call'd Emplasteration ; only their Emplasteration was cutting out a large Piece of the smooth Bark of a Tree, with several Buds upon it, and then opening the Bark of another Tree in such Manner as to lay the Bark of the bearing Tree close to the Wood of the Stock ; they then cover'd the wounded Parts over with a kind of Mortar, or prepar'd Loam. This Method is

fafer and firer in the way of Inoculation, than our inoculating with a fingle Bud, becaufe the great Quantity of Bark taken off with the Buds, which may be about Two Inches fquare, muft hold a good Fund of Nourifhment to fupport the Buds 'till they have join'd with the Stock: But, however, our common Way of inoculating with a fingle Bud is not inferior to moft of the modern Ways of Grafting, provided we take Care to be guided by the Vigour of the Sap: I mean, that we never attempt to Bud or Inoculate any Tree, but when the Bark will rife freely from the Wood, as the Gardeners fay; or, in other Terms, will flip from the Wood.

Our Buds, in this Cafe, muft be fuch as can be taken from the laft perfect Shoot of a Tree, and of the Bark in which this Bud happens to be plac'd about half an Inch below the Bud, and as much above it, and on each Side the Bud about half an Inch; then making the Incifion in the Bark of our Stock, like the Letter T, we raife that Bark on both Sides from the Wood, and then ftripping the Bud from the Woody Parts which join to it, infert it between the Bark and the Wood of the Stock, and tye it with Bafs, fo that the Bud may not be hurt or cover'd; or
 elfe

else some of the Grafting-wax, being apply'd as directed in the former Graftings, will be sufficient without tying.

I have now only to prescribe the Method of approaching, or Grafting by Approach, which some have falsely taken for Inarching. The Ancients, in most of their Works, recommend it as the surest Way, and I have had Experience enough to find it as they say: I have mention'd it in my Monthly Writings, but I know no Gardener that has it in Practice, at present, but Mr. *Whitmill* of *Hoxton*. It is perform'd in young Shoots, while the Sap is fluent, or in Shoots of the last Growth, when the Sap is beginning to flow vigorously; we then place Two Plants together, and paring off the Bark from one Side of a Branch of each of them, we apply the wounded Parts to one another, and tie them together with Bafs; and if they are tender shooting Plants, they will soon unite in their Woods, and may be cut off in Three or Four Months: And when Plants are very different in their Nature, as the Fig and the Mulberry, or the Vine and the Passion-Tree, we may reconcile them by this Means, as may be observ'd in the Garden above-mention'd. As for the Method

thod used by the Ancients, of Ferebration, or bowing of Trees, it was no more than piercing thro' the Bark, and then pressing the Instrument downwards, between the Wood and the Bark, they made Room enough to receive the Foot of the Cion Two or Three Inches, by which Way the Cion was fed, and struck Root in the Tree; but the Foot, or Bottom Part of the Cion, must be prun'd a little, so as to make it terminate in a Point, and when it is fix'd we must close the Orifice with Grafting-wax. This is now out of Practice among the Gardeners, but I find it of good Use, especially in difficult Cases: The Time I have try'd it with Success, was when the Bark would slip easily.

Thus I have gone thro' the Business I propos'd in this Discourse, and I shall conclude with observing, that a curious Man, in this Way, may employ himself every Month in the Year, either in the Experiment of encreasing Plants by Cuttings, Layers, &c. or in improving them by Grafting, &c. I mean, if the Winter is not too severe to shut him out of the Earth.



DISCOURSE VII.

The Manner of making PLANTATIONS, either for Pleasure or Profit.



IN a former Discourse, I have hinted at several necessary Considerations, when we are to make Plantations of Trees, *viz.* that the best Season to remove or transplant Trees is in the Summer, while they may have an immediate Opportunity of striking Root. In the next

Place, that it is improper to cut off the Head of a Tree when we plant it, because the Juices while the Head is on, have a greater Power of acting upon, and assisting the wounded Root ; for while the Branches are on the Tree, the Circulation is better maintain'd than when they are taken off, for the Branches will imbibe a Moisture from the Air and Dews, and while the Branches and Leaves I mention can have the least Share of Action, the whole Body, upon which they depend, must be in Action to fix the Earth close about the Roots of a Tree, when we transplant it, and let as little Air as possible come at the Root in the removing it from one Place to another, for the Air dries and shrinks the Roots, so that they are a long Time before they can recover. I have also touch'd upon the Necessity of plaistering the Wounds of the great Roots, if any of them have been cut, with Mixtures of Gums, so that the Air and the Wet may be kept from having any Communication with the Sap-Vessels, which would either shrink them or rot them : Besides, when these Vessels are stop't, the Juices in the Body of the Tree are more capable of performing their Circulation regularly, and of dispensing their Nourishment to those

Buds

Buds which are to act as Roots, which, with the Cautions abovemention'd, will do their Duty immediately, as they are already acquainted with their Office, while the Buds of Cuttings, or Layers from Trees, which had already been prepar'd for acting above Ground, would be tedious in reconciling themselves to the Change of making Roots.

But it is necessary, that I lay down some general Rules for the preparing of the Mixtures of Gums to be used as Plaisters to the Wounds of Trees, that they may serve to nourish the Plants as well as heal their Wounds. I have already mention'd the Benefit which Cuttings, and even Leaves of Plants receive from Mixtures of Gums in general; but to be particular, one may reasonably suppose, that such Gums as comes nearest to the Juice of any Plant we are to use them to, will be more helpful to such a Plant than Gums which are of a different Nature. Let us then consider, we have Pitch, Rozin, Turpentine, Gums of Plumbs, Cherries, &c. to which one may add Bees-wax, which is gather'd from the finer Parts of Flowers, without Distinction, which is also a Sort of Gum. From these, one
may,

may, I suppose, prepare such Compositions as might agree with the Temper of any Plant, especially if we take in to our Assistance any Juices or Infusion, Decoction or Digestion of Animal Parts, such as Tallow, or such as may be incorporated with Gums.

So, for Example, if we are to prepare a Mixture for Firs, Pines, Pinafters, and such like Turpentine, may have the greater Share in the Preparation; but with this we may put Beeswax, and a small Share of Tallow, in such Quantities, as that the Tenacity of the Turpentine may not be lost; but if we shall happen by Accident to have put too much Tallow, we may then have Recourse to Rosin, which, in a small Quantity, will bind the Parts of the Mixture.

In preparing such Mixtures, we must provide a clean Pipkin, well glaz'd, into which we should first put our softest Ingredients, and by Degrees as they melt, break in the others, keeping them all stirring together, 'till they are incorporated as much as possible. We must also, while this Mixture is gently simmering, set it on Fire, to let it burn Two or Three Minutes: This Burn-
ing

ing will help to mix the Parts of the Mixture, and to consume the more Earthy or heavy Parts. We put out this Flame by covering the Pipkin with a Trencher, and we may renew it Four or Five Times; but as the making of this Preparation is somewhat dangerous in a House, it is best to be done Abroad, where we may make it with Safety.

In the preparing of Mixtures for Trees of other Kinds, we may use the Ashes of them infus'd in Oil, and then mixing a small Quantity of the Oil with Bees-wax, some Turpentine, and a Proportion of Rosin, to bind the Parts, we shall have a Mixture to our Mind: Or for grosser Plants, such as Elms, and such like, I have used Pitch instead of Turpentine with good Success; for I find both Turpentine and Pitch are good general Gums for almost any Plants; but Turpentine, especially, is helpful to any Plant, as well as its own; and Bees-wax ought to be in every Mixture of this Kind, for the Reason beforemention'd.

When we use these Preparations, let them be melted, and when they are Blood-warm, apply them

them with a Brush to the wounded Parts, either of the great Roots or Branches, after we have smooch'd them well with a sharp Knife. This Operation should not be neglected a Minute, if possible, after any great Part of a Tree is cut off.

In the next Place, I come to speak of the transplanting large Trees in Summer, which advantageous Discovery is owing to Mr. Secretary *Johnstoun* at *Twittenham*, which Gentleman now has many Experiments of this Kind in his Garden, *viz.* of Trees of various Kinds planted in *May*, in *June*, in *July*, and in *August*, which prosper as well as if they had not been remov'd, altho' they were very large at the Time of transplanting. The Method is, to open the Trenches, or dig the Holes of a convenient bigness, to receive as much Root of the Trees as possible, and then to prepare a large Quantity of Earth well skreen'd, and made as fine as may be. We then set about our Work in taking up the Trees with as many Roots as we can preserve, plaistering the great Wounds as they happen to be made: This freeing the Roots from the Ground should be done as expeditiously as possible,

ble, that the smaller Fibres may not dry, and then clearing the Roots from all the great Clots of Earth, convey it to the Pit or Trench where it is to be replanted; first having furnish'd the Bottom of the Hole or Trench with a thin Mud made of the fine skreen'd Earth and Water, which must be kept stirring 'till the Root of the Tree is set in it, and then immediately pour into the Hole or Trench as much Mud of the same Sort as will fill up the Hole or Trench, which Mud must be ready prepar'd in large Tubs; and kept stirring 'till we use it: We must then, by small Parcels, sprinkle some of the fine skreen'd Mould upon the Mud, dashing it every now and then with Water, to settle it, and so continue this Work 'till the Mud in the Trench is well thicken'd. Our Trees, thus planted, must be well secur'd with Stakes, as those planted at other Seasons, and when this is done, throw on some of the skreen'd or sifted Mould over the Surface, to prevent the Muddy Part from cracking, and letting in the Air to any of the Roots, which it will be apt to do in a Day's Time, as the Moisture of the Mud sinks away.

The second Day after planting, we should carefully stir the Surface as well an Inch deep of the settled Mud, as the other dry Mould upon it, and dash the whole well with Water, to fill the Cracks, if there are any ; and we may depend upon the Welfare of the Plant : But we must be sure to observe what I have said before, concerning the planting in Clay Grounds ; we must not dig into the Clay, but raise the Surface. A Tree thus order'd may be prun'd, or have some of its Boughs thin'd, Three Weeks after planting. I s^{aw} did that Work at Midsummer, which is the best Time of planting, we must observe also, that after the second Day's Work is over, of stirring the Surface of the new planted Ground, we must lay some Fern, or such like, upon that Surface, and there will be no Necessity of watering such Trees afterward, unless the Earth be very light. We must also be careful to apply some of the Mixtures of Gums to the Wounds of such great Branches as we may cut off when we come to prune such Trees, and in the lopping of the great Branches, cut them clean to the Stem of the Tree ; for if we leave any Stumps, they will make unprofitable Shoots,

and

and rob the other Branches. After this Manner, I have known Elms, Limes, Chesnuts, Oaks, Ilex, Firrs, Pines, Peaches, Apricocks, Nectarines, Cherries, Plumbs, Vines, Gooseberries, Currans, and almost every Kind of Fruit-Trees, planted with Fruit upon them, which Fruit, for the most Part, has ripen'd well, and the little Check, which the Trees receiv'd from this Removal, has brought them into a better State of bearing than they were in before.

In my former Discourse, concerning the Circulation of Sap in Plants, I have given my Reason why we ought not to take off the Head of a Tree when we transplant it, as the Gardeners do in all great Plantations: And besides what I have there observ'd, I may add, that the Timber will be spoil'd by it, for as it is the Stem of the Tree which is to produce the valuable Timber, so if we cut off the Top of that Stem, the remaining Part will be subject to rot at the Heart, and the Tree, if it grows, will be little better than Pollard. The Gardeners, however, when they plant Wall-Fruit-Trees, always leave their Tops on, 'till they have struck Root, and few of the Trees so order'd fail to grow well, therefore
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it is surprizing to find them act ſo contrary to this Practice in planting other Trees, when it is plain that the Principles of Vegetation are the ſame in every Tree.

With the Method directed above for Summer-planting, I have remov'd Peach-Trees, after they have been train'd againſt Walls Six Years, and they have proſper'd very well ; and conſidering the Time this Way of planting will gain in making a Fruit-Garden or an Orchard, or a good Shade about an Houſe, ſo as immediately to answer their Deſigns ; I ſuppoſe that a little extraordinary Expence will not be regarded by thoſe who truly conſider what Time is. In the tranſplanting of Fruit-Trees of this ſtanding, I have found that the conveying them from one Place to another has been the greateſt Difficulty, eſpecially if the Places have been many Miles aſunder. In this Caſe, I have provided large Tubs, ſuch as Pipes cut in Two ; in one of which one might well enough put the Roots of Five or Six of theſe Wall-Trees, after having taken all the Clods of Earth from them, and then pour into them as much thin Mud as will cover their Roots, and lay ſome Straw
over

over the Top of it. In the mean Time, the Trees, with their Branches and Fruit, must be so secured as not to fall out of these Tubs, nor to be strain'd or torn by the Motion of the Waggon; by this means we may bring them safe to their new Station, and then preparing the Holes, or Trenches, as before, take them out of the Tubs for planting One by One, as we want them. In the Carriage of small Plants of Curiosity, I have used Bladders fill'd with thin, Mud, prepar'd as before; and have kept Plants in that Manner a Fortnight, without injuring them; or we may convey small Trees safely thro' a three Weeks Travel, with laying their Roots in fresh Cow-dung.

But it is necessary likewise, that we consider how great Plantations may be made to the best Advantage; with the smallest Expence. It is certain, that there is no better or cheaper Way of raising Woods than by sowing the Mast or Nutts of Timber-trees, where they are always to remain; but if we come to make Plantations, let us chose small Plants; of a Yard or Six Foot in free Shoot, rather than large Plants; for in all my Experience, I find the

Plants of Three Foot, will, in Five or Six Years, be taller, and more vigorous, than such Trees as are planted at the same Time in the common Way, of Fifteen or Sixteen Foot high.

It is to be observed as a general Rule, that in light Soils, if we follow the usual Seasons of planting, it is best to plant in Autumn, and in heavy Soils in the Spring. What I mean by Autumn is, from the last Week of *September* inclusive, to the second Week in *October*; and by the Spring, from the Beginning of *February*, till the last Week in that Month; and, whether the Earth be light or heavy, it must be skreen'd or sifted in the Holes where we plant the Trees, if we expect our Labours to be crown'd with Success; and immediatly after planting every Tree, give the Ground, where it is planted, such a Watering, as may settle the Earth close about its Roots.

I also lay it down as a Maxim, that in the planting of Grafted or Budded Trees, we must not bury the Tree so high as the Bud or Graft, for the Moisture of the Earth will rot the Foundation of it; and in transplanting of Trees, which

which are neither budded or grafted, we must not left them be planted deeper than they were before. In the planting of Trees against Walls, we must take Care, that we do not plant the Bottom of the Stem nearer the Wall than six Inches, for, by planting it clofer to the Wall, the Roots are subje&t to canker, and infect the Branches:





DISCOURSE VIII.

RULES FOR PRUNING OF WALL-TREES, DWARFS, and such others, as are subject to the Knife.



S every Tree was naturally designed to remain always in the same Station, when its Seed was first bury'd, and where it first began its Vegetation ; so in Nature there is no Design of Pruning ; but since by Art, Trees of any Kind may be removed from one place to another, and must necessarily loose some of their Roots by

by such Removal, to consequently Pruning becomes necessary, that we may keep a just Balance between the Roots and the Branches; for when a Tree loses any of its Roots, some of the Branches, if not all of them, must, on Course, be influenced by the Loss of such Roots, that is, the Stock, upon which such Branches grow, will not be able to receive Nourishment enough to Support all the Branches, as it did before it lost some of its Roots; And therefore, when we find such a Tree has began to make new Roots, it is then necessary to take as many Branches out of the Head as may be necessary to counter-balance the lost Roots, that the young Ones, which are now beginning to shoot, may draw in Supply enough to nourish the Buds which are to shoot in the Head, for I have observed before, that Roots of every Plant, must shoot before the Buds or Branches, in Order to get Nourishment beforehand, to feed the Head of the Plant. In Timber-trees, we must always Prune off the Weakest Branches, but in Fruit-trees, the contrary is practised. However, where Pruning can be avoided, the Tree will fare much better without it; and especially since the Use of the

Knife is so little understood, I esteem it the most dangerous Instrument that can come into a Garden; for, I am perswaded, that Three Fourths of the Wall-Fruit in *England*, is lost every Year by the Knife only; so few have we among those who profess Gardening, that know any thing of the Matter.

But however, the Knife may be well understood by a few, yet there are common Instances to prove, that a Tree will prosper better, and bear more Fruit without Pruning than with it; Witness all Standard-trees in Orchards, that have been planted very young without Grafting; such as we may frequently meet with in *Devonshire*. And also the Peach-trees, which are rais'd from the Nutt or Stone in *America*, or in *Italy*, and the South of *France*: Those Trees bear plentifully, and are not apt to canker, as these are which are subject to the Knife. Likewise it is observable, that Standards either of Pears, or Cherries, or Plums, &c. which have been Grafted or Budded, and carefully removed, will prosper well, and bear Plenty of Fruit, without any Pruning at all; so in Stand-

ard-

ard-trees, that have been well managed at first, Pruning does not appear to be at all necessary.

But let us now enquire into the Reason for pruning of Wall-trees: In Order to which, we must consider, that all the Trees, which we plant against Walls, are thus station'd, because they are such as are Natives of the warmer Climates, and therefore require the Assistance of a Wall to defend them against the Severity of our Winter Storms, and also to receive such a Warmth from the Wall in the Summer, as may expediate the Ripening of their Fruit; for a Wall, heated by a few Hours of the Summer Sun, will remain with a Warmth in it a long time after the Sun has left it, and the Shoots of our Wall'd-trees being nail'd to it, will be advantaged by that Warmth, so as to find little Difference between the Warmth of the Wall, and that of its own Climate. Again, the nailing of these Trees close to the Wall, secures their Shoots, and Branches from being bruised by Winds or Hurricanes. Thus we see the Occasion of planting Trees against Walls, and the Advantages we receive from it, is, that our

Fruits,

Fruits, against our best exposed Walls, will ripen near a Month sooner than those growing upon Standards: If we should happen to have any Standards of the same sort, so that besides the planting of Fruit-trees against Walls, as absolutely require them, it is thought adviseable to plant others, in Order to bring them earlier than usual to the Table. In this Case it is necessary to consider first, that our Trees have their Branches spread in good Order, and that the Branches, which we lay to the Wall, be such as will bring Fruit: Also we must have Regard to the Number of Branches which we lay to the Wall, that we may leave Room enough for those Shoots which will be made the Summer following; and again, that we allow no Branches to lie a cross one another, nor strain in any Branch, which happen to shoot forward in a Tree; these are general Rules: And as to Particulars, we shall begin with the Peach, and direct the Manner of Pruning it. In this, we are to observe, that the Fruit-bearing Branches are those of the last Year, and no others. The smallest Shoots, which have finish'd their Growth the last Midsummer, are those which will bear, and the larger Shoots will be unfruitful for
 this

this Year ; but if we want to fill a Vacancy, they will be of Use, by producing Bearing-Shoots for the following Year. Of the small, or Bearing-Shoots, we must preserve those which will best come to the Wall, and may prune off their Tops, provided we leave Two or Three Leaf-Buds beyond the Blossom-Buds, otherwise the Blossoms, tho' they may set or knit for Fruit, will drop, and disappoint us. In the leaving of large Shoots, to fill Vacancies, we must have Regard to their Strength when we Prune or Top them, *viz.* if they are a Yard long, and as thick as one's little Finger at the Bottom, we may leave them full Two Foot long ; considering what I have remark'd before, that every Shoot is a Plant growing upon a Tree ; and the more the Buds we leave, so the Branches they make, will be less nourish'd, and less vigorous, than if we were to leave only a few : and, as I have mention'd above, 'tis the smaller Shoots, in this Case, will bear Fruit at this Time of pruning, which is the Spring-pruning, and must be perform'd when the severe Weather is over. We must be careful to cut out all the dead or canker'd Wood, and then nail every Branch in its proper Place, rather with

Lift

List of Woollen Cloath, than Leather; because
 Leather, after it has been wet, grows hard, and
 is apt to bind too close about the tender Shoots,
 and occasion them to canker. Again, about
 Midsummer, when the Summer-Shoot is com-
 pleted, we must lay up to the Wall, as many
 of the new Shoots as we can conveniently, in
 Order to be adjusted the Spring following. At
 this Time, we must cut off all the stragling
 Shoots, which do not grow naturally, to be
 lay'd to the Wall; observing to cut them close
 to the Stem, which they spring from; and, as
 it is in Peaches, so it is also in Nectarines, ne-
 cessary to observe the Directions above; for
 the Manner of their Growing and Bearing is
 the same; nor is the Pruning of the Apricock
 very different, only the Apricock is more apt
 to ramp, or shoot into great Wood, than the
 Peach, or Nectarine, and is not to subject to
 canker. When we find our Apricock so dis-
 pos'd, we must bind down some of its larger
 Shoots Horizontally to the Wall, shortening
 them a little, and the *January* following, we
 may open the Ground about it, and cut off a
 great Root or Two, which will prevent its Vi-
 gour for the future, and dispose it for Fruit-
 bearing.

bearing. In all these Prunings, we must spread our Branches as Horizontally as we can, by which Means, the Bottom of our Wall will be fill'd, which too generally is left naked and uselefs. The Pruning of Plumbs against Walls must likewise be the same with the Apricock; for these, as well as the Apricock, Peach, and Nectarine, bring their Fruits upon the Shoots of the last Summer; but we must observe, among the great Varieties of Plumbs that some will shoot more vigorously than others, and there will be a considerable Difference between the Substance of the Bearing-Shoots of one sort, and those of another: However they will always be known, by being the least Shoots of the Tree they grow upon, and for the others, which are Shoots for Wood, they must, if we want them, be top't, in proportion to their Length and Substance, as I said before; and it is necessary sometimes to leave one of these entire without pruning, to carry off the too great Luxuriance of a Tree. The other Stone-Fruit, which I shall have Occasion to mention, is the Cherry, which also brings its Fruit upon the Shoots of the last Year, so that we must be tender how we cut off those Shoots,

espe-

especially of the *May-Cherry* and the *Morello*: Some Cherries are apt to bring their Blossom-buds in Clusters, which one may always discover at Midsummer, but none of these love the Knife. We must observe in their Pruning, to leave their Summer-shoot as perfect as possible; for all that is necessary to take from them is the *Autumn-shoot*, for they do Harm, in expending the Juices of the Tree to no Purpose. There is one Remark which we may make upon the Fruits before-mention'd, which is, that the Fruit-buds stand closer together than the Leaf-Buds; and I have said in another Discourse, are more turgid. But before I leave the Cherry, I am to take Notice, that 'tis the common Practice to top the Shoots when we lay them to the Wall; so that we may observe, there is little Difference in the Management of the several Sorts of Stone-fruit, which are those chiefly, which are cultivated against Walls: the Peaches, Nectarines, and Apricocks, against such Walls as are expos'd to the South Sun; the Plumbs and Cherries to the West and East Aspects; and also to these Aspects some of the most forward Peaches may be expos'd.

It remains now, that I should prescribe the Method of Pruning Pears against Walls, for sometimes it is thought necessary to give them that Assistance because some Sorts of them will not bring their Fruit to Maturity without such Help, but I cannot joyn with the common Practice of Planting Pears, which are hard to ripen against Walls ; which are exposed to a North Aspect, where they are more out of the Suns way, than if they were in Espaliers, or in the open Ground, it is much more rational if they are such as want extraordinary Heat, to Plant them against what we call a South Wall ; that is, such a Wall as lyes expos'd to the South Sun, here they will have an Opportunity of ripening their Juices. But to be bury'd in Shade will only make their Fruit lager and their Juices harsh : But let us consider what general Rules may be laid down for the Pruning of Pears ; of this Fruit, I must remark, as I have done before of the Stone Fruit, that we shall find some Sorts will always be more Luxuriant than others, or more inclining to Run into great Wood, some will make Shoots in a Summer above an Ell long and near an Inch,

Inch Diameter, at the Bottom of the Shoot; others will not produce Shoots of half the Strength, and in these the smaller Branches will soonest bear Fruit, but the others are not to be despised, for a little time will make them fruitful; that is, that they will produce Fruit Branches without Pruning; as is evident in Standard-trees, it is to be consider'd principally, in these sorts of Fruit-trees, that some Sorts will produce Fruit upon the Shoots of the last Summer, even to the very tops of their Branches, other Sorts there are, which bring their Fruit upon the Shoots of two Summers, and some which only brings Fruit upon the Shoots of three Summers. This Difference happens from the Juices of one Sort, that are more easily digested than others, those which are digested the soonest bear Fruit the soonest; of these Sorts we ought to have, at Pruning-time, as many Shoots as may be convenient to fill the Wall easily, so as to leave Room for the Product of the Summer, and cut all the rest away close to the Stem. In those other kinds, which bear upon the second Summer's Wood, we must be careful in the ordering our
 Branches;

Branches, ſo as to let our Tree conſiſt of immediate bearing Branches one half, and of ſuch as will come to bearing the following Year another half; ſo we may expect a good Share of Fruit every Year, and in the Pruning of thoſe Trees, which bear upon the Wood of three Summers, let there only appear at one time a third part of the Tree for immediate bearing, one third for the Summer following, and another for the Summer after that, obſerving to take away that Wood which has born Fruit every Year at Pruning-time, which may be any time in the Winter, but beſt in *November*. By this means we ſhall always have our Trees in a bearing ſtate, and they will not lie under the Imputation of being bad Bearers, which is the general Excuse of bad Pruners. The bearing Buds of all Pears made at *Midſummer*, and they are then very eaſily diſtinguiſhed, becauſe they are three times as large as the Leaf-Buds, and very thick and ſhort, ſomewhat of the Figure of a Boys Top: And upon thoſe, which ſhould remain for another Year, we ſhall find at *Midſummer* two ſmall Leaves at each Joint. Theſe Rules are not only to be obſerved in
the

the Pruning of Pears against Walls, but in the ordering of those which are planted in Hedges or Espaliers; for they must be manag'd the same way, except only if we find our Trees unruly or over luxuriant, it is proper in Espaliers, to let a single Branch in the middle of every Tree grow up without Pruning, and as it rises above the Espalier let it make a stem of about two Foot, and then allow it to grow into a Head; from this way of Management the superfluous Juices in the Hedge-part of the Tree will be drawn off, and the Branches in that part will come to bearing much sooner than they would otherwise do; and, at the same time, the great Demand of Nourishment below will so model the upright Branch that it will come to bearing also. An Instance of this is at *Cambden-House at Kensington*, where I made the Experiment ten Years ago, and I am inform'd by some Persons of Quality, who are my Friends, that the Year, 1724, those Trees were so full of good Fruit, that they had not seen any thing of the same kind equal to them.

It is upon these Rules that we ought to Prune all Pear-trees, either against Walls or in Espaliers, and the Difficulty is only, that in Espaliers we must keep them in a regular Form, and of a certain Height; but as long as we can lay our Branches horizontally, we are free from the other Inconveniency or Restraint. Mr. *John Warner*, a very ingenious Gentleman of *Rotherhith*, or *Redriff*, as it is call'd, has something like this in the Management of his Dwarf-trees, with great Success: When he finds a Tree is inclinable to run into Wood, he leaves the most sturdy Branch, which he can find in the Middle of the Tree, to run up, and carry off the undigested Juices; these he, very properly, calls the Waste-pipes. And this Method, with his judicious Rule of Keeping always his Trees full of young Wood, brings him so great a Quantity of Fruit, as is admirable; but if we do not follow this Practice in our Dwarfs, or Espaliers, (and we cannot well do it on our Walls) and the Trees are yet too luxuriant, cut off some of their great Roots in *January*, and it will bring the Trees into

a better State of Bearing. We must observe, that tho' Standard-trees, without pruning, bear more Fruit in Proportion than a Dwarf, or a Tree in Espalier, yet the Fruit of the Two last, as well as those of the Wall-trees, is generally larger; the Reason is, because the Stock has not so many Branches to feed in a Tree that is prun'd, as in a Standard; which agrees with what I have said in a former Discourse. 'Tis the Figure of a Dwarf-tree is generally more regarded by the Pruner, than the Fruit it ought to bear, which is the Reason it does not always produce Fruit: But take this as a Maxim, that in the Management of Dwarf-Pears, keep your Trees constantly in young Wood; and be assured, that all Branches, of more than Three Years old, are unprofitable, unless they be such as such Shoots spring from.

As for the Management of Apples, they are the same with that of Pears, but in Espaliers and Dwarfs; for I cannot find that our Walls need be troubled with them, and a North-Wall, or a Wall with a North Aspect,

is in my Opinion, fit for nothing but such early Sorts of Fruits as we have a Mind to retard in their ripening.

There are still Vines and Figs, which are to be consider'd, but the Methods of Pruning them, I shall treat of in the following Discourse, relating to Kitchen-Gardens.





DISCOURSE IX.

Of the Disposition of a KITCHEN-
GARDEN and the particular
Management of VINES and
FIGS.



Have thought it convenient to treat of the Management of Vines and Figs in this Discourse of the Kitchen-Garden, because Vines and Figs ought, by no Means, to accompany Peaches, or Nectarines, or other Wall-Fruit, for they are great Shooters, and the Drip of their Leaves does Mischief to other
Wall-

Wall-trees, ſo that where they are planted together, one muſt either be obliged to keep our Vine under by Pruning, and loſe half the Fruit it would produce, or elſe to give it Liberty, and loſe our Peaches.

The Vine is very different, in the Manner of its Growth, from other Wall-Fruits, and ſo its Manner of Pruning is alſo as different. I have, in a former Diſcourſe mention'd the ſeveral Ways of increaſing of Vines, ſo that it will be needleſs to repeat it in this Place: I ſhall proceed, therefore to lay down the proper Rules for Pruning them. We are to know, that all Vines bring their Fruit upon the Shoots of the ſame Summer, and thoſe Bearing-Shoots are always produced from the young Wood of the laſt Summer, *i. e.* the Shoots which will be made in *May*, 1727, will bring their Fruit upon them, and thoſe new Shoots will always ſpring from the Shoots made in the preceding Year, 1726, ſo that old Wood is of no Uſe in a Vine, unleſs it be in the Caſe where we have a Mind to cover a high Wall: In that many Sorts of Vines, which we have

in *England*, we find various Manners of shooting, some will make Shoots of Twelve Foot long in a Summer, and others will not Shoot above Three or Four Foot: We generally find the largest Shoots about Three Quarters of an Inch Diameter, towards the Bottom, and the smaller Shoots, about the Thickness of a large Goose-Quill. In the larger Shoots, the Joints, or Internodes between the Buds, are sometimes 8 or 9, or 10 Inches long; but towards the Bottom of such Branches, the Buds stand much closer together: These which stand the closest together are fruitful Buds, but such as have long Joints between them, are not fruitful; and in those Trees which are the smallest Shooters, the Joints between the Buds are shorter in Proportion, as well those which are between the unprofitable Buds, as those between the fruitful Buds: But this will be better explain'd by the Figure, as well as the Manner of Pruning, whereby we shall find the Necessity of leaving the larger Shoots sometimes above a Yard long, or a Yard and half, when the smaller Shoots may not be left above half a Yard. We shall also find there, how

to avoid Confusion in Pruning, and by One Example be led into the Method of Pruning all sorts of Vines.

I come next to consider the Fig, which is a Fruit, in my Esteem, of good Value, especially some of the best Sorts, as the Vardone, the *Brugiotti*, and some others, which I have got from *Italy*, all of this Sort of Fruit, are apt to shoot with great Vigour, and presently come into great Wood, if we have not a due Regard to prune them; in which Operation we must have Regard to cut off such Branches as are necessary in warm Weather, for wounding them in Winter, spoils the Tree. When the young Shoots of this Tree begins to harden into Wood, we may expect them to knot for Fruit, but as the Fruit grows large, so will the Top-Bud of the same Shoot sprout forward very vigorously, and if we suffer it to grow to any considerable Length without nipping off the Top-Bud, our Fruit, however vigorous it may seem to be, will be subject to drop off before it is ripe. In the sloping of the young Sprouts, at the Ends of

the Bearing-Shoots, we may leave Four or Five Buds upon the green Wood of each of them ; and the Consequence will be, that the Fruit will ripen well, and the green Wood, instead of putting out *Autumn-Fruit*, will put out as many Shoots as we left Buds upon the young green Shoots that we prun'd. These last Shoots will be short jointed, and bring Fruit the *May* following in great Abundance. We shall find the nipping of these Buds necessary about *June*, and 'till the Middle of *July*, but not later. When we nip off the Tops of these Shoots, there will flow a great Quantity of Milk from them, which may make some believe the Tree will be injur'd by this Expence of Sap ; but there's no Danger, these Wounds will heal in a few Minutes, and we shall be sure of Fruit. Some few of the latest Sort of Figs may be nail'd against South Walls ; but, for the most Part, Figs will be best in Dwarfs or Standards. I have try'd above a Dozen Sorts without Walls, and they ripen very well ; and, sometimes, will ripen Two Crops of Fruit in a Summer. They love a very dry, rocky, or stoney Soil, as well as the

the Vine. We may propagate one Sort upon another, by approaching, the Manner of doing which, I have fet down in a former Discourſe.

But I come now to ſpeak of a Kitchen-Garden, and of the Manner of diſpoſing it to the beſt Advantage.

A Kitchen-Garden ought chiefly to be the Place where we cultivate our choicest Fruits, as well as Herbs and Roots, for the Uſe of the Table; it ſhould, if poſſible, be Wall'd about for the Sake of the tender Fruits, which we ought to cultivate there as well as for Security. This Garden ought, particularly, to be well expoſed to the riſing Sun, and the South-Sun, to give the Contents of it the greater Perfection, and bring them to a due Maturity. Here we ought alſo to have the Command of Water, and there ſhould be an eaſy Connection between this and the Stable-Yard, for the more eaſy bringing the Dung, or other Manure, and carrying out of Weeds, or other Incumbrances. The beſt Way for ſuch a Garden to be diſpoſed, is to lay it
in

in large ſquare Quarters, and to Fence in ſuch Quarters with Eſpaliers of Fruit-trees, ſuch as Pears, or Vines of the earlieſt rip Grapes, or Apricocks, or Plumbs; but theſe Fruits ſhould not be mixt in one Walk, but let all the Pears be together, for the Sake of making the Walk all of One Face, and ſo the others in the ſame Manner; the Walks where I propoſe the Hedges or Eſpaliers of Fruit, are thoſe which ſhould be the principal Walks for Pleaſure; and when we have Fruit, to protect them, we ſhall find no Loſs in allowing ſuch a Diſtance between the Hedges, as may prevent one Hedge from over-ſhadowing the other; the Fruit of the Hedges will ſufficiently pay the Loſs of Ground in theſe Walks, and theſe are neceſſary to keep a Correſpondence between one Quarter and another, beſides the Pleaſure of them to Walk in, for a Walk lin'd with Fruit is none of the moſt unpleaſant Sight. Particularly, we ſhould contrive an eaſy Correſpondence between one Part and another of our Garden; for when the Paſſages of Communication are not eaſy, a Gardiner may loſe Half his Time in going from one Place to another about his Buſineſs, which is too much Loſs

to the Master. For the same reason we should always contrive our Quarter for Hot-beds near the Stable-Yard, or such Place where the Litter for Hot-beds may be brought in Carts; for if this Spot happens to lie remote from such Places, the Dung must be brought a long way in Barrows, to the spoiling of the Walks, and the extraordinary Expence of the Mens Time. The Place where these Hot-beds ought to be, should be fenced in well with Reeds, and be kept under Lock and Key by the Gardiner, that none should have the Opportunity of looking into his Hot-beds but himself; for the lifting up a single Glass, for half a Minute or less, at an improper Season, will destroy his whole tender Crop, and besides he will then have no Body to blame but himself, if any Miscariage happens. In this Place should be a Frame for Ripening Fruits artificially, if such a thing is desired, and also a Tool-House and a proper Place for drying of Seeds and Herbs, and preserving of Fruit with Conveniences, if possible, for the Gardiner to reside that he may always be ready to survey his more Curious Works, and be in the way to defend his Treasure of Fruit from Robbers, which should be

constantly under his Care, if he be an Understanding Man, that every Sort may be brought to Table in its proper Season; and not, as too frequently it happens, to send a fine eating Fruit to the Oven, because they are lodg'd in such Hands, where they are not understood, and often occasions either a Reflection to be cast upon the Nursery-Man who proved the Trees, or the Gardener's Conduct; for my own Part, I find it the best way to have the Name of every Sort of Fruit that is planted in a Garden written at length upon a board, with the Season of its Perfection; and that Board placed over the Tree that every one may see it: This Method will save the Loss of a great deal of Fruit in a Garden much frequented, in which Case it is too frequently practis'd, to gather harsh unripe Fruit, and after the first Taste to fling it away, and then in the first Company decry the Fruit of the whole Garden, tho' perhaps it possesses the best Collection in the World.

As I have mention'd the several Sorts of Fruits which ought to be train'd against Walls, and in Espaliers, I come now to observe that
this

this is the Garden for Raspberries, Gooseberries, Currans and Strawberries; the Raspberries should be planted in Lines, a Foot a-funder, and be free on each Side, the Strawberries in Lines upon Beds, at Ten Inches Distance, and be every Spring stript of their Runners; or Goose-berries and Currans may be planted at Four or Five Foot distance, in such Places where there is no constant Crop.

There should be, particularly, near the Kitchen, some Place planted with all Sorts of Sweet-herbs, as Rosemary, Lavender, Sage, Thyme, Sweet-Marjoram, Penny-Royal, &c. for extraordinary Use, when the Gardener does not happen to be in the Way.

The other Parts are then to be dispos'd either for the Leguminous Plants or Pulse, such as Beans, Pease, Kidney-beans, &c. or for the Olitary Herbs, as Cabbages, Colly-flowers, Spinach, Asparagus, Coleworts, &c. and for Sallads, Cresses, Chervil, Taragon, Lettice, Raddish, Sellery, Endiff, Corn-Sallad, Fennel, &c. and of Roots, Carrots, Parsnips, Beats, Turnips,

Seor-

Scorzonera, Salfifie, Skirrets, Potatoes, Onions, Garlick, Eschalotts, Rocambole, Chives; And we may add Leeks as an Auxiliary: These make the Sum of a Kitchen-Garden. Now it is to be observed, that Pease and Beans have a very short Share of Life in the Year, they are Crops of Three Months, and then make Way for others, they are hardy enough, either to be sown in *November* or *December*, or may be sown in the Spring. The Beans will prosper in a heavy Soil, but the Pea-kinds rather chose a light Soil. The larger Sort of Pease, such as the *Dutch Admirals*, *Rouncevalls*, and *Spanish Morettos*, must have their Lines about Four Foot asunder, and be supported by Stakes, and the several Kinds of Kidney-Beans, which are given to run or twine, must also be supported with Stakes, but there are some Sorts which we call Dwarfs which do not want Supports. These Dwarfs have done their Business of Bearing in 3 Weeks, or a Month; but the twining Sorts of Kidney-Beans will bear Fruit many Months, and some of them, if they could be shelter'd from our Weather, would remain fruitful for several Years. The

Difference

Difference that there will be in Beans that grow in light Ground and heavy Ground is; that the light Ground Beans will be sooner tough and old than the heavy Ground Beans.

For sowing or planting of Roots, we must always lay it down as a Rule, that they will be much sweeter in light Ground, than in heavy Ground, and be much larger, if they are of those Sorts that run down deep in the Ground, for heavy Ground obstructs their Growth. The Roots I have mention'd above, such as Carrots, Parsnips, Turnips, Skirrets, Scorzonera, Salsifie, Onions, and Leeks, must be sown in *February*. Skirrets, also, may be propagated by dividing the Roots at that Time: The small Roots of Potatoes may likewise be then put into the Ground. Garlick, Eschallots, and Rocombole, must be put into the Ground in *January*, if the Weather be open, and Chives from that Time 'till *May* or *June*. Horse-Raddish, likewise, must be increased from Bits of Roots in some of the Winter-Months, when the Leaves are off. The Carrots, Parsnips Turnips, Beats, and Onions, are Crops of a few Months, but Horse-radish, Skerrets, Rocombole,
and

and Chives, remain in the Ground a long Time; and Potatoes must be carefully pickt out of the Ground, to get rid of them : As for Eschalots, they are to be taken up and dry'd, as soon as their Green begins to decay. We must Note, that Turnips are also to be sown the End of *July*, for a Winter-Crop ; and also Carrots may then be sown, and some Onions for the Winter.

As for the Oletary Herbs, such as Cabbages, Colly-flowers, Savoys, Spinach, and Asparagus, we must consider them in their Order. Cabbages and Colly-flowers may be sown about the Middle of *July*, in Order to bring forward Plants in Perfection in *May*, but the Colly-flowers Plants must be shelter'd from the great Frosts of the Winter. We must likewise sow these in *February*, to have Plants that will be fit for us at the End of the Summer ; and also in *April*, we may sow Colli-flowers' to have them about *Christmases*. All of these Cole-Rase are great Lovers of Water, and are best planted for Summer-Crops in moist Places. As for Spinach, it is an Herb, which, in the Spring, soon runs to seed, and then

then has an Earthy Taste, but we sow it at that Season, because we have no other boyling Herb but young Cabbage-plants, or Coleworts. In the *Autumn*, we also sow it, because the Winter Weather restrains the Juices, and it is not so much fill'd with Earthy Parts; it then has its true Taste, and a Crop of it will last the whole Winter, for only the single Leaves of it should be then gather'd, and the Plants will make new ones. In the raising of Asparagus, the Time of sowing the Seed, is the Beginning of *March*, and when the Plants are one Year old, they will be fit to plant out: For this End, we must prepare a fresh Piece of Ground, by Trenching it well, and, according to the Gardener's Rule, bury about Eight Inches under the Surface, a good Quantity of well-consumed Horse-Dung. We then mark out this Piece for planting about *February*, and set out Plants Ten Inches a-part in Lines, allowing Four Lines for a Bed, and two Foot Space to be made into Alleys, the second Year after Planting; for the first Year we let the whole Piece lye smooth and even, and sow Onions upon it: And the Third Year, we shall not fail of a good Crop, if our Plants Grow.

For we should not cut any till the third Spring; we must observe, in the mean time, to mark the Places with Sticks where any of the Asparagus-Plants happen to be deficient, that we may supply the Defects. We must also take care to provide a rich Piece of Ground for Artichokes, which should be planted from Suckers in *February* or Beginning of *March*, at two Foot Distance in Lines, and three Foot space between the Lines; this is a lasting Crop, but will now and then want a little recruiting with fresh Plants in some Places, where Plants happen to dye by too much Wet in the Winter, or extream Frosts.

The sweet Herbs which I have mention'd, such as Thyme, Rosemary, Lavender, Rhue, Sage, Hyssop, Pot-Marjoram, &c. they may all be rais'd from Slips or Cuttings, planted in *April* or in *August*; or we may raise Hyssop, Rosemary and Thyme from Seeds sown in *April*, but by Cuttings is the quickest way.

But I am now to speak of Sallads, and the Management.

The Lettice (first) is of various Sorts, viz. Imperial, *Siletia*, *Roman*, *Brown-Dutch*; all which Cabbage very well; we sow these thinly among our Spring Crops, to Cabbage upon the Spot; and in *August* and *September* we sow some of the *Brown-Dutch* Lettice, to be planted out for Cabbaging early in the Spring: We have also what is call'd the *Cofs-Lettice*; which, as soon as its Leaves are about ten Inches long, we should tie them together with Bass, in Order to Blanch or Whiten the middle Leaves. Lettice is also used in Winter, the small Leaves only.

Sellery is another Herb proper for Winter-Sallads, and to be stew'd or boyl'd in Soups; this is sown in *March* and *April*, and when it has made four Leaves, it must be planted out upon Beds of fine Earth; and about *July* we may dig Trenches to Plant it in, about ten Inches deep; laying the earth we take out of such Trenches on each side, to sling into the Trenches at distant times by Degrees, as the Plants shoot to blanch them; here the Plant:

may be set 6 Inches asunder. 'Tis the keeping the Air from Plants which blanches them; and must be consider'd when we have a Mind to blanch any Part.

Radishes are also necessary for Spring-Sallads; we should sow them among our Spring Crops in *February*, in *March*, and in *April*. And also about *Michaelmas*, to come early in the Spring. Remember that all Roots which shoot downward, love a light open Soil.

Taragon is another Plant, which some use in Sallads; but it is very strong, and not agreeable to every Taste; two or three Leaves is enough for a Sallad: This Plant is propagated by Slips from the Root in *March*.

Charvile is rais'd from Seeds sown in *March*, and again in *August* for Winter Use.

Cresses are generally sown in Lines upon the Natural Ground, from *February* till *November*; and then upon old Hot-Beds under Glasses, to cut them in their first Leaf; but we may have some Cresses to stand abroad in the Winter.

Mustard

Mustard and Rape, or Turnep and Radish may also be sown in the same Manner, and must be cut in the first Leaf.

Corn-Sallad may be sown in *March*, and afterwards it will take Care to sow it self.

Fennel must be also sown in *March*, it will last several Years; but dye to the Root every Year. Dill must be sown like Fennel. Sorrel ought also to be rais'd from Seeds in *March*; and we should sow Parsly then, and in *August*.

As to what concerns the raising of Cucumbers, Melons and Mushrooms, I shall speak of that in the Discourse that relates to Hot-Beds and artificial Heats.



DISCOURSE X.

Concerning the Disposition of a
 FLOWER-GARDEN, with some
 new Observations relating to the
 Improvement of FLOWERS
 and EXOTIC PLANTS.



BEFORE I enter upon the
 particular Culture of Flowers,
 it will be necessary to say
 something concerning the Dis-
 position of a Flower-Garden.

The Piece of Ground, which we allot for this
 Use, ought to be well shelter'd from tempe-
 tuous Winds, and yet enjoy the Sun; for
 this end I prefer Hedges of such Trees as lose
 their

their Leaves in Winter, because from the Fall of the Leaf to the Middle of *April*, they are naked, and do not hinder the Sun from influencing the Ground; But as a Flower-Garden is generally a small Piece of Ground, so if it was to be fenced with Walls, then would be eddy Winds which would help to blight and destroy our Flowers. When I speak of a Flower-Garden, I mean such a Spot as is necessary for our choicest Flowers, and to try such Experiments in, as relate to their Improvement; this Garden therefore should be fenced from the publick Part of our Garden, that it may be safe from indiscreet Hands, which do not know the Value of a good Flower, nor the Advantage which may arise by a good Experiment.

This Piece of Ground should, if possible, lie near the Green-house, because it may serve to set our Exotic Plants in, after our principal Show of Flowers is over: And besides, all our Rarities will be then together, and the Gardener will more readily take care of them, than if our Curiosities were straggling in different Parts of the Garden. This Garden

ought to be disposed in Beds, for the Reception of our fine Bulbous-Roots, and our Seedlings of Auriculas, Polyanthos, and the Seedlings of Bulbous-Flowers; the whole should consist of light Soil, even the Allies should be regarded as well as the Beds, for a noisom Vapour coming from the Allies may under all our Care in the Preperation of our Beds, if we are situate upon a Clay, have regard to what I have mention'd in my Discourse concerning Soils, not to dig into it, but lay a good Quantity of light Soil upon it, as well where our Allies are to be, as where we design our Borders; what I call a good Quantity is half a Yard thick, if it can be done, and the best Part of it skreen'd; when this is done, I think Edgings of Box are preferable to Border-boards, for Box is continually increasing in Value, while Border-boards are decaying.

The Flower-Garden being thus in Order, we are next to provide Boxes or Cases of seven or eight Inches deep, with Holes at their Bottoms, these are for raising some of the choicest Seeds of Flowers: Such as those of Carnations, Auriculas, Renunculas, Anemonies, Polyanthos, Tulips, Hyacinths, Narcissus, and

and such like ; for from the Seed is produced all the Variety we have of every Race of Flowers. It is a Remark I have made before, that where we have already Varieties of Flowers of the same Tribe, standing or growing together, we may expect great Varieties from the Seeds of such Flowers, according to the Doctrine of the Generation of Plants ; for the sowing of the Seeds mention'd before, we must provide different Sorts of Earth ; for the Auriculas, Polyanthos, Renunculas, and Anemonies, we must have rotted Willow-Earth, as we call it ; that is, such Earth as we find the Heart of rotted Willows, or, for want of that, the Bottom of an old Wood-Pile well sifted, will do. But we Use this only upon the Surface ; for in the Bottoms of the Boxes we use fresh Sandy-Loam, if we can get it ; the Willow-Earth need not be quite an Inch thick, just enough for these Seeds to strike their first tender Roots in, and none of them must be cover'd more than the Thickness of half a Crown ; the old Method was, to lay the Willow-Earth on very light, and after sowing the Seed, to press the Earth and Seeds down close with a smooth Board ; and if we sow them in the Spring, to give them frequent Waterings. and when the Water begins

to grow warm, set the Boxes in the Shade. It will happen sometimes, that the Auricula Seed and the Polyanthus Seed, notwithstanding this Care, will not come up the same Season; or, perhaps, but a few of them; but the next *Autumn*, or the Spring following, we may expect a good Crop, as I have observed. We may likewise sow these Seeds in *September*, which I take to be the best Way, because they have the Advantage of a moist Season, to bring them up. But we must defend them from the most rigorous Frosts; as for the Ranunculas, and the Seeds of Anemonies, they are very light, and should be sown shallow in the same Sort of Earth in *September*, rather than any other Season; tho' I have known them do well to be sown in *February*. When we find these Seedlings come up, we must order them in the following Manner; the Auriculas and Polyanthos must be planted out on Beds of fine Earth about Midsummer, and shaded for some time, as all new planted Flowers or Herbs ought to be; and the Situation they delight in, is where they can Enjoy the Morning-Sun only. The Ranunculas and Anemonies which we may rank among the dry Roots, should remain in their Cases

Cases till they Flower ; and then we must mark those which are the most delightful, and take their Roots out of the Ground as soon as the Flowers and Leaves are decay'd : When we have taken these Roots up, it is proper to keep the Renunculas Roots in dry Sand ; but the Sand must be very dry, or the Root will rot ; or, according to the common Method, keep them in Paper-bags in a dry Place : The Renunculas and Anemonies will, for the most Part, blossom the same Year they come up, and some the second Year, at which time we may expect Flowers from the Auriculas and Polyanthes, and need not scruple to remove such as we like best into Pots, while they are in Flower.

In the next Place, we must provide Cases for the Seeds of Tulips, Hyacinths, Trittularies, Narcissus, Bulbous Iris, Crocus and other curious Bulbs. The Earth for these should be very fine and light ; and for the time of sowing the Seeds, it should be as soon as they are ripe ; remembering the Rule I have laid down before, that all Seeds, in proportion to their Weight and Substance, must

be bury'd deeper or shallower in the Earth ; the lightest and weakeft of thefe will not bear to be cover'd thicker than the eighth Part of an Inch, and the moft Subftantial of them not quite half an Inch. Thefe Seeds will come up the firft Year, but we muft have a little patience before they will come to Flower, as four or five Years, it may be ; but then we are fure of new Varieties, and our Labour will be well recompenced. When we have once begun to make fuch Seminaries, we fhould fow of thefe Seeds every Year, to have a Succeffion of them ; and in the mean time we fhall be amufed with our Seedling-Auriculas, Renunculas, Polyanthes, and Anemonies ; befides the Varieties which we may expect from Seedling-Carnations, which I fhall mention by and by ; but in thefe young Nurseries of Bulbs, we are to obferve, that the *July* after the Seeds are come up, we fhould plant them into other Cafes about an Inch and half afunder, let them ftand in fome Place which is well expofed to the Sun, and where they may be fhelter'd from fevere Frofts : The third Year, we may plant them in Beds about four Inches apart ; and the Year after that, only take them up for a few
Days

Days, in hot dry Weather, in *July*; and when a fresh Bed is prepared for them, plant the Tulip-roots, Narcissus, and Bulbous-Iris six Inches apart, and the Crocus four Inches; and let them stand to Flower. In the saving of the Seeds for these Seminaris, the Seed must be perfectly ripe and dry, when we gather it; and if we save it from such Plants as stood among a good Collection, we may expect Variety enough from it, according to the System of the Generation of Plants. *Samuel Traxell, Esq*; has had prodigious Success in his Undertakings of this Kind, in his Gardens at *Poplar*; especially in raising of Tulips and Hyacinths from Seeds: The Tulips particularly are remarkable, because he saved the Seed from one Sort of Tulip, call'd, *The Triumph of Europe*, which has a particular Manner of flowering, very different from any others; but as this Flower stood among many other curious Tulips, so the Seedlings partake of them all, and many of them out-do the very best Tulips that have yet appear'd in the World; and his Hyacinths likewise are no less to be admired.

The Seeds of Carnations or July-Flowers ought all to be saved from the best variagated Flowers, which have stood in a good Collection: The Earth to sow them in, should be fine sandy Loam, well sifted, and the time of sowing should be about the Beginning of *May*; for if we sow them sooner they will grow too much into hard Branches, inclining to be woody, and we shall hardly get any Layers from them the second Year, when they come to blow. We may sow these upon an open Bed, and plant them out the *August* following, to stand for flowering; the Beds we transplant them upon should be narrow, so as to hold only two Rows in each; letting the Plants stand about a Foot asunder, for the better Convenience of making Layers of such of them as happen to be worth Increasing.

The Cyclamens or Sow-beads, are only increased by Seeds sown in Cases of fine Earth, as soon as the Seeds are ripe.

Having thus set forth the Manner of raising our most curious Flowers from Seeds, I
 come

come next to prescribe the Methods of preserving and improving them into larger Pots, for blowing, as for those which are commonly called Bulbous-Roots, such as our Tulips, Anemonies, Renunculas, Hyacinths and Bulbous-Iris, they should be taken out of the Ground as soon as their Seed is full ripe, and their Stalks and Leaves are decay'd, for so long as they are growing, or are green above Ground, so long are their Bulbs improving in the Ground, from the Juices which circulate from the Leaves and Stems: But when the Work of Circulation is over in the Leaves, it ceases in the Root also, and we may take them up; for which Work, we should always chuse dry Weather, and after scaling and picking our Roots clean, lay them upon Mats exposed to the Sun, for a few Days, without letting any Rain fall upon them, nor suffer them to receive any Moisture from the Dews. When they are throwly dry, put them in Paper-Bags, and lay them in a dry Place till *September*, when we may plant our bearing Roots of Tulips and Bulbous-Iris, and Hyacinths; but it may be the End of the Month before we put the Renunculus and Anemonies into
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the Ground; at which time also we may plant our Crocus, if they happen to be taken up: As for the Anemonies we must break their Roots, and chuse out the largest Buds for blowing, and plant the Off-sets in some by Place. The Narcissus Roots and the Junquil, must never remain above a Month out of the Ground; they may be taken up in *June*, and put in again in *July*; for they are very forward to shoot. It is a certain Rule, that all Bulbous Roots may be taken out of the Ground, when their Leaves and Flower-stalks are wither'd and decay'd, and should be put in again before they begin to sprout; then our transplanting them from one Place to another will be safe: For my Part, I know no Necessity of taking any Bulbs out of the Ground, but to separate their Off-sets from them, or when we want to change them, from one Soil to another.

As for the Polyanthos, and Auriculas, they delight in the same Manner of Treatment; that is, the Soil for them should be light sandy Loam, and when we plant them in Borders under Walls, those Borders should lie steep
and

and flopping, to fling off the Wet, but we must always chuse out shady Places for them. The time of encreasing these, by taking off their Off-sets, is when they have almost done flowering, or at St. *James*-tide; which Work should be done every other Year, at furthest: The Polyanthos will prosper much better in Beds than in Pots, but our fine Auriculas must be potted, that we may shelter them when they are in Flower; for their Beauty is lost if we suffer their Flowers to take the Rain, which dashes off the fine Dust which give them their rich Appearance.

The Carnation or July-Flower, ought also to cultivate in Pots, when we blow them in a Collection: The time of laying them for Encrease is as soon as the Layers or Shoots, growing about the Roots, are long enough; that is, when they have five or six Knots or Joints between their Roots and the Crown or Tuft of Leaves. We then clear away the Leaves from the Joints, and with a fine Penknife cutting one of the Joints half through, we then turn our Knife and slit it upwards towards

the other Joint; and so pin it down into the Earth, with a little Hook of Wood. Sometimes we may do this Work in *June*, and sometimes not till *July*, 'tis as the Layers are fit for it: When these have taken Root, which will be in six or seven Weeks time, if we keep them water'd, take off the Layers, and plant them in small Pots about four Inches over, in which we may let them remain till the Middle of *February* following; and then turning them out, with the Earth about them, we must plant them, but we must take care to shelter them in severe Weather, in such a Place where they may have Air enough. As soon as these Plants begin to spindle for flowering, we must set Sticks by every one of them, in order to secure the Spindles from breaking by the Winds; we tie these gently to the Sticks, with Bass, and when their Buds appear, we take away all but two or three, that the Blossoms may be strong; one Blossom upon a Stalk is enough, if we would have them large.

Having

Having now lay'd down proper Rules for the Management of our choicest Flowers, I shall proceed to give Directions for the ordering of those Flowers, which are call'd *Vivaceous*; what I mean by vivaceous Flowers, are such, whose Roots are constantly lasting and increasing in the Earth, and which put forth Flower-stems every Spring, which decay as soon as they have done Flowering; of these are the Peony, the Asters or Stanwort, and many others: The time-of increasing them is, while they are vacant of their Flower-stems, and we may part their Roots safely. This is a general Rule which serves for all Flowers of this Nature.

The fibrous-rooted Flowers, which are constant above Ground; such as the Violet, &c. the best Time of transplanting or increasing them, is just before they make their Spring-Shoot, or about *September*.

The Stock-Gilly-Flowers, Wall-Flowers, and such like, which will endure two or three

Years only, must be rais'd from Seeds sown in *March* ; and we may also raise them by Cuttings in *August*, or the Spring.

It remains now that I speak of Annal-Flowers, which may be sown upon the natural Ground; for the more tenderer Sorts, I have treated of them in the Discourse of Hot-beds and artificial Heats. Those which I shall mention here are the Lark-spurs, Corn-bottles, Lobels, Calch-fly, *Elos Adonis*, Poppies, Annal-Stocks, Candy-Tufts, Venus-Looking-Glass, Venus-Navel-Wort, Lupines, Scarlet-Beans, Wing'd Pease, Sweet-scented Pease, and such like ; we may sow them all, but the four last, in *March*; and the other four will do better to be sown in *April*. We must be sure to Water evrey thing we transplant; very well, for a good Watering at that Time, save a great many Waterings. And the best Time of the Day to transplant in Summer, is in the Afternoon ; a little before the Sun is going down ; for the Dews of the Night help the Plants. It is also necessary, if it can be done conveniently, to shade all Plants for three or four Days, after transplanting

I now come to speak of Exotic-Plants: We must first consider every Exotic or Foreign Plant, is maintain'd by the same Principles of Vegetation, as the Plants of our own Country: We must understand likewise, that all such Plants as are brought to us from Abroad, do not require Shelter in the Winter; we must learn the Countries they came from, and consider the Climates, in Order to give them such a Share of Heat or Cold with us, as they enjoy'd when they were at Home. We should also inform our selves of the Times when their Spring happens in every Country we receive Plants from. All which we easily learn from the Name of the Country; for that being given, we have the Latitude in Course from the Mapps, and then by finding out the Course of the Sun, we know when that Country is the most influenced by the Sun, and may judge in what Degree such a Country is heated by it. For the better Information of the Gardeners in these Particulars, I have publish'd a Table of Latitudes and Degrees of Heat, in my Monthly Works; and have regulated Ther-

mometers accordingly, to act with the more certainty, when we apply any of our artificial Heats to Plants; which Mr. *John Fowler*, an excellent Mathematical Instrument-Maker, in *Smithin's-Ally* by the *Royal-Exchange*, has so contrived, that all of his making are exact in their Motions one to another; or, as one may say, work together in true Proportions; so that those in Hot-Beds, Stoves, Green-houses, or other Places, bear a just Proportion to one another, with regard to their different Degrees of Heat or Cold. It is necessary however to know, that fifteen Degrees higher than his Degree of Heat, mark'd for the Ananas or Pine-Apple, is sufficient to support Plants which are brought to us from under the Line, or ten Degrees Latitude on either Side of it. And I think it is impossible to come nearer a certainty, than by this Method; because we may always manage our Fires so, as to keep the Air in the House, within few Degrees more or less of the Point we aim at, as will appear by the Spirits in the Thermometer. As for Plants which come from Places between ten Degrees, and two or three and twenty Degrees Latitude,

Latitude, we must keep the Air of our Conservatory so warm, as that the Spirits in the Thermometer may rise to the Height where the Word Ananas is placed. The Plants which are brought from those Parts of the World, as lie between the Latitudes of twenty three and thirty six, will require another House, where the Heats need not be so great as the former; and then a common Green-House, which will only keep out Frosts, will be sufficient to preserve such Plants in the Winter, as are Natives of Countries lying between thirty six and forty eight Degrees Latitude; and for all other Plants, growing in Latitudes from forty eight to the most Northern Latitude, they will do best abroad in our Climate; we should by no means give them Shelter in an House, nor attempt to give them any artificial Warmth upon any account; for Warmth is quite contrary to the Nature of such Plants, as are Natives of the frozen Climates; which I think necessary to hint at, because I have known some ingenious Gardiners, who by applying artificial Heats to Plants brought from *Hudson's Bay*, have destroy'd them.

With all the Plants which we receive from Abroad, we ought to have an Account of the Soil and Situation where they grew ; for it is remarkable, that there will be as much Difference between the Temper of the Air on the South Side of a Mountain and on the North Side, as one shall find in six or seven Degrees of Latitude upon a Plane. And again, we may remark that all Trees of the Firr-kind, or others of the like Sorts, which abound in Terebintine Juices, will bear to stand abroad with us, tho' we find them naturally growing between the Tropies ; and as for the Soil, it is as necessary to be known, because we find that some Plants are natural to Boggs, others to Rocks and stony Ground, and some which are Inhabitants of the Waters only ; so that if we were to attempt the Culture of such Plants in a contrary Manner from their natural Mode of Growth, we should certainly destroy them.

Upon the Foot of these general Remarks, the Culture of Exotic-Plants may be render'd easy and familiar, and without considering them, our Labour must always be uncertain.

In Order still to help us in our Designs, with regard to the Culture of the most tender Exotic-Plants, it will be necessary that I lay down a few proper Rules to be observed in Building of Stoves and Green-Houses. In all Edifices of this Nature, our first Consideration ought to be the Situation; so that the Front of our Building may receive the Benefit of the Sun, as much as possible in Winter; it is therefore we chuse to lay our Front exposed to the South, or South-East; which last I think much the best, because our House then receives the Morning-Sun, which is of great Moment after the long Nights. In the Fronts of these Conservatories we cannot have too much Glass, and, if possible, the whole Front should be Glass, if the Roof of the House could be supported. On the other hand the Back-Walls of such Conservatories cannot well be too thick, to keep the Cold Northern-Air from penetrating into the House; and for the East and West ends, if our House fronts the South, it is necessary to have a large Pannel of Glass in each of them; for in the Winter, when our
tender

tender Plants want the Sun the most, and the Weather is most commonly gloomy, then half an Hour's Sun is of extraordinary Benefit to Plants, in correcting the Damps of our Houses, and no Opportunity should be lost of receiving the Sun at any time of the Day, when it has any power; for every Minute of the Sun's Presence rarifies the Air in our Houses, and puts it into a quicker Motion than it was before, till in a quarter of an Hour our Houses will be warm, and will continue nearly of the same Warmth till sixteen or eighteen Hours afterwards, if we do not prevent it by letting in the cold Air upon it, when the Sun is gone off: The Observation I make concerning the Air's remaining warm so long as sixteen Hours, if we do not open the Doors, is done by observing the Height of the Spirits in the Thermometer, which one may perceive easily thro' the Windows.

But notwithstanding how necessary it is, when we have only a short Gleme of Sunshine, to let our House remain close till the Morning following, yet it is as necessary to
refresh

refresh our Houses sometimes with Air from abroad, which ought to be as frequent as possible, always having regard to the Climate our Plants come from ; and to judge, in some Sort, what Degree of Cold they will bear without Injury ; I have therefore thought it necessary in all Conservatories, which I have built for the Preservation of tender Plants, to make the Entrances into them from some Room, rather than to let in the open Air at once upon the Plants ; by which Practice, I found that my Plants prosper'd, and flourished better than others, where this Conveniency was wanting.

The Floors of these Conservatories should rather be laid with square Tiles than with any Hard Stone; because such Stone, as it is very hard, is apt to condense the Air of the House, and have a Dew lie upon them in moist Weather, which is no way healthful to Plants ; but the Tiles I speak of, are so spongy that they imbibe the Moisture of the Air of the House, and prevent those pernicious Damps, which occasion Mouldiness upon Plants, which is very frequent in such Conservatories

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as are pav'd with hard Stone or Marble. Nōr is a Floor of Boards proper in such a Place, because by frequent watering our Plants, a boarded Floor will soon rot. Again, we must observe in building our Conservatories for the most tender Plants, I mean such as are Natives of Places near the Line, or Ten, or Fifteen Degrees Latitude on either Side the Line; such Conservatories should be very shallow, that is, between the South-Front, and the Back, not above Seven or Eight Foot, provided that the Glasses in the Front are as high; and so in Proportion to the Height of the Glasses in the Front, we may make our Stoves deeper or wider. Some are of Opinion, that the Front Glasses of such Houses should lie sloping, so as to drop about a Foot from the upright; but I do not see any great Occasion for that Situation of the Glasses, if our Front is all Glass, there are good Examples of this Kind at *Chelsea* Physick-Garden. We shall also find it necessary in such Structures to raise the Floor about Two Foot above Ground, because under such Floors must lie our Pipes of Conveyance for Heat, or what are generally call'd Flues, which never should

should be bury'd in the Ground, for the Moisture of the Earth damps the Fires. These Flues should run from the Fire-place along the Front of the Conservatories, and turn at the End with a Sweep, and then along the Back of the House, and up a Chimney. The Fire-place should be large, like an Oven, and covered with an Iron-plate; which Plate, being once heated, will keep the Air of the House dry and warm a long time, with a small Fire of Turfs or Peats, or such Cakes as are made by the Tanners of their old Bark. And it must be observed, that when we begin to make Fires in these Stoves, we must continually keep them on Foot, till the Season is warm enough to leave them off, which our Thermometer will inform us, as well as instruct us when our Stove is too hot, which is as great a Fault as being too cold: If our House should happen to be over-hot, the Air will consequently be too dry, and the Plants will suffer by wanting the Nourishment which they draw from a free, warm Air; but we may remedy this, letting in fresh Air from the Room adjoining, thro' Pipes which one may place

in the Wall for that purpose. It would be well likewise to take care, that our Roof be well lined with Straw, to prevent the Cold on that Side; and I think that good Shutters to the Windows in the Front, would be necessary in severe Weather, tho' some use Mats only to cover their Glasses when the Weather is extream Cold. These are the necessary Precautions to be taken in building our Hot-Houses; only to render them useful in Summer as well as Winter, we may have a Trench in the Floor, about four Foot wide, and within four or five Foot as long as the Stove, and about two Foot and half, or three Foot deep, to be brick'd on all Sides : The Use of this Trench is for Tanners-Bark in the Summer-time, into which we must then plunge the Pots with our Ananas or Pine-Apples, and such other Plants as come from the hottest Countries.

But over Stove Fir-Plants, which require a less Share of Heat, we may allow it to be ten Foot wide, and use our Fire-Flues with Gentleness, allowing more Air in this than the
Plants

Plants in the former will bear ; and our Green-House, if the Front to the Cieling is 16 or 18 Foot high, then we may suffer it to be 16 or 18 Foot wide, and our Windows should be the same Heighth ; observing also, that the Peers of Brick-work between the Glass, be as narrow as can be, for the safety of the Roof ; for if the Peers be thick, then we shall never have the Sun full in the House, but at Noon ; which is the Case of many large, pompous Green-Houses, which have been built within the last twenty Years.

'Tis to be observed, that a large Green-House will keep the least tender Plants, such as Orange-trees, and such like, much better than a small one ; because the Quantity of Air which is contain'd in a large Space, will be longer nourishing to Plants, than what can be enclosed in a small House ; sometimes the Severity of the Weather will occasion the Gardiner to enclose his Green-House for a Month or more, without giving any Air at all ; and then upon admitting fresh Air, on sudden it will have as bad an Effect upon the

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the Plants, as if we were to let Plants want Water too long, and then give them a Flood to make good the Deficiency ; this would make them shed their Leaves, and make them distemper'd ; but in a large House, the Air enclosed for three Weeks or a Month, will remain still nourishing to Plants ; and the Admission of fresh Air upon such a Body of enclosed Air, will not so readily hurt the Plants, as when it is to be let in upon a small Body of enclos'd Air. The late Lord *Capell* had no Regard to Glafs in the Front of his Green-house, for Orange-trees, Myrtles, and such like, and in the place of it, put Canvas Sashes and Shutters to them ; for he well knew how necessary Air was to Plants of their Nature, and as well knew the Ignorance of the Gardiners of his Time, in judging of the proper Seasons to give Air to confine Plants ; and therefore provided against it by this Means, and against Frost by the Shutters.

Our Pots and Cafes for Exotic-Plants ought to have the Holes at the Bottoms clear, that at the several Waterings which we give to the Plants, the Water may pass easily thro'; for if there is not a free Passage, the Water will chill and rot the Roots; as I have related in a former Discourse, where I have also taken Notice of the Quantities of Water which should be dispenced to different kinds of Plants, in that Maxim, that the most succulent Plants require the least Share of it. And it is necessary to observe likewise, that the very succulent Plants of all, should have no Water from the End of *September* to the Middle of *March*, if we do not keep them in our hottest Houses, where the Air is kept dry all the Winter; for the common Moisture of the Winter Air in Green-Houses is sufficient to feed them.

As for the Earth for Orange-trees and others, which are to undergo the Fatigue of the House, it ought always to be indifferently light, for the better Passage of the Water

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through the Pots ; but it should be tenacious enough to hold some Share of Moisture ; and for the most succulent Plants, it must be of a dry Nature, as I have related in a former Discourse. For the Seasons of setting our Plants out of the Conservatories, there is one general Rule, depending upon the Latitudes which they come from on this Side the Line, those of the most Northern Latitudes, which must be housed, may be set abroad first, and set the last into the House ; but it is dangerous to let any be put abroad till the violent Frosts are over, and to leave them abroad till smart Frosts begin ; for Myrtles, and such Sorts, *April* is commonly the Season of setting them out, and *October* of putting them into the House ; but Orange-trees, and the Plants that accompany them, is better about the Middle of *May*, and Middle of *September* to set them out and in ; observing, if possible, to set them Out in wet, and into the House in dry Weather.

Some others of the tenderest Sorts, which may come abroad in Summer, must stay till the

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the Beginning of *June*, before they are put out, and be return'd in *August*: But in the setting out those Plants which should be the most early abroad, we must have Regard that they are not in their tender Shoot, because a little Frost will hurt them. Upon these Foundations we may cultivate any kind of Exotic-Plants.

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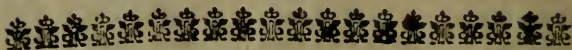
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