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C

At a Meeting of the Council of the ROYAL SOCIETY, *Feb.* 22. 168½

DR. *Grew* having read ſeveral *Lectures* of the *Anatomy* of *Plants*, ſome whereof have been already printed at divers times, and ſome are not printed; with ſeveral other *Lectures* of their *Colours*, *Odours Taſts*, and *Salts*; as alſo of the *Solution* of *Salts* in *Water*; and of *Mixture*; all of them to the ſatisfaction of the ſaid *Society*: It is therefore Ordered, That He be deſired, to cauſe them to printed together in one Volume.

CHR. WREN P.R.S.

Pre-Linnean
QK41
.G82
1682
[#672]

THE ANATOMY OF PLANTS.

WITH AN

IDEA

OF A

Philosophical History of Plants,

And several other

LECTURES,

Read before the

ROYAL SOCIETY.

By *NEHEMIAH GREW* M.D. Fellow of the *ROYAL SOCIETY*, and of the *COLLEGE* of *PHYSICIANS*.

Printed by *W. Rawlins*, for the Author, 1682.

Mo.Bot. Garden,
1902.

Printed by W. Graphic for the Author, 1785.

COLLEGE of PHYSICIANS

of the ROYAL SOCIETY and of the

BY NEHEMIAH GREW M.D. F.R.S.

ROYAL SOCIETY

Read before the

LECTURES

And (except the

PHILOSOPHICAL HISTORY of PLANTS.

ON

IDEA

OF

ANATOMY

THE

TO HIS MOST

Sacred Majesty

CHARLES II.

King of Great Britain, &c.

May it please Your Majesty,

THE *Dedication of one Part of the following* Anatomy *having been very graciously received by Your Majesty: I am now emboldened most humbly to present the Whole into* Your Royal Hands.

By which Your Majesty will find, That there are Terræ Incognitæ *in* Philosophy, *as well as* Geography. *And for so much, as lies here, it comes to pass, I know not how, even in this Inquisitive Age, That I am the first, who have given a Map of the Country.*

Your

Your Majeſty will here ſee, That there are thoſe things within a Plant, *little leſs admirable, than within an* Animal. *That a* Plant, *as well as an* Animal, *is compoſed of ſeveral* Organical Parts; *ſome whereof may be called its* Bowels. *That eve-ry* Plant *hath* Bowels *of divers kinds, conteining divers kinds of* Liquors. *That even a* Plant *lives partly upon* Aer; *for the reception whereof, it hath thoſe Parts which are anſwerable to* Lungs. *So that a* Plant *is, as it were, an* Animal *in Quires; as an* Animal *is a* Plant, *or rather ſeveral* Plants *bound up into one* Volume.

Again, that all the ſaid Organs, Bowels, *or other* Parts, *are as artificially made; and for their* Place *and* Number, *as punctually ſet together; as all the* Mathematick Lines *of a* Flower *or* Face. *That the* Staple *of the* Stuff *is ſo exquiſitely fine, that no* Silk-worm *is able to draw any thing near ſo ſmall a* Thred. *So that one who walks about with the meaneſt* Stick, *holds a Piece of Natures Handicraft, which far ſurpaſſes the moſt elaborate* Woof *or* Needle-Work *in the World.*

That by all theſe Means, the Aſcent *of the* Sap, *the* Diſtribution *of the* Aer, *the* Confection *of ſeveral ſorts of* Liquors, *as* Lympha's, Milks, Oyls, Balſames; *with other parts of* Vegetation, *are all contrived and brought about in a Mechanical way.*

In

In ſum, Your Majeſty will find, that we are come aſhore into a new World, whereof we ſee no end.

It may be, that ſome will ſay, into another Utopia. *Yet not I, but Nature ſpeaketh theſe things: the only true* Pallas, *wherewith it is treaſonable for the moſt curiouſly handed* Arachne *to compare. In whoſe Name, I, the meaneſt of her Pupils, do in all humility crave Your Majeſties Gracious Patronage. Whereof I cannot doubt, ſince Your Majeſty hath been pleaſed to be the Founder, and to ſtyle Your Self the Patron of that* Society, *of which I have the honour to be a Member. Your Majeſty deeming it to be a more Noble Deſign, To enlarge the Territories of Knowledge, than thoſe of Dominion: and the Higheſt Pitch of Human Glory, not to rule, in any ſort, over many; but to be a Good Prince over Wiſe Men. I am*

Your Majeſties

moſt humble

and

moſt obedient

Subject

NEHEMIAH GREW.

THE PREFACE.

IT is a *Politick* or *Civil Virtue* in every prudent mans Eye, To ſet himſelf an example, in what he doth, unto others. And in ſo doing, he looks upon himſelf as accountable, in ſome ſort, to all Men. To thoſe therefore, who may either expreſly, or tacitly, expect the Reaſons, upon which I firſt undertook the *Anatomy* of *Plants*, and alſo made the after-progreſs therein; I ſhall ſumme them up as follows.

The firſt occaſion of directing my Thoughts this way, was in the *Year* 1664, upon reading ſome, of the many and curious Inventions of Learned Men, in the *Bodies* of *Animals*. For conſidering, that both of them came at firſt out of the ſame *Hand*; and were therefore the *Contrivances* of the ſame *Wiſdom*: I thence fully aſſured my ſelf, that it could not be a vain Deſign; to ſeek it in both. And being then newly furniſhed with a good ſtock of *Seeds*, in order to raiſe a *Nurſery* of *Plants*; I reſolved, beſides what I firſt aimed at, to make the utmoſt uſe of them for that purpoſe: that ſo I might put ſomewhat upon that ſide the *Leaf* which the beſt *Botanicks* had left bare and empty. And in which, notwithſtanding ſome other Learned Men had inſerted ſomewhat of this nature; as Dr. *Highmore* in his *Book* of *Generation*, Dr. *Sharrock* of the *Propagation* of *Plants*, and Mr. *Hook* in his *Micrography*: yet but collaterally, and whithout ſhewing any purpoſe of managing this *Part* of *Natural Hiſtory*. And although it ſeemed at firſt an Ob-

jection in my way, That the first projectors seldome bring their business to any good end: yet I also knew, That if Men should stay for an Example in every thing; nothing extraordinary would ever be done.

But notwithstanding the reasonablenes of the Design; yet I did not forget, that, in respect of the Undertaker, there might be *Impar congressus*. And therefore, before I had ventured very far, in the Year 1668, I imparted it to my Brother-in-Law, the Learned Dr. *Henry Sampson*, now *Fellow* of the *Colledge* of *Physicians* in *London*. Who not only very well liked the same; but also excited me to a vigorous and accurate prosecution of it. Which he did, partly, by mentioning a very pertinent passage of Dr. *Glisson*, in the *Preface* to his *Book de Hepate*, (*a*) which I had not then read.

(*a*) Ch. 1.

Plantæ quoque in hunc censum (sc. Anatomicum) *veniunt; variâ enim Partium texturâ, & differentiis constant: & proculdubio, ex acurata earundem dissectione, utiles valde observationes nobis exurgerent: præstaretque in illis (inferioris licet ordinis) rebus examinandis operam impendere, quam in transcribendis ut sæpe sit, aliorum laboribus, inutiliter ætatem transigere. Quippe hoc pacto, ignavarum apum more, aliena duntaxat alvearia expilamus, nihilque bono publico adjicimus.*

After I had finished the *First Book*, that I might know the sense also of other Learned Men, whether the steps I had already taken, would warrant me to proceed any further: I put some part of it into the same Hand; who, in the Year 1670, communicated the same to Mr. *Oldenburge*, then *Secretary* to the *Royal Society*: and after he had read it over, it was, upon his motion, delivered to that excellent Person Dr. *John Wilkins* then *Bishop* of *Chester*; who produced it at a Meeting of the *Royal Society*, and desired, they might see the rest. Which, or the greatest part, being also presented to them, the Right Honourable the Lord Vicount *Brouncker*, then *President* of the *Royal Society*, was pleased to peruse the same. Presently, after which, at a Meeting of the Council

of

of the ſaid *Society*, the following *Order* was made, and entred in their Council-Book with this Date, and in theſe words:

May 11th 1671.

Then was Licenſed Dr. Nehemjah Grew's *Book, Entituled,* The Anatomy of Vegetables *begun; together with an account of* Vegetation *grounded thereupon. And Ordered to be Printed by the Printer to the* Royal Society.

Hereupon, I was obliged to ſend the Book to the Preſs. And upon the 9th of *November* following in the ſame Year 1671, when it was near being printed, my Lord *Brouncher* ſigned the forementioned *Order*: the Printer, whoſe Name was to be inſerted therein, not having received his *Diploma* till that time.

The Book being quickly after printed off; I ordered it to be Preſented to the *Royal Society*; which was accordingly done at one of their Meetings *December* 7, 1671. And alſo to be ſent to the Biſhop of *Cheſter*; who was pleaſed to ſignifie his acceptance thereof by a Letter dated at *Cheſter, December* 26th 1671. now filed amongſt others in the Cuſtody of the *Royal Society*: part whereof, in regard it relates to matter of Fact, I ſhall here recite.

Sir,

I did yeſterday receive your Book; and am very ſenſible of the Honour you have done me in the Dedication of it. You was very happy in the choice

of this Subject to write upon; one of the most Noble and the most Copious parts of Philosophy; *and such an one, as hath hitherto lain uncultivated. And you have been very successful in your first Attempt about it, in so many remarkable Observations and Discoveries, as you have made already. I could heartily wish, that you would still apply your self to this kind of Enquiries. You will find that Additionals will come in more copiously and easily. And it is not fit, that any one should, by his Superstructions, carry away the praise from him, who was the first Inventor, and who laid the Foundations, wherein the greatest difficulty doth consist,* &c.

Having thus submitted my self to the Judgment of many Learned Men; I saw that my Journey must not here end. So that, like one who is got into a Wood, I thought I might as fairly find my way out, by going on, as by making a retreat. Whereupon, I began to draw up a *Scheme* of the whole *Design.*

While I was doing this, I received news from *London*, that the same day, *December* 7. 1671, in which my Book, then printed, was presented to the *Royal Society:* there was also presented a *Manuscript* (without *Figures*) from Seignior *Malpighi*, upon the same Subject; dated at *Bononia*, *November*, 1st 1671. the same, which Mr. *Oldenburge*, when it came to be printed, calleth his *Idea.* And of this, entry was made in their Journal Book. So that the *Royal Society* having now a Prospect of the good service of an Ancient *Member*, and one, who had highly merited by his Works then extant; from thence forward, I looked upon my self to be excused.

But soon after, receiving another Letter from the Bishop of *Chester*, dated at *London*, *Febr.* 18. 1672. I found

found the matter otherwiſe; and that the *Society* were pleaſed to engage me to proceed. Whereof entry was made by the *Secretary* in their Journal Book, at one of their Meetings, *April*, 18. 1672, in theſe words:

The Society *was made acquainted with one particular lately paſſed in the Council*; ſc. *That the Biſhop of* Cheſter *had there propoſed Dr.* Grew *to be a Curator to the* Royal Society *for the* Anatomy *of* Plants: *and that the Council had approved of that* Propoſal. *Upon which, it was Ordered, That the Thanks of the* Society *be returned to the Lord Biſhop of* Cheſter, *for this* Propoſal, *and to the Council for their Approbation of the ſame.*

This they might be induced to do; upon conſidering, that it would be no diſadvantage to the credit of thoſe matters, which were ſo new and ſtrange, to be offered to the World from a double Authority. For one, although he may have no mind to deceive; yet is it more likely for one, than for two, to be deceived. Likewiſe, that the ſame Subject, being proſecuted by two Hands, would be the more illuſtrated by the different Examples produced by both. And that, as in other matters, ſo here, the defects of both, would mutually be ſupplyed.

Whether for theſe, or other Reaſons alſo, they were pleaſed to paſs the forementioned *Order*; that being done, it had been very ill manners in me, not to have anſwered their expectation therein. And therefore reaſſuming the Deſign I had laid by, and having reduced it to ſome intelligible *Idea*, it was ſubmitted to the Cenſure of the *Royal Society*: and it was thereupon ordered it ſhould be printed.

Not

Not long after, I received a Curious and Learned Book from Monſ. *Dodart*, *Archiater* to the Prince of *Conde*, and *Fellow* of the *Royal Academy* at *Paris*; in perſuance of whoſe Order, it was by him compoſed and publiſhed. Which being a Deſign of a like Import, I was glad to ſee it ſo far juſtify'd by that Illuſtrious *Society*, as well as by our own.

In this *Idea*, one principal Thing I inſiſt upon, for a *Philoſophical Hiſtory* of *Plants*, is *Anatomy*. And, agreeing to the *Method* therein propoſed, all the Obſervations conteined in the *Firſt Book*, except one or two, were made with the *Naked Eye*. To the end, I might firſt give a proof, How far it was poſſible for us to go, without the help of *Glaſſes:* which many Ingenious Men want; and more, the patience to manage them. For the Truth of theſe Obſervations, Seignior *Malpighi*, having procured my Book to be tranſlated into Latin for his private uſe, ſpeaks his own ſenſe, in ſome of his Letters to Mr. *Oldenburge*, printed at the end of his *Anatomy* of *Plants*. And ſome of them, have ſince been confirmed, both by our Learned Country-men Dr. *Wallis*, and Mr. *Liſter*; and by the Ingenious Mr. *Lewenhoeck*, abroad.

Having thus begun with the bare Eye; I next proceeded to the uſe of the *Microſcope*. And the Obſervations thereby made, firſt on *Roots*, and afterwards on *Trunks* and *Branches*, together with the *Figures*, were all exhibited to the *Royal Society* at ſeveral times from *May* 15. 1672. to *April* 2. 1674; being the *Materials* for the *Second* and *Third Parts*: and hereof *Memorials* were inſerted in their Journal Books.

After this, the *Royal Society* received from Seignior *Malpighi* his *Second Part* of the *Anatomy* of *Plants*, together with the *Figures* therein deſcribed, and his *Letters* to their *Secretary*, dated at *Bononia Aug.* 20th of the ſame year 1674. when, and not before, he gave leave that the two ſaid *Parts* ſhould be printed.

So

So ſoon as I had finiſhed the *Second* and *Third Parts*, I proceeded to the *Laſt*, *ſc.* of *Leaves*, *Flowers*, *Fruits* and *Seeds*: and thoſe Things I met with, more remarquable, were preſented to the ſaid *Society* in the Years 1676 & 1677. And the publiſhing of the former *Parts* ſucceſſively, as well as of all together, hath been done in purſuance of their ſeveral *Orders* for the ſame.

Having concluded the *Hiſtory* of *Perfect Plants*; I intended to have ſubjoyned the *Deſcription* of thoſe which are *Imperfect*. As alſo of *Paraſitical*, *Marine*, and *Senſitive Plants*. Aud laſtly, a view of the chief Particulars, wherein the *Mechaniſme* of a *Plant*, is different from that of an *Animal*. But theſe things I leave to ſome other Hand.

The *Firſt Book*, a little after it came forth; was tranſlated into the French *Tongue*, by Monſ. Le *Vaſſeur* an Ingenious Gentleman in *Paris*; elegantly, and in the Judgment of thoſe who are well skilled in that *Language*, with much exactneſs, as to the ſenſe. He having taken ſpecial care, to have all the difficulties of our own, by Me, cleared to him. And in a late Book Entituled, *Philoſophia vetus & nova* printed at *Noriberg* 1682. the Learned Author ſeems to have made uſe of this Tranſlation, for all that he hath taken notice of in that my *Firſt Book*.

By the Ingenious Collectors of the *German Ephemerides*, both my *Firſt*, *Second*, and *Third Books*, are all publiſhed in *Latine*. But their unskilful Interpreter doth often fail of the *Grammatical Senſe*. Whoſe Errors, many of them very groſs, I deſire may be imputed neither to them, nor to my ſelf.

Beſides theſe, the *Second Lecture* of *Mixture* is alſo tranſlated into *French*, by Monſ. *Meſmin* a Learned Phyſician in *Paris*: whoſe *Verſion* is very well approved by thoſe who are competent Judges hereof.

This,

This, and the reſt which follow, are placed, not in the order of *Time*; but more according to their Nature or Relation one to another. All of them intended as a Commentary upon ſome particulars mentioned, either in the *Firſt Lecture*, or in the *Idea*.

In the *Plates*, for the clearer conception of the *Part* deſcribed, I have repreſented it, generally, as entire, as its being magnified to ſome good degree, would bear. So, for inſtance, not the *Barque*, *Wood*, or *Pith* of a *Root* or *Tree*, by it ſelf; but at leaſt, ſome portion of all three together: Whereby, both their *Texture*, and alſo their Relation one to another, and the *Fabrick* of the whole, may be obſerved at one *View*. Yet have I not every where magnify'd the *Part* to the ſame degree; but more or leſs, as was neceſſary to repreſent what is ſpoken of it. And very highly, only in ſome few Examples, as in *Tab.* 40. which may ſuffice to illuſtrate the reſt. Some of the *Plates*, eſpecially thoſe which I did not draw to the *Engravers* hand, are a little hard and ſtiff: but they are all well enough done, to repreſent what they intend.

THE

AN IDEA OF A Philosophical History OF PLANTS.

Read before the

ROYAL SOCIETY,

January 8. and *January* 15. 1672.

By *NEHEMIAH GREW* M.D. Fellow of the *Royal Society*, and of the *College* of *Physicians*.

The Second Edition.

LONDON,

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Mo.Bot. Garden,
1902.

AN

INDEX

OF

Philosophical History

OR

PLANTS.

Jan. 8. and Jan. 15. 1672.

By NEHEMIAH GREW M.D. Fellow of the Royal Society, and of the College of Physicians.

LONDON,

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TO THE

Moſt Illuſtrious

THE

ROYAL SOCIETY,

The following

IDEA

Is moſt HUMBLY

PRESENTED.

AND,

In their NAMES alſo

PROPOSED

TO THE

CONSIDERATION

Of other

Learned Men.

By the AUTHOR

NEHEMIAH GREW.

BY THE AUTHOR

NEHEMIAH GREW.

Lectures Read

Of other

CONSIDERATION

TO THE

PROPOSED

In that NAMES &c

AND

PRESENTED

From HOMERY

IDEA

The following

ROYAL SOCIETY.

THE

Most Illustrious

TO THE

THE

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AN

AN IDEA OF A Philosophical History OF PLANTS.

IF WE take an account of the *Degrees* whereunto the Knowledge of *Vegetables* is Advanced, it appeareth, That besides the great Varieties, which the Successful *Arts* of *Florists*, or Transplantations from one *Climate* to another, have produced; we have very many *Species* brought to light, especially Natives of the *Indies*, which the *Ancients*, for any thing that appears in their *Writings* now extant, were ignorant of. In which particular *Clusius*, *Columna*, *Bauhinus*, *Boccone*, and others, have performed much. Withall, That their *Descriptions* (of all Parts above ground) their *Places* and *Seasons*, are with good diligence and preciseness set before us. Likewise their Order and Kindred: for the adjusting whereof our Learned Countryman Mr. *Ray*, and Dr. *Morrison*, have both taken very laudable pains. As also the ordering of them with respect to their *Alimental* and *Mechanick* Uses; for which, amongst others, Mr. *Evelyn* and Dr. *Beal* have deserved many thanks, and great praise. We are also informed, of the *Natures* and infallible *Faculties* of *many* of them. Whereunto so many as have assisted, have much obliged their *Posterity*.

2. §. By

2. §. By due Reflection upon what hath been *Performed*; it alſo appears, what is left *Imperfect*, and what *Undone*. For the *Virtues* of moſt *Plants*, are with much *uncertainty*, and too *promiſcuouſly* aſcribed to them. So that if you turn over an *Herbal*, you ſhall find almoſt every *Herb*, to be good for every *Diſeaſe*. And of the *Virtues* of many, they are altogether ſilent. And although, for the finding out, and juſt appropriation of them, they have left us ſome *Rules*, yet not all. The *Deſcriptions* likewiſe of many, are yet to be perfected; eſpecially as to their Roots. Thoſe who are very curious about the other *Parts*, being yet here too remiſs. And as for their *Figures*, it were much to be wiſhed, That they were all drawn by one *Scale*; or, at moſt, by Two; one, for *Trees* and *Shrubs*; and another for *Herbs*. Many likewiſe of their *Ranks* and *Affinities*, are yet undetermined. And a great number of *Names*, both *Engliſh* and *Latine*, not well given. So what we call *Goat's-Rue*, is not at all of kin to that Plant, whoſe *Generical Name* it bears. The like may be ſaid of *Wild-Tanſy*, *Stock-July-Flowers*, *Horſe-Radiſh*, and many more. So alſo when we ſay *Bellis Major*, *& Minor*, as we commonly do, theſe *Names* would intimate, That the *Plants* to which they are given, differ (as the great double *Marigold*, doth from the leſs) only in Bulk: whereas, in truth, they are two *Species* of *Plants*. So we commonly ſay, *Centaurium Majus & Minus*, *Chelidonium Majus & Minus*, and of others in like manner, which yet are diſtinct *Species*, and of very different *Tribes*. But for the *Reaſon* of *Vegetation*, and the *Cauſes* of all thoſe infinite *Varieties* therein obſervable (I mean ſo far as *Matter*, and the various *Affections* hereof, are inſtrumental thereunto) almoſt all Men have ſeemed to be unconcerned.

3. §. That Nothing hereof remaineth further to be known, is a Thought not well Calculated. For if we conſider how long and gradual a *Journey* the *Knowledge* of *Nature* is; and how ſhort a Time we have to proceed therein; as on the one hand, we ſhall conclude it our eaſe and profit, To ſee how far Others have gone before us: ſo ſhall we beware on the other, That we conceive not unduly of *Nature*, whilſt we have a juſt value for Thoſe, who were but her *Diſciples*, and inſtructed by Her. Their Time and Abilities both, being ſhort to her; which, as She was firſt Deſigned by *Divine Wiſdom*; ſo may Her vaſt Dimenſions beſt be adjudged of, in being compared Therewith. It will therefore be our Prudence, not to inſiſt upon the Invidious Queſtion, Which of Her *Scholars* have taken the faireſt meaſure of Her; but to be well ſatisfied, that as yet She hath not been Circumſcribed by Any.

4. §. Nor doth it more behove us to conſider, how much of the Nature of *Vegetation* may lie before us yet *unknown*; Than, to believe, a great part thereof to be *knowable*. Not concluding from the acknowledged, much leſs ſuppoſed Inſucceſsfulnes, of any Mens Undertakings: but from what may be accounted Poſſible, as to the Nature of things themſelves; and from *Divine Providence*, by Infinite Ways conducting to the knowledge of them. Neither can we determine how great a part This may be: Becauſe, *It is impoſſible to Meaſure, what we See not.* And ſince we are moſt likely to under-meaſure, we ſhall hereby but intrench our Endeavours, which we are not wont to carry beyond the *Idea*, which we have of our *Work*.

5. §. And

5. §. And how far ſoever this kind of Knowledge may be attainable, its being ſo far alſo worthy our attainment will be granted. For beholding the Many and Elegant Varieties, wherewith a Field or Garden is adorned; Who would not ſay, That it were exceeding pleaſant to know what we See: and not more delightful, to one who has *Eyes*, to diſcern that all is very fine; than to another who hath *Reaſon*, to underſtand *how*. This ſurely were for a Man to take a True Inventory of his Goods, and his beſt way to put a price upon them. Yea it ſeems, that this were not only to be *Partaker* of *Divine Bounty*; but alſo, in ſome degree, *To be Copartner in the Secrets of Divine Art.* That which were very deſireable, unleſs we ſhould think it impertinent for us to deſign the *Knowing* of *That*, which *God* hath once thought fit to *Do*.

6. §. If for theſe, and other *Reaſons*, an inquiry into the Nature of *Vegetation* may be of good Import; It will be requiſite to ſee, firſt of all, What may offer it ſelf to be enquired of; or to underſtand, what our *Scope* is: That ſo doing, we may take our aim the better in making, and having made, in applying our Obſervations thereunto. Amongſt other Inquiries therefore, ſuch as theſe deſerve to be propoſed. Firſt, by what means it is that a *Plant*, or any *Part* of it, comes to *Grow*, a *Seed* to put forth a *Root* and *Trunk*; and this, all the other *Parts*, to the *Seed* again; and all theſe being *formed*, by continual Nutrition ſtill to be *increaſed*. How the Aliment by which a *Plant* is fed, is duly prepared in its ſeveral *Parts*; which way it is *conveyed* unto them; and in what manner it is *aſſimilated* to their reſpective Natures in them all. Whence this Growth and Augmentation, is not made of one, but many differing Degrees, unto both extremes of *ſmall* and *great*; whether the compariſon be made betwixt ſeveral *Plants*, or the ſeveral *Parts* of one. How not only their *Sizes*, but alſo their *Shapes* are ſo exceeding various; as of *Roots*, in being Thick or Slender, Short or Long, Entire or Parted, Stringed or Ramified, and the like: of *Trunks*, ſome being more Entire, others Branched, others Shrub'd: of *Leaves*, which are Long or Round, Even-edg'd or Eſcallop'd, and many other ways different, yet always Flat: and ſo for the other *Parts*. Then to inquire, What ſhould be the reaſon of their various *Motions*; that the *Root* ſhould *deſcend*; that its deſcent ſhould ſometimes be *perpendicular*, ſometimes more *level*: That the *Trunk* doth *aſcend*; and that the aſcent thereof, as to the ſpace of *Time* wherein it is made, is of different *meaſures*: and of divers other *Motions*, as they are obſervable in the *Roots*, *Trunks*, and other *Parts* of *Plants*. Whence again, theſe *Motions* have their Different, and Stated *Terms*; that *Plants* have their ſet and peculiar *Seaſons* for their *Spring* or *Birth*, for their *Full Growth*, and for their *Teeming*; and the like. Further, what may be the Cauſes as of the *Seaſons* of their *Growth*; ſo of the *Periods* of their *Lives*; ſome being *Annual*, others *Biennial*, others *Perennial*; ſome *Perennial* both as to their *Roots* and *Trunks*; and ſome as to their *Roots* only. Then, as they paſs through theſe ſeveral *Seaſons* of their *Lives*, in what manner their convenient *feeding*, *houſing*, *cloathing* or *protection* otherwiſe, is contrived; wherein, in this kind and harmonious *Oeconomy*, one *Part*, may be officious to another, for the preſervation of the health and life of the *whole*. And laſtly, what care is taken, not only for themſelves, but for their *Poſterity*; in

what manner the *Seed* is prepared, formed and fitted for *Propagation:* and this being of ſo great concernment, how ſometimes the other *Parts* alſo, as *Roots*, in putting forth *Trunks*; *Trunks* in putting forth *Roots*; yea in turning oftentimes into *Roots* themſelves; whereof, in the *Second Book of the Anatomy of Plants*, I ſhall give ſome inſtances. With other *Heads* of Inquiry of this kind.

7. §. Nor are the *Natures*, *Faculties*, and *Contents* of *Vegetables* leſs various, or a particular Inſpection hereinto, of leſs concernment. For ſince All, or Moſt, ſeem to grow in the ſame manner, with one *Sun*, one *Rain*, indifferently well upon one *Soil*, and, to outward appearance, to have the ſame *Common Parts*; it may be asked, *How* it comes to paſs, that their *Liquors*, or other *Contained Parts*, are of ſuch different *Kinds*; one being Watry, another Winy, a third *Oily*, a fourth *Milky*, and the like. *How* alſo there is ſuch a variety in their *Senſible Qualities*, as their *Colours*, *Taſtes*, and *Smells*; what thoſe *Materials* are, which are neceſſary to the *Being* of theſe *Qualities*; and thoſe *Formalities*, wherein their *Eſſence* doth conſiſt; as what it is that makes a *Plant*, or *Flower*, to be *white* or *red*; *fragrant* or *fetid*; *bitter* or *ſweet*; or to be of any other *Colour*, *Smell*, or *Taſte*. In like manner, their *Faculties* and *Powers*, what that is, or thoſe things are, by which they are conſtituted; as whence one becomes *Purgative*, another *Vomitory*, a third *Diaphoretick*, *&c*, Theſe, I ſay, with many other particular Inquiries depending hereupon; as they cannot but much oblige the Reaſon of Man to be obſequious to them, ſo by bringing in, at leaſt, ſome ſatisfaction, will no leſs reward it. Eſpecially, if it be withal conſidered, that beſides our ſatisfaction as to the *Nature* of *Vegetation*; ſome further Light, to divers other parts of Knowledge, may likewiſe hence ariſe.

