X. *The Concluſion of Dr.* Deſagulier's *Account of* Mr. Hales's *Vegetable Staticks.*

CHAP. VII. *Of Vegetation.*

OUR Author in this Chapter applies his ſeveral Experiments, and Concluſions drawn from them, to Vegetation; and ſhews chiefly the following Things, *viz.* That Vegetables are compos'd of Sulphur, volatile Salt, Water, Earth and Air.

That in Nutrition the Sum of the attracting Powers of thoſe Subſtances is ſuperior to the Sum of the repellent; and as the watry Vehicle flies off, the Parts harden.

That Oil, which is made up of Sulphur and Air, abounds in Seeds for their better preſervation.

That in cold Countries, where thoſe Principles are not ſo firmly united, ſmall Wines, ſuch as *Rheniſh*, moſt eaſily yield their Tartar (which by Experiments appears to contain Oil and Air;) but generous Wines, ſuch as *Madera*, having thoſe Principles more firmly united, will bear a great degree of Heat before they part with them.

That the uſe of the Leaves of Trees is to bring up Nouriſhment within reach of the Attraction of the Fruit, to carry off the redundant watry Fluid; to imbibe Rains and Dews which are impregnated with Salt and Sulphur; as likewiſe to imbibe Air, and to be of the ſame uſe to Plants as the Lungs are to Animals.

That Plants which are overſhaded, or too replete with Moiſture, cannot ſo well imbibe Air: Therefore, tho' they will ſhoot out faſt, and have much Wood, they will be more barren in proportion.

Mr.

Mr. *Hales*, by a very ingenious Contrivance, found the Degrees of growing in every part of young Shoots, which in their growing extend themſelves moſt in the middle, and leaſt towards the top and the bottom; the ductile Matter for their growth being drawn out in length like melted Glaſs-Tubes, which retain a Hollowneſs, tho' drawn out to the ſmalleſt Thread. N.B. *In ſome Animals there is ſuch a tough ductile Subſtance, which hardens when expos'd to the Air in ſmall Threads, as in Spiders and Silk-Worms.*

He ſhews, that the Pith ſerves to ſupply the dilating Moiſture for the tender Shoots; but that their Figure may be oblong, and not round, as the Fruit commonly is, there are tough Diaphragms in the Pith at ſmall diſtance from each other, which check the lateral Expanſion; as alſo horizontal Fibres, which ſerve for the ſame purpoſe: And of the ſame ſort is the Pith in the large growing Feathers of Birds; which is made up of Veſicles that can be diſtended lengthwiſe, but have Sphincters at the ends, to prevent too large a lateral Dilatation. — That the Bones of Animals do not grow at the Joynts (which would prevent their free Motions) but at the *Symphyſis*, viz. where the Heads joyn to the Shanks of the Bones — That there are particular Veſſels in Vegetables, as well as Animas, appropriated for conveying different ſorts of Nutriment; and that where a viſcid Subſtance is to beſurniſhed, the Veſſels are lengthen'd, and often fetch a compaſs to retard the Velocity of the Fluid, which is to be inſpiſſated into an hard Subſtance. Thus in hard Stone-Fruits the Umbilical Veſſel goes round theConcave of the Stone, and then enters the Kernel near its Cone.

Then at laſt, our Author traces the Vegetation of a Plant, from a Seed to a Tree again producing Seed; which

which Account, as it cannot well be contracted, without leaving out ſomething material; and as it ſerves to ſhew ſome of the excellent uſes of our ingenious Philoſopher's happy Diſcoveries, I ſhall (to conclude this Abſtract) give in the Author's own Words.

" Supported by the Evidence of many of the fore-
" going Experiments, I will now trace the Vegetation
" of a Tree, from its firſt ſeminal Plant in the Seed,
" to its full Maturity and Production of other Seeds,
" without entring into a particular Deſcription of the
" Structure of the Parts of Vegetables; which has
" already been done by Dr. *Grew* and *Malpighi*.

" We ſee by *Experiment* 56, 57, 58, on diſtilled
" Wheat, Peaſe, and Muſtard-Seed, what a wonderful
" Proviſion Nature has made, that the Seeds of Plants
" ſhould be well ſtored with very active Principles;
" which Principles are there compacted together by
" him, who curiouſly adapts all things to the pur-
" poſes for which they were intended, with ſuch a juſt
" degree of Coheſion, as retains them in that State,
" till the proper Seaſon of Germination: For if they
" were of a more lax Conſtitution, they would too
" ſoon diſſolve like the other tender Annual Parts of
" Plants: And if they were more firmly connected,
" as in the Heart of an Oak, they muſt neceſſarily
" have been many Years in germinating, tho' ſupplied
" with Moiſture and Warmth.

" When a Seed is ſown in the Ground, in a few
" Days it imbibes ſo much Moiſture, as to ſwell with
" very great force; as we ſee in the Experiment on
" Peaſe in an Iron-Pot. This forcible Swelling of the
" Lobes of the Seed *a r*, *a r*, (Fig. 1.) does probably
" protrude Moiſture and Nouriſhment from the capil-
" lary Veſſels *r r*, which are called the Seed-Roots,

" into the Radicle *c z d*; which Radicle, when it is thus
" ſhot ſome length into the Ground, does then im-
" bibe Nouriſhment from thence; and after it has ac-
" quir'd ſufficient Strength, as this tender ductile Root
" is extending from *z* to *c*, it muſt neceſſarily carry
" the expanding Seed-Lobes upwards at the ſame time
" that the dilating from *z* to *d* makes it ſhoot down-
" wards; and when the Root is thus far grown, it
" ſupplies the Plume *b* with Nouriſhment; which
" thereby ſwelling and extending, opens the Lobes
" *a r*, *a r*, which are at the ſame time raiſed above-
" ground with the Plume *i*, where they by expanding
" and growing thinner, turn to green Leaves (except
" the Seeds of the Pulſe-kind;) which Leaves are of
" ſuch importance to the yet tender Plume, that it
" periſhes, or will not thrive if they are pulled off:
" Which makes it probable, that they do the ſame Of-
" fice to the Plume that the Leaves adjoining to Ap-
" ples, Quinces and other Fruit do to them, *viz.* they
" draw Sap within the reach of their Attraction. (See
" *Exper.* 8. and 30.) But when the Plume is ſo far
" advanced in growth, as to have Branches and ex-
" panded Leaves to draw up Nouriſhment, then theſe
" ſupplemental ſeminal Leaves *a r*, *a r*, being of no
" farther uſe, do periſh; not only becauſe the now-
" grown and more expanded Leaves of the young
" Plant or Tree do ſo overſhade the ſupplemental
" Leaves, that the former more plentiful Perſpiration
" is much abated; and thereby alſo their power of
" attracting Sap fails; but alſo becauſe the Sap is
" drawn from them by the Leaves; and they being
" thus deprived of Nouriſhment, do periſh.

" As the Tree advances in ſtature, the firſt, ſecond,
" third and fourth Order of the lateral Branches ſhoot
" out, each lower Order being longer than thoſe imme-
" diately

" diately above them; not only on the account of " Primogeniture, but alſo becauſe being inſerted in " larger parts of the Trunk, and nearer the Root, " they have the advantage of being ſerved with greater " plenty of Sap, whence ariſes the beautiful parabolical Figure of the Trees.

" But when Trees ſtand thick together in Woods or " Groves, this their natural Shape is alter'd; becauſe " the lower lateral Branches being much ſhaded, they " can perſpirelittle; and therefore drawing little Nouriſhment, they periſh: But the Top-Branches being " expoſed to a free drying Air, they perſpire plentifully; and thereby drawing the Sap to the Top, " they advance much in height. But *vice verſâ*, if " when ſuch a Grove of tall Trees is cut down, there " be left here and there a ſingle Tree, that Tree will " then ſhoot out lateral Branches; the Leaves of which " Branches now perſpiring freely, will attract plenty " of Sap; on which account, the Top being deprived " of its Nouriſhment, it uſually dies.

" And as Trees in a Grove or Wood grow only in " Length, becauſe all the Nouriſhment is by the Leaves " drawn to the top, moſt of the ſmall lateral ſhaded Branches in the mean time periſhing for want of Perſpiration and Nutrition: So the caſe is the very ſame in " the Branches of a Tree, which uſually making an Angle of about 45 Degr. with the Stem of the Tree, do " thereby beautifully fill up at equal and proper Diſtances the ſpace between the lower Branches and the top " of the Tree, forming thereby as it were a parabolical " Grove or Thicket; which ſhading the Arms, the " ſmall lateral Shoots of thoſe Arms uſually periſh for " want of due perſpiration; and therefore the Arms " continue naked like the Bodies of Trees in a Grove; " all the Nouriſhment being drawn up to the tops of

" the ſeveral Branches by the Leaves which are there
" expos'd to the warm Sun and free drying Air, where-
" by the Branches of Trees expand much.

" And where the lateral Branches are very vigo-
" rous, ſo as to make ſtrong ſhoots, and attract the
" Nouriſhment plentifully, there the Tree uſually a-
" bates of its height: But where the Tree prevails in
" height, as in Groves, there commonly its lateral
" Branches are ſmalleſt. So that we may look upon a
" Tree as a complicated Engine, which has as many
" different Powers as it has Arms and Branches, each
" drawing from their common Fountain of Life the
" Root: And the whole of each yearly growth of the
" Tree will be proportionable to their attracting Pow-
" ers, and the Quantity of Nouriſhment the Root af-
" fords. But this attracting Power and Nouriſhment
" will be more or leſs, according to the different Ages
" of the Tree, and the more or leſs kindly Seaſons of
" the Year.

" And the proportional growth of their lateral and
" Top-Branhes in relation to each other, will much
" depend on the difference of their ſeveral attracting
" powers. If the Perſpiration and Attraction of the
" lateral Branches is little or nothing, as in Woods and
" Groves, then the Top-Branches will mightily pre-
" vail; but when in a free open Air the Perſpiration
" and Attraction of the lateral Branches come nearer
" to an Equality with that of the Top, then is the a-
" ſpiring of the Top-Branches greatly check'd. And
" the caſe is the ſame in moſt other Vegetables, which
" when they ſtand thick together, grow much in length
" with very weak lateral Shoots.

" And as the Leaves are thus ſerviceable in promo-
" the growth of a Tree, we may obſerve, that Nature
" has plac'd the Pedals of the Leave-ſtalks where moſt

" Nou-

" Nouriſhment is wanting to produce Leaves, Shoots " and Fruit; and ſome ſuch thin leafy Expanſion is " ſo neceſſary for this purpoſe, that Nature provides " ſmall thin Expanſions, which may be called prima- " mary Leaves that ſerve to protect, and draw Nou- " riſhment to the young Shoot and Leaf-buds before " the Leaf it ſelf is expanded.

" And herein we ſee the admirable Contrivance of " the Author of Nature, in adapting her different " Ways of conveying Nouriſhment to the different " Circumſtances of her Productions. For in this *Em-* " *bryo*-ſtate of the Buds a ſuitable proviſion is made " to bring Nouriſhment to them in a Quantity ſuffici- " ent for their then ſmall Demands. But when they " are in ſome degree increaſed and formed, a much " greater quantity of Nouriſhment is neceſſary in pro- " portion to their greater Increaſe: Nature, that ſhe " may then no longer ſupply with a ſcanty hand, im- " mediately changes her Method in order to convey " Nouriſhment with a more liberal hand to her Pro- " ductions; which Supply daily increaſes by the grea- " ter Expanſion of the Leaves, and conſequently the " more plentiful Attraction and Supply of Sap, as the " greater growth and demand of it increaſes. We find " a much more elaborate and beautiful *Apparatus* for " the like purpoſe, in the curious Expanſions of Bloſ- " ſoms and Flowers, which ſeem to be appointed by " Nature, not only to protect, but alſo to draw and " convey a Nouriſhment to the *Embryo*-Fruit and " Seeds. But as ſoon as the *Calix* is form'd into a " ſmall Fruit now impregnated with its minute ſemi- " nal Tree, furniſh'd with its *Secondine*, *Chorion* and " *Amnion* (which new-ſet Fruit may in that ſtate be " look'd upon as a compleat Egg of the Tree, yet in " Embryo) then the Bloſſom falls off, leaving this

new-

" new-form'd Egg or firſt-ſet Fruit in this Infant-ſtate,
" to imbibe Nouriſhment ſufficient for it ſelf, and the
" *Fœtus* with which it is impregnated : Which Nou-
" riſhment is brought within the reach and power of
" its Suction by the adjoyning Leaves.

" If I may be allow'd to indulge Conjecture (in a
" Caſe, in which the moſt diligent Inquirers are as
" yet, after all their laudable Reſearches, advanced
" but little farther than meer Conjecture) I would
" propoſe it to their conſideration, whether from the
" manifeſt Proof we have that Sulphur ſtrongly at-
" tracts Air, a hint may not be taken to conſider whe-
" ther this may not be the primary uſe, of the *Farina*
" *fœcundans*, to attract and unite with it ſelf elaſtick
" or other refin'd active Particles.

" That this *Farina* abounds with Sulphur, and that
" a very refin'd ſort, is probable from the ſubtil Oil
" which Chymiſts obtain from the Chives of Saffron.
" And if this be the uſe of it, was it poſſible
" that it could be more aptly placed for the
" purpoſe on very movable *Apices* fixed on the ſlender
" Points of the *Stamina*, whereby it might eaſily with
" the leaſt breath of Wind be diſperſed in the Air,
" thereby ſurrounding the Plant as it were with an At-
" moſphere of ſublimed ſulphureous Pounce ? For many
" Trees and Plants abound with it ; they may be per-
" haps inſpir'd at ſeveral parts of the Plant, and eſpe-
" cially at the *Piſtillum*, and be thence conveyed to
" the *Capſula ſeminalis*, eſpecially towards Evening;
" and in the Night, when the beautiful *Petala* of the
" Flowers are cloſed up, and they, with all the other
" parts of the Vegetable, are in a ſtrongly imbibing
" ſtate. And if to theſe united ſulphureous and aerial
" Particles we ſuppoſe ſome Particles of Light to be
" joyned (for Sir *Iſaac Newton* has found that Sulphur

" attracts

" attracts Light ſtrongly) then the reſult of theſe " three by far the moſt active Principles in Nature, " will be a *Punctum Saliens* to envigorate the *Seminal* " Plant: And thus we are at laſt conducted by the " regular Analyſis of vegetable Nature to the firſt " enlivening Principle of their minuteſt Origin.

P. S. *Since I began this Abſtract, I was with the ingenious Author, who by ſome Experiments try'd ſince the writing of his Book, was become certain of ſome things which he ſpoke doubtfully of before,* viz, 1. *That the Diaphragm-Inſtrument (ſee Page* 263, *of his Book) wou'd ſerve to breathe* 8 ½ *Minutes when it was entirely dry, and the Diaphragms impregnated with Salt of Tartar.* 2. *That Leaves imbibe Air, as he has ſince tried in Mint in the manner that he mention'd (in Page* 329.) 3. *That this year the Heat of the Weather has been at* 84 *Degrees, mark'd on his Thermometers.*

F I N I S.

Advertiſement.

WHereas I publiſh'd a Paper concerning the Figure of the Earth, in the *Philoſophical Tranſactions,* Numb. 388, and a Paragraph which I cancell'd, was, by the miſtake of my *Amanuenſis,* printed whilſt I was ſick: I deſire ſuch Readers as have that *Tranſaction* by them, to cancel from the Words, *Laſtly, Let us ſuppoſe,* Page 280. Lin. *ult.* to the End of the Paragraph.

Having from time to time neglected to give this notice, I choſe to do it here, tho' late, rather than wholly to omit it.

J. T. Deſaguliers.