8. §. For ſince the preſent Deſign will ingage us, to an accurate and multifarious Obſervation of *Plants*; we may hereby be enabled to *range* and *ſort* them with more certainty, according to the Degrees of their *Affinity*. And all *Exoticks*, *Plants* or *Parts* of *Plants*, may probably be reduced to ſome ſuch *Domeſticks*, unto which they may bear the beſt Reſemblance. Again, it may frequently conduct our minds to the conſideration of the *State* of *Animals*; as whether there are not divers material Agreements betwixt them both; and what they are. *Wherein* alſo they may conſiderably differ, and what thoſe things are which are more eſſential to their diſtinguiſhment. And *beſides*, not only to compare what is already known of both; but alſo, by what may be obſerved in the *one*, to ſuggeſt and facilitate the finding out of what may yet be unobſerved in the *other*. So *alſo* the conſideration of the *Colours*, *Smells* and *Taſtes* of *Vegetables*, may conduce to the Knowledge of the ſame *Qualities* in General; or of what it is, that conſtitutes them ſuch, in any other Body: not as they are *actually* received by *Senſe*; but ſo far, as ſuch *Materials* or external *Circumſtances*, are requiſite to their becoming the *Adequate Objects* thereof. *It may* lead us alſo to inquire into further Ways of *Cultivation*, with reſpect to the whole *Plant*, or to the *Flower*, *Fruit*, or other *Part*: To amend them as to their *Sizes*, *Colours*, *Taſtes*, *Fruitfulneſs*, or otherwiſe: To think of other Ways of *Propagation*; or to apply thoſe already known to other *Plants* than hath been uſed. Likewiſe the Knowledge of their *Mechanical* Uſes may hereby be enlarged; both as to the

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Reaſon of their uſe, in ſuch particular *Trades* and *Manufactures*, already known; and the diſcovery of other uſes yet unknown. As alſo their *Alimental*, with reſpect both to *Meats* and *Drinks*; the preparation of ſome, and the finding out of others. But eſpecially their *Medicinal*; ſome *Plants* which have hitherto been neglected, may be applied to uſe; the *Perverted* uſes of ſome, and the *Confuſed* uſes of others, may be rectified. What may beſt correct their *Malignancies*, or inforce their *Virtues*; When needful to add the preparations of *Art* to That of *Nature*; How to Enlarge thoſe of *Art*, and Rectifie thoſe which are indeed Inartificial, may hereby be better conjectured. The knowledge of all which, that we may know how far it is acceſſible, and what probable Approaches may be made towards it; thoſe ſeveral Means I have thought of, and ſuppoſe neceſſary thereunto, are next to be propoſed.

9. §. Reflecting then upon the preſent Deſign, and ſeeing this to lie wide; we ſhall, in the firſt place, conclude the *Means* attending thereon, ſhould do ſo likewiſe. Wherefore, although ſome may preſent themſelves unto us as more promiſing; yet let us ſuppoſe what ſeveral Perſons, were they hereunto engaged, each according to his Senſe and Genius, would poſſibly make choice of. Believing, that although Conſidering Men may vary, in the approval of their own Senſe and Notion; yet not always mearly, becauſe it is their own; but becauſe each, may probably ſee ſomewhat more in his own, than others do. Wherefore it will be our ſureſt Logick to conclude, Not becauſe no *Mean* may be approved by all Men, that all *Means* ſhould be rejected; but rather, becauſe each may be approved by ſome, that therefore, all be made choice of. And theſe, I think, may be comprehended under Five General *Heads* of Enquiry. *Firſt*, Of thoſe Things, which are of more *External* Conſideration about *Plants*, as their *Figures*, *&c.* *Secondly*, Of their Compounding *Parts*, as *Veſſels*, *&c.* *Thirdly*, Of their *Liquors*, and other *Contents*. *Fourthly*, Of their *Principles*, as *Salts*, *&c.* *Fifthly*, Of their *Aliment*, as *Water*, and other Means of Growth.

10. §. AND FIRST of all, whatever is of more *External* Conſideration, as the *Figures*, *Proportions*, *Motions*, *Seaſons*, *Situations* of *Vegetables*, and of their ſeveral *Parts*, ſhould be obſerved. In doing which, a particular ſurvey of all their Varieties ſhould be taken. And then a Compariſon made betwixt theſe, and the ſeveral *Plants*, or *Parts* of *Plants*, whereof they are the *Properties*. To the end, We may, if poſſible, be thereby conducted to find out, what other, either ſenſible, or more recluſe *Property*, any of them may agree together in. For it is not more certain, that the three Angles of every *Rectilinear Triangle*, becauſe all ways equal to two *Right Angles*, are therefore, if put together, always the ſame: than that *one Property*, agreeing to divers *Vegetables*, ſhould have one *Cauſe*: For although the *Scope* and *End* may vary; yet the *Cauſe*, as it is the *Cauſe* of that *Property*, muſt be *one*: and conſequently, muſt alſo import ſome *Identity* in the *Nature* of all thoſe *Vegetables* wherein it Acts. Wherefore by thus comparing of them, we ſhall be able more exactly to ſtate the *Orders* and *Degrees* of their *Affinities*; Better to underſtand both the *Cauſes* and *Ends* of their *Varieties*: And more probably to conjecture of their *Natures* and *Vertues*.

The Firſt General *Mean.*

11. §. First then the various *Figures* of their ſeveral *Parts* ſhould be obſerved; and that with reſpect both to the *Forms*, and the *Poſitions*, by which their *Roots*, *Trunks*, *Branches*, *Leaves*, *Flowers*, *Fruits*, and *Seeds* may vary, or agree; and thoſe ſeveral *Lines*, by which both the ſaid *Varieties* are determin'd. In which of theſe *Parts*, the agreement chiefly lies; this being both more obſervable, and more material in ſome of them; leſs in the Root, more in the Flower, or Seed. And in how many of theſe *Parts* together; whether one, more, or all. By both which, the *Orders* and *Degrees* of *Affinity*, which are many, may be accounted; either as to what we ſtrictly call *Kindred*, or elſe *Analogy*. For there are found, not only *Herbs* accounted of ſeveral *Tribes*, which are ally'd; and ſome of the Smalleſt, which are of kin to the Greateſt: But there are alſo, probably, ſome *Herbs*, which have a particular Relation, to many Kinds of *Shrubs*; and ſome *Shrubs*, to many Kinds of *Trees*. Thus the ſeveral ſorts of *Letuce*, are of Kin, together in the *Firſt Degree*; with *Endive*, in the *Second*. The ſeveral *Clarys*, amongſt themſelves in the *Firſt*; with *Horehound*, in the *Second*; with *Lamium*, in the *Third*. All *Strawberries* agree together, in the *Firſt Degree*; with *Cinquefoyl*, in the *Second*; with *Tormentil* in the *Third*; and with *Avens*, *&c.* in other Degrees more remote. So *Agrimony*, hath alike Analogy unto *Strawberry*; as *Goats-Rue*, hath to *Claver*: And *Strawberry*, the like unto the *Raſp*; as *Goos-berry* to the *Vine*; or *Burnet*, to the *Roſe*. Amongſt the ſeveral *Sorts* of *Graſs*, there are ſome which match all thoſe of *Corn*; which is but a greater kind of *Graſs*. So again all *Pulſe*, are not only of kin, in their ſeveral Degrees, to one another; but likewiſe, to almoſt all kinds of *Trefoyls*, as *Melilot*, *Fœnugreek*, and the common *Clavers* themſelves; as by comparing not only their *Leaves*, but *Flowers*, *Seeds*, and *Cods* together, may be evident. For the ſeveral *parts* of the *Flower* of a *Trefoyl*, are ſo many more *Flowers*, containing ſo many *Cods* of ſmall *Seeds*, all, in ſhape, agreeable to the *Flowers*, *Cods*, and *Seeds* of *Pulſe*. The ſame Relation, which *Trefoyls* have to the *Peas* or other *Pulſe*; *Colts-foot*, hath to *Buttyr-Bur*; *Chickweed* to *Leucanthemum*; *Groundſell*, to *Jacobæa*; or *Scorodonia*, to *Foxglove*: Or, to go higher, as the *Leguminous* Kinds of *Herbs*, have to *Sena*, or ſome other of the *Lobed Shrubs* and *Trees*. And, as among *Animals*, there are ſome which connect ſeveral Kinds; as the *Batt* doth *Beaſts* and *Birds*: So, among *Plants*, there are ſome alſo, which ſeem to ſtand between two *Tribes*; as *Lappa*, between *Knapweeds* and *Thiſtles*; *Lampſana*, between the *Intybaceous* Kind, and the *Mouſe-ears*.

12. §. From hence likewiſe, the *Natures* of *Plants* may be conjectured. For in looking upon divers *Plants*, though of different *Names* and *Kinds*; yet if ſome affinity may be found betwixt them, then the *Nature* of any one of them being well known, we have thence ground of conjecture, as to the *Nature* of all the reſt. So that as every *Plant* may have ſomewhat of *Nature individual* to it ſelf; ſo, as far as it obtaineth any *Viſible Communities* with other *Plants*, ſo far, may it partake of *Common Nature* with thoſe alſo. Thus the *Wild*, and *Garden Cucumers*, have this difference; that the one *purgeth* ſtrongly, the other, *not at all*: yet in being *Diuretick*, they both agree. The *Natures* of *Umbelliferous Plants*, we know, are various; yet 'tis moſt probable, that they all agree in this one, *ſcil.* in being *Carminative*.

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The ſeveral ſorts, both of *Corn* and *Graſs*, are all akin; there is no doubt therefore, but that the *Seeds* of *Graſs* themſelves (of *Rye* and *Oats* it is tryed) if it were worth the while to order them, as *Barley*, would yield an inflammable Spirit. So likewiſe the ſeveral Kinds of *Pulſe*, have ſome one community in their Form, as is ſaid: for which reaſon, I queſtion not, but that in ſome Caſes, wherein *Cicers* are eſteemed a good *Medicine*; a *Decoction* of the better ſort of *Peaſe*, eſpecially that we call the *Sugar-Peaſe*, may go beyond them. As doth alſo the *Flower* or *Meal* of *Beans*, that of the *Seeds* of *Fœnugreek*; even there, where they are accounted excellent. So *Tulips*, *Lillies*, *Crocuſes*, *Jacynths*, and *Onions* themſelves, with many others, in their ſeveral Degrees, are all *allied*. If therefore *Crocuſes*, *Onions*, *Lillies*, agree in one or more *Faculties*, then why may not all the reſt? as in being *Anodyne*; or in ſome other *Common Nature*; whereby, in their *Vegetation*, their *Parts* are Governed and Over-ruled, to one Common or *Analogous Form*.

13. §. The *Proportions* likewiſe, amongſt the ſeveral *Parts* of *Vegetables*, for the ſame Reaſons, deſerve to be obſerved; the compariſon being made, both betwixt the *Parts* of ſeveral *Plants*, and the ſeveral *Parts* of one. And here again, either betwixt any Two of the *Parts*, or any One of them, and the Whole beſides, or all the reſt put together. So ſome larger *Seeds*, produce a ſmall *Root*; as thoſe of *Cucumer*: and others ſmaller, produce one very great; as thoſe of *Bryony*. Some *Plants*, as the *Melon*, though themſelves but very ſlender, yet have a vaſt and bulky *Fruit*; others again, as *Thiſtles*, and many yet more ſubſtantial, have no other *Fruit*, beſides their *Seed*. So the *Seeds* of all *Pulſe*, and eſpecially, the *Garden Bean*, though large, yet produce but a ſmall *Plant*: but thoſe of *Foxglove*, *Mullen*, *Burdock*, *Sun-flower*, *&c.* being themſelves much leſs, do yet produce a far greater. And eſpecially, thoſe *Seeds*, which are incloſed in the Thicker ſort of *Cover*, (analogous to that I have elſewhere called the *Secondine*) as that of *Peony*; whoſe *Seed*, ſo called, is only the *Neſt* wherein the true and real *Seed* is lodged, no bigger than a little Pins head: which is alſo obſervable of the *Seeds* of divers other *Plants*. Theſe, and the like *Proportions*, as they lie betwixt the ſeveral *Parts*, ſhould be noted: and to what *Plants* or *Parts* eſpecially, any of them may agree: comparing alſo in what other kind of *Properties* an agreement betwixt the ſaid *Parts* may be found: that ſo doing, we may, if poſſible, amongſt all their *Individual Natures*, be inſtructed to ſingle out thoſe *Common Ones*, which are concomitant to ſuch Agreeing *Properties*.

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14. §. The ſeveral *Seaſons* alſo of *Plants*, and of their *Parts*, ſhould be conſidered. Obſerving at what particular Times of the Year, any of them chiefly *Spring*, Early or Late. The Times wherein they *Germinate*; whether for ſome Space only, or all the Year long. Wherein they *Spring*, after Sowing; or *Flower*, after Springing, ſooner, or ſlower. Which Flower, the *firſt* Year, or not till the *ſecond*. Which *after* the *Leaves* are put forth, or *before* them; for ſo, ſome do, as the *Crocus Vernus*, *Bears-foot*, *Hepatica aurea*, and others; all the *Leaves*, at the time of their flowering, being old, or of the foregoing Year's growth. So likewiſe the *Maturation* of the *Fruit* or *Seed*; how long after the *Flower*, and the like. All or ſome of which *Varieties*, being

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laid together, we may probably conjecture the *Cauſes* thereof, and the *Natures* of the *Plants* in which they are ſeen: *ſcil.* as ſuch a Degree of Heat may be neceſſary for the Fermentation, or the better Diſtribution of the *Sap* of ſuch a *Plant*; or for the Impregnation of the *Aer*, to be mixed therewith; or the due Diſpoſing of the *Soil*, to render the moſt convenient Aliment thereunto. So the *Principles* of ſuch *Plants*, which flower all the Year, may be more equally proportion'd. Thoſe which flower before the *Leaves* put forth, as the *Crocus Vernus*, and thoſe which flower in *Spring*, may be accounted *Rank*, and full of *Volatile Salt*. But *Autumn Plants* eſpecially, to abound with a Fixed: and the like.

15. §. The proper *Places* alſo of *Plants*, or ſuch wherein they have, from their *Seeds*, or other way of *Propagation*, a Spontaneous growth, ſhould be conſidered. And that as to the *Climate*; whether in one Colder, Temperate, or more Hot. The *Region*; Continent, or Iſland. The *Seat*; as Sea, or Land, Watry, Boggy, or Dry; Hills, Plains, or Vallies; Open, in Woods, or under Hedges; Againſt *Walls*, rooted in them, or on their Tops: and the like. And perhaps the *Seeds* of ſome *Plants*, as of *Moſſes*, (which, through their ſmallneſs, will aſcend like Moths in the Sun) may fly or ſwim for ſome time, in the Aer, *viz.* till they begin to ſhoot, and ſo become heavy enough, to fall down upon the Ground. From whence, in like manner, as from their *Seaſons*, their particular *Natures* may be directed unto. In that, ſo far as we may conjecture the nature of ſuch an *Aer*, *Soil*, or *Seat*, we may alſo of ſuch a *Plant*, to which they are *congenial*.

16. §. So likewiſe, thoſe many Varieties obſervable in the *Motions* of *Plants*, and of their Parts, both Kinds and Degrees; *Aſcending*, *Deſcending*, and *Horizontal*; *Rectilinear*, and *Spiral Motions*, ſhould be noted; to what *Plants* they agree, and wherein any of theſe Motions may be analogous to thoſe of *Animals*. And in a word, any other *Forenſick Properties* of *Plants*. And then, to Compare them all together; both being neceſſary. For *Thoughts* cannot work upon nothing, no more than *Hands*. He that will build an Houſe, muſt provide Materials. And on the contrary, the Materials will never become an Houſe, unleſs, by certain Rules, we joyn them all together. So, it is not, *ſimply*, the Knowledge of *many things*, but a multifarious Copulation of them in the Mind, that becomes prolifick of further Knowledge. And thus much for the firſt General *Mean*.

The Second General *Mean*.

17. §. THE NEXT which I propoſe, and that a moſt neceſſary one, is *Anatomy*. For when upon the Diſſection of *Vegetables*, we ſee ſo great a difference in them, that not only their Outward *Figures*, but alſo their Inward *Structure*, is ſo Elegant; and in all, ſo Various; it muſt needs lead us thus to Think, That theſe Inward *Varieties*, were either to no *End*; or if they were, we muſt aſſign to what. To imagine the firſt, were exceeding vain; as if *Nature*, the Handmaid of *Divine Wiſdom*, ſhould with Her fine *Needle* and *Thred*, ſtitch up ſo many ſeveral *Pieces*, of ſo difficult, and yet ſo groundleſs a Work. But if for ſome *End*, then either only to be looked upon, or ſome other beſides. If for this only, then this muſt be ſuch as in reſpect whereof, Her Work is at no time, nor in any degree fruſtrate; the contrary whereunto, is moſt manifeſt. For although Men do every where, with frequent pleaſure, behold the Outward Elegancies of

Plants;

Plants; yet the Inward Ones, which, generally, are as Preciſe and Various as the Outward; we ſee, how uſual it is, for the beholding of Theſe, to be omitted by them. And beſides, when we have obſerved *Nature's* Work, as well as we can; it may be no impediment to our beſt Endeavours, to believe, That ſome Parts of it, will ſtill remain behind, *Unſeen*. So that if to be *Seen*, were the only End of it, it muſt needs be wholly fruſtrate, as to the greater number of Men; and, in ſome part, as to all. Wherefore, we muſt ſuppoſe ſome other *Ends* of the ſaid Varieties, which ſhould have their *Effect*, and ſo Theſe, not be in vain, whether Men beheld them or not; which, are, therefore, ſuch as have reſpect to *Vegetation:* That the *Corn* might grow, *ſo*; and the *Flower*, *ſo*, whether or no Men had a mind, leiſure, or ability, to underſtand *how*.

18. §. If then the *Anatomy* of *Vegetables* be ſo uſeful a *Mean*, we ought not to ſtreighten it; but to force this, as well as the reſt, to its utmoſt Extent. And therefore, firſt of all, To go through all the *Parts*, with equal care; examining the *Root*, *Trunk*, *Branch*, *Leaf*, *Flower*, *Fruit*, and *Seed*. Then to Repeat or Retrograde the Diſſection, from *Part* to *Part*: in that, although the beſt Method of Delivery, for clear Diſcourſe, can be but one, according to that of *Nature*, from the *Seed* forward, to the *Seed*: yet can it not but be uſeful, for That of Diſſection, to proceed *to* and *fro*; ſomewhat or other being more Viſible in each ſeveral *Part*, from whence ſtill an Hint may be taken, for the uſhering in the obſervation of it in the others. To examine, again, not only all the *Parts*, but *Kinds* of *Vegetables*, and comparatively, to obſerve divers of the ſame *ſize*, *ſhape*, *motion*, *age*, *ſap*, *quality*, *power*, or any other way the *ſame*, which may alſo agree, in ſome one or more particulars, as to their *Interiour Structure*: and to make this compariſon, throughout all their *Parts* and *Properties*. To obſerve them likewiſe, in ſeveral *Seaſons* of the Year, and in ſeveral *Ages* of the *Plants*, and of their *Parts*; in both which, divers of them may be noted to change, not only their *Dimenſions*, but their *Natures* alſo; as *Veſſels*, do into *Ligaments*; and *Cartilages*, into *Bones*, ſometimes, in *Animals*. And to do all this by ſeveral Ways of *Section*, Oblique, Perpendicular, and Tranſverſe; all three being requiſite, if not to Obſerve, yet the better to Comprehend, ſome Things. And it will be convenient ſometimes to Break, Tear, or otherwiſe Divide, without a *Section*. Together with the *Knife* it will be neceſſary to joyn the *Microſcope*; and to examine all the *Parts*, and every Way, in the uſe of That. As alſo, that both Immediate, and Microſcopical Inſpections, be Compared: ſince it is certain, That ſome things, may be demonſtrated by Reaſon and the Eye conjunct, without a Glaſs, which cannot be diſcovered by it; or elſe the diſcovery is ſo dark, as which, alone, may not be ſafely depended on.

19. §. By theſe ſeveral Ways of Inſpection, it will be requiſite, To obſerve their Compounding *Parts*; as *Simply* conſidered, and as variouſly *Proportioned*, and *Diſpoſed*. As *Simply* conſidered, to note their *Number*; what, and whether the ſame, in all: their *Kinds*, wherein different in the ſame, or divers *Vegetables:* their *Original*, in part, or in whole: *Structure*, as to their *Contexture* and their *Cavities*; Their *Contexture*, within themſelves ſeverally, and as joyned together: their *Cavities*, as to their *Size*, *Shape*, and *Number*; in which a great va-

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riety will be found. Next their *Poſitions* one amongſt another, which are alſo various; as Anterior, Poſterior, Collateral, Surrounding, Mediate, Immediate, Near, Remote; both as they reſpect the ſeveral *Parts*, and the ſeveral portions of one: And all theſe, as few, or more; theſe or others of them, may be diverſly Compounded together. And then the *Proportions* they bear one to another; whether as to Minority, Equality, or Exceſs; each *Part* compared with each, and that as to the ſeveral Degrees appearing in the ſaid *Proportions*; the Varieties whereof may be exceeding numerous. For if we ſhould ſuppoſe but *Four* conſiderable *Parts* generally conſtitutive of a *Vegetable*: Theſe *Four*, produce a Variety *Four* ways. Firſt, when One is Unequal; and then it produceth only *Four* Varieties: and thoſe two ways, *ſcil.* when one is Greater, and the other three, Equal and Leſs; or when one is Leſs; and the other three, Equal and Greater. Secondly, when Two be Unequal; and then they produce *Six* Varieties. Thirdly, when Three be Unequal, which produceth *Twelve* Varieties. Or laſtly, when all Four be Unequal; which produceth *Twenty four*: which general Varieties, may be further multiplied by their ſeveral Degrees.

20. §. From all which, we may come to know, what the *Communities* of *Vegetables* are, as belonging to all; what their *Diſtinctions*, to ſuch a Kind; their *Properties*, to ſuch a Species; and their *Peculiarities*, to ſuch Particular ones. And as in *Metaphyſical*, or other Contemplative Matters, when we have a diſtinct knowledge of the *Communities* and *Differences* of Things, we may then be able to give their true *Definitions*: ſo may we poſſibly, here attain, to do likewiſe: not only to know, That every *Plant* Inwardly differs from another, but alſo wherein; ſo as not more ſurely to Define by the Outward *Figure*, than by the Inward *Structure*, What that is, or thoſe things are, whereby any *Plant*, or Sort of *Plants*, may be diſtinguiſhed from all others. And having obtained a knowledge of the *Communities* and *Differences* amongſt the *Parts* of *Vegetables*; it may conduct us through a *Series* of more facile and probable *Concluſions*, of the ways of their *Cauſality*, as to the *Communities* and *Differences* of *Vegetation*. And thus much for the Second General *Mean*.

The Third General *Mean*.

21. §. HAVING THUS far examined the *Organical* and *Containing Parts* of *Vegetables*; it will be requiſite, more deſignedly, to obſerve thoſe alſo which are *Fluid*, or any others Contained in them: and that, for our better underſtanding both of the *Nature* of *Vegetation*, and of the ſaid *Contained Parts*. And to make inquiry, *Firſt* of their *Kinds*; as *Spirits*; both ſuch as agree, in general, in being *Vinous*; and thoſe that are Special, to particular *Plants*. *Aers* and *Vapours*; for the exiſtence whereof, in all *Vegetables*, there are Arguments certainly concluding. And for the difference of their *Natures*, in being more dry, or moiſt, more ſimple or compounded, as they are exiſtent in ſeveral *Parts*, there are probable ones. *Lympha's* or clear and watry *Saps*; which moſt *Plants*, in one *Part* or other, at ſome time of the Year, do *Bleed Mucilages*; as in *Mallow* and *Violet Leaves*; in many *Seeds*, as of *Quinces*, *Clary*; *Fruits*, as in *Cucumers*; diſtinct from the watry *Sap*, as by permitting it to ſtand and gelly upon the *Veſſels* from whence it iſſues, is plain: And in the young *Berrys* of White *Bryony*, when about the bigneſs of a *Pepper-Corn*;

Corn; the juyce whereof is so Viscous, that the twentieth part of a *Grain*, will draw out above a *Yard* in length. *Oyles*; not only in *Seeds*, and some *Fruits*, but other *Parts*; as in certain little cavities in the *Leaves* of *Savine*, visibly collected while they are growing. *Gumms* or *Resines*; as in *Pine*, *Fir*, and others of this Kind. *Milks*; as in a vast number of *Plants*, and amongst them, many not suspected to yield any. For, of *Herbs*, not only most of the *Umbelliferous Kind*, are *Milky*; but all or most of the *Intybous*; *Poppys*; *Tracheliums*; *Perwinkles*; divers *Thistles*; and even *Onions*, if cut at the bottome; with a great many more. Of *Trees*, not only the Little *Maple*, but the young *Shoots* of *Lawrel*, especially being crushed; as also those of *Elder*, and some others. To which may be added, such *Mucilages*, which though not so properly contained *within* the *Parts*, yet are found lying *over* them; as over the first *Spring-leaves* of all kinds of *Docks*; betwixt the *Leaves* and the *Veil* wherein they are involved. That fine white Flower or Powder, which lies over the *Leaves* of some *Plants*, as of *Bears-Ear*: And in *Princes-Feather*, about certain *Apertures* only on the edges of the *Leaves*.

22. §. Of all these should be observed, *first* their *Receptacles*; some of them, being proper to one; others, common to two or more of them: since it is certain, that some of them do Transmigrate from one, into another *Receptacle*, or that the same *Receptacle* is filled with Fluid Bodies, of a quite different Nature, at the different *Seasons* of the *Year*, and *Ages* of the *Vegetable*. And it is also very probable, That two of some of them, may, sometimes, be contained in one *Receptacle*, at the same time; as in *Animals*, the *Lympha* in the D. *Thoracicus*, and that, and the *Chyle*, in the *Sanguineous Vessels*.

23. §. Then their *Motions*; both *Natural*, and such as may be effected by *Art*: and those either by Descent or Ascent; And in ascending, through what different *Chanels* or *Parts* of the *Trunk*; since it is certain, That there is a variety, both in respect of the *Season*, and of *Vegetables*. Where it will fall in, To observe the *Tapping* of *Trees*. As also their *Bleeding*: to what *Trees* it is proper to *bleed*: in those to which it is, with what difference of *Celerity*: and when their peculiar *Season*: for none will bleed at all times; neither will all *bleed* at the same. And then their Collateral *Motion*, together with the Mode of their Transition from one *Organical Part* to another.

24. §. Next their *Quantities*, either of *one*; as the Comparison is made betwixt several *Plants*, or betwixt the *Parts* of the same. So the true *Seed* of all *Plants*, containeth more *Oyl*, in proportion, than any of the other *Parts*. Or else of *divers*, as coexistent and bearing such a proportion one to another in the same *Part*: of most of which, it may be known by their respective *Receptacles*. Yet the Computation must not be made from the number of the said *Receptacles*, *simply*; but as that is in conjunction with their *Capacity*; and as their *Capacity* is proportioned to their surrounding *Sides*; the *Sides* of those of the least *Capacity*, being usually as thick, as those of the greatest: so that suppose Ten lesser, to lye within the compass of One greater; the *Content* of these altogether, would scarce be equal to half the *Content* of that One.

25. §. Alſo their *Conſiſtence*; *ſcil:* of ſo many of them as are diſcriminable by Touch; in being Soft or Hard; Thin or Thick; Mucilaginous, Gummous, Glutinous, Friable, *&c.* And theſe in their ſeveral Degrees; in which there is a Variety, as in the *Milks* of ſome *Plants*, which are more *Dilute*, than that of others: *Mucilages*; which in ſome, are very thick and *Viſcous*, in others, more diluted and coming nearer to a *watry Sap*. And by This, to be compared in the ſame manner, as by their *Quantity*.

26. §. Likewiſe their *Colours*, *Smells*, and *Taſtes:* The general and particular Kinds of all which ſhould be noted. And to what *Contained Parts*, and in what Variety, they appertain. So moſt *Reſinous Gumms* are Tinctur'd, ſome, not; as that which drops from the *Domeſtick Pine*, is as clear as Rock-water. The *Milks* of ſome *Plants* are *Paler*, as in *Burdock*; of others *Whiter*, as in *Dandelyon*, *Scorzonera*; *Citrine*, as in the Root of *Trachelium*, *Angelica*; *Yellow*, as in *Lovage*. In ſome *Plants*, *Odorous*, as in *Umbelliferous*; in others not, as in *Cichoraceous*. That of Little *Maple*, *Taſtleſs*; of Garden *Chervil*, *Sweet*; of *Fenil*, *Hot*; of *Scorzonera*, *Aſtringent*; of *Dandelion*, *Bitter*; and generally, in other *Plants*; but with many Degrees of Strength, and in conjunction with other *Taſts*. But moſt *Mucilages*, have little either *Colour*, *Taſte*, or *Smell*; and the like. Here alſo the ſame *Qualities* are to be inquired into, as, in general ſpeaking, they are ſaid to belong to a *Vegetable*. Since it is more than probable, that all *Colours* (excepting *White*, which is ſometimes common both to *Containing* and *Contained Parts*) all *Odours*, and *Taſtes*, which are more immediately, and without a reſolution of their *Eſſential Principles*, perceptible in a *Plant*; are not aſcribable either to the *Organical*, or *Containing Parts*; but only to Thoſe, Contained in them; as from divers reaſons hereafter may appear.

27. §. And *firſt*, their *Colours*; where, with reſpect to ſeveral *Plants* and *Parts*, they are more *Changeable*; as Red, in *Flowers*; or *Conſtant*, as Green, in *Leaves*. Which, with reſpect to ſeveral Ages of one *Part*, are more *fading*, as Green in *Fruits*; or *durable*, as Yellow in *Flowers*. In what *Parts* more *Single*, as always in the *Seed*; or more *Compounded*, as in the *Flower*; and in what *Plants* more eſpecially, as in *Pancy*. Which proper to *Plants* that have ſuch a *Taſte* or *Smell*, as both, in *White Flowers*, are uſually leſs ſtrong. To *Plants* that flower in ſuch a *Seaſon*, as a *Yellow Flower*, I think, chiefly, to *Spring Plants*. And to *Plants* that are natural to ſuch a *Soil* or *Seat*, as to *Water-plants*, more uſually, a *white Flower*. What, amongſt all *Colours*, more Common to *Plants*, as *Green*; or more Rare, as *Black*. And what all theſe Varieties of *Colours* are upon *Cultivation*, but chiefly, in their natural *Soil*. To obſerve alſo with their ſuperficial *Colours*, thoſe within: ſo the *Roots* of *Docks*, are *Yellow*; of *Biſtort*, *Red*; of *Avens*, Purple; but of moſt, White. Where the Inward, and Superficial *Colours* agree; as in the *Leaves*; or vary, as in the other Parts frequently. And in what manner they are *Situated*; ſome univerſally ſpreading, others running only along with the *Veſſels*, as in the *Leaves* of Red *Dock*, and the *Flowers* of *Wood-Sorrel*.

28. §. Next their *Odours*; what may be their principal *Seat*; whether one or divers *Seats* in the ſame *Plant*. What the chief *Matter* out of which they are continually bred. What ſimilitude betwixt

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the *Smells* of divers *Vegetables*; as betwixt *Baume*, and a *Limon*; the Green *Leaves* of *Meadow-sweet*, and the green Rinds of *Walnuts*. Or betwixt those of *Plants* and *Animals*; as the *Smell* of green and well-grown *Carduus*, is like to that rank *scent*, *ab aliquorum axillis spiranti*. Which have a more sensible *Smell*; as most have; and which have less, as *Corn*. Where the green *Leaf* is the most Fragrant *Part*, as in *Musk-Cranesbill*; where the *Flower*, as in *Roses*; the *Root*, as in sweet *Calamus*. Where all the *Parts* have some *Odour*, where some, or one, only; as in *Scurvy-grass*, only the *Flowers*, unless the *Leaves* are bruis'd; and in *Arum*, the *Pestil* only; for neither the *Leaf*, nor *Root* hath any *Smell*, unless cut; but this is strong enough, not much unlike to *Humane Excrements*.

29. §. But especially their *Tastes*, which it much importeth us more precisely to distinguish; *First*, by their general *Kinds*; for the number, even of these, may be computed greater than usually it is. I remember not, that *Heat* and *Acritude*, with respect to *Taste*, are distinguished; yet *Arum-Root* is very *Pungent*, without any proper *Heat*; and *Cloves*, are very *Hot*, without any proper *Pungency*. So the White *Roots* of *Yarrow*, have a *Taste*, hardly any other way perceptible, than by causing a gentle *glowing* and *continued Warmth* upon the Tongue. Also their *Respondencies* one to another; as that of *Zedoary*, and of the lesser *Cardamoms*, is somewhat like to *Camphire*. Likewise their *Degrees*; in which there is a great latitude, and may be extended from *One* to *Ten*, or with easie distinction, from *One* to *Five*: So the *Root* of *Sorrel*, is Bitter in the *first*; of *Dock*, in the *second*; of *Dog-Rose*, in the *third*; of *Dandelyon*, in the *fourth*; of *Gentian*, in the *fifth*: observing them, not only as they vary in several *Kinds* of *Plants*, but the several *Species* of one, as in *Cichory*, *Hawk-weed*, *Dandelyon*. And then their *Compositions*; for *Tastes* are as truly *conjunct* in one *Part*, as *Colours*: by which, the latitude is still greater; In that all Kinds of *Tastes*, in all their Degrees, and in differing Numbers, may be variously Compounded together: For the most part, *Two*, as in the *Leaves* of *sharp-pointed Dock*, *Astringent*, and *Sowre*; in *Sorrel-Roots*, *Astringent* and *Bitter*; and in *Aloes*, *Bitter* and *Sweet*; the one in the *fifth*, the other, in the *first Degree*; as upon an unprejudiced tryal may be perceived: and yet more evidently in the *Gall* of any *Land-Animal*. Sometimes *three*, as in *Agrimony*, *Bitter*, *Rough*, and *Sowrish*; and in *Agarick*, *Bitter*, *Rough*, and *Sweet*. And sometimes, perhaps more. The Sensible distinctions of all which, may lye almost as wide, as of *Plants* themselves. Wherefore, although it may be thought rashness, to take away the distinctions of *Hot*, *Cold*, *Moist*, *Dry*, *Thin*, *Gross*, and other *Qualities*, in their several Degree, which the *Ancients* have affixed to particular *Plants*: yet since they have done it, to many of them, with much uncertainty; and that, withal, they are, more properly, the *Effects* and *Operations* of *Plants*, than their *Qualites*; Practical Observation, may therefore approve it useful, to add these Sensible Ones of various *Tastes*, precisely distinguishing their *Conjugations* and *Degrees*. Lastly, their several Varieties and Mutations, with respect to the Subject wherein they reside, should also be noted, As, of all *Tastes* found in *Plants*, *Bitter* and *Sowr*, are most common; *Sweet* and *Salt*, most rare. Which latter, is not only perceptible in some *Sea-Plants*; but upon some others, as upon the fresh

Leaves of *Tamarisk*; which being licked while they grow, or when immediately gathered, are plainly *Saltiſh*. How they vary with the *Age* of the *Plant*, or *Part*; as the *Roots* of *Radiſhes*, growing up to *Seed*, loſe the ſtrength of their *Taſt*; ſo moſt *Fruits* are firſt *Sowre*, then *Sweet*. What proper to the ſeveral *Parts* of any one *Plant*; ſo the *Leaves* of *Wormwood* are extraordinary *Bitter*; the *Root* ſcarcely ſo at all; of an *Hot*, but quite different *Taſte*. What more Common, or Rare, to any *Part*; ſo no *Root* that I ever taſted, is *Sowre*. And how they Alternate in ſeveral *Plants*; as the *Root* of *Stock-July-flower* is biting, not the *Leaves*; on the contrary, the *Leaves* of the *Water-Arſmart*, are *Biting*; but not the *Root*; and the like. To which we may add the difference of Time wherein the *Taſtes* of *Plants* are perceived; as thoſe of *Arum*, and *Rape-Crowfoot*, are both *Biting*; but that of the firſt, as it is ſlowly perceived, ſo it continues long; that of the other, quickly comes, and quickly goes.

30. §. Amongſt the other Adjuncts of the *Contained Parts*, though not of theſe only, the *Faculties* of *Vegetables* are to be reputed. For ſo the *Roſin* of *Jalap*, which is Purgative, is as truly contained in the *Organical Parts* of that *Root*, as Blood is in *Veins*: It will be requiſite therefore to make particular obſervation of theſe alſo. And firſt, what *Faculties* chiefly may reſide in *Plants*, above others: ſo there is none of known uſe in *Salivation*, except by holding in the mouth: Although we may ask, Why ſome amongſt them, may not (being Taken inwardly) have a power to evacuate by This, as well as other Violent ways? Where the *Faculty* is more univerſally ſpread over all the *Parts* of a *Vegetable*, as in *Aſarum*. Where belonging chiefly or wholly to any particular *Parts* or *Part*; as chiefly to the *Root* of *Rhubarb*; and only to the true and proper *Seed* of *Barbado Nuts*. Whether ſome *Faculties*, may be proper to ſome *Parts* eſpecially. What conjunction they may have with any ſenſible *Qualities*. So, many *Purgers*, are not only *Reſinous* and *Gummous*; But alſo *Mucilaginous*; as *Bryony*, wild *Cucumer*, *Lapathum Sativum*; and therefore probably *Rhubarb*, when growing; *Mallows*, *Violets*, *&c.* Such as are Purging and Vomitory, though ſome of them have a ſtrong *Taſte*, yet the greater part, and of thoſe, many of the ſtronger ſort, have no *Taſte*, or not Great; as *Senna*, *Jalap*, *Scammony*, *Hellebore*, *Aſarum*, and others. Amongſt which, although *Hellebore* hath a very *Durable Taſte*, yet is it not very *High* or *Great*. So alſo, thoſe that are moſt ſenſibly taſted, are, I think, for the moſt part, more or leſs *Bitter*; either ſimply, as *Colocynthis*; or *Bitter* and *Aſtringent*, as *Rhubarb*; or *Bitter* and *Sweet*, as *Aloe*; or *Bitter*, *Aſtringent*, and *Sweet*, as *Agarick*. Few are *Hot*, as *Iris*. Or *ſimply* Sweet. And though ſome may be Subacid, that are Mollifying or Lenitive, yet no proper Purge or Vomit is *Sowre*. Such *Plants* as are of a ſoft and ſweetiſh *Taſte*, without Viſcoſity, may be accounted good *Antiſcorbuticks*, eſpecially againſt the *Sea*, or other *Salt-Scurvey*; as are good ſweet Peaſe: And ſometimes the *Water* or *Spirit* of the *Shells*; which may eaſily be drawn from them, being firſt duly fermented, and hath a true *Vinous Taſte*; but very mild, and not unpleaſant. Thoſe *Plants*, whoſe Parts are not only *Hot* but *Volatile*, as *Onions*, are generally good for *Burns*. Such as have a *Balſamick Taſte* or *Smell*, with a little *Aſtringency*, as *Hypericum*, *Golden-Rod*, *Lamium Luteum*, *&c.* the beſt *Wound-Herbs*. And ſuch as are gently *Bitter*,

Bitter, and *Penetrant* upon the *Tongue*, or in the *Throat*, as *Daisy*, *Anagallis*, good *Cleansers*. That such *Bodys*, principally, are *Anodyne*, which are *Yellow*, I think, is more than a conceit; Yelks of Eggs, Fœnugreek Seeds, Lint-seed Oyl, May-Butyr, Marrow, *Pinguedo Humana*, *Hyoscyamus luteus*, Safron, Sulphur, Opium, all *Anodyne* and *Yellow*. How likewise their *Faculties* and *Qualities* may vary their Degrees, either differently or together: so *Aloe* and *Colocynthis*, are both *Bitter* in the highest Degree; yet *Aloe*, which is also *Sweet*, Purgeth more moderately; *Colocynthis*, which is *Bitter*, but not *Sweet*, most Violently. How far the *Faculties* of *Vegetables*, as well as their *Qualities*, may be Compounded; where, and which chiefly; as Astrictive and Purgative in *Rhabarb*. Where this Question may be put, Whether divers other, and yet more extreme *Faculties*, as well as these of Astrictive and Purgative, may not somewhere or other be also found, or made, to meet: whereby the same *Plant*, or some *Preparation* of it, may be most Potent, and yet most Innocent; the *Malignity* thereof exerting its Power, and the *Virtue* its Soveraignty at the same time. And lastly, what *Affinity* there may be betwixt them; as most *Plants*, that are strong Purgatives, and especially Vomitories, I think, are also *Sternutatory*; as white *Hellebore*, *Jalap*, *Tobacco*: and on the contrary, such as are *Sternutatory*, are some of the most proper and most potent *Medicines* for the Head, Brain, and *Genus Nervosum*, Taken inwardly, as *Lilium convalle*, *&c.* and the like.

31. §. Thus far a particular observation of the *Qualities* and *Faculties* of the *Contents* of *Vegetables* may proceed, as they are existent in their *Natural Estate*. From which, although some probable Conjectures may be made, of their Material and Formal *Essences*, and of the *Causes* of their determinate Varieties, or the *Modes* of *Vegetation* necessary thereunto: yet will our Conceptions hereof be more facile, clear, and comprehensive, if by all other Ways of Observation, they be likewise examined, according as *Experiment* may be applicable to any of them.

32. §. As by *Contusion*; so some *Plants* give their *Smell*, not without Rubbing, or not so well; as the green *Leaves* of *Stramonium*, *Scurvygrass*, and many more: others lose it by Rubbing, as the *flowers* of *Violets*, *Carnations*, *Borage*, *&c.* others yield it both ways, as *Rosemary*, *&c.* So some *Apples* mend their *Taste*, by Scoaping, and *Pears* by Rowling, especially that called the *Rowling Pear*.

33. §. By *Agitation*; which doth that, sometimes, by Force, which *Digestion*, doth by Heat: so any cold *Oyl* and a *Syrup* being, in a due manner, agitated together, of two Fluid bodies will become one Consistent, as is known.

34. §. By *Frigifaction*; how far the *Juyces* of *Plants*, either without or within them, may be any of them, or some more than others, subject to *Cold*: and thereby to be deprived of their *Motion* or natural *Consistence*, or may suffer alteration in their *Colour*, *Taste*, or *Smell*.

35. §. By *Infusion*; where I mean *Infusion* only in Common Water; So both *Cassia Lignea*, and *Cinnamon* are a little Mucilaginous; but the former most. Some of the *Contents* of *Plants*, may be wholly dissolved in Common Water; some but in part, others not at all; or very little; which is proper to some *Milks*, as well as *Gums*. The *Colours*, *Smells* or *Tastes* they hereupon yield, are found various; and in some

ſome very unexpected: So the green *Leaves* of *Bawm*, being duly infuſed in common Water, without any other Body added, tincture it with a clear and deep Red, near that of *Claret Wine*, as I have often tryed.

36. §. By *Subſiding*; So the Juyce of *Sorrel*, being ordered as that of *Grapes*, will, in time, let fall a kind of *Tartar* or *Eſſential Salt*. And ſo perhaps will that of many other *Plants*, without any previous *Decoction*; although that be commonly thought to be neceſſary.

37. §. By *Digeſtion* with *Fermentation*; either of the entire *Vegetables*, or of the *Juyces*, or other *Contents*; and theſe by themſelves, or with common Water. And hereby to note, what difference may be in the Strength, Celerity, or Continuance of the *Fermentation*. Likewiſe, how their *Qualities* may thereby be altered; as the Smell of *Violet-flowers*, from a moſt excellent *Fragrancy*, may, by *Digeſtion*, be reduced to an odious and abominable *Stink*, like that of the black Mud of *Gutters*.

38. §. By *Digeſtion* with *Calefaction*; ſo the *Colour* of the *Juyce* of *Limons*, from Tranſparency (if that be a Colour) may be turned to a perfect Red. Whence it is that many are deceived in the *Preparation* called the *Tincture* of *Corals*; ſuppoſing the *Corals* to give the *Menſtruum* its Colour. Whereas the *Menſtruum* will obtain it, only by *Digeſtion*, without any *Corals*, mixed with it.

39. §. By *Decoction*; either of *Vegetables* themſelves, or of their *Liquors*; and to obſerve what alterations follow. So *Turpentine* boiled becometh friable; *Sugar*, *Bitter*, and of a Brown Red. *Turneps* loſe their Biting *Taſte*; *Onions*, their Picquancy; yet neither of them convey thoſe ſelf ſame *Qualities* to the Water. The ſame may be obſerved in the *Decoction* of *Sweet-Fennel-ſeeds*, *Aniſeeds*, and others, loſing much of their *Taſtes* themſelves, and yet conveying very little of them to the *Liquors* wherein they are boiled; the greater portion of their Volatile parts, and ſo their *Virtue* and *Taſte* therewith, flying away. Whereof therefore it is much better to make an *Emulſion*, than to *decoct* them; or to make an *Emulſion* from them, with their own *Decoction*, eſpecially if the *Medicine* be intended to be *Carminative*, as I have frequently obſerved. The *Decoction* ſhould alſo be carried on throughout all degrees to that of an *Extract*; by which the *Qualities* thereof, ſometimes, are much altered; as the *Colour* of all or moſt green *Leaves*, from a kind of Yellow, deepens at laſt into a dark one, as Black as Pitch.

40. §: By *Diſtillations*; both with the cold *Still*, *Alembick*, *Chappel-* and open *Furnace*: and to note what *Vegetables* thus give their *Smell* or *Taſte*, and in what Degrees of ſtrength, either under, or over their natural ones; as *Mint*, *Pennyroyal*, and the like, which are *Aromatick* and *Hot*, give their *Taſtes* perfect: but *Wormwood*, which is *Aromatick* and *Bitter*; gives it but by halfs, pretty fully as *Aromatick*, little as *Bitter*. And *Carduus*, though alſo ſo exceeding *Bitter*, yet not being *Aromatick*, yieldeth a much weaker *Taſte*. Alſo what *Vegetables* yield *Oyl* moſt plentifully; and what difference may be in thoſe *Oyls*, as to their *Colour*, *Weight*, or otherwiſe; as that of *Cloves* is ſometimes Red; of *Cinnamon*, limpid; both Ponderous. So to diſtil *Juices*, *Gums*, or other *Contents*, with an hot *fire*; and to ſee, what Bodies they yield, and of what *Qualities*; as *Turpentine* is known to yield, beſides

its

its *Oyl*, a ſubacid *Water*; *Vinegar*, an Eager *Spirit*; as that part may be called, which *Chymiſts* are wont to call the *Phlegm.*

41. §. By *Arefaction*; ſo *Milks* which are Liquid, and White in their Natural Eſtate, in Standing, grow Gummous, Yellow, and otherwiſe different, ſo doth that of *Scorzonera*; and that of *Fenil* becomes a Balſamical, but Limpid *Oyl.* The *Roots* of *Angelica*, being dry'd, and cut by the length, exhibit their ſmall *Veins* fill'd with an Aromatick *Roſin.* In the whiter parts of *Rhubarb*, is gathered a kind of *Saline Concret*; by which, this *Root*, in chewing, ſeems as if it were a little gritty. *Cabbage-Stalks*, ſliced, and laid in the Shade to dry, gather on them a kind of *Nitrous* Hoar. *Raiſins* and *Corins* contain, not only a ſweet Juyce, but alſo a true *Sugar*, which lies *curdled* in the *Pulp*, as the more *Saline* parts do in Green Soap. And the like is gather'd on the out-ſide of a *Fig*; ſaving, that it is more *Nitrous*, as lying next the *Aer.* The *Roots* of *Arum*, upon drying, loſe much of the ſtrength of their *Taſte*; but the contrary may be noted of many other *Roots*, which, upon drying, increaſe it. Some, being cut and laid by, change their Natural *Colours*, into Red, Purple, Yellow, Green, or White; as *Liquoriſh*, into White, in ſome places; and *Peony*, into Red: and ſometimes into two; as *Patience*, into Yellow and Red.

42. §. By *Aſſation*; thus *Apples*, by roaſting, eat more Sowre. The *Root* of *Horſe-Radiſh*, toaſted, taſteth like a *Turnep*. *Potatoes*, *Onions*, and many other *Roots*, and *Parts*, have their *Taſtes*, either Altered or Refracted; which chiefly, and in what manner, ſhould be obſerved. There is one alteration, as remarkable, as commonly known; and is that which followeth upon roaſting or baking in one kind of the *Waldenſian Pears*, which, for a *Walden*, we corruptly call a *Warden.*

43. §. By *Uſtion*; wherein ſome *Plants*, or *Parts* of them, burn very quietly; others, not without violent motions; ſo *Fenil-Seeds*, held in the flame of a Candle, will ſpit and ſpurtle, like the *Serum* of *Blood.* Some *Vegetables* loſe their *Smell*, as *Roſes*; others, keep it, as *Roſemary*; and others, mend it, as *Lignum Aloes*, To note, not only the alteration of their *Qualities*, but what they yield; as *Turpentine*, which, in *Diſtillation*, yieldeth *Oyl* and *Water*, both limpid; upon *Uſtion*, ſheweth nothing but a black *Soot.* So *Benzoine*, by *Diſtillation*, *Oyl*; by *Uſtion*, white *Flowers*, as is known.

44. §. By *Calcination*; and here to obſerve, wherein the *Caput Mortuum* of one, may differ from, or agree in Nature with that of another; and alſo to compare theſe with thoſe of *Animal Bodies.* As alſo in their *Quantities.* And to compare them with what they yield by *Diſtillation* and *Uſtion* as to both. Thus far they have been tryed *ſingly*, or by themſelves. They ſhould alſo be examined,

45. §. By *Compoſition*; not only with *Water*, as in ſimple *Infuſions*, *&c.* but with any other Bodies, which may have a power of acting upon them, or upon which, theſe may have a power to act. And ſo to make *Infuſions*, *Deſtillations*, *Decoctions*, *Digeſtions*, in divers kinds of *Liquors*, as *Vinegar*, *Urine*, *Spirit* of *H. H. Wine*, *Blood*, *Milk*, or others. So in *Infuſions*, ſome Red Colours are heightned by *Acids*; Blews, turned Purple. So fetid *Spirits* (as of *H.H.*) may be rendred much more grateful, by being *Rectified*, once or twice, with freſh *Aromaticks*, To obſerve alſo what follows, upon mixing the *Liquors*, or other Parts

of

of *Plants* together; as *Oyl* of *Turpentine*, by *Digeſtion* with a *Lixivial Salt*, extracteth thence a Red *Tincture*. Or with *Salts*, *Earths*, *Metals*, or any other Bodies; as the *Juyce* of the green *Leaves* of *Rasberry*, *Primroſe*, and divers other *Plants* (I think principally ſuch as are Aſtringent) expreſſed upon *Steel*, as it drieth, becometh of a *Purple Colour*.

46. §. Laſtly, by *Compounding* the *Experiment* it ſelf, or joyning two or more of them, upon the ſame matter: as *Fermentation* and *Deſtillation*, as is uſed for ſome *Waters*. *Infuſion* and *Fermentation*, as in making of *Beer*. *Fermentation* and *Coction*, or rather *Aſſation*, as in making of *Bread*. *Arefaction* and *Deſtillation*, as may be tryed upon ſome *Herbs*; and with what difference from what may be noted, upon their being diſtilled, moiſt.

47. §. Having proceeded thus far, by all the above particular Ways of Obſervation; a Comparative Proſpect muſt be taken of them: by which, at laſt, the *Communities* and *Differences* of the *Contents* of *Vegetables*, may be diſcerned; the manner of their *Cauſation* and *Original*, partly, be judged of; and wherein it is, that the *Eſſence* of their ſeveral *Natures* and *Qualities* doth conſiſt, in ſome meaſure comprehended. And conſequently, both from the knowledge of their particular *Natures*, and the Analogy found betwixt them; we may be able, better to conjecture, and try, what any of them are, or may be good for. For certainly, we ſhall then know, more readily, to apply things unto, and more fitly to prepare them for, their Proper Uſes, when we firſt know, *what they are*. Notwithſtanding, ſince the *Faculties* of *Plants*, do often lie more recluſe; it is beſt, therefore, not wholly to acquieſce in ſuch Conjectures, as their *Taſtes*, or other *Senſible Properties* may ſuggeſt; but to ſubjoyn *Experiment*. In making of which, and in paſſing a Judgment thereupon, many Cautions, both in reſpect of the *Plant* whereof, and the *Subject* whereupon it is made, are requiſite to be attended. Which yet, in regard they reſult not ſo directly from the Matter at preſent in hand; I ſhall not, therefore, here inſiſt upon them, And thus much for the Third General *Mean*.

The Fourth General *Mean*.

48. §. THE *Contents* of the *Organical Parts* of *Vegetables*, having been thus duly Examined: it will be requiſite to make the like Inquiry, into their *Principles*; or the *Bodys*, immediately concurrent and eſſential to their Being. And of theſe, we are to obſerve, Firſt, their *Number*; whether well reducible to *five*, *ſix*, *ſeven*, or *more*, or *fewer*: and the Special Differences obſervable under any one General; ſince there are many Bodies, of very different Natures, confounded under one Name. Next their *Conjugation*; which they are, that either under or over thoſe obſervable in *animal*, or other *Bodies*, are here joyned together in a *Plant*; How far common to the *Organical Parts* of divers *Plants*; or to the ſeveral *Organical Parts* of one; or how far different in them. So the predominant *Principle* of the *Parenchymous Parts* of a *Plant*, that it is an *Acid*, ſeems evident, From the general Nature of *Fruits*; and of *Corn*; and moſt *Parenchymous Roots*, which are either Spirituous, or Sower, or by Digeſtion, do eaſily become ſuch. Likewiſe their *Proportions*; which ſtand in the greateſt, which in the leaſt, or in the meaner *Quantities*, and in what Degrees; both in divers *Vegetables*, and in the ſeveral *Organical Parts* of one. And then the *Concentration* and *Union* of them altogether; as to the de-

grees

grees of their Closeness or Laxity; or the manner of their Implication and Coherency; or as to their Location, one being more Central, another more Exposed and Rampant over the rest; or otherwise different. To examine these *Principles*, by their *Colour*, *Taste*, *Smell*, *Consistence*, *Fixedness*, *Volatility*, *Weight*, *Figures*, or other *Accidents*. And to these purposes, to go through the formentioned Ways of *Experiment*; as *Ustion*, *Calcination*, *Destillation*, *&c.* as any of them may appear applicable hereunto. So the *Essential Salt* of *Wormwood*, which may be obtained from the *Lixivial*; is *Bitter*, transparent, and commonly, of a *Cylindrick* figure: whereas that which is obtained by *Coction*, or from the *Extract*, is *tastless*, greyish, and almost *Cubick*: and that in the Extract of the Green *Leaves* of *Violets*, appears in fine transparent *Shoots*, like so many little Needles. And it is probable, That the *Salts* of most Kinds of *Plants*, whether Lixivial or Essential; and of these, whether obtained by *Decoction*, or otherwise, have either their *Figure*, or other *Qualities*, proper to themselves, whereby they are all distinguished one from another. And lastly, to make *Experiment* upon these *Principles*, mixing them with one another, or with other Bodies, or otherwise.

49. §. I know it will be difficult to make observations of this kind upon the *Organical Parts* of *Plants*, severally. Yet I have thought of some Ways, whereby true and undeceivable ones may be made. And the better to illustrate what I mean, I shall give one or two Instances of Tryal to this purpose. For the making of which, and some others of the like nature, I considered, That upon the *Anatomical Analysis* of all the *Parts* of a *Plant*, I had certainly found, (and shall hereafter shew) That in all *Plants*, there are *Two, and only Two Organical Parts Essentially distinct, viz.* The *Pithy Part*, and the *Lignous Part*, or such others as are analogous to either of These. So that, if we can think of any *Plants*, which will afford us either of these two, though not perfectly, yet in some good measure, simple and unmixed: We may then see, by putting them to a *Chymical*, *Test*, what *Principles* and *Proportion* of *Principles*, concur to *specifie* their *Substantial Forms*.

50. §. To the *Pithy Part*, *Starch*, or pure *Manchet* is analogous, as having very little of the *Lignous* mixed with them. I therefore ordered ℔ ij of *Starch* to be put into a *Retort*, and with a *Receiver* affixed, to be set in a *Sand Furnace*; and that all it would yield, should, by degrees, be forced over; which, besides what was evaporated at the Neck of the *Receiver*, was about ℔ j. of an acid and eager *Liquor*, of a heavy and blackish *Oyl* ʒ ij, and of a light *Oyl* ʒ j. The *Caput Mortuum* could not be reduced to Ashes, by the strongest heat which a *naked fire* in that Furnace would produce.

51. To the *Lignous Part*, *Hemp* or *Flax* is analogous, having very little of the *Pithy* mixed with them. I caused therefore ℔ ij of *Flax* to be put into a *Retort*, and manag'd as the *Starch*: whereupon, it yielded a Liquor, as I remember, somewhat like the former, and about the same quantity; no *Oyl* which remained liquid, when cold; but instead of that a *Butyr*, almost of the Consistence and Colour of the *Oyl* of *Mace*; and of this above ʒ iij, or near six times the quantity of the *Oyl* which was yielded by the *Starch*. The *Caput Mortuum* being burned to a white *Ash*, yielded some portion of a *Lixivial Salt*.

52. §. From whence, I ſhall, at preſent, only make theſe two Remarques; *Firſt*, That although the chief portion, as to quantity, in both theſe *Bodys*, (as in moſt *Plants*) is an Acid Liquor; yet the latter, yields alſo ſome of an Alkaly, which the other doth not. So that they are the *Lignous Parts* of a *Plant*, generally, which yield the *Alkalick Salt*, or at leaſt in the greateſt Proportion. *Secondly*, That the *Sulphurious or Oleous Principle*, is alſo much more predominant in the *Lignous Part*, than in the *Pithy*. To theſe, the like Tryals upon other *Plants*, ſhould be added; and other ways. So, in regard the *Soot* of moſt *Woods*, yields a *Volatile Alkaly*; it were fit to examine, Whether the *Soot* which is made of the *Pithy Parts* and that, of the *Lignous*, afford the ſaid *Alkaly*, in equal qantity; or whether, as is moſt likely, that of the *Lignous* doth afford it in a far greater: and the like.

53. §. The proſecution of what is here propoſed, will be requiſite, To a fuller and clearer view, of the *Modes* of *Vegetation*, of the *Senſible Natures* of *Vegetables*, and of their more Recluſe *Faculties* and *Powers*. Firſt, of the *Modes* of *Vegetation*. For ſuppoſe we were ſpeaking of a *Root*; from a due conſideration of the *Properties* of any *Organical Part* or *Parts* thereof; 'tis true, that the real and genuine *Cauſes* may be rendred, of divers other dependent *Properties*, as ſpoken generally of the whole *Root*. But it will be asked again, What may be the *Cauſes* of thoſe *firſt* and Independent ones? Which, if we will ſeek, we muſt do it by inquiring alſo, What are the *Principles* of thoſe *Organical Parts*? For it is neceſſary, that the *Principles* whereof a Body doth conſiſt, ſhould be, if not all of them the *active*, yet the *capacitating Cauſes*, or ſuch as are called *Cauſæ ſine quibus non*, of its becoming and being, in all reſpects, both as to *Subſtance* and *Accidents*, what it is: otherwiſe, their Exiſtence, in that Body, were altogether ſuperfluous; ſince it might have been without them: which if ſo, it might then have been made of any other; there being no neceſſity of putting any difference, if neither thoſe, whereof it is made, are thought neceſſary to its Being. Wherefore if we will allow a Body, and ſo the *Organical Parts* of a *Vegetable* to have *Principles*, we muſt allow theſe *Principles* their neceſſary Uſe; and that the Shapes or other Properties of the ſaid *Parts*, are as much dependant upon the *Nature* of Theſe; as is the Roundneſs of a Drop of Ink, upon the Fluidity of Water, ingredient to it.

54. §. Again, the *Principles* of the *Organical Parts* being known, we may from thence obtain a further knowledge of the *Natures*, and *Cauſation* or *Original* of their *Contents*; ſince theſe *Contents* are not only included in the ſaid *Organical Parts*, but alſo Created by them: and muſt needs be ſo, whether we will ſuppoſe the *Principles* of theſe *Contents* to be præ-exiſtent to their reception thereinto, or not. For, if not præ-exiſtent, what can be clearer, than that the ſaid *Parts* give them their Exiſtence? And if præ-exiſtent, yet in regard they are diſtinguiſhed, and ſuch only of them admitted in ſuch ſort into an *Organical Part*, from amongſt others, as are apt to combine and mix together in ſuch a *Form*, and ſo to conſtitute ſuch a *Liquor*; it is as clear, that the Exiſtence, if not of thoſe *Principles*, yet of that *Liquor*, is dependent on the ſaid *Part*.

55. §. And if by means of the ſaid *Organical Parts*, it is, that their *Contents* become *ſuch* and *ſuch* peculiar *Mixtures*; it is hence alſo manifeſt, That, by the ſame means, they are of *ſuch* diſtinct *Faculties* and *Powers*: Becauſe the *Faculty* or *Power* of a Body, lieth not in any of its *Principles* apart; but is a Reſultance from them all; or from their being, in ſuch peculiar ſort and manner, United and Combined together. So the *Principles* of the Purgative Parts of a *Root*, as of *Rhubarb*, although we ſhould ſuppoſe them to be exiſtent in the ſurrounding *Earth*, yet we cannot ſay, That *that Earth*, or the *Principles* therein contained, are Purgative; but only that they are ſuch, as by being combined together, in ſuch a peculiar way, may become *ſo*. So the ſeveral parts of a *Clock*, although they are and muſt be all præ-exiſtent to it, and it is their *Form*, by which they are, what they are; yet is it the *ſetting together* of ſuch *Parts*, and in ſuch a way only, that makes them a *Clock*. And ſince we ſee that the *Mixture* of two Bodies of two different *Qualities*, as of Two *Colours*, will produce a Third *Colour*, differing from them both; as Blue and Red, do a Murrey: Why ſhould not Two or More Bodies of different *Natures*, be ſo combined together, as to produce a Third *Nature*? Or wherefore may not that be allowed to be performed by *Nature*, which by Artificial Compounding of *Medicines*, or other Bodies, is deſigned, and oftentimes effected? I'll give but one Inſtance; *Water*, *Greaſe*, and an *Alcalizate Salt*, may be eaſily ſo ordered as to be inveſted with new *Qualities*, *Nature*, and *Powers*; the *Salt*, to loſe its extreme fiery Pungent *Taſte*; the *Tallow*, its *Smell*; and being before unſociable with the *Water*, to mingle therewith: neither *Tallow*, *Salt*, nor *Water* alone, will fetch out a ſpot of *Greaſe*; but all united eaſily do it: the ſame Three Bodys united, are, in ſome Caſes, as in the *Jaundies*, no ill *Medicine*; any of which, given alone, may rather prove prejudicial, than a cure: and all this done, only by duly boiling them together into one Body, which we call *Sope*.

56. §. Whence again, if it be ſuch an *Union*, and *Proportion*, of ſuch a *Sort* of *Principles*, which produceth ſuch a *Faculty*; and that we may, by any means, come to know what theſe are; we may, poſſibly, alſo attain to the knowledge of ſuch *Rules*, whereby any kind of *Faculty* may be made; as to Compound ſuch Bodies, which are neither Purgative nor Vomitory, ſo together, as to be Inveſted with thoſe *Faculties*. And if to Make them, then conſequently, to Mend, Exalt, Strengthen, and Enoble them, with greater eaſe and certainty. And thus much for the Fourth General *Mean*.

The Fifth General *Mean*.

57. §. HITHERTO, We have conſidered the *Materials* of a *Vegetable*, only as Ingredient to it: there yet remains a *Fifth Story* to be aſcended; which is, to conſider theſe *Materials* as they are derived from *abroad*: or as, after they are received and naturalized, they may, with others yet abroad, have any kind of correſpondence. And theſe are *Four* in general, *ſcil. Earth*, *Water*, *Aer*, and *Sun*; all which, in that they contribute ſo univerſally to *Vegetation*, and to whatſoever is contained in a *Vegetable*, it is therefore requiſite, that of Theſe likewiſe, Particular Obſervation ſhould be made.

58. §. And Firſt, of the *Earth*, and of all Solid Receptacles of *Plants*. Where we are to conſider their ſeveral *Kinds*; as Mellow, Sandy, Clayie, Chalky, and others. Their *Ingredients*; as Rank and

Mellow *Earth*, with Sand, or with Clay; or Sand with Clay; or altogether; and in what Proportions. The *Principles* whereinto any one of these *Ingredients*, separated from the rest, and put to the Test of *Distillation*, *Ustion*, *Calcination*, or other, either alone, or by mixture with other Bodies, may be Resolved. And by their *Qualities*, as *Colour*, *Smell*, *Taste*, *&c.* both *Ingredients* and *Principles* to be examined. To make tryal of the growth of *Plants*, in all kinds of *simple Soils*; either *Earthy or Mineral*, as Clay, Marl, Oker, Fullers Earth, Bole Armeniac, Vitriol, Allum, *&c.* or *Vegetable*, as Rotten Wood, Brans, Starch, or Flower, *&c.* or *Animal*, as Dungs, pounded Flesh, dried and powdered Blood, and the like; that it may appear, how far any of these may contribute to the growth of a *Plant*; or to one, above another.

59. §. Next of the *Water*, and of all Liquid Receptacles. Where the several kinds of *Water*, from Wells, Springs, Rain, and Rivers are, by their *Qualities* and *Faculties*, to be examined; as these, and by these, their *Principles*, either in their Natural State, or upon Digestion, or otherwise, may be observable: since Common *Water* it self, is undoubtedly compounded of several *Principles*; the simplicity thereof, not being argued, from its Clearness and Transparency; for a Solution of *Alum*, though it containeth a considerable quantity of *Earth*, is yet very Clear: nor from its seeming to have neither *Smell* nor *Taste*; for *Water-drinkers* will tell you of the varieties of both in different *Waters*. Besides, if these *Qualities* should be accounted rather Phansie, than Sense; the difference of *Waters* is yet more manifest, from their different Effects, observed by *Cooks*, *Laundresses*, *Brewers*, and others, that have occasion to use them: for not to mix with *Sope*, without curdling; not to boil Meat tender, or without colouring it red; and the like, are the vices of some *Waters*, not of others, which yet would seem, in Colour, Taste, and Smell, to be the same. Tryal should also be made of the growth of *Plants* in all kinds of Liquid Receptacles, as *Common Water*, *Snow Water*, *Sea Water*, *Urine*, *Milk*, *Whey*, *Wine*, *Oyl*, *Ink*, *&c.* Or any of these, with a solution of *Salt*, *Nitre*, *Sal prunellæ*, *Sope*, or other body. And hereby to observe what follows, either in the *Liquor*, or in the *Plant* it self: as if any *fixed* Body, being weighed before its dissolution in *Water*; and if the *Plant*, set herein, groweth; the *Water*, being then evaporated; whether the quantity of that dissolved body, continue the same, or is lessened. So, whether any *Vegetable* will become *Opiate*, by growing a considerable time in a plain Solution or Water-tincture of *Opium*; and the like. Which *Experiments*, what event soever they have, yet at least, for our further instruction in the *Nature* of *Vegetation*, may be of use.

60. §. Next of *Aer*, where it will be requisite to inquire, what sort of Bodies may be herein contained: It being probable, from the variety of *Meteors* formed herein; and of *Vapours* and *Exhalations* continually advanced hereinto; that some or other of them, may bear an Analogy, to all Volatile Bodys, whether *Animal*, *Vegetable*, or *Mineral*. The flourishings also of *Frozen Dew*; and the Green Colour, which the *Aer* gives the Ground or Water, when, for some time exposed to it; and other effects; seem to argue, that it is Impregnated with *Vegetable Principles*. To consider also the peculiar Nature of that Body, which is strictly called, *Aer*, And of that true *Aerial Salt*, which to me, seemeth probable,

bable, that it is dissolved in the *Æther*, as other *Salts* are in *Water*, or in the Vaporous parts of the *Aer*. As also to try, what different Effects, a diversity of *Aer* may have upon a *Vegetable*; as by setting a *Plant*, or *Seed*, either exceeding Low, as at the bottom of a deep Well; or exceeding High, as on the top of a Steeple. Or else by exposing some *Soil* to the *Aer*, which is assuredly free from any *Seed*, and so, as no *Seed* can light upon it; and to observe, whether the *Aer* hath a power of producing a *Vegetable* therein, or not: and the like.

61. §. Lastly of the *Sun*; as to which, it may be considered, What Influence it may have upon the *Plant* it self; upon the *Soil*; Or upon the *Aer*. Whether that *Influence* is any thing else besides Heat: or may differ from that of a *Fire*, otherwise, than by being Temperate, and more Equal. That it doth, seems evident from an *Experiment* sometime since given us, in one of the *Parisian Journals des Scavans*, and which I therefore think very applicable to our present purpose. If you hold a *Concave* at a due distance, against a Fire, it will collect and cast the Heat into a burning *Focus*: but if you put a peice of plain Glass between them, the Glass will scatter the Heat, and destroy the *Focus*. Whereas the *Sun-Beams*, being gathered in like manner, will pass through the interposed Glass, and maintain their *Focus*. As for That, of the Collection of the *Sun-beams*, by the help of *Glasses*, in the form of a *Magistery*, or of *Flowers*, and such like, I desire to suspend my thoughts of them, till I see them. I will only say thus much further at present, That I do not understand why the *Sun* should not have some Influence upon Bodies, besides by Heat, if it may be granted, That the *Moon* hath; for which, it should seem, there are some good Arguments.

62. §. WE HAVE thus far examined the *Principles* necessary to *Vegetation*. The *Question* may be put once more, In what manner are these *Principles* so adapted, as to become capable of being assembled together, in such a *Number*, *Conjugation*, *Proportion*, and *Union*, as to make a *Vegetable Body*? For the comprehension whereof, we must also know, What are the *Principles* of these *Principles*. Which, although they lie in so great an abyss of obscurity; yet, I think, I have some reason to believe, that they are not altogether undiscoverable. How far they may be so, I am so far from Determining, that I shall not now Conjecture. A Sixth General *Mean*. Only hinted.

63. §. THIS is the *Design*, and these the *Means* I propose in order thereunto. To which, I suppose, they may all appear to be necessary. For what we obtain of *Nature*, we must not do it by commanding, but by courting of Her. Those that woo Her, may possibly have her for their Wife; but She is not so common, as to prostitute her self to the best behaved *Wit*, which only practiseth upon it self, and is not applied to her. I mean, that where ever Men will go beyond Phansie and Imagination, depending upon the Conduct of *Divine Wisdom*, they must Labour, Hope and Persevere. And as the *Means* propounded, are all necessary, so they may, in some measure, prove effectual. How far, I promise not; the Way is long and dark: and as Travellers sometimes amongst Mountains, by gaining the top of one, are so far from their Journeys end; that they only come to see another lies before them: so the Way of *Nature*, is so impervious, and, as I may say, down Hill and up Hill, that how far soever we go, yet the surmounting of one difficulty, is wont still to give us the prospect of another. We may there- The Conclusion.

therefore believe, our attainments will be imperfect, after we have done all: but becauſe we cannot attain to all, that therefore we ſhould endeavour after nothing; is an Inference, which looks ſo much awry from the Practical Senſe of Men, that it ought not to be anſwered. Nor with better Reaſon, may we go about determining, what may be done. The greateſt Deſigns that any Men undertake, are of the greateſt uncertainty, as to their Succeſs: which if they appear to be of good Import, though we know not how far they are attainable, we are to propound the *Means*, in the utmoſt uſe whereof only, we can be able to judge: A *War* is not to be quitted, for the hazards which attend it; nor the *Councils* of *Princes* broken up, becauſe thoſe that ſit at them, have not the Spirit of Prophecy, as well as of Wiſdom. To conclude, If but little ſhould be effected, yet to deſign more, can do us no harm: For although a Man ſhall never be able to hit *Stars* by ſhooting at them; yet he ſhall come much nearer to them, than another that throws at *Apples*.

F I N I S.

TO THE

RIGHT HONOURABLE

WILLIAM

Lord Vi-Count Brouncker,

THE

PRESIDENT,

And to the

Council and Fellows

OF THE

ROYAL SOCIETY,

The following

ANATOMY

Is moſt HUMBLY

PRESENTED

By the AUTHOR

NEHEMIAH GREW.

STATICKS:

OR, AN

ESSAY

OF THE

PLANTS

BEGUN.

WITH A

General Account

OF

VEGETATION,

Grounded thereupon.

The FIRST BOOK.

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And afterwards in Print, December 7. of the same Year 1672.

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Mo.Bot. Garden,
1902.

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ANATOMY

Is most HUMBLY

PRESENTED

By the AUTHOR,

WILLIAM GREW.

TO THE

Right Reverend JOHN

Lord Biſhop of

CHESTER.

MY LORD,

I Hope your pardon, if while you are holding *That beſt of Books* in one Hand, I here preſent ſome Pages of that of *Nature* into your other: Eſpecially ſince *Your Lordſhip* knoweth very well, how excellent a *Commentary* This is on the *Former*; by which, in part, *GOD* reads the World his own Definition, and their Duty to him.

But if this Addreſs, *my Lord*, may be thought congruous, 'tis yet more juſt; and that I ſhould let *Your Lordſhip*, and others know, how much, and how deſervedly, I reſent *Your* extraordinary Favours. Particularly, that you were pleaſed, ſo far to animate my Endeavours, towards the Publiſhing the following *Obſervations*. Ma-

ny whereof, and moſt belonging to the *Firſt Chapter*, having now lain dormant, near ſeven years; and might ſtill, perhaps, have ſo continued, had not *Your Lordſhips* Eye, at length, created Light upon them. In doing which, *You* have given one, amongſt thoſe many Tokens, of as well *Your* readineſs to promote Learning and Knowledge by the hands of others; as *Your* high Abilities to do it by *Your* Own: Both which, are ſo manifeſt in *Your Lordſhip*, that, like the firſt Principles of *Mathematical Science*, they are not ſo much to be aſſerted, becauſe known and granted by all.

The Conſideration whereof, *my Lord*, may make me not only *Juſt*, in owning of your Favours; but alſo moſt *Ambitious* of your *Patronage*: Which yet, to beſpeak, I muſt confeſs, I cannot well. Not that I think, what is Good and Valuable, is always its own beſt Advocate: for I know, that the Cenſures of Men, are humorous, and variable; and that one *Age*, muſt have leave to frown on thoſe *Books*, which another, will do nothing leſs than kiſs and embrace. But, chiefly, for this Reaſon, Leſt I ſhould ſo much as ſeem deſirous, of *Your Lordſhips* Solliciting my Cauſe, as to all I have ſaid. For as it is your Glory, that you like not ſo to ſhine, as to put out the leaſt Star; ſo were it to *Your* Diſhonour, to borrow *Your* Name, to illuſtrate the Spots, though of the moſt conſpicuous. I am,

My Lord,

Your Lordſhips

Moſt Obliged,

And

Moſt Humble Servant

NEHEMJAH GREW.

Coventry,
June 10. 1671.

THE

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THE

THE ANATOMY OF PLANTS,

BEGUN.

With a General Account of *Vegetation*,

Founded thereupon.

CHAP. I.

Of the Seed in its State of Vegetation.

BEING to ſpeak of *Plants*; and, as far as Inſpection, and conſequent Reaſon, may conduct, to enquire into the viſible *Conſtitutions*, and *Uſes* of their ſeveral *Parts*: I chooſe that Method, which, to the beſt advantge, may ſuit with what we have to ſay hereon. And that is the Method of Nature her ſelf, in her continued Series of *Vegetations*; proceeding from the *Seed ſown*, to the formation of the *Root*, *Trunk*, *Branch*, *Leaf*, *Flower*, *Fruit*, and laſt of all, of the *Seed* alſo to be *ſown again*; all which, we ſhall, in the ſame order, particularly ſpeak of.

2. §. The *Eſſential Conſtitutions* of the ſaid *Parts* are in all *Plants* the ſame: But for Obſervation, ſome are more convenient; in which I ſhall chiefly inſtance. And firſt of all, for the *Seed*, we chooſe the great *Garden-Bean*.

3. §. If then we take a *Bean* and diſſect it, we ſhall find it cloathed with a doubled *Veſt* or *Coat*. Theſe *Coats*, while the *Bean* is yet green, are ſeparable, and eaſily diſtinguiſhed. Or in an old one, after it hath lay'n two or three days in a mellow Soil; or been ſoaked as long a time in Water: as in *Tab.* 1. When 'tis dry, they cleave ſo cloſely together, that the Eye not before inſtructed, will judge them but one; the inner *Coat* (which is of the moſt rare contexture) ſo far ſhrinking up, as to ſeem only the roughneſs of the outer, ſomewhat reſembling *Wafers* under *Maquaroons*.

Tab. 1. *f.* 2.

4. §. The Inner *Coat*, in its Natural State, is every where twice, and in ſome places, thrice as thick, as the Outer. Next to the *Radicle*, which I ſhall preſently deſcribe, it is ſix or ſeven times thicker; and encompaſſes the *Radicle* round about, as in the ſame *Figure* appears.

Tab. 1. *f.* 2.

5. §. At the thicker end of the *Bean*, in the outer *Coat*, a very ſmall *Foramen* preſents it ſelf, even to the bare Eye. In Diſſection 'tis found to terminate againſt the point of that *Part* which I call the *Radicle*. It is of that capacity, as to admit a ſmall *Virginal* Wyer; and is moſt of all conſpicuous in a green *Bean*. Eſpecially, if a little magnified with a good *Spectacle-Glaſs*. This *Foramen* is not a hole caſually made, or by the breaking off of the Stalk; but deſignedly formed, for the uſes hereafter mentioned. It may be obſerved not only in the great *Garden-Bean*, but likewiſe in the other *kinds*; in the *French-Bean* very plainly; in *Peaſe*, *Lupines*, *Vetches*, *Lentiles*, and other *Pulſe* 'tis alſo found; and in many *Seeds* not reckoned of this kindred, as in that of *Fœnugreek*, *Medica Tornata*, *Goats-Rue*, and others: In many of which, 'tis ſo very ſmall, as ſcarcely, without the help of *Glaſſes* to be diſcovered; and in ſome, not without cutting off part of the *Seed*, which otherwiſe would intercept the ſight hereof.

Tab. 1. *f.* 1--a

6. §. That this *Foramen* is truly permeable, even in old *Setting-Beans*, and the other *Seeds* above named, appears upon their being ſoaked for ſome time in Water. For then, taking them out, and cruſhing them a little, many ſmall bubles will alternately ariſe and break upon it.

7. §. Of all *Seeds* which have thick or hard *Covers*, it is alſo obſervable, That they have the ſame likewiſe *Perforated*, as above ſaid, or in ſome other manner. And accordingly, although the *Coats* of ſuch *Seeds* as are lodg'd in *Shells* or *Stones*, being thin, are not viſibly *perforated*; yet the *Stones* and *Shells* themſelves always are; as in *Chap.* 7. ſhall be ſeen how. To which *Chapter*, what is farther obſervable, either as to the nature and number of the *Covers* of the *Seed*, I alſo refer.

8. §. The *Coats* of the *Bean* being ſtripp'd off, the proper *Seed* ſhews it ſelf. The parts whereof it is compoſed, are three; *ſc.* the *Main Body*, and two more, appendant to it; which we may call, the Three *Organical Parts* of the *Bean*.

9. §. The *Main Body* is not one entire piece, but always divided, lengthwiſe, into two halves or *Lobes*, which are both joyn'd together at the *Baſis* of the *Bean*. Theſe *Lobes* in dry *Beans*, are but difficultly ſeparated or obſerv'd; but in young ones, eſpecially boil'd, they eaſily ſlip aſunder.

Tab. 1. *f.* 2, 3.

10. §. Some very few *Seeds* are divided, not into two *Lobes*, but into more; as that of *Creſſes* into Six. And ſome are not at all divided, but entire; as the Grains of *Corn*. Excepting which few, all other *Seeds*, even the ſmalleſt, are divided, like as the *Bean*, into juſt two *Lobes*. Whereof, though in moſt *Seeds*, becauſe of their minuteneſs, we cannot by diſſection be inform'd; yet otherwiſe, we eaſily may, as in this *Chapter* ſhall be ſeen. *Tab.* 1. *f.* 4. *f.* 5.

11. §. At the *Baſis* of the *Bean*, the two other *Organical Parts* ſtand appendent; by mediation whereof, the two *Lobes* meet and join together. The greater of theſe two *Parts* ſtands without the two *Lobes*, and upon diveſting the *Bean* of its *Coats*, is immediately viſible. 'Tis of a white colour, and more gloſſie than the *Main Body*, eſpecially when the *Bean* is young. In the *Bean*, and many other *Seeds*, 'tis ſituated ſomewhat above the thicker end, as you hold the *Bean* in its moſt proper poſture for growth. In *Oak-Kernels*, which we call *Acorns*, *Apple-Kernels*, *Almonds*, and many other *Seeds*, it ſtands prominent juſt from the end; the *Baſis* and the *End* being in theſe the ſame, but in the *Bean* divers. *Tab.* 1. *f.* 2. & 3---a *Tab.* 1. *f.* 6---c

12. §. This *Part* is found not only in the *Bean*, and the *Seeds* above mentioned; but in all others: being that, which upon the Vegetation of the *Seed*, becomes the *Root* of the *Plant*; which therefore may be called the *Radicle*: by which, I mean the Materials, abating the Formality, of a *Root*. In *Corn*, it is that *Part*, which *Malſters*, upon its ſhooting forth, call the *Come*. 'Tis not eaſie to be obſerved, ſaving in ſome few *Seeds*, amongſt which, that of the *Bean* is the moſt fair and ample of all I have ſeen. But that of ſome other *Seeds*, is, in proportion, greater; as of *Fœnugreek*, which is full as big as one of its *Lobes*. *Tab.* 1. *f.* 7---c

13. §. The leſſer of the two ſaid Appendents lies occult beeween the two *Lobes* of the *Bean*, by ſeparation whereof only it is to be ſeen. 'Tis enclos'd in two ſmall *Cavities*, form'd in the *Lobes* for its reception. Its colour comes near to that of the *Radicle*; and it is founded upon the *Baſis* thereof, having a quite contrary production, *ſc.* towards the *Cone* of the *Bean*; as being that very *Part*, which, in proceſs, becomes the *Body* or *Trunk* of the *Plant*. In *Corn*, it is that *Part*, which after the *Radicle* is ſprouted forth, or *come*, ſhoots towards the ſmaller end of the *Grain*; and by many *Malſters*, is called the *Acroſpire*. *Tab.* 1. *f* 3---b

14. §. This *Part* is not, like the *Radicle*, an entire Body, but divided, at its looſe end, into divers pieces, all very cloſely couched together, as Feathers in a Bunch; for which reaſon it may be called the *Plume*. They are ſo cloſe, that only two or three of the outmoſt are at firſt ſeen: but upon a nice and curious ſeparation of theſe, the more interiour ſtill may be diſcovered. In the *Bean*, this may be done: but in very few other *Seeds*; becauſe of the extreme ſmallneſs of the *Plume*. Now as the *Plume* is that *Part* which becomes the *Trunk* of the *Plant*, ſo theſe pieces are ſo many true, and already formed, though not diſplay'd *Leaves*, intended for the ſaid *Trunk*, and foulded up in the ſame *plicature*, wherein upon the ſprouting of the *Bean*, they afterwards appear. In a *French Bean*, and eſpecially in the larger white Kind, or in the great *Indian Phaſeolus*, the two outmoſt are very fair and elegant. In the great *Garden-Bean* two extraordinary ſmall *Plumes* often, if not always, ſtand one on either ſide the great one now deſcrib'd: From *Tab.* 1. *f.* 8---b

which, in that they differ in nothing ſave in their ſize, I therefore only here juſt take notice of them. And theſe three Parts, *ſc.* the *Main Body*, the *Radicle*, and the *Plume*, are concurrent to the making up of a *Seed*; and no more than theſe

15. §. Having thus taken a view of the *Organical Parts* of the *Bean*, and other *Seeds*; let us next examine the *Similary*, *ſc.* thoſe whereof the *Organical* are compos'd: a diſtinct obſervation of which, for a clear underſtanding of the *Vegetation* of the *Seed*, and of the whole *Plant* ariſing thence is requiſite: To obtain which, we muſt proceed in our *Anatomy*.

16. §. Diſſecting a *Bean* then, the firſt *Part* occurring is its *Cuticle*. The Eye and firſt Thoughts, ſuggeſt it to be only a more denſe and gloſſy Superficies; but better enquiry diſcovers it a real *Cuticle*. 'Tis ſo exquiſitely thin, and for the moſt part, ſo firmly continuous with the Body of the *Bean*, that it cannot, except in ſome ſmall Rag, be diſtinctly ſeen, which, by carrying your Knife aſlant into the *Bean*, and then very gently bearing upward what you have cut, will ſeparate, and ſhew it ſelf tranſparent. This *Cuticle* is not only ſpread upon the *Convex* of the *Lobes*, but alſo on their *Flats*, where they are contiguous, extending it ſelf likewiſe upon both the *Radicle* and *Plume*, and ſo over the whole *Bean*.

17. §. This *Part*, though it be ſo far common with the *Coats* of the *Bean*, as to be like thoſe, an *Integument*; yet are we in a quite different Notion to conceive of it: For whereas the *Coats*, upon ſetting the *Bean*, do only adminiſter the *Sap*, and, as being ſuperſeded from their Office, then die; as ſhall be ſeen: this, on the contrary, with the *Organical Parts* of the *Bean*, is nouriſhed, augmented, and by a real *Vegetation* co-extended.

18. §. Next to the *Cuticle*, we come to the *Parenchyma* it ſelf; the *Part* throughout which *the Inner Body*, whereof we ſhall ſpeak anon, is diſſeminated; for which reaſon I call it the *Parenchyma*. Not that we are ſo meanly to conceive of it, as if (according to the ſtricter ſenſe of that word,) it were a meer concreted Juyce. For it is a Body very curiouſly *organiz'd*, conſiſting of an infinite number of extreme ſmall *Bladders*; as in *Tab.* 1. is apparent. The *Surface* hereof is ſomewhat denſe, but inwardly, 'tis of a laxer Contexture. If you view it in a *Microſcope*, or with a very good *Spectacle-Glaſs*, it hath ſome ſimilitude to the *Pith*, while *ſappy* in the *Roots* and *Trunks* of *Plants*; and that for good reaſon, as in *Ch.* 2. ſhall be ſeen. This is beſt ſeen in green *Beans*.

Tab. 1. *f.* 9.

19. §. This *Part* would ſeem by its colour to be peculiar to the *Lobes* of the *Bean*; but as is the *Cuticle*, ſo is this alſo, common both to the *Radicle* and *Plume*; that is, the *Parenchyma* or Pulp of the *Bean*, as to its eſſential ſubſtance, is the ſame in all three. The reaſon why the colour of the *Plume*, and eſpecially of the *Radicle*, which are white, is ſo different from that of the *Lobes*, which are green, may chiefly depend upon their being more compact and denſe, and thence their different Tinctures. And therefore the *Lobes* themſelves, which are green while the *Bean* is *young*; yet when it is *old* and *dry*, become whitiſh too. And in *many* other *Seeds*, as *Acorns*, *Almonds*, the *Kernels* of *Apples*, *Plums*, *Nuts*, *&c.* the *Lobes*, even *freſh* and *young*, are pure white as the *Radicle* it ſelf.

20. §.

20. §. But although the *Parenchyma* be common, as is ſaid, to all the *Organical Parts*; yet in very differing proportions. In the *Plume*, where it is proportionably leaſt, it maketh about three *Fifths* of the whole *Plume*; in the *Radicle*, it maketh above five Sevenths of the whole *Radicle*; and in each *Lobe*, is ſo far over-proportionate, as to make at leaſt nine Tenths of the whole *Lobe*.

21. §. By what hath been ſaid, that the *Parenchyma* or *Pulp* is not the only conſtituting *Part*, beſides the *Cuticle*, is imply'd: there being another *Body*, of an eſſentially different ſubſtance, emboſom'd herein: which may be found not only in the *Radicle* and *Plume*, but alſo in the *Lobes* themſelves, and ſo in the whole *Bean*.

22. §. This *Inner Body* appears very plain and conſpicuous in cutting the *Radicle* athwart, and ſo proceeding by degrees towards the *Plume*, through both which it runneth in a large and ſtrait *Trunk*. In the *Lobes*, being it is there in ſo very ſmall proportion, 'tis difficultly ſeen, eſpecially towards their *Verges*. Yet if with a ſharp Knife you ſmoothly cut the *Lobes* of the *Bean* athwart, divers ſmall *Specks*, of a different colour from that of the *Parenchyma*, ſtanding therein all along in a Line, may be obſerv'd; which *Specks* are the Terminations of the *Branches* of this *Inner Body*. *Tab.*1. *f.* 10, 11, & 12. *Tab.*1. *f.* 13.

23. §. For this *Inner body*, as it is exiſtent in every *Organical Part* of the *Bean*; ſo is it, with reſpect to each *Part*, moſt regularly diſtributed. In a good part of the *Radicle* 'tis one entire *Trunk*; towards the *Baſis* thereof, 'tis divided into three main *Branches*; the middlemoſt runneth directly into the *Plume*; the other two on either ſide it, after a little ſpace, paſs into the *Lobes*; where the ſaid *Branches* dividing themſelves into other ſmaller; and thoſe into more, and ſmaller again, are terminated towards the Verges of each *Lobe*; in which manner the ſaid *Inner Body* being diſtributed it becomes in each *Lobe* a true and perfect *Root*. *Tab.*1. *f.* 14.

24. §. Of this *Seminal Root*, as now we'll call it, from the Deſcription here given, it is further obſervable; That the two main *Branches* hereof; in which the ſeveral *Ramifications* in each *Lobe* are all united, are not committed into the *Seminal Trunk* of the *Plume*, nor yet ſtand at right angles with *That* and the *Radicle*, and ſo with equal reſpect towards them both: but being produced through part of the *Parenchyma* of the *Radicle*, are at laſt united therein to the main *Trunk*, and make acute Angles therewith: as may be ſeen in the ſame. *f.*14. *Tab.*1. *f.* 14.

25. §. This *Seminal Root* being ſo tender, cannot be perfectly excarnated, (as may the *Veſſels* in the *Parts* of an *Animal*) by the moſt accurate Hand. Yet by diſſection begun and continu'd, as is above declared, its whole frame and diſtribution may be eaſily obſerv'd. Again, if you take the *Lobe* of a *Bean*, and lengthwiſe pare off its *Parenchyma* by degrees, and in extreme thin ſlices, many *Branches* of the *Seminal Root*, (which by the other way of Diſſection were only noted by ſo many *Specks*) both as they are fewer about the Baſis of the *Bean*, and more numerous towards its Verges, in ſome good diſtinction and entireneſs will appear. For this you muſt have new *Beans*: or elſe ſoaked in Water, or buryed for ſome time.

26. §. As the *Inner Body* is branched out in the *Lobes*, ſo is it in the *Plume*: For if you cut the *Plume* athwart, and from the *Baſis* proceed along the Body thereof, you'll therein find, firſt, one large *Trunk*

or

or *Branch*, and after four or five very ſmall *Specks* round about it, which are the terminations of ſo many leſſer *Branches* therewith diſtributed to the ſeveral parts of the *Plume*. The diſtribution of the *Tab.1.f.*11-c *Inner Body*, as it is continuous throughout all the *Organical Parts* of the *Bean*, is repreſented, *Tab.*1.*f.*14.

27. §. This *Inner Body* is, by diſſection, beſt obſervable in the *Bean* and great *Lupine*. In other larger *Pulſe* it ſhews likewiſe ſome obſcure Marks of it ſelf. But in no other *Seeds*, which I have obſerved, though of the greateſt ſize: as of *Apples*, *Plums*, *Nuts*, &c. is there any clear appearance hereof, upon diſſection, ſaving in the *Radicle* and *Plume*; the reaſon of which is partly from its being, in moſt *Seeds*, ſo extraordinary little; partly from its Colour, which in moſt *Seeds*, is the ſame with that of the *Parenchyma* it ſelf, and ſo not diſtinguiſhable from it.

28. §. Yet in a *Gourd-Seed*, the whole *Seminal Root*, not only its *Tab.*1.*f.*15-c *Main Branches*, but alſo the Sub-diviſions and *Inoſculations* of the leſſer ones, are without any diſſection, upon the ſeparation of the *Lobes*, on their contiguous Flats immediately apparent.

And as to the exiſtence of this *Seminal Root*, what Diſſection cannot attain, yet an ocular inſpection in hundreds of other *Seeds*, even the ſmalleſt, will demonſtrate; as in this *Chapter* ſhall be ſeen how.

29. §. In the mean time, let us only take notice; That when we ſay, every *Plant* hath its *Root*, we reckon ſhort. For every *Plant* hath really two, though not contemporary, yet ſucceſſive *Roots*; its *Original* or *Seminal-Root* within the *Lobes* or *Main Body* of its *Seed*; and its *Plant-Root*, which the *Radicle* becometh in its growth: the *Parenchyma* of the *Seed*, being in ſome reſemblance, that to the *Seminal Root* at firſt, which the Mould is to the *Plant-Root* afterwards; and the *Seminal Root* being that to the *Plant-Root*, which the *Plant-Root* is to the *Trunk*. For our better underſtanding whereof, having taken a view of the ſeveral *Parts* of a *Bean*, as far as Diſſection conducts; we will next briefly enquire into the Uſe of the ſaid *Parts*, and in what manner they are the Fountain of *Vegetation*, and concurrent to the being of the future *Plant*.

An Account of the *Vegetation* of the *Seed*.

30. §. THE GENERAL Cauſe of the growth of a *Bean*, or other *Seed*, is *Fermentation*. That is, the *Bean* lying in the Mould, and a moderate acceſs of ſome moiſture, partly diſſimilar, and partly congenerous, being made, a gentle *Fermentation* thence ariſeth. By which, the *Bean* ſwelling, and the *Sap* ſtill encreaſing, and the *Bean* continuing ſtill to ſwell, the work thus proceeds: as is the uſual way of explicating. But that there is ſimply a *Fermentation*, and ſo a ſufficient ſupply of *Sap* is not enough: but that this *Fermentation*, and the *Sap* wherein 'tis made, ſhould be under a various Government, by divers *Parts* thereto ſubſervient, is alſo requiſite; and as the various preparation of the *Aliment* in an *Animal*, equally neceſſary: the particular proceſs of the Work according whereto, we find none undertaking to declare.

31. §. Let us look upon a *Bean* then, as a piece of Work ſo fram'd and ſet together, as to declare a Deſign for the production of a *Plant*; which, upon its lying in ſome convenient Soil, is thus effected. Firſt of all, the *Bean* being enfoulded round in its *Coats*, the *Sap* wherewith it is fed, muſt of neceſſity paſs through theſe: By which means, it is not

not only in a proportionate quantity, and by degrees; but alſo in a purer body; and poſſibly not without ſome *Vegetable Tincture*, tranſmitted to the *Bean*. Whereas, were the *Bean* naked, the *Sap* muſt needs be, as over-copious, ſo but crude and immature, as not being *filtred* through ſo fine a *Cotton* as the *Coats* be. And as they have the uſe of a *Filtre* to the tranſient *Sap*; ſo of a *Veſſel* to that which is ſtill depoſited within them; being alike accommodated to the ſecurer *Fermentation* hereof, as Bottles or Barrels are to Beer, or any other *Fermentative Liquor*.

32. §. And as the *Fermentation* is promoted by ſome *Aperture* in the Veſſel; ſo have we the *Foramen* in the upper *Coat* alſo contrived. That if there ſhould be need of ſome more *Aiery* Particles to excite the *Fermentation*; through *this*, they may obtain their Entry. Or, on the contrary, ſhould there be any ſuch *Particles* or *Steams*, as might damp the genuine proceeding thereof, through this again, they may have eaſie iſſue. Or if, by being over copious, they ſhould become too high a *Ferment*; and ſo precipitate thoſe ſoft and ſlow degrees, as are neceſſary to a due *Vegetation*. The ſaid *Aperture* being that, as a common Paſport, here to the *Sap*, which what we call the *Bung-hole* of the Barrel, is to the new tunn'd Liquor.

33. §. And the *Radicle* being deſigned to ſhoot forth firſt, as preſently ſhall be ſhew'd how; therefore is it diſtinctly ſurrounded with the Inner and more ſucculent *Coat*. That being thereby ſuppled on every ſide, its eruption may be the better promoted.

34. §. The *Sap* being paſſed through the *Coats*, it next enters the Body of the *Bean*; yet not indiſcriminately neither; but, being filtred through the *Outer Coat*, and fermented in the Body of the *Inner*, is by mediation of the *Cuticle*, again more finely filtr'd, and ſo entereth the *Parenchyma* it ſelf under a fourth Government.

35. §. Through which *Part* the *Sap* paſſing towards the *Seminal Root*, as through that which is of a more ſpatious content; beſides the benefit it hath of a farther *percolation*, it will alſo find room enough for a more free and active fermenting and *maturation* herein. And being moreover, part of the true Body of the *Bean*, and ſo with its proper *Seminalities* or *Tinctures* copiouſly repleat; the *Sap* will not only find *room*, but alſo *matter* enough, by whoſe Energy its *Fermentation* will ſtill be more advanced,

36. § And the *Sap* being duly prepared here, it next paſſeth into all the *Branches* of the *Seminal Root*, and ſo under a fifth Government. Wherein how delicate 'tis now become, we may conceive by the proportion betwixt the *Parenchyma* and this *Seminal Root*; ſo much only of the beſt digeſted *Sap* being diſchargedfrom the whole Stock in that, as this will receive. And this, moreover, as the *Parenchyma*, with its proper *Seminalities* being endowed; the *Sap* for the ſupply of the *Radicle*, and of the young *Root* from thence, is duly prepared therein, and with its higheſt *Tincture* and *Impregnation* at laſt enriched.

37. §. The *Sap* being thus prepared in the *Lobes* of the *Bean*, 'tis thence diſcharg'd; and either into the *Plume*, or the *Radicle*, muſt forthwith iſſue. And ſince the *Plume* is a dependent on the *Radicle*; the *Sap* therefore ought firſt to be diſpenced to this: which accordingly, is ever found to ſhoot forth before the *Plume*: and ſometimes an inch or two in length. Now becauſe the primitive courſe of the *Sap* into

the

the *Radicle*, is thus requisite; therefore, by the frame of the *Parts* of the *Bean* is it also made necessary. The two main *Branches* of the *Seminal Root*, being produced, as is before observed, not into the *Plume*, but the *Radicle*. Now the *Sap* being brought as far as the *Seminal Root*, in either *Lobe*; and according to the conduct thereof continuing still to move: it must needs immediately issue into the same *Part*, *Tab.*1. *f.* 14. whereinto the main *Branches* themselves do; that is, into the *Radicle*. By which *Sap*, thus bringing the several *Tinctures* of the *Parts* aforesaid with it, being now fed; it is no longer a meer *Radicle*, but is made also *Seminal*, and so becomes a perfect *Root*.

38. §. The *Plume*, all this while, lyes close and still. For the sake of which, chiefly it is, that the *Bean* and other *Seeds* are divided into *Lobes*, *viz.* That it might be warmly and safely lodged up between them, and so secur'd from the Injuries so tender a *Part* would sustain from the Mould; whereto, had the *Main Body* been entire, it must, upon the cleaving of the *Coats*, have lay'n contiguous.

39. §. But the *Radicle* being thus impregnated and shot into a *Root*; 'tis now time for the *Plume* to rouze out of its Cloysters, and germinate too: In order whereto, 'tis now fed from the *Root*, with laudable and sufficient *Aliment*. For as the Supplies and Motion of *Sap* were first made from the *Lobes*, towards the *Root*: so the *Root* being well shot into the Mould, and now receiving a new and more copious *Sap* from thence; the motion hereof must needs be stronger, and by degrees proceed in a contrary course, *&c.* from the *Root* toward the *Plume*: and, by the coutinuation of the *Seminal Root*, is directly conducted thereinto; by which being fed, it gradually enlarges and displays it self.

40. §. The course of the *Sap* thus turned, it issues, I say, in a direct Line from the *Root* into the *Plume*: but collaterally, into the *Lobes* also; *&c.* by those two aforesaid *Branches* which are obliquely transmitted from the *Radicle* into either *Lobe*. By which *Branches* the said *Sap* being disburs'd back into all the *Seminal Root*, and from thence, likewise into the *Parenchyma* of the *Lobes*, they are both thus fed, and for some time augmenting themselves, really grow: as in *Lupines* is evident.

41. §. Yet is not this common to all *Seeds*. Some rot underground; as *Corn*; being of a laxer and less Oleous Substance, differing herein from most other *Seeds*; and being not divided into *Lobes*, but one entire thick Body. And some, although they continue firm, and are divided into *Lobes*, yet rise not; as the great *Garden Bean*. In which, therefore, it is observable, That the two Main *Branches* of the *Lobes*, in comparison with that which runs into the *Plume*, are but *Tab.*1. *f.* 14. mean; and so insufficient to the feeding and vegetation of the *Lobes*; the *Plume*, on the contrary, growing so lusty, as to mount up without them.

42. §. Excepting a few of these Two Kinds, all other *Seeds* whatsoever, (which I have observed) besides that they continue firm; upon the *Vegetation* of the *Plume*, do mount also upwards, and advance above the Ground together with it; as all *Seeds* which spring up with one or more *Dissimilar Leaves*: These *Dissimilar Leaves*, for the most part *Two*, which first spring up, and are of a different shape from those that follow, being the very *Lobes* of the *Seed*, divided, expanded, and thus advanced.

43. §.

43. §. The Impediments of our apprehenſion hereof are the Colour, Size and Shape of the *Diſſimilar Leaves*. Notwithſtanding, that they are nothing elſe but the *Main Body* of the *Seed*, how I came firſt to conceive, and afterwards to know it, was thus. Firſt, I obſerved in general, that the *Diſſimilar Leaves*, were never jagg'd, but even edg'd: And ſeeing the even verges of the *Lobes* of the *Seed* hereto reſpondent, I was apt to think, that thoſe which were ſo like, might prove the ſame. Next deſcending to particular *Seeds*, I obſerved, firſt, of the *Lupine*; that, as to its Colour, advancing above the Ground, (as it uſeth to do) it was always changed into a perfect Green. And why might not the ſame by parity of Reaſon be inferred of other *Seeds*? That, as to its ſize, it grew but little bigger than when firſt ſet. Whence, as I diſcern'd (the Augmentation being but little) we here had only the two *Lobes*: So, (as ſome augmentation there was) I inferr'd the like might be, and that, in farther degrees, in other *Seeds*. *Tab.* 2. *f.* 1.

44. §. Next of the *Cucumber-Seed*, That, as to its Colour, often appearing above ground, in its primitive white, from white it turns to yellow, and from yellow to green; the proper colour of a *Leaf*. That, as to its ſize, though at its firſt ariſe, the *Lobes* were little bigger than upon ſetting; yet afterwards, as they chang'd their Colour, ſo their dimenſions alſo, growing to a three-four-five-fold amplitude above their primitive ſize. But whereas the *Lobes* of the *Seed*, are in proportion, narrow, ſhort and thick: how then come the *Diſſimilar Leaves*, to be ſo exceeding broad, or long, and thin? The Queſtion anſwers it ſelf: For the *Diſſimilar Leaves*, for that very reaſon are ſo thin, becauſe ſo very broad or long; as we ſee many things, how much they are extended in length or breadth, ſo much they loſe in depth, or grow more thin; which is that which here befalls the now effoliated *Lobes*. For being once diſ-impriſoned from their *Coats*, and the courſe of the *Sap* into them, now more and more encreaſed; they muſt needs very conſiderably amplifie themſelves: and from the manner wherein the *Seminal Root* is branched in them, that amplification cannot be in thickneſs, but in length or breadth. In both which, in ſome *Diſſimilar Leaves*, 'tis very remarkable; eſpecially in length, as in thoſe of *Lettice*, *Thorn-Apple*, and others; whoſe *Seeds*, although very ſmall, yet the *Lobes* of thoſe *Seeds* growing up into *Diſſimilar Leaves*, are extended an Inch, and ſometimes more, in length. Though he that ſhall attempt to get a clear ſight of the *Lobes* of *Thorn-Apple*, and ſome others, by *Diſſection*, will find it no eaſie Task; yet is that which may be obtained; and in the Laſt *Book* ſhall be ſhew'd. From all which, and the obſervation of other *Seeds*, I at laſt found, that the *Diſſimilar Leaves* of a young *Plant*, are nothing elſe but the *Lobes* or *Main Body* of its *Seed*. So that, as the *Lobes* did at firſt feed and impregnate the *Radicle* into a *perfect Root*; ſo the *Root*, being perfected, doth again feed, and by degrees amplifie each *Lobe* into a perfect *Leaf*. *Tab.* 2. *f.* 2. *Tab.* 2. *f.* 3.

45. §. The Original of the *Diſſimilar Leaves* thus known, we underſtand, why ſome *Plants* have none; becauſe the *Seed* either riſeth not, as *Garden-Beans*, *Corn*, &c. Or upon riſing, the *Lobes* are little alter'd, as *Lupines*, *Peaſe*, &c. Why, though the proper *Leaves* are often indented round; the *Diſſimilar* like the *Lobes* are even-edg'd. Why, though the proper *Leaves* are often hairy, yet theſe are ever ſmooth. Why ſome have more *Diſſimilar Leaves* than two, as *Creſſes*,

Hiſt. of the *Prop.* of *Vege.*

which have ſix, as the Ingenious Mr. *Sharrock* alſo obſerves. The reaſon whereof is, becauſe the *Main Body* is not divided into Two, but Six, diſtinct *Lobes*, as I have often counted. Why *Radiſhes* ſeem at firſt to have four, which yet after appear plainly two: becauſe the *Lobes* of the *Seed*, have both a little Indenture, and are both plaited, one over the other. To which, other Inſtances might be added.

46. The uſe of the *Diſſimilar Leaves* is, firſt, for the protection of the *Plume*; which being but young, and ſo but ſoft and tender, is provided with theſe, as a double Guard, one on either ſide of it. For this reaſon it is, that the *Plume*, in *Corn*, is truſſed up within a membranous *Sheath*: and that of a *Bean*, cooped up betwixt a pair of *Surfoyls*: But where the *Lobes* riſe, there the *Plume* hath neither of them, being both needleſs.

Tab. 3.

47. §. Again, ſince the *Plume*, being yet tender, may be injur'd not only by the *Aer*, but alſo for want of *Sap*, the ſupplies from the *Root* being yet but ſlow and ſparing; that the ſaid *Plume* therefore, by the *Diſſimilar Leaves*, may have the advantage likewiſe of ſome refreſhment from Dew or Rain. For theſe having their *Baſis* a little beneath that of the *Plume*, and expanding themſelves on all ſides of it, they often ſtand after Rain, like a Veſſel of Water, continually ſoaking and ſuppling it, leſt its new acceſs into the *Ayr*, ſhould ſhrivel it.

48. §. Moreover, that ſince the *Diſſimilar Leaves* by their *Baſis* intercept the *Root* and *Plume*, the greater and groſſer part of the *Sap*, may be, by the way, depoſited into thoſe; and ſo the pureſt proceed into the yet but young and delicate *Plume*, as its fitteſt *Aliment*.

49. §. Laſtly, we have here a demonſtration of the being of the *Seminal Root*: which, ſince through the colour or ſmalneſs of the *Seed*, it could not by Diſſection be obſerv'd, except in ſome few; Nature hath here provided us a way of viewing it in the now effoliated *Lobes*, not of one or two *Seeds*, but of hundreds; the *Seminal Root* viſibly branching it ſelf towards the Cone or Verges of the ſaid *Lobes*, or now *Diſſimilar Leaves*.

CHAP.

CHAP. II.

Of the ROOT.

HAVING Examin'd and purſu'd the Degrees of *Vegetation* in the *Seed*, we find its two *Lobes* have here their utmoſt period: and, that having conveyed their *Seminalities* into the *Radicle* and *Plume*; theſe therefore, as the *Root* and *Trunk* of the *Plant*, ſtill ſurvive. Of theſe, in their order, we next proceed to ſpeak; and firſt, of the *Root*: whereof, as well as of the *Seed*, we muſt by Diſſection inform our ſelves.

2. §. In Diſſection of a *Root* then, we ſhall find it with the *Radicle*, as the *Parts* of an Old Man with thoſe of a *Fœtus*, ſubſtantially, one. The firſt *Part* occurring is its *Skin*, the Original whereof is from the *Seed:* For that extreme thin *Cuticle* which is ſpread over the *Lobes* of the *Seed*, and from thence over the *Radicle*, upon the ſhooting of the *Radicle* into a *Root*, is co-extended, and becomes its *Skin.*

3. §. The next *Part* is the *Cortical Body.* Which, when it is thin, is commonly called the *Barque.* The Original hereof, likewiſe is from the *Seed*; or the *Parenchyma*, which is there common both to the *Lobes* and *Radicle*, being by *Vegetation* augmented and prolonged into the *Root*, the ſame becomes the *Parenchyma* of the *Barque.* *Tab.2. f. 4.*

4. §. The Contexture of this *Parenchyma* may be well illuſtrated by that of a *Sponge*, being a Body Porous, Dilative and Pliable. Its *Pores*, as they are innumerable, ſo, extream ſmall. Theſe *Pores* are not only ſuſceptive of ſo much Moiſture as to fill, but alſo to enlarge themſelves, and ſo to dilate the *Cortical Body* wherein they are: which by the ſhriv'ling in thereof, upon its being expos'd to the Air, is alſo ſeen. In which dilatation, many of its Parts becoming more lax and diſtant, and none of them ſuffering a ſolution of their continuity; 'tis a Body alſo ſufficiently pliable; that is to ſay, a *moſt exquiſitely fine-wrought Sponge.*

5. §. The Extention of theſe *Pores* is much alike by the length and breadth of the *Root*; which from the ſhrinking up of the *Cortical Body*, in a piece of a cut *Root*, by the ſame dimenſions, is argu'd.

6. §. The proportions of this *Cortical Body* are various: If thin, 'tis, as is ſaid, called a *Barque*; and thought to ſerve to no other end, than what is vulgarly aſcrib'd to a *Barque*; which is a narrow conceit. If a Bulky Body, in compariſon with That within it, as in the young *Roots* of *Cichory*, *Aſparagus*, &c. 'tis here, becauſe the faireſt, therefore taken for the prime *Part*; which, though, as to Medicinal uſe, it is; yet, as to the private uſe of the *Plant*, not ſo. The Colonr hereof, though it be originally white, yet in the continued growth of the *Root*, divers *Tinctures*, as yellow in *Dock*, *red* in *Biſtort*, are thereinto introduced.

7. §. Next within this Part ſtands the *Lignous Body*: This *Lignous Body*, lyeth with all its parts, ſo far as they are viſible, in a Circle or *Ring*. Yet are there divers extreme ſmall *Fibres* thereto parallel, uſually mixed with the *Cortical Body*; and by the ſomewhat different colour of the ſaid *Cortical Body* where they ſtand, may be noted. Theſe *Fibres* the *Cortical Body*, and *Skin*, altogether, properly make the *Barque*. The Original of this *Lignous Body*, as of the two former, is from the *Seed*; or, the *Seminal Roots* of both the *Lobes*, being united in the *Radicle*, and with its *Parenchyma* co-extended, is here in the *Root* of the *Plant*, the *Lignous Body*.

Tab.2.f 4.b.

8. §. The Contexture hereof, in many of its parts, is much more cloſe than that of the *Cortical*; and their *Pores* very different. For whereas thoſe of the *Cortical* are infinitely numerous, theſe of the *Lignous* are in compariſon nothing ſo. But theſe, although fewer, yet are they, many of them, more open, fair and viſible: as in a very thin Slice cut athwart the young *Root* of a *Tree*, and held up againſt the light, is apparent. Yet not in all equally; in *Coran*-Tree, *Goosberry*-Tree, *&c.* leſs, in *Oak*, *Plums*, and eſpecially *Damaſcens*, more; in *Elder*, *Vines*, *&c.* moſt conſpicuous. And as they are different in number and ſize, ſo alſo (whereon the numerouſneſs of the *Pores* of the *Cortical Body* principally depends) in their ſhape. For whereas thoſe of the *Cortical Body* are extended much alike both by the length and breadth of the *Root*; theſe of the *Lignous*, are only by the length; which eſpecially in *Vines*, and ſome other *Roots* is evident. Of theſe *Pores*, 'tis alſo obſervable, that although in all places of the *Root* they are viſible, yet moſt fair and open about the *filamentous Extremities* of ſome *Roots*, where about, the *Roots* have no *Pith*; as in *Fenil*. And in many *Roots*, higher.

Tab. 2. *f.* 5.

Tab.2.f.7 a.b.

9. §. The proportion betwixt this *Lignous Body* and the *Cortical*, is various, as was ſaid; yet in this, conſtant, *ſc.* that in the *filamentous* and ſmaller Parts of the *Root*, the *Lignous Body* is very much the leſs; running like a ſlender *Wyer* or *Nerve* through the other ſurrounding it. Whereas in the upper part, it is often times of far greater quantity than the *Cortical*, although it be encompaſs'd by it. They ſtand both together pyramidally, which is moſt common to *Infant Roots*, but alſo to a great many others.

10. The next *Part* obſervable in the *Root*, is the *Inſertment*. The exiſtence hereof, ſo far as we can yet obſerve, is ſometimes in the *Radicle* of the *Seed* it ſelf; I cannot ſay always. As to its ſubſtantial natnre, we are more certain; that it is the ſame with that of the *Parenchyma* of the *Radicle*; being always at leaſt augmented, and ſo, in part, originated from the *Cortical Body*, and ſo, at ſecond hand, from the ſaid *Parenchyma*. For in diſſecting a *Root*, I find, that the *Cortical Body* doth not only environ the *Lignous*, but is alſo wedg'd, and in many Pieces *inſerted* into it; and that the ſaid inſerted Pieces make not a meer Indenture, but tranſmit and ſhoot themſelves quite through as far as the *Pith*: which in a thin Slice cut athwart the *Root*, as ſo many lines drawn from the Circumference towards the Center, ſhew themſelves.

Tab. 2. *f.* 5.

11. §. The *Pores* of the *Inſertment* are ſometimes, at leaſt, extended ſomewhat more by the breadth of the *Root*, as about the top of the *Root* of *Borage* may be ſeen; and are thus different from thoſe of the

the *Cortical Body*, which are extended by the length and breadth much alike; and from those of the *Lignous*, being only by its length.

12. §. The number and size of these Insertions are various. In *Hawthorn*, and some others, and especially *Willows*, they are most extream small; in *Cherries* and *Plums* they are Biger; and in the *Vine* and some other *Trees*, very fairly apparent. In the *Roots* of most *Herbs* they are generally more easily discoverable; which may lead to the observation of them in all. *Tab. 2. f. 5. & 6.*

13. §. These *Insertions*, although they are continuous through both the length and breadth of the *Root*; yet not so in all Parts, but by the several shootings of the *Lignous Body* they are frequently intercepted. For of the *Lignous Body* it is (here best) observable; That its several *Shootings*, betwixt which the *Cortical* is inserted, are not, throughout the *Root*, wholly distinct, strait and parallel: but that all along being enarch'd, the *Lignous Body*, both in length and breadth, is thus disposed into *Braces* or *Osculations*. Betwixt these several *Shootings* of the *Lignous Body* thus osculated, the *Cortical* shooting, and being also osculated answerably *Brace* for *Brace*, that which I call the *Insertment* is framed thereof. *Tab. 2. f. 8.*

14. §. These *Osculations* are so made, that the *Pores* or *Fibres* of the *Lignous Body*, I think, notwithstanding, seldom or never run one into another; being, though contiguous, yet still distinct. In the same manner as some of the *Nerves*, though they meet, and for some space are associated together, yet 'tis most probable, that none of their *Fibres* are truly inosculated, saving perhaps, in the *Plexures*.

15. §. These *Osculations* of the *Lignous Body*, and so the interception of the *Insertions* of the *Cortical*, are not to be observ'd by the traverse cut of the *Root*, but by taking off the *Barque*. In the *Roots* of *Trees*, they are generally obscure; but in *Herbs* often more distinctly apparent; and especially in a *Turnep*: the appearance whereof, the *Barque* being stripp'd off, is as a piece of close-wrought Network, fill'd up with the *Insertions* from thence.

16. §. The next and last distinct *Part* of the *Root* is the *Pith*. The substantial nature thereof, is, as was said of the *Insertment*, the same likewise with that of the *Parenchyma* of the *Seed*. And according to the best observation I have yet made, 'tis sometimes existent in its *Radicle*; in which, the two main *Branches* of the *Lobes* both meeting, and being osculated together, are thus dispos'd into one round and tubular *Trunk*, and so environing part of the *Parenchyma*, make thereof a *Pith*; as in either the *Radicle*, or the young *Root* of the great *Bean* or *Lupine*, may, I think, be well seen.

17. §. But many times the Original hereof is immediately from the *Barque*. For in dissection of divers *Roots*, both of *Trees* and *Herbs*, as of *Barberry* or *Mallows*, it is observable, That the *Cortical Body* and *Pith*, are both of them participant of the same Colour; in the *Barberry*, both of them tinged yellow, and in *Mallows*, green. In cutting the smaller Parts of the *Roots* of many *Plants*, as of *Borage*, *Mallows*, *Parsley*, *Columbine*, *&c.* 'tis also evident, That the *Lignous Body* is not there, in the least Concave, but standeth Solid, or without any *Pith*, in the Center; and that the *Insertions* being gradually multiplied afterwards, the *Pith*, at length, towards the thicker parts of the *Root*, shews and enlarges it self. Whence it appears, that in all such *Roots*, *Tab. 2. f. 9. a*

the

the *Pith* is not only of the ſame ſubſtantial nature, and by the *Inſertions* doth communicate with the *Barque*; and that it is alſo augmented by it; which is true of the *Pith* of all *Roots*; but is moreover, by mediation of the ſaid *Inſertions*, wholly originated from it; that is to ſay, from the *Parenchymous* Part thereof. The various appearances of the *Inſertions* and *Pith* from the filamentous *Parts* to the
Tab. 2. f. 9. top of the *Root*, ſee in *Tab.* 2. The *Pores* of the *Lignous Body*, as it ſtands entire in the ſaid filamentous *Parts*, are beſt ſeen when they have lain by a night to dry, after cutting.

18. §. A farther evidence hereof are the Proportions betwixt the *Cortical Body* and *Pith*. For as about the inferiour Parts of the *Root*, where the *Pith* is ſmall, the *Cortical Body* is proportionably great; ſo about the top, where the *Pith* is enlarged, the *Cortical Body* (now more properly becoming a *Barque*) groweth proportionably leſs, *ſc.* becauſe the *Inſertions* do ſtill more and more enlarge the *Pith*. Likewiſe the peculiar frame of ſome *Roots*, wherein beſides the *Pith*, the *Lignous Body* being divided into two or more *Rings*, there are alſo one or more thick *Rings*, of a white and ſoft ſubſtance, which ſtand betwixt them; and are nothing elſe but the *Inſertions* of the *Cortical Body* collected into the ſaid *Rings*; but, towards the top of the *Root*, being inſerted
Tab.2.f.8. again, thus make a large and ample *Pith*; as in older *Fennel*-Roots, thoſe of *Beet*, *Turnep*, and ſome other *Herbs*, is ſeen.

19. §. The *Pores* of the *Pith*, as thoſe of the *Cortical Body*, are extended both by the breadth and length of the *Root*, much alike; yet are they more or leſs of a greater ſize than thoſe of the *Cortical Body*.

20. §. The Proportions of the *Pith*, are various; in *Trees*, but ſmall; in *Herbs*, generally, very fair; in ſome making by far the greateſt part of the *Root*; as in a *Turnep*: By reaſon of the wide circumference whereof, and ſo the finer Concoction and Aſſimilation of its Sap; that *Part* which in moſt old *Trunks* is a dry and harſh *Pith*, here proves a tender, pleaſant meat.

21. §. In the *Roots* of very many *Plants*, as *Turneps*, *Carrots*, *&c.* the *Lignous Body*, beſides its main utmoſt *Ring*, hath divers of its *oſculated Fibres* diſperſed throughout the Body of the *Pith*; ſometimes all alike, and ſometimes more eſpecially in, or near, its Center; which *Fibres*, as they run towards the top of the *Root*, ſtill declining the Center, at laſt collaterally ſtrike into its Circumference; either all of them, or ſome few, keeping the Center ſtill. Of theſe principally, the Succulent part of the *Lignous Body* of the *Trunk* is often originated.

22. §. Some of theſe *Pith-Fibres*, although they are ſo exceeding ſlender, yet in ſome *Roots*, as in that of *Flower de liz*, they are viſibly concave, each of them, in their ſeveral Cavities alſo emboſoming a very ſmall *Pith*; the ſight whereof, the *Root* being cut traverſe, and laid in a Window for a day or two to dry, may without *Glaſſes* be obtain'd. And this is the general account of the *Root*; the declaration of the manner of its growth, with the uſe and ſervice of its ſeveral *Parts*, we ſhall next endeavour.

An Account of the Growth of the *Root*.

23. §. I SAY THEN, That the *Radicle* being impregnate, and ſhot into the Moulds, the contiguous moiſture, by the *Cortical Body*, being a Body laxe and Spongy, is eaſily admitted: Yet not all indiſcriminately, but that which is more adapted to paſs through the ſurrounding

Cuticle.

Cuticle. Which tranſient *Sap*, though it thus becomes fine, yet is not ſimple; but a mixture of *Particles*, both in reſpect of thoſe originally in the *Root*, and amongſt themſelves, ſomewhat heterogeneous. And being lodg'd in the *Cortical Body* moderately laxe, and of a Circular form; the effect will be an eaſie Fermentation. The *Sap* fermenting, a ſeparation of *Parts* will follow; ſome whereof will be impacted to the Circumference of the *Cortical Body*, whence the *Cuticle* becomes a *Skin*; as we ſee in the growing of the Coats of Cheeſes, of the Skin over divers Liquors, and the like. Whereupon the *Sap* paſſing into the *Cortical Body*, through this, as through a *Manica Hippocratis*, is ſtill more finely filtred. With which *Sap*, the *Cortical Body* being dilated as far as its *Tone*, without a ſolution of Continuity, will bear; and the ſupply of the *Sap* ſtill renew'd: the pureſt part, as moſt apt and ready, recedes, with its due *Tinctures*, from the ſaid *Cortical Body*, to all the parts of the *Lignous*; both thoſe mixed with the *Barque*, and thoſe lying within it. Which *Lignous Body* likewiſe ſuper-inducing its own proper *Tinctures* into the ſaid *Sap*; 'tis now to its higheſt preparaton wrought up, and becomes (as they ſpeak of that of an Animal) the Vegetative *Ros* or *Cambium*: the nobleſt part whereof is at laſt coagulated in, and aſſimilated to the like ſubſtance with the ſaid *Lignous Body*. The remainder, though not united to it, yet tinctur'd therein, thus retreats, that is, by the continual appulſe of the *Sap*, is in part carried off into the *Cortical Body* back again, the *Sap* whereof it now tinctures into good *Aliment*. So that whereas before, the *Cortical Body* was only relaxed in its Parts, and ſo dilated; 'tis now increas'd in real quantity or number of parts, and ſo is truly nouriſh'd. And the *Cortical Body* being ſaturate with ſo much of this Vital *Sap* as ſerves it ſelf; and the ſecond Remainders diſcharged thence to the *Skin*; this alſo is nouriſh'd and augmented therewith. So that as in an *Animal Body* there is no inſtauration or growth of Parts made by the *Bloud* only, but the *Nervous Spirit* is alſo thereunto aſſiſtant; ſo is it here: the *Sap* prepared in the *Cortical Body*, is as the *Bloud*, and that part thereof prepared by the *Lignous*, is as the *Nervous Spirit*; which partly becoming Nutriment to it ſelf, and partly being diſcharged back into the *Cortical Body*, and diffuſing its Tincture through the *Sap* there, that to the ſaid *Cortical Body* and *Skin*, becomes alſo true Nutriment, and ſo they all now grow.

24. §. In which growth, a proportion in length and breadth is requiſite: which being rated by the benefit of the *Plant*, both for firm ſtanding and ſufficient *Sap*, muſt therefore principally be in length. And becauſe it is thus requiſite, therefore by the conſtitution of one of its *Parts*, *ſc.* the *Lignous Body*, it is alſo made neceſſary. For the *Pores* hereof, in that they are all extended by its length, the *Sap* alſo according to the frame and ſite of the ſaid *Pores* will principally move; and that way as its *Sap* moves, the ſame way will the generation of its Parts alſo proceed; *ſc.* by its length. And the *Lignous Body* firſt (that is by a *priority cauſal*) moving in length it ſelf; the *Cortical* alſo moves therewith. For that which is nouriſh'd, is extended: but whatever is extended, is mov'd: that therefore which is nouriſh'd, is mov'd: The *Lignous Body* then being firſt nouriſh'd, 'tis likewiſe firſt mov'd, and ſo becomes and carries in it the Principle of all Vegetative motion in the *Cortical*; and ſo they both move in length.

25. §.

25. §. Yet as the *Lignous Body* is the *Principle* of Motion in the *Cortical*; ſo the *Cortical* is the *Moderator* of that in the *Lignous:* As in Animal Motions, the *Principle* is from the *Nerves*; yet being once given to the *Muſcle* or *Limb*, and that moving proportionably to its ſtructure, the *Nerves* alſo are carried in the ſame motion with it. We ſuppoſe therefore, that as the principal motion of the *Lignous Body* is in length, ſo is its *proper tendency* alſo to *Aſcend.* But being much exceeded both in Compaſs and Quantity by the *Cortical*, as in the ſmaller parts of the *Root* it is; it muſt needs therefore be over-born and governed by it; and ſo, though not loſe its motion, yet make it that way wherein the *Cortical Body* may be more obedient to it; which will be by deſcent. Yet both of them being ſufficiently pliable, they are thus capable, where the Soyl may oppoſe a direct deſcent, there to divert any way, where it is more penetrable, and ſo to deſcend obliquely. For the ſame reaſon it may alſo be, that though you ſet a *Bean* with the *Radicle* upward; yet the *Radicle*, as it ſhoots, declining alſo gradually, is thus arch'd in form of an Hook, and ſo at laſt deſcends. For every declination from a perpendicular Line, is a mixed motion betwixt Aſcent and Deſcent, as that of the *Radicle* alſo is, and ſo ſeeming to be dependent upon the two *Contrary Tendencies* of the *Lignous* and *Cortical Bodies.* What may be the cauſe of thoſe *Tendencies* (being moſt probably external, and a kind of *Magnetiſme*) I ſhall not make my Task here to enquire.

26. §. Now although the *Lignous Body*, by the poſition and ſhape of its *Pores*, principally groweth in length; yet will it in ſome degree likewiſe in breadth: For it cannot be ſuppoſed that the pureſt *Sap* is all received into the ſaid *Pores*; but that part thereof likewiſe, ſtaying about its *Superficial Parts*, is there tinctur'd and agglutinated to them. And becauſe theſe *Pores* are prolonged by its length; therefore it is much more laxe and eaſily diviſible that way; as in ſlitting a Stick, or cleaving of Timber, and in cutting and hewing them athwart is alſo ſeen. Whence it comes to paſs, that in ſhooting from the Center towards the Circumference, and there finding more room, its ſaid original *Laxity* doth eaſily in divers places now become greater, and at length in open *Partments* plainly viſible. Betwixt which *Partments*, the *Cortical Body*, being bound in on the one hand, by the ſurrounding *Skin* and *Moulds*, and preſſed upon by the *Lignous* on the other, muſt needs inſert it ſelf, and ſo move contrary to it, from the Circumference *towards* the *Center.* Where the ſaid contrary motions continued as begun, they at laſt meet, unite, and either make or augment the *Pith.* And thus the *Root* is fram'd, and the *Skin*, the *Cortical* and *Lignous Bodies*, ſo as is ſaid, thereunto concurrent. We ſhall next ſhew the uſe of the two other *Parts*, *ſc.* the *Inſertment* and *Pith*; and firſt of the *Pith.*

27. §. ONE true uſe of the *Pith* is for the better Advancement of the *Sap*, whereof I ſhall ſpeak in the next Chapter. The uſe I here obſerve, is for the quicker and higher Fermentation of the *Sap:* For although the Fermentation made in the *Cortical Body* was well ſubſervient to the firſt *Vegetations*, yet thoſe more perfect ones in the *Trunk* which after follow, require a Body more adapted to it, and that is the *Pith*; which is ſo neceſſary, as not to be only common to, but conſiderably large in the *Roots* of moſt *Plants*; if not in their inferiour parts,

parts, yet at their tops. Where though either deriv'd or amplify'd from the *Cortical Body*, yet being by its *Inſertions* only, we may therefore ſuppoſe, as thoſe, ſo this, to be more finely conſtituted. And being alſo from its coarctation, while inſerted, now free; all its *Pores*, upon the ſupply of the *Sap*, will more or leſs be amplified: Upon which accounts, the *Sap* thereinto received, will be more pure, and its fermentation therein more active. And as the *Pith* is ſuperiour to the *Cortical Body* by its *Conſtitution*, ſo by its *Place*. For as it thus ſtands central, it hath the *Lignous Body* ſurrounding it. Now as the *Skin* is the Fence of the *Cortical Body*, and that of the *Lignous*; ſo is the *Lignous* again a far more preheminent one unto the *Pith*; the *Sap* being here a brisk Liquor, *tunn'd up* as in a wooden *Cask*.

28. §. And as the *Pith* ſubſerves the higher Fermentation of the *Sap*; ſo do the *Inſertions* its purer Diſtribution; that ſeparation which the parts of the *Sap*, by being fermented in the *Pith*, were diſpos'd for; being, upon its entrance into the *Inſertions*, now made: So that as the *Skin* is a *Filtre* to the *Cortical Body*, ſo are the *Inſertions* a more preheminent one to the *Lignous*. And as they ſubſerve the purer, ſo the freer and ſufficient diſtribution of the *Sap*: For the *Root* enlarging, and ſo the *Lignous Body* growing thicker, although the *Cortical* and the *Pith* might ſupply *Sap* ſufficient to the nutrition of its *Parts* next adjacent to them; yet thoſe more inward, muſt needs be ſcanted of their *Aliment*; and ſo, if not quite ſtarv'd, yet be uncapable of equal growth: Whereas the *Lignous Body* being through its whole breadth frequently diſparted, and the *Cortical Body* inſerted through it; the *Sap* by thoſe *Inſertions*, as the *Bloud* by the diſſeminations of the *Arteries*, is freely and ſufficiently convey'd to its intimate Parts, even thoſe, which from either the *Barque* or from the *Pith*, are moſt remote. Laſtly, as the conſequent hereof, they are thus aſſiſtant to the *Latitudinal growth* of the *Root*; as the *Lignous Body* to its growth in Length; ſo theſe *Inſertions* of the *Cortical*, to its better growth in Breadth.

29. §. Having thus ſeen the ſolitary uſes of the Several *Parts* of the *Root*, I ſhall laſtly propound my Conjectures of that Deſign whereto they are altogether concurrent, and that is the *Circulation* of the *Sap*.

30. §. That the *Sap* hath a Double, and ſo a *Circular* Motion, in the *Root*; is probable, from the proper Motion of the *Root*, and from its Office. From its Motion, which is Deſcent: for which, the *Sap* muſt likewiſe, ſome where, have ſuch a Motion proper to it. From its Office, which is, To feed the *Trunk*: for which, the *Sap* muſt alſo, in ſome *Part* or other, have a more eſpecial Motion of Aſcent.

31. §. We may therefore ſuppoſe, That the *Sap* moving in the *Barque*, towards the *Pith*, through the *Inſertions*, thereinto obtains a paſs, Which paſſage, the upper *Inſertions* will not favour; becauſe the *Pith* ſtanding in the ſame heigth with them, is there large, the fermenting and courſe of the *Sap* quick, and ſo its oppoſition ſtrong. But through the lower it will much more eaſily enter; becauſe there, from the ſmalneſs of the *Pith*, the oppoſition is little, and from the ſhortneſs of the *Inſertions*, the way more open. So that the *Sap* here meeting with the leaſt oppoſition, here it will beſtow it ſelf (feeding the *Lignous Body* in its paſſage) into the *Pith*. Into which, freſh *Sap* ſtill entring, this being yet but crude, will ſubſide: that

firſt receiv'd, and ſo become a Liquor higher wrought, will more eaſily mount upwards. And moving in the *Pith*, eſpecially in the *Sap-Fibers* there diſpers'd, as in the *Arterys*, in equal altitude with the upper-*Inſertions*; the moſt volatile parts of all will ſtill continue their direct aſcent towards the *Trunk*. But thoſe of a middle nature, and, as not apt to aſcend, ſo being lighter than thoſe beneath them, not to deſcend neither; they will tend from the *Pith* towards the *Inſertions* in a Motion betwixt both. Through which *Inſertions* (feeding the *Lignous Body* in its paſſage) it is, by the next ſubſequent *Sap*, diſcharged off into the *Cortical Body*, and ſo into the *Sap-Fibres* themſelves, as into the *Veins*, back again. Wherein, being ſtill purſu'd by freſh *Sap* from the Center, and more occurring from the Circumference, towards the lower *Inſertions*, it thus deſcends. Through which, together with part of the *Sap* afreſh imbib'd from the Earth, it re-enters the *Pith*. From whence, into the *Cortical Body*, and from thence into the *Pith*, the cruder part thereof, is reciprocally disburs'd; while the moſt *Volatile*, not needing the help of a *Circulation*, more directly aſcendeth towards the *Trunk*.

CHAP.

CHAP. III.

Of the TRUNK.

HAVING thus declar'd the degrees of *Vegetation* in the *Root*; the continuance hereof in the *Trunk* ſhall next be ſhew'd: in order to which, the Parts whereof this likewiſe is compounded, we ſhall firſt obſerve.

1. §. That which without diſſection ſhews it ſelf, is the *Coarcture:* I cannot ſay of the *Root*, nor of the *Trunk*; but what I chooſe here to mention, as ſtanding betwixt them, and ſo being common to them both; all their *Parts* being here bound in cloſer together, as in the tops of the grown *Roots* of very many *Plants*, is apparent.

2. §. Of the *Parts* of the *Trunk*, the firſt occurring is its *Skin:* The Formation whereof, is not from the Air, but in the *Seed*, from whence it is originated; being the production of the *Cuticle*, there inveſting the two *Lobes* and *Plume*.

3. §. The next *Part* is the *Cortical Body*; which here in the *Trunk* is no new ſubſtantial Formation; but, as is that of the *Root*, originated from the *Parenchyma* of the *Plume* in the *Seed*; and is only the increaſe and augmentation thereof. The *Skin*, this *Cortical Body* or *Parenchyma*, and (for the moſt part) ſome Fibers of the *Lignous* mixedherewith, alltogether make the *Barque*. *Tab.3. f. 1, & 4.*

4. §. Next, the *Lignous Body*, which, whether it be viſibly divided into many ſofter *Fibers* or ſmall *Threads*, as in the *Bean*, *Fennel*, and moſt *Herbs*; or that its Parts ſtand more compact and cloſe, ſhewing one hard, firm and ſolid piece, as in *Trees*; it is, in all, one and the ſame *Body*; and that not formed originally in the *Trunk*, but in the *Seed*; being nothing elſe but the prolongation of the *Seminal Root* diſtributed in the *Lobes* and *Plume* thereof. *Tab. 3. f. 1.*

5. §. Laſtly, The *Inſertions* and *Pith* are here originated likewiſe from the *Plume*, as the ſame in the *Root*, from the *Radicle:* So that as to their *Subſtantial Parts*, the *Lobes* of the *Seed*, the *Radicle* and *Plume*, the *Root* and *Trunk* are all one.

6. §. Yet ſome things are more fairly obſervable in the *Trunk*. Firſt, the *Latitudinal* ſhootings of the *Lignous Body*, which in *Trunks* of ſeveral years growth, are apparent in ſo many *Rings*, as is commonly known. For ſeveral young Fibers of the *Lignous Body*, as in the *Root*, ſo here, ſhooting in the *Cortical* one year, and the ſpaces betwixt them being after fill'd up with more (I think not till) the next, at length they become altogether a firm compact *Ring*; the *Perfection* of one *Ring*, and the *Ground-work* of another, being thus made concomitantly. *Tab. 3. f. 5, & 8.*

7. §. From these Annual younger *Fibers* it is, that although the *Cortical Body* and *Pith* are both of the same substantial nature, and their *Pores* little different; yet whereas the *Pith*, which the first year is green, and of all the *Parts* the fullest of *Sap*, becomes afterwards white and dry: The *Cortical Body*, on the contrary, so long as the *Tree* grows, ever keepeth green and moist, *&c.* because the said *Sap-Fibers*, annually grow therein, and so communicate with it.

8. §. The *Pores* likewise of the *Lignous Body*, many of them, in well-grown Timber, as in Oaken boards, are very conspicuous, in cutting both lengthwise and traverse. They very seldom, if ever, run one into another, but keep, like so many several *Vessels*, all along distinct; as by cutting, and so following any one of them as far as you please, for a Foot or half a Yard, or more together, may be observ'd. And so, the like, in any *Cane*.

Tab. 3. *f.* 2. & 3.

9. §. Besides these, there are a lesser sort; which, by the help only of a good *Spectacle Glass* may be observ'd.

10. §. And these are all the *Pores* visible without a *Microscope*. The use of which, excepting in some few particulars, I have purposely omitted in this first *Book*. Mr. *Hook* sheweth us, besides these, a third, and yet smaller Sort; and (as a confirmation of what, in the Second *Chapter*, I have said of the *Pores* of the *Lignous Body* in general) that they are all continuous and prolonged by the length of the *Trunk*, as are the greater ones: whereof he maketh Experiment, by filling up, in a piece of *Char-coal*, all the said *Pores* with *Mercury*: which appears to pass quite through them, in that by a very good *Glass* it is visible in their Orifices at both ends; and without a *Glass*, by the weight of the Coal alone, is also manifest. All these I have seen, with the help of a good *Microscope*, in several sorts of *Woods*. As they all appeare in a piece of *Oak*, cut transversely, See *Tab.* 3.

Micrography.

C. 2. §. 8.

Tab. 3. *f.* 7.

11. §. Upon further Enquiry, I likewise find, That the *Pores* of the *Lignous Body* in the *Trunks* of *Herbs*, which at first I only supposed, by the help of good *Glasses*, are very fairly visible: each *Fibre* being sometimes perforated by 30, 50, 100, or hundreds of *Pores*. Or what I think is the truest notion of them, That each *Fibre*, though it seem to the bare eye to be but *one*, yet is, indeed, a great number of *Fibres* together; and every *Pore*, being not meerly a space betwixt the several parts of the Wood, but the *Concave* of a *Fiber*. So that if it be asked, what all that Part of a *Plant*, either *Herb* or *Tree*, which is properly called the *Woody-Part*; what all that is, I suppose, That it is nothing else but a *Cluster* of innumerable and most extraordinay small *Vessels* or *Concave Fibers*: as in a Slice of the Trunk of *Burdock* is apparent.

Tab. 3. *f.* 6.

12. §. Next the *Insertions* of the *Cortical Body*, which in the *Trunk* of a *Tree* saw'd athawrt, are plainly discerned as they run from the Circumference toward the Center; the whole Body of the *Tree* being visibly compounded of two distinct Substances, that of the several *Rings*, and that of the *Insertions*, running cross; shewing that in some resemblance in a *Plain*, which the *Lines* of *Latitude* and of the *Meridian* do in a *Globe*. The entrance of the *Insertions* into the *Wood*, is also, upon striping off the Barque, very apparent; as in the same *Fig.* 8.

Tab. 3. *f.* 5. & 8.

13. §.

13. §. Theſe *Inſertions* are likewiſe very conſpicuous in Sawing of *Trees* length-ways into Boards, and thoſe plain'd, and wrought into *Leaves* for *Tables*, *Wainſcot*, *Trenchers*, and the like. In all which, as in courſe *Trenchers* made of *Beech*, and *Tables* of *Oak*, there are many parts which have a greater ſmoothneſs than the reſt; and are ſo many *inſerted Pieces* of the *Cortical Body*; which being by thoſe of the *Lignous*, frequently intercepted, ſeem to be diſcontinuous, although in the *Trunk* they are really extended, in continued Plates, throughout its Breadth. *Tab. 3. f. 2. & Tab. 4. f. 1.*

14. §. Theſe *Inſertions*, although as is ſaid, of a quite diſtinct ſubſtance from the *Lignous Body*, and ſo no where truly incorporated with it, yet being they are in all parts, the one as the *Warp*, the other as the *Woof*, mutually *braced* and *interwoven* together, they thus conſtitute one ſtrong and firmly coherent Body; as the Timber of any *Tree*. *Tab. 4. f. 1.*

15. §. As the Pores or Veſſels are greater or leſs, ſo are the *Inſertions* alſo: To the bare eye uſually the greater only are diſcernable: But through an indifferent *Microſcope* there are others alſo, much more both numerous and ſmall, diſtinctly apparent, as in a tranſverſe piece of *Oak*. *Tab. 3. f. 7.*

16. §. In none of all the *Pores* can we obſerve any thing which may have the true nature and uſe of *Valves*, which is, Eaſily to admit that, to which they will by no means allow a regreſs. And their non-exiſtence is enough evident, from what in the firſt *Chapter* we have ſaid of the *Lobes* of the *Seed:* in whoſe *ſeminal Root*, were there any *Valves*, it could not be, that by a contrary *Courſe* of the *Sap*, they ſhould ever grow; which yet, where-ever they turn into *Diſſimilar Leaves*, they do. Or if we conſider the growth of the *Root*, which oftentimes is *upward* and *downward* both at once. And being cut tranſverſely, will bleed, both the ſame ways, with equal freedom. *C. 1. §. 42.*

17. §. The *Inſertions* here in the *Trunk* give us likewiſe a ſight of the poſition of their *Pores*. For in a plained piece of *Oak*, as in *Wainſcot*, *Tables*, *&c.* beſides the larger *Pores* of the *Lignous Body*, which run by the *length* of the *Trunk*; the *Tract* likewiſe of thoſe of the *Inſertions* may be obſerved to be made by the breadth, and ſo directly croſs. Nor are they continuous as thoſe of the *Lignous Body*, but very ſhort, as thoſe both of the *Cortical Body* and *Pith*, with which the *Inſertions*, as to their ſubſtance, are congenerous. Yet they all ſtand ſo together, as to be plainly ranked in even *Lines* or *Rows* throughout the breadth of the *Trunk*: As the *Tract* of thoſe *Pores* appears to the naked Eye, ſee in *Tab. 3. Fig. 9.* The *Pores* themſelves may be ſeen in the *Root* of a *Vine* deſcribed and figured in the Second *Book*, as it appears through a good *Microſcope*. *Tab. 3. f. 2.* *Tab. 17.*

18. §. The *Pores* of the *Pith* likewiſe being larger here in the *Trunk*, are better obſervable than in the *Root:* the width whereof, in compariſon with their *Sides* ſo exquiſitely thin, may by an *Hony-Comb* be groſly exemplified; and is that alſo which the vaſt diſproportion betwixt the Bulk and Weight of a dry *Pith* doth enough declare. In the *Trunks* of ſome *Plants*, they are ſo ample and tranſparent, that in cutting both by the length and breadth of the *Pith*, ſome of them through the tranſparency of the *Skins* by which they are bounded, or of which they conſiſt, would ſeem to be conſidera-

bly

bly extended by the length of the *Pith*; but are really diſcontinuous and ſhort, and as 'tis ſaid, ſomewhat anſwerable to the *Gells* of an *Hony-Comb*. This is the neareſt we can come to them, by the bare Eye without the aſſiſtance of a good *Microſcope*. Mr. *Hook* ſheweth in his *Micrography*, That the *Pores* of the *Pith*, particularly of *Elder-Pith*, ſo far as they are viſible, are all alike diſcontinuous; and that the *Pith* is nothing elſe but (as he calls them) an heap of *Bubbles*. Although, in regard they are not fluid, but fixed Parts, I ſhall chooſe rather to call them, *Bladders*. As they appear through a good *Glaſs*, in a piece of *Burdock*, See in *Tab.* 3. But a more particular Deſcription of the *Sizes*, *Figures*, and admirable *Textures* hereof, I have given in ſeveral places in the following *Books*.

Tab. 3. f. 6.

19. §. Beſides what this Obſervation informs us of here, it farther confirms what in the Second *Chapter* we have ſaid of the Original of the *Pith* and *Cortical Body*, and of the ſameneſs of both their natures with the *Parenchyma* of the *Seed:* which is nothing elſe but a Maſs of *Bladders*; as in the Firſt *Chapter* hath been ſaid.

C.2. §.3,16, 17.

C. 1. §. 18. & Tab.1.f.9.

20. §. In the *Piths* of many *Plants*, the greater *Pores* or *Bladders* have ſome of them leſſer ones within them, and ſome of them are divided with croſs Membranes: And betwixt their ſeveral ſides, have, I think, other ſmaller *Bladders* viſibly interjected. However, that they are all permeable, is moſt certain. They ſtand together not confuſedly, but in even *Ranks* or *Trains*; as thoſe of the *Inſertions* by the breadth, ſo theſe by the length of the *Trunk*. And thus far there is a general correſponding betwixt the parts of the *Root* and *Trunk*. Yet are there ſome conſiderable Diſparities betwixt them; wherein, and how they come to paſs, and to what eſpecial Uſe and End, ſhall next be ſaid.

An Account of the *Growth* of the *Trunk*.

21. §. WE SAY then, that the *Sap* being in the *Root* by Filtrations, Fermentations (and in what *Roots* needful, perhaps by Circulation alſo) duly prepar'd; the prime part thereof paſſing through the intermediate *Coarctare*, in due moderation and purity is entertain'd at laſt into the *Trunk*. And the *Sap* of the *Trunk* being purer and more volatile, and ſo it ſelf apt to aſcend; the motion of the *Trunk* likewiſe will be more noble, receiving a diſpoſition and tendency to aſcend therewith. And what by the *Sap* the *Trunk* is in part dipos'd to, by the reſpective poſition and quantity of its Parts it is effectually enabled. For whereas in the *Root* the *Lignous Body* being in proportion with the *Cortical*, but little, and all lying cloſe within its Center; it muſt therefore needs be under its controul: on the contrary, being here comparatively of greater quantity, and alſo more dilated, and having divers of its Branches ſtanding more abroad towards the Circumference, as both in the *Leaves* and Body of the young *Trunk* and *Plume*, is ſeen; it will in its own *magnetical* tendency to *aſcend*, reduce the *Cortical Body* to a compliance with it.

22. §. And the *Trunk* thus ſtanding from under the reſtraint of the Ground in the open Air, the diſpoſition of its *Parts*, originally different from that of the *Parts* in the *Root*, will not only be continued, but improved. For by the force and preſſure of the *Sap* in its collateral Motion, the *Lignous Body* will now more freely and farther be dilated.

lated. And this being dilated, the *Cortical Body* alſo, muſt needs be *inſerted*; and is therefore in proportion always, more or leſs, ſmaller here in the *Trunk*, than in the *Root*. And as the *Cortical Body* leſſens, ſo the *Pith* will be enlarged, and by the ſame proportion is here greater. And the *Pith* being enlarged it ſelf, its *Pores* (the *Lignous Body*, upon its dilatation, as it were tentering and ſtretching out all their ſides) muſt needs likewiſe be enlarged with it; and accordingly, are ever greater in the *Pith* of the *Trunk*, than of the *Root*. And the dilatation of the *Lignous Body* ſtill continued, it follows, that whereas the *Pith* deſcendent in the *Root*, is not only in proportion leſs and leſs, but alſo in the ſmaller extremities thereof, and ſometimes higher, altogether abſent: Contrariwiſe, in the *Trunk*, it is not only continued to its top and ſmalleſt *Twigs*, but alſo there, in proportion, equally ample with what it is in any other inferiour part.

23. §. But although the openneſs of the Aer permitting, be allways alike; yet the Energy of the *Sap* effecting, being different; as therefore that doth, the dilatation of the *Trunk*, will alſo vary. If that be leſs, ſo is this; as in the *Trunks* of moſt *Trees*: If that be greater, ſo this; as in *Herbs* is common; the *Lignous Body* being uſually ſo far dilated, that the *utmoſt Shootings* thereof may eaſily be ſeen to jut out, and adjoyn to the *Skin*. And if the *Sap* be ſtill of greater energy, it ſo far dilates the *Lignous Body*, as not only to amplifie the *Pith* and all its *Pores*; but alſo ſo far to ſtretch them out, as to make them tear. Whereupon either running again into the *Cortical Body*, or ſhrinking up towards it, the *Trunk* thus ſometimes becomes an *hallow Stalk*, the *Pith* being wholly, or in part voided. But generally it keeps entire; and where it doth, the ſame proportion and reſpect to the *Lignous* and *Cortical Bodies*, as is ſaid. The Conſequences of all which will be, the *Strength* of the *Trunk*, the *Security* and *Plenty* of the *Sap*, its *Fermentation* will be quicker, its *Diſtribution* more effectual, and its *Advancement* more ſufficient.

24. §. Firſt, the Erect Growth and Strength of the *Trunk*; this being, by the poſition of its ſeveral Parts, effected: for beſides the ſlendering of the *Trunk* ſtill towards the top, the *Circumferential* poſition of the *Lignous Body*, likewiſe is, and that eminently, hereunto ſubſervient. So that as the *Lignous*, *Body*, in the ſmaller parts, of the *Root* ſtanding Central, we may thence conceive and ſee their pliableneſs to any oblique motion; ſo here, on the contrary, the *Lignous Body* ſtanding wide, it thus becomes the Strength of the *Trunk*, and moſt advantageous to its Perpendicular Growth. We ſee the ſame Deſign in *Bones* and *Feathers*: The ſtrongeſt *Bones*, as thoſe in the Legs, are hollow. Now ſhould we ſuppoſe the ſame *Bone*, to be contracted into a Solid; although now it would be no heavier, and in that reſpect, as apt for motion; yet would it have far leſs ſtrength, than as its Parts are dilated to a *Circumferential* poſture. And ſo for *Quills*, which, for the ſame Reaſons, in ſubſerviency to flying, as they are exceeding light; So, in compariſon with the thinneſs of their *Sides*, they are very ſtrong, and much leſs apt to bend, than if contracted into a Solid *Cylinder*. We ſee it not only in *Nature*, but *Art*. For hence it is, that *Joyners* and *Carpenters* unite and ſet together their Timber-pieces and ſeveral Works oftentimes with double Joynts; which, although

though they are no thicker, than a ſingle one might be made; yet ſtanding at a diſtance, have a greater ſtrength than That could have. And the ſame Architecture, will have the ſame uſe, in the *Trunks* of *Plants*; in moſt whereof 'tis very apparent; as for inſtance, in *Corn*. For *Nature* deſigning its *Sap* a great Aſcent; for its higher maturity, hath given it a tall *Trunk*: But to prevent its ravenous deſpoiling either of the *Ear*, or *Soyl*; although it be tall, yet are its ſides but thin: And becauſe again, it ſhould grow not only tall and thriftily, but for avoiding propping up, ſtrongly too; therefore, the ſame proportion as its heigth bears, to the thinneſs of its ſides, doth the greatneſs of its Circumference alſo; being ſo far dilated as to parallel a *Quil* it ſelf.

25. §. Beſides the poſition of the *Lignous Body* within the compaſs of a *Ring*, there are ſome *Shootings* thereof, often ſtanding beyond the Circumference of the ſaid *Ring*, making ſometimes a triangular, oftner a quadrangular Body of the *Trunk*. To the end, that the *Ring*, being but thin, and not ſelf-ſufficient, theſe, like *Splinters* to *Bones*, might add ſtrength and ſtability to it.

26. §. Next, the ſecurity and plenty of the *Sap*. For ſhould the *Lignous Body*, as it doth in the ſmaller Parts of the *Root*, ſtand Central here alſo, and ſo the *Cortical* wholly ſurround it: the greater part of the *Sap* would thus be more immediately expos'd to the *Sun* and *Aer*; and being lodged in a laxe Body, by them continually be prey'd upon, and as faſt as ſupplied to the *Trunk*, be exhauſted. Whereas, the *Pith* ſtanding in the Center, the *Sap* therein being not only moſt remote from the *Aer* and *Sun*, but by the *Barque*, and eſpecially the *Wood*, being alſo ſurrounded and doubly immur'd, will very ſecurely and copiouſly be convey'd to all the Collateral Parts, and (as ſhall be ſaid how) the top of the *Trunk*.

27. §. And the *Sap* by the amplitude, and great poroſity of the *Pith*, being herein more copious, its Fermentation alſo will be quicker; which we ſee in all Liquors, by ſtanding in a greater quantity together, proceeds more kindly: And being *tun'd up* within the *Wood*, is at the ſame time not only ſecur'd from loſs, but all extream mutations; the Day being thus, not too hot; nor the Night, too cold for it.

28. §. And the Fermentation hereof being quicker, its motion alſo will be ſtronger, and its Diſtribution more effectual, not only to the dilatation of the *Trunk*, but likewiſe the ſhooting out of the *Branches*. Whence it is, that in the Bodies of *Trees*, the *Barque* of it ſelf, though it be Sappy, and many *Fibres* of the *Lignous Body* mixed with it, yet ſeldom ſendeth forth any; and that in *Herbs*, thoſe with the leaſt *Pith* (other advantages not ſupplying this defect) have the feweſt or ſmalleſt Branches, or other collateral Growths: and that *Corn*, which hath no *Pith*, hath neither any Branches.

29. §. Laſtly, the Advancement of the *Sap* will hence alſo be more ready and ſufficient. For the underſtanding where, and how, we ſuppoſe, That in all *Trunks* whatſoever there are two Parts joyntly hereunto ſubſervient. In ſome, the *Lignous Body* and the *Cortical*, as in older *Trunks*; the *Pith* being either excluded, or dried: But in moſt, principally, the *Lignous Body* and *Pith*; as in moſt Annual Growths of *Trees*; but eſpecially *Herbs*, where the *Cortical Body* is uſually much and often wholly Inſerted.

30. §.

30. §. Of the *Lignous Body* it is ſo apparent by its *Pores*, or rather by its *Veſſels*, that we need no farther Evidence. For to what end are *Veſſels*, but for the conveyance of Liquor? And is that alſo, which upon cutting the young Branch of a Sappy *Tree* or *Herb*, by an accurate and ſteady view may be obſerved. But when I ſay the *Veſſels* of the *Lignous Body*, I mean principally them of the *younger ſhootings*, both thoſe which make the *new Ring*, and thoſe which are mixed with the *Cortical Body* in the *Barque*: that which aſcendeth by the *Pores* or *Veſſels* of the Wood, being probably, becauſe in leſs quantity, more in form of a *Vapour*, than a *Liquor*. Yet that which drenching into the ſides of its *Pores*, is with all thereunto ſufficient Aliment; as we ſee *Orpine*, *Onions*, *&c.* only ſtanding in a moyſter Aer will often grow. And being likewiſe in part ſupplied by the *Inſertions* from the younger *Shoots*: But eſpecially becauſe as it is but little, ſo (conſidered as Aliment) it ſerveth only for the growth of the *Wood*, and no more; whereas, the more copious Aliment aſcendent by the younger *ſhoots*, ſubſerves not only their own growth, but the generation of others; and is beſides with that in the *Cortical Body* the Fountain of *Perſpirations*, which we know even in *Animals* are much more abundant than the *Nutritive Parts*; and doubtleſs in a *Vegetable* are ſtill much more.

31. §. But theſe *Pores*, although they are a free and open way to the aſcending *Sap*; yet that meer *Pores* or *Veſſels* ſhould be able of themſelves to advance the *Sap* with that ſpeed, ſtrength and plenty, and to that height, as is neceſſary, cannot probably be ſuppoſed. It follows then, that herein we muſt grant the *Pith* a joynt ſervice. And why elſe is the *Pith* in all Primitive *Growths* the moſt *Sappy* part, why hath it ſo great a ſtock of *Sap*, if not, after due maturation within it ſelf, ſtill to be diſburſed into the *Fibres* of the *Lignous Body*? Why are the Annual *Growths* of all both *Herbs* and *Trees*, with great *Piths*, the quickeſt and the longeſt? But how are the *Pores* or *Bladders* of the *Pith* permeable? That they are ſo, both from their being capable of a repletion with *Sap*, and of being again wholly emptied of it, and again, inſtead thereof fill'd with *Aer*, is as certain as that they are *Pores*. That they are permeable, by the breadth, appears from the dilatation of the *Lignous Body*, and from the production of *Branches*, as hath been, and ſhall hereafter be ſaid. And how elſe is there a Communion betwixt *This* and the *Cortical Body*? That they are ſo alſo, by the length, is probable, becauſe by the beſt *Microſcope* we cannot yet obſerve, that they are viſibly more open by the breadth, than by the length. And withall are ranked by the length, as thoſe of the *Inſertions* by the breadth of the *Trunk*. But if you ſet a piece of dry *Elder-Pith* in ſome tinged Liquor, why then doth it not penetrate the *Pores*, ſo as to aſcend through the Body of the *Pith*? The plain reaſon is, becauſe they are all fill'd with *Aer*. Whereas the *Pith* in a Vegetating *Plant*, as its Parts or *Bladders* are ſtill generated, they are at the ſame time alſo fill'd with *Sap*; which, as 'tis gradually ſpent, is ſtill repaired by more ſucceeding, and ſo the *Aer* ſtill kept out; as in all Primitive *Growths*, and the *Pith* of *Elder* it ſelf: Yet the ſame *Pith*, by reaſon of the following Winter, wanting a more copious and quick ſupply of *Sap*, thus once become, ever after keeps dry. And ſince in the aforeſaid Trial the Liquor only aſcends by the ſides of the *Pith*, that

is of its broken *Bladder*, we ſhould thence by the ſame reaſon conclude that they are not penetrable by the breadth neither, and ſo no way; and then it need not be ask'd what would follow. But certainly the *Sap* in the *Bladders* of the *Pith* is diſcharged and repaired every moment, as by its ſhriv'ling up, upon cutting the *Plant*, is evident.

32. §. We ſuppoſe then, that as the *Sap* aſcendeth into the *Trunk* by the *Lignous Body*, ſo partly alſo by the *Pith*. For a piece of *Cotton* with one end immers'd in ſome tinged Liquor, and with the other erect above, though it will not imbibe the Liquor ſo far as to overrun at the top, yet ſo as to advance towards it, it will. So here, the *Pith*, being a porous and ſpongy Body, and in its Vegetating ſtate, its *Pores* or *Bladders* being alſo permeable, as a curious *Filtre* of *Natures* own contrivance, it thus advanceth, or as people uſe to ſay, ſucks up the *Sap*. Yet as it is ſeen of the Liquor in the *Cotton*; ſo likewiſe are we to ſuppoſe it of the *Sap* in the *Pith*; that though it riſeth up for ſome way, yet is their ſome term, beyond which it riſeth not, and towards which the motion of the aſcending *Sap* is more and more broken, weak and ſlow, and ſo the quantity thereof leſs and leſs. But becauſe the *Sap* moveth not only by the length, but breadth of the *Pith*; at the ſame time therefore as it partly aſcendeth by the *Pith*, it is likewiſe in part preſſed into the *Lignous Body* or into its *Pores*. And ſince the motion of the *Sap* by the breadth of the *Pith* not being far continued, and but collateral, is more prone and eaſie, than the perpendicular, or by its length; it therefore follows, that the collateral motion of the *Sap*, at ſuch a height or part of the *Pith*, will be equally ſtrong with the perpendicular at another part, though ſomewhat beneath it; and that where the perpendicular is more broken and weak, the collateral will be leſs; and conſequently where the perpendicular tendency of the *Sap* hath its term, the collateral tendency thereof, and ſo its preſſure into the *Pores* or *Veſſels* of the *Lignous Body*, will ſtill continue. Through which, in that they are ſmall, and ſo their ſides almoſt contiguous, the *Sap* as faſt as preſſed into them willeaſily run up; as in very ſmall Glaſſe Pipes, or betwixt the two halves of a Stick firſt ſlit, and then tyed ſomewhat looſely together, may alſo any Liquor be obſerved to do. By which Advantage the facility and ſtrength of that aſcent will be continued higher in the ſaid *Veſſels*, than in the *Pith*. Yet ſince this alſo, as well as that in the *Pith* will have its term; the *Sap*, although got thus far, would at laſt be ſtagnant, or at leaſt its aſcent be very ſparing, ſlow and feeble, if not ſome way or other re-inforced. Wherefore, as the *Sap* moving by the breadth of the *Pith*, preſſeth thence into the *Veſſels* of the *Lignous Body*; ſo having well fill'd theſe, is in part by the ſame Collateral motion disburſed back, into a yet higher Region of the *Pith*. By which partly, and partly, by that portion of the *Sap*, which in its perpendicular aſcent was before lodged therein; 'tis thus here, as in any inferiour place equally repleniſhed. Whereupon the force and vigour of the perpendicular motion of the *Sap* herein, will likewiſe be renew'd; and ſo its Collateral motion alſo, and ſo its preſſure into the *Veſſels* of the *Lignous Body*, and conſequently its aſcent therein: and ſo by a preſſure, from theſe into the *Pith*, and from the *Pith* into theſe, reciprocally carried on; a moſt ready and copious aſcent of the *Sap* will be continued, from the bottom to the top, though of the higheſt *Tree*.

An

An Appendix.

Of Trunk-Roots and Claſpers.

THE diſtinct *Parts* whereof theſe are compoſed, are the ſame with thoſe of the *Trunk*, and but the continuation of them.

1. §. *Trunk-Roots* are of two kinds: Of the one, are thoſe that vegetate by a direct deſcent: The place of their Eruption is ſometimes all along the *Trunk*; as in *Mint*, &c. Sometimes only at its utmoſt point, as in the *Bramble.*

2. 2. The other ſort are ſuch as neither aſcend nor deſcend, but ſhoot forth at right Angles with the *Trunk*; which therefore, though as to their *Office*, they are true *Roots*, yet as to their *Nature*, they are a *Middle Thing* betwixt a *Root* and a *Trunk.*

3. §. *Claſpers*, though they are but of one kind, yet their Nature is double; not a mean betwixit that of the *Root* and that of the *Trunk*, but a compound of both; as in their Circumvolutions, wherein they often mutually aſcend and deſcend, is ſeen.

4. §. The uſe of theſe *Parts* may be obſerved as the *Trunk* Mounts, or as it Trails. In the mounting of the *Trunk*, they are for Support and Supply. For Support, we ſee the *Claſpers* of *Vines*: the *Branches* whereof being very long, fragile and ſlender; unleſs by their *Claſpers*, they were mutually contain'd together, they muſt needs by their own weight, and that of their Fruit, undecently fall; and be alſo liable to frequent breaking. So that the whole care is divided betwixt the Gardener and Nature; the Gardener, with his Ligaments of Leather, ſecures the main Branches; and Nature, with theſe of her own finding, ſecures the Leſs. Their Conveniency to which end, is ſeen in their *Circumvolutions*, a motion, not proper to any other *Part:* As alſo in their toughneſs, though much more ſlender than the *Branches* whereon they are appendent.

5. §. The *Claſpers* of *Bryony* have a retrograde motion about every Third *Circle*, to the form a Doublet-Claſp. Probably for the more certain hold; which, if it miſs one way, it may be ſure to take another.

6. §. For Supply, we ſee the *Trunk-Roots* of *Ivy*. For mounting very high, and being of a cloſer or more compact Subſtance than that of a *Vine*; the *Sap* could not be ſufficiently ſupplied to the upper *Sprouts*, unleſs theſe, to the *Mother-Root*, were joyntly aſſiſtant. Yet ſerve they for ſupport likewiſe; whence they ſhoot out, not as in *Creſſes*, *Brook-lime*, &c. recipocrally on each ſide, but commonly, all on one; that ſo they may be faſtned at the neareſt hand.

7. §. In the Trailing of the *Trunk*, they ſerve for ſtabiliment, propagation and ſhade. For ſtabiliment, the *Claſpers* of *Cucumbers* are of good uſe. For the *Trunk* and *Branches* being long and fragile, the Bruſhes of the Winds would injuriouſly hoiſe them to and fro, to the dammage both of themſelves and their tender Fruits, were

they not by these Ligaments brought to good Association and Settlement.

8. §. As for this end, so for Propagation, the *Trunk-Roots* of *Chamæmile* do well serve. Whence we have the reason of the common observation, that it grows better by being trod upon: the Mould, where too laxe, being thus made to lie more conveniently about the said *Trunk-Roots* newly bedded therein; and is that which is sometimes also effected in Rowling of *Corn*.

9. §. For both these ends, Serve the *Trunk-Roots* of *Strawberries*; as also for shade; for in that all *Strawberries* delight; and by the trailing of the *Plant* is well obtain'd. So that as we are wont to tangle the Twigs of *Trees* together to make an *Arbour Artificial*; the same is here done to make a *Natural one*: as likewise by the *Claspers* of *Cucumbers*. For the *Branches* of the one by the Linking of their *Claspers*, and of the other by the Tethering of their *Trunk-Roots*, being couched together; their tender Fruits thus lie under the Umbrage of a *Bower* made of their own Leaves.

CHAP. IV.

Of the GERMEN, BRANCH, *and* LEAF.

THE Parts of the *Germen* and *Branch*, are the same with those of the *Trunk*; the same *Skin*, *Cortical* and *Lignous Bodies*, *Insertment* and *Pith*, hereinto propagated, and distinctly observable herein.

2. §. For upon Enquiry into the Original of a *Branch* or *Germen*, it appears, That it is not from the *Superficies* of the *Trunk*; but so deep, as to take, with the *Cortical*, the *Lignous Body* into it self: and that, not only from its Circumference, but from in *Inner* or *Central Parts*; So as to take the *Pith* in also. Divers of which *Parts* may commonly be seen to shoot out into the *Pith*; from which *Shoots*, the surrounding and more superiour *Germens* are originated; in like manner as the Succulent Part of the *Lignous Body* of the *Trunk* is sometimes principally from those Fibrous *Shoots* which run along the *Pith* in the *Root*.

3. §. The manner wherein usually the *Germen* and *Branch* are fram'd, is briefly thus: The *Sap* (as is said, *Chap.* 3.) mounting in the *Trunk*, will not only by its length, but by its breadth also, through the *Insertions* partly move. Yet, its Particles being not all alike qualified, in different degrees. Some are more gross and sluggish; of which we have the formation of a Circle of Wood only, or of an *Annual Ring*. Others are more brisk; and by these, we have the *Germen* propagated. For by the vigour of their own motion from the Center, they impress an equal tendency on some of the inner *Portions* of the *Lignous Body* next adjacent

cent to the *Pith*, to move with them. And ſince the *Lignous Body* is not entire, but frequently diſparted; through theſe *Diſpartments*, the ſaid interiour *Portions*, upon their Nutrition, actually ſhoot; not only towards the Circumference, ſo as to make part of a *Ring*; but even beyond it, in order to the production of a *Germen*. And the *Lignous Body* thus moving, and carrying the *Cortical* along with it; they both make a force upon the *Skin*. Yet their motion being moſt even and gradual, that force is ſuch likewiſe; not to cauſe the leaſt breach of its parts, but gently to carry it on with themſelves; and ſo partly, by the extenſion of its already exiſtent parts, as of thoſe of *Gold* in drawing of Guilded *Wyer*; and partly, by the accretion of new ones, as in the enlarging of a *Bubble* above the Surface of the Water; it is extended with them to their utmoſt growth. In which growth, the *Germen* being prolonged, and ſo diſplaying its ſeveral parts, as when a *Proſpective* or *Teleſcope* is drawn out, thus becomes a *Branch*.

4. §. The ſame way as the propagation of the *Parts* of a *Germen* is contriv'd, is its due nutrition alſo. For being originated from the inner part of the *Lignous Body*, 'tis nouriſhed with the beſt fermented *Sap* in the *Trunk*, *ſc.* that next adjacent to it in the *Pith*. Beſides, ſince all its *Parts*, upon their ſhooting forth, divaricate from their perpendicular, to a croſs Line, as theſe and the other grow and thrive together, they bind and throng each other into a *Knot*: through which *Knot* the *Sap* being ſtrain'd, 'tis thus, in due moderation and purity delivered up into the *Branch*.

5. § And for *Knots*, they are ſo neceſſary, as to be ſeen not only where collaterl *Branches* put forth; but in ſuch *Plants* alſo, as ſhoot up in one ſingle *Trunk*; as in *Corn*. Wherein, as they make for the ſtrength of the *Trunk*; ſo by ſo many percolations, as they are *Knots*, for the traſmiſſion of the *Sap* more and more refined towards the *Ear*. So that the two general uſes of *Knots* are, For *ſimer ſtanding*, and *ſiner growth*.

6. §. Laſtly, as the due Formation and Nutrition of the *Germen* are provided for, ſo is its ſecurity alſo; which both in its poſition upon the *Trunk*, and that of its *Parts* among themſelves, may be obſerved. The poſition of its *Parts* ſhall be conſidered in ſpeakimg of the *Leaf*. As to its ſtanding in the *Trunk*, tis alwayes betwixt the *trunk* or *older Branch*, and the *Baſis* of the Stalk of *a Leaf*; whereby it is not only guarded from the Injuries of any contingent Violence; but alſo from the more piercing aſſaults of the Cold; ſo long, till in time 'tis grown larger, and more hardy. The maner and uſes of the poſition of every *Germen*, conſidered as after it becomes a *Branch*; hath already been, by the Ingenious Mr. *Sharrock* very well obſerved; to whom I refer. Hiſt. of the *Prop.* of *Veget.*

7. §. UPON THE prolongation of the *Germen* into a *Branch*, its *Leaves* are thus diſplay'd. The *Parts* whereof are ſubſtantially the ſame with thoſe of a *Branch*. For the *Skin* of the *Leaf*, is only the ampliation of that of the *Branch*; being partly by the accretion of new, and partly the extention of its already exiſtent parts, dilated (as in making of *Leaf-Gold*) into its preſent breadth. The *Fibres* or *Nerves* diſperſed through the *Leaf*, are only the Ramifications of the *Branch's* Wood, or *Lignous Body*. The *Parenchyma* of the *Leaf*, which

which lies betwixt the *Nerves*, and as in Gentlewomens Needle-works, fills all up, is nothing elſe, but the continuation of the *Cortical Body*, or *Parenchymous* part of the *Barque* from the *Branch* into it ſelf, as in moſt *Plants* with a thick *Leaf*, may eaſily be ſeen.

8. §. The *Fibers* of the *Leaf* neither ſhoot out of the *Branch*, or the *Trunk*, nor ſtand in the *Stalk*, in an *even* Line; but alwayes in either an *Angular* or *Circular* poſture; and uſually making either a *Triangle*, or a *Semi-Circle*, or *Chord* of a Circle; as in *Cichory*, *Endive*, *Cabbage*, &c. may be obſerved. And if the *Leaf* have but one main *Fiber*, that alſo is poſtur'd in a bowed or *Lunar* Figure; as in *Mint* and others. The uſual number of theſe *Vaſcular Threds* or *Fibres* is 3,5,or 7.

Tab. 4. *f.* 2. to *f.* 11.

9. §. The reaſon of the ſaid Poſitions of the *Fibers* in the *Stalk* of the *Leaf*, is for its more *Erect* growth, and greater *Strength*: which, were the poſition of the ſaid *Fibers* in an *even Line*, and ſo the *Stalk* it ſelf, as well as the *Leaf*, flat; muſt needs have been defective; as from what we have ſaid of the Circumferential poſture of the *Lignous Body* in the *Trunk*, we may better conceive.

C. 3. §. 24.

10. §. As likewiſe for the ſecurity of its *Sap*: For by this means it is, that the ſeveral *Fibers*, and eſpecially the main or middle *Fiber* of the *Leaf*, together with a conſiderable part of the *Parenchyma*, are ſo diſpoſed of, as to jut out, not from its upper, but its back, or neither Side. Whence the whole *Leaf*, reclining backward, becomes a Canopy to them, defending them from thoſe Injuries which from colder Blaſts, or an hotter Sun, they might otherwiſe ſuſtain. So that by a mutual benefit, as Theſe give *ſuck* to all the *Leaf*, ſo that again *protection* to Theſe.

11. §. Theſe *Fibers* are likewiſe the immediate Viſible Cauſe of the Shape of the *Leaf*. For if the nethermoſt *Fiber* or *Fibers* in the *Stalk* (which thence runs chiefly through the length of the *Leaf*) be in proportion greater, the *Leaf* is long; as in *Endive*, *Cichory*, and others: If all of a more equal ſize, it ſpreads rounder, as in *Ivy*, *Doves-foot*, *Colts foot*, &c. And although a *Dock-Leaf* be very long, whoſe *Fibers* notwithſtanding, as they ſtand higher in the *Stalk*, are diſpoſed into a *Circle* all of an equal ſize; yet herein one or more peculiar *Fibres*, ſtanding, in or near the *Center*, betwixt the reſt, and running through the length of the *Leaf*, may be obſerved.

Tab. 4.

12. §. In correſpondence alſo to the ſize and ſhape of theſe *Fibres*, is the *Leaf* flat. In that either they are very ſmall, or if larger, yet they never make an entire Circle or *Ring*; but either half of one, as in *Borage*, or at moſt three parts of one, as in *Mullen*, may be ſeen. For if either they were ſo big, as to contain, or ſo entire, as perfectly to include a *Pith*, the Energy of the *Sap* in that *Pith*, would cauſe the ſaid *Lignous Ring* to ſhoot forth on every ſide, as it doth in the *Root* or *Trunk*: But the ſaid *Fibers* being not figur'd into an entire *Ring*, but ſo as to be open; on that hand therefore where open they cannot ſhoot any thing directly from themſelves, becauſe there they have nothing to ſhoot; and the *Sap* having alſo a free vent through the ſaid opening, againſt that part therefore which is thereunto oppſite, it can have no force; and ſo neither will they ſhoot forth on that hand; and ſo will they conſequently, that way only, which the force of the *Sap* directs, which is only on the right and left.

Tab. 4.

13. §.

13. §. The ſeveral *Fibers* in the *Stalk*, are all Inoſculated in the *Leaf*, with very many Sub-diviſions. According as theſe *Fibers* are Inoſculated near, or at, or ſhoot directly to the edge of the *Leaf*, is it Even, or Scallop'd. Where theſe *Inoſculations* are not made, there we have no *Leaves*, but only a company of *Filaments*; as in *Fennel.*

14. §. To the *Formations* of *Leaves*, the *Fouldings* immediately follow. And ſometimes they have one Date, or are the contemporary works of *Nature*; each *Leaf* obtaining its diſtinct ſhape, and proper poſture together; both being perfect, not only in the outer, but Central and minuteſt *Leaves*, which are five hundred times ſmaller than the outer: both which in the Cautious opening of a *Germen* may be ſeen.

15. §. Nor is there greater Art in the *Forms*, than in the *Foulds* or *Poſtures* of *Leaves*; both anſwerably varying, as this or that way they may be moſt agreeable. Of the *Quincuncial* poſture, ſo amply inſtanc'd in by the Learned Sir *Thomas Brown*, I ſhall omit to ſpeak. Others there are, which though not all ſo univerſal, yet equally neceſſary where they are, giving two general advantages to the *Leaves*, *Elegancy* and *Security*, *ſc.* in taking up, ſo as their *Forms* will bear, the leaſt room; and in being ſo conveniently couch'd, as to be capable of receiving protection from other Parts, or of giving it one to another; as for inſtance, Treat. of the *Quincunx.*

16. §. Firſt, There is the *Bow-Lap*, where the *Leaves* are all laid ſomewhat convexly one over another, but not plaited; being to the length, breadth and number of *Leaves* moſt agreeable; as in the Buds of *Pear-tree*, *Plum-tree*, &c. But where the *Leaves* are not ſo thick ſet, as to ſtand in the *Bow-Lap*, there we have the *Plicature*, or the *Flat-Lap*; as in *Roſe-Tree*, *Strawberry*, *Cinquefoyl*, *Burnet*, &c. For the *Leaves* being here plaited, and ſo lying in half their breadth, and divers of them thus alſo collaterally ſet together; the thickneſs of them all, and half their breadth, are much alike dimenſions; by which they ſtand more ſecure within themſelves, and in better conſort with other *Germen-Growths* in the ſame *Truſs.* If the *Leaves* be much indented or jagg'd, now we have the *Duplicature*; wherein there are divers *Plaits* in one *Leaf*, or *Labels* of a *Leaf*, but in diſtinct *Sets*, a leſſer under a greater; as in *Souchus*, *Tanſey*, &c. When the *Leaves* ſtand not collaterally, but ſingle; and are moreover very broad; then we have the *Multiplicature*; as in *Gooſeberries*, *Mallows*, &c. the *Plaits* being not only divers in the ſame *Leaf*, but of the ſame *Set* continuant, and ſo each *Leaf* gather'd up in five, ſeven or more *Foulds*, in the ſame manner as our Gentlewomens Fans. Where either the thickneſs of the *Leaf* will not permit a *Flat-Lap*, or the fewneſs of their number, or the ſmalneſs of their *Fibers*, will allow the *Rowl*, there This may be obſerved. Which is ſometimes ſingle, as in *Bears-Ears*, *Arum*, *Flammula*, *Jeruſalem Cowſlip*, &c. Sometimes double, the two *Rowls* beginning at each edge of the *Leaf*, and meeting in the middle. Which again, is either the *Fore-Rowl*, or the *Back-Rowl.* If the *Leaf* be deſign'd to grow long, now we have the *Back-Rowl*, as in *Docks*, *Sorrels*, and the reſt of this Kindred: as alſo in *Primroſe*, and other like *Plants.* For the main *Fibers*, and therewith a conſiderable part of the *Cortical Body* ſtanding prominent from the *Back-ſide* of the *Leaf*, they thus ſtand ſecurely couch'd up betwixt

twixt the two *Rowls*; on whose security the growth of the *Leaf* in length depends. But those of *Bears-Ears*, *Violets*, *Doves Foot*, *Warden*, and many more, upon contrary respects, are rowled up inwards. Lastly, there is the *Tre-Rowl*, as in *Fern*; the *Labels* whereof, though all rowled up to the *main Stem*, yet could not stand so firm and secure from the Injuries either of the *Ground* or *Weather*, unless to the *Rowls* in breadth, that by the length were super-induc'd; the *Stalk* or *main Stem* giving the same Protection here, which in other *Plants* by the *Leaves*, or some particular *Mantling*, is contriv'd. These, and other *Foulds*, See in the *Figures* belonging to the *First* Part of the *Fourth* Book.

17. §. According to the *Form* and *Foulding* of every *Leaf* or *Germen*, is its Protection order'd; about six ways whereof may be observ'd; *sc.* by *Leaves*, *Surfoyls*, *Interfoyls*, *Stalks*, *Hoods* and *Mantlings*. To add to what we have above given, one or two Instances. Every *Bud*, besides its proper *Leaves*, is covered with divers Leafy *Pannieles* or *Surfoyls*; which, what the *Leaves* are to one another, are that to them all: For not opening except gradually, they admit not the *Weather*, *Wet*, *Sun* or *Aer*, to approach the *Leaves*, except by degrees respondent, and as they are gradually inur'd to bear them. Sometimes, besides *Surfoyls*, there are also many *Interfoyls* set betwixt the *Leaves*, from the Circumference to the Center of the *Bud*; as in the *Hasel*. For the *Fibres* of these *Leaves* standing out so far from a plain surface; they would, if not thus shelter'd, lie too much expos'd and naked to the *Severities* of the *Weather*. Where none of all the Protections above-named, are convenient, there the *Membranes* of the *Leaves* by continuation in their first forming (together with some *Fibres* of the *Lignous Body*) are drawn out into so many *Mantles* or *Veils*; as in *Docks*, *Snakeweed*, &c. For the *Leaves* here being but few, yet each *Leaf* and its *Stalk* being both exceeding long; at the bottom whereof the next following *Leaf* still springs up; the form and posture of all is such, as supersedes all the other kinds of Protection, and so each *Leaf* apart is provided with a *Veil* to it self. These, and other *Protections*, See in the *Figures* belonging to the *First* Part of the *Fourth* Book.

18. § The Uses of the *Leaves*, I mean in respect of their service to the *Plant* it self, are these: First, for Protection; which, besides what they give one to another, they afford also to the *Flower* and *Fruit*. To the *Flower* in their *Foulds*; that being, for the most part, born and usher'd into the open Aer by the *Leaves*. To the *Fruit*, when afterwards they are display'd, as in *Strawberries*, *Grapes*, *Rasps*, *Mulberries*, &c. On which, and the like, should the Sun-Beams immediately strike, especially while they are young, they would quite shrivel them up; but being by the *Leaves* screened off, they impress the circumjacent *Aer* so far only as gently to warm the said *Fruits*, and so to promote their *Fermentation* and *Growth*. And accordingly we see, that the *Leaves* above-named are exceeding large in propotion to the *Fruits*: whereas in *Pear-trees*, *Apple-trees*, &c. the *Fruit* being of a solider *Parenchyma*, and so not needing the like protection, are usually equal with, and often wider in Diameter than the *Leaves*.

19. §.

19. §. Another uſe is for Augmentation; or, the capacity for the due ſpreading and ampliation of a *Tree* or other *Plant*, are its, *Leaves.* For herein the *Lignous Body* being divided into ſmall *Fibres*, and theſe running all along their lax and ſpongie *Parenchyma*; they are thus a *Body* fit for the imbibition of *Sap*, and eaſie *Growth.* Now the *Sap* having a free reception into the *Leaves*, it ſtill gives way to the next ſucceeding in the *Branches* and *Trunk*, and the voyding of the *Sap* in theſe, for the mounting of that in the *Root*, and ingreſs of that in the *Ground.* But were there no *Leaves* to make a free reception of *Sap*, it muſt be needs be ſtagnant in all the *Parts* to the *Root*, and ſo the *Root* being clogg'd, its fermenting and other Offices will be voyded, and ſo the due *Growth* of the whole. As in the motion of a *Watch*, although the original term thereof be the *Spring*, yet the capacity for its continuance in a due meaſure throughout all the *Wheels*, is the free and eaſie motion of the *Ballance.*

20. §. Laſtly, As the *Leaves* ſubſerve the more copious advancement, ſo the higher purity of the *Sap.* For this being well fermented both in the *Root*, and in its Aſcent through the *Trunk*, and ſo its *Parts* prepar'd to a farther ſeparation; the groſſer ones are ſtill depoſited into the *Leaves*; the more elaborate and eſſential only thus ſupplied to the *Flower*, *Fruit* and *Seed*, as their convenient *Aliment.* Whence it is, that where the *Flowers* are many and large, into which the more odorous *Particles* are copiouſly receiv'd, the green *Leaves* have little or no ſmell; as thoſe of *Roſe-tree*, *Carnations*, *French-Marigold*, *Wood-bind*, *Tulips*, &c. But on the contrary, where the *Flowers* are none, or ſmall, the green *Leaves* themſelve are likewiſe of a ſtrong ſavour; as thoſe of *Wormwood*, *Tanſie*, *Baum*, *Mint*, *Rue*, *Geranium Moſchatum*, *Angelica*, and others.

An Appendix.

Of Thorns, Hairs and Globulets.

Thorns are of two kinds, *Lignous* and *Cortical.* Of the firſt are ſuch as thoſe of the *Hawthorn*, and are conſtituted of all the ſame ſubſtantial *Parts* whereof the *Germen* or *Bud* it ſelf, and in a like proportion: which alſo in their Infancy are ſet with the reſemblances of divers minute *Leaves.* Of affinity with theſe are the *Spinets* or *Thorny Prickles* upon the Edges and Tops of divers *Leaves*, as of *Barbery*, *Holly*, *Thiſtle*, *Furze*, and others; all which I think are the filamentous extremities of the *Lignous Body* ſheathed in the *Skin.* But this principal differnce betwixt a *Bud* and theſe *Lignous Thorns*, is obſervable; That the *Bud* hath its Original from the Inner part of the *Lignous Body*, next the *Pith:* But theſe *Thorns*, from the outer, and leſs fecund Part; and ſo produceth no *Leaves*, but is, as it were, the *Mola* of a *Bud.*

2. §. *Cortical Thorns* are ſuch as thoſe of the *Rasberry* Buſh, being not, unleſs in a moſt extraordinary ſmall and inviſible proportion propagated from the *Lignous Body*, but as, it ſeems, wholly from the *Cortical* and *Skin*, or from the exteriour part of the *Barque*.

C. 2. §. 25. 3. §. The *Growth* of this *Thorn* may farther argue what in the *Second Chapter* we ſuppoſed; *ſc.* That as the proper *Tendency* of the *Lignous Body*, is to *Aſcend*; ſo of the *Cortical* to *Deſcend*. For as the *Lignous Thorn*, like other *Parts* of the *Trunk*, in its *Growth* aſcends; This, being almoſt wholly *Cortical*, pointeth downward. The uſe of *Thorns* the Ingenious Mr. *Sharrock* hath obſeved.

Hiſt. of the *Prop.* of *Veget.* 4. §. Upon the *Leaves* of divers *Plants* two *Productions* ſhew themſelves, *ſc. Hairs* and *Gloubulets*. Of *Hairs*, only one kind is taken notice of; although they are various. Ordinarily they are of a *Simple Figure*; which when fine and thick ſet, as on moſt *Hairy Buds*; or fine and long, as on thoſe of the *Vine*, we call them *Down*.

5. §. But ſometimes they are *Branched out*, from the bottom to the top, reciprocally on every ſide, in ſome reſemblance to a *Stags Horn*; as in *Mullen*. And ſometimes they are *Aſtral*, as upon *Lavender*, and ſome other *Leaves*, and eſpecially thoſe of *Wild Olive*; wherein every *Hair* riſing in one round entire *Baſis* a little way above the ſurface of the *Leaf*, is then diſparted, Star-like, into ſeveral, four, five or ſix *Points*, all ſtanding at right Angles with the ſaid perpendicular *Baſis*.

6. §. The Uſes of *Hairs* are for *Diſtinction* and *Protection*. That of *Diſtinction* is but ſecondary, the *Leaves* being grown to a conſiderable ſize. That of *Protection* is the prime, for which they were originally form'd together with the *Leaves* themſelves, and whoſe ſervice they enjoy in their Infant-eſtate: For the *Hairs* being then in form of a *Down*, always very thick ſet, thus, give that *Protection* to the *Leaves*, which their exceeding tenderneſs then requires; ſo that they ſeem to be veſted with a Coat of *Frize*, or to be kept warm, like young and dainty *Chickens*, in *Wool*.

7. §. *Globulets* are ſeen upon *Orach*, both Garden and Wild; and yet more plainly on *Mercury* or *Bonus Henricus*. In theſe, growing almoſt upon the whole *Plant*, and being very large, they are by all taken notice of.

8. §. But ſtrict Obſervation diſcovers, that theſe *Globulets* are the natural and conſtant Off-ſpring of very many other *Plants*. Both theſe *Globulets*, and likewiſe the diverſity of *Hairs*, I find that Mr. *Hook* hath alſo obſerved. I take notice, that they are of two kinds; *Tranſparent*, as upon the *Leaves* of *Hyſop*, *Mint*, *Baume*, and many more *White*, as upon thoſe of *Germander*, *Sage*, and others. All which, though the naked Eye will diſcover, yet by the help of *Glaſſes* we may obſerve them moſt diſtinctly. The uſe of theſe we ſuppoſe the ſame, in part, with thoſe of the *Flower*, whereof we ſhall ſpeak.

Micrography.

CHAP.

CHAP. V.

Of the FLOWER.

WE next proceed to the *Flower*. The general *Parts* whereof are moſt commonly three; *ſc.* the *Empalement*, the *Foliation*, and the *Attire*.

2. §. The *Empalement*, whether of one or more pieces, I call that which is the utmoſt *Part* of the *Flower*, encompaſſing the other two. 'Tis compounded of the three general *Parts*, the *Skin*, the *Cortical* and *Lignous Bodies*, each *Empaler* (where there are divers) being as another little *Leaf*; as in thoſe of a *Quince-Flower*, as oft as they happen to be overgrown, is well ſeen. As likewiſe in the *Primroſe*, with the *green Flower*; commonly ſo call'd, though by a miſtake: For that which ſeems to be the *Flower*, is only the more flouriſhing *Empalement*, the *Flower* it ſelf being *White*. But the continuation of all the three aforeſaid *Parts* into each *Empaler*, is diſcoverable, I think, no where better than in an *Artichoke*, which is a true *Flower*, and whoſe *Empalers* are of that amplitude, as fairly to ſhew them all: As alſo, that the Original of the *Skin* of each *Empaler* or *Leaf* is not diſtinct from that of the reſt; but to be all one piece, laid in ſo many *Plaits* or *Duplicatures*, as there are *Leaves*, from the outermoſt to the inner and moſt Central ones.

3. §. The Deſign of the *Empalement*, is to be *Security* and *Bands* to the other two *Parts* of the *Flower*: To be their *Security* before its opening, by intercepting all extremities of *Weather*: Afterwards to be their *Bands*, and firmly to contain all their *Parts* in their due and moſt decorous poſtnre: ſo that a *Flower* without its *Empalement*, would hang as uncouth and taudry, as a *Lady* without her *Bodies*.

4. §. Hence we have the reaſon why it is various, and ſometimes wanting. Some *Flowers* have none, as *Tulips*; for having a fat and frim *Leaf*, and each *Leaf* likewiſe ſtanding on a broad and ſtrong *Baſis*, they are thus ſufficient to themſelves. *Carnations*, on the contrary, have not only an *Empalement*, but that (for more firmitude) of one piece: For otherwiſe, the Foot of each *Leaf* being very long and ſlender, moſt of them would be apt to break out of compaſs: yet is the top of the *Empalement* indented alſo; that the *Indentments*, by being lapp'd over the *Leaves* before their expanſion, may then protect them; and by being ſpread under them afterwards, may better ſhoulder and prop them up. And if the Feet of the *Leaves* be both long and very tender too, here the *Empalement* is numerous, though conſiſting of ſeveral pieces; yet thoſe in divers *Rounds*, and all with a counterchangeable reſpect to each other (which alſo the Learned Sir *Thomas Brown* obſerves) as in all *Knapweeds*, and other *Flowers*; whereby, how commodious they are for both the aforeſaid ends, may eaſily be conceiv'd; and well enough exemplified by the Scales of *Fiſhes*, whereunto, as to their poſition, they have not an unapt reſemblance. Treat. of the *Quincunx*.

5. §. THE FOLIATION alſo, is of the ſame ſubſtantial *Nature* with the green *Leaf*; the *Membrane*, *Pulp*, and *Fibres* whereof, being, as there, ſo here, but the continuation of the *Skin*, the *Cortical* and *Lignous Bodies*.

6. §. The *Foulds* of the *Flower* or *Foliation* are various, as thoſe of the green *Leaf*; but ſome of them different. The moſt general are, Firſt, The *Cloſe-Couch*, as in *Roſes*, and many other double *Flowers*. Then the *Concave-Couch*, as in *Blattaria flore albo*. Next the *Plait*, as in ſome of the *Leaves* of *Peaſe-Blooms*, in the *Flowers* of *Coriander*, &c. which is either ſingle, as in thoſe nam'd; or double, as in *Blew-Bottle*, *Jacea*, and more of that rank. Next, the *Couch*, and *Plait* together in the ſame *Flower*, as in *Marigolds*, *Daiſies*, and all others of an agreeing form: where the firſt apparent *Fould* or *Compoſture* of the *Leaves* is in *Couch*; but the *Leaves* being erect, each likewiſe may be ſeen to lie in a double *Plait* within it ſelf. Then the *Rowl*, as in the *Flowers* of *Ladies-Bower*, the broad top of each *Leaf* being by a double *Rowl* foulded up inwardly. Next, the *Spire*, which is the beginning of a *Rowl*; and may be ſeen in the *Flowers* of *Mallows*, and others. Laſtly, the *Plait* and *Spire* together, where the *Part* analogous to the *Foliation*, is of one piece, the *Plaits* being here laid, and ſo carried on by *Spiral Lines* to the top of the *Flower*, as is in divers, and I think, in *Convolvulus Doronici folio*, more elegantly ſeen. Theſe and other *Foulds*, See in the *Figures* belonging to the *Second* Part of the *Fourth* Book. The reaſon of all which varieties, a comparative conſideration of the ſeveral *Parts* of the *Flower* may ſuggeſt. I'le only mention, That no *Flower*, that I find, hath a *Back-Rowl*, as hath the green *Leaf*. For two Reaſons; becauſe its *Leaves* have not their *Fibres* ſtanding out much on their backſide, as the green *Leaves* have; and becauſe of its *Attire*, which it ever emboſomes, and cannot ſo well do it by a *Back-Rowl*.

7. §. The uſual *Protections* of *Flowers* by the Precedents are expreſs'd, *ſc. Green Leaves* and *Empalements*. Some have another more peculiar, that is a *double Veil*; as the *Spring-Crocus*. For having no *Empalement*, and ſtarting up early out of the *Mould*, even before its *Green Leaves*, and that upon the firſt opening of the Spring; leſt it ſhould thus be quite ſtarved, 'tis born ſwath'd up in a double *Blanket*, or with a pair of *Sheets* upon its *Back*.

8. §. The *Leaves* of divers *Flowers* at their *Baſis* have an *hairy Tuft*; by which *Tufts* the Concave of the *Empalement* is filled up; That, being very choice and tender, they may thus be kept in a gentle and conſtant Warmth, as moſt convenient for them.

9. §. The *Leaves* of the *Flower*, though they are not hairy all over, yet in ſome particular parts they are often ſet with a fine Downy *Velvet*; that, being by their ſhape and poſture in thoſe parts contiguous to their delicate and tender *Attire*, they may thus give it a more ſoft and warmer touch. Thus in the *Flower* of *Ladies Bower*, thoſe parts of its *Leaves* which rowl inward, and lie contiguous to the *Attire*, are Downy; whereas the other *Parts* are ſmooth or bald: So the *Flowers* of *Peaſe*, *Spaniſh Broom*, *Toad-Flax*, and many others, where contiguous to their *Attires*, are deck'd with the like *Hairy Velvet*.

10. §.

10. §. As upon the Green *Leaves*, ſo upon the *Flowers* are *Globulets* ſomtimes ſeen; as upon the backſide of that of *Enula*. On none more plainly than that kind of *Blattaria* with the white *Flower*; where they are all tranſparent, and growing both on the *Stalk* and *Leaves* of the *Flower*, each ſhewing likewiſe its *Pedunele* whereon it is erected.

11. §. The uſe of the *Flower*, or the *Foliation* whereof we now ſpeak, (that is, as to its private ſervice) is for the protection of the *Attire*; *This*, as its under, and the *Empalement* as its upper Garments. As likewiſe of the *Fruit:* The neceſſity of which Service, in ſome Caſes, by the different ſituation of the *Flower* and *Fruit*, with reſpect to each other, is evident; *Apples*, *Pears*, and ſeveral other *Fruits*, ſtanding behind or under the *Flower*; but *Cherries*, *Aprecots*, and divers others, within it. For theſe. being of a very tender and pulpous Body, and withal putting forth with the colder part of the Spring; could not weather it out againſt the Variations and Extremities of the Air, (as thoſe of a more ſolid *Parenchyma* can) except lodged up within their *Flowers*.

12. §. And as the *Flower* is ſerviceable to the ſafety of the *Fruit*, ſo is it to its growth; *ſc.* in its Infancy, or *Embryo*-eſtate; for which purpoſe, as there is a *Flower*, ſo that *Flower* is greater or leſs, according as the nature of the *Fruit* to which it belongs, and the plenty of the *Sap* by which the *Fruit* is fed, doth require. Thus, where the young *Fruit* is of a ſolider Subſtance and the aſcent of the *Sap* leſs copious, were there here no *Flower* to promote the ſaid aſcent thereof into the *Fruit* (in the manner as is effected by the Green *Leaves*) it muſt needs pine and die, or prove leſs kindly. On the contrary, ſhould the *Flower* be over-large, it would not only promote the aſcent of the *Sap* up to the *Fruit*, but being as yet over-proportionate to it, would likewiſe it ſelf exhauſt the ſame *Sap*, as faſt as aſcendent; like a greedy Nurſe, that prepares the Meat for her Child, and then eats it up her ſelf. Thus we ſee *Apples* and *Pears*, with a *Flower* of a moderate *Size*; like their *Body*, of a middle Conſtitution, and their *Sap*, of a middle quantity: But *Quinces*, being more ſolid, beſides that they have as great a *Flower*, the *Impalers* of their *Flower* alſo thrive ſo far as to become handſom *Leaves*; continuing alſo after the *Flower* is fallen, firm and verdent a great while; ſo long, till the *Fruit* be able to provide for it ſelf. On the other hand, *Plums* being more tender and Sappy than *Appels* and *Pears*, beſides that their *Empalers* are much alike, their *Flower* is leſs. and *Gooſberries* and *Currans*, which are ſtill more Pulpy, and the courſe of the *Sap* towards them more free, have yet a *Flower* far leſs. And *Grapes*, whoſe *Sap* is ſtill of quicker Aſcent, have ſcarce any *Flower* at all; only ſome ſmall reſemblance thereof, ſerving juſt upon the ſetting of the *Fruit*, and no longer.

13. §. THE ATTIRE, I find to be of two kinds, *Seminiforme*, and *Florid*. That which I call *Seminiforme*, is made up of two general *Parts*, *Chives* and *Semets*, one upon each *Chive*. Theſe *Semets* (as I take leave to call them) have the appearance, eſpecially in many *Flowers*, of ſo many little *Seeds*: but are quite another kind of *Body*. For, upon enquiry, we find, that theſe *Semets*, though they ſeem to be

be ſolid, and for ſome time after their firſt formation, are entire; yet are they really hollow; and their ſide, or ſides, which were at firſt entire, at length crack aſunder: And that moreover the *Concave* of each *Semet* is not a meer vacuity, but fill'd up with a number of minute Particles, in form of a *Powder*. Which, though common to all *Semets*, yet in ſome, and particularly thoſe of a *Tulip* or a *Lilly*, being larger, *Tab.* 4 *f.* 12. is more diſtinctly obſervable.

14. §. Theſe *Semets* are ſomtimes faſtned ſo, as to ſtand erect above their *Chive*, as thoſe of *Larks-heel*. Somtimes, and I think uſually, ſo as to hang a little down by the midle, in the manner and figure of a *Kidney*; as in *Mallows*. Their *Cleft* or *Crack* is ſometimes ſingle, but for the moſt part double: At theſe *Clefts* it is that they disburſe *f.* 12. -a. their *Powders*; which as they ſtart out, and ſtand betwixt the two Lips of each *Cleft*, have ſome reſemblance to the common Sculpture of a *Pomegranate* with its *Seeds* looking out at the *Cleft* of its *Rind*. This muſt be obſerv'd when the *Clefts* are recently made, which uſually is before the expanſion of the *Flower*.

15. §. The Particles of theſe *Powders*, though like thoſe of Meal or other Duſt, they appear not eaſily to have any relugar ſhape; yet upon ſtrict obſervation, eſpecially with the aſſiſtance of an indifferent *Glaſs*, it doth appear, That they are a *Congeries*, uſually, of ſo many perfect *Globes* or *Globulets*; Sometimes of other *Figures*, but always regular. That which obſcures their *Figure* is their being ſo ſmall: In *Dogs-Mercury*, *Borage*, and very many more *Plants*, they are extreamly ſo. In *Mallows*, and ſome others, more fairly viſible.

16. §. Some of theſe *Powders*, are *yellow*, as in *Dogs-Mercury*, *Goats-Rue*, &c. and ſome of other Colours: But moſt of them I think are *white*; and thoſe of *yellow Henbane* very elegant; the disburs'd *Powers* whereof, to the naked eye, are *white* as *Snow*; but each *Globulet*, through a Glaſs, tranſparent as Cryſtal; which is not a fallacy from the *Glaſs*, but what we ſee in all tranſparent *Bodies* whatſoever, lying in a *Powder* or ſmall Particles together The Parts of this *Attire*, ſee in *Tab.* 4. But eſpecially, in the *Figures* belonging to the *Second* Part of the *Fourth* Book.

17. §. The *Florid Attire*, is commonly known by the blind and rude Name of *Thrums*; as in the *Flowers* of *Marigold*, *Tanſie*, &c. How in adequate its impoſition is, obſervation will determine. For the ſeveral *Thrums* or rather *Suits*, whereof the *Attire* is made up, however elſe they may differ in various *Flowers*, in this agree, that they are ever conſiſtentof more than one, ſometimes of Two, and for *Tab.* 4. *f.* 13. a. the moſt part of Three *Pieces* (for which I call them *Suits*) and each *Piece* of a different, but agreeable and comely form.

18. §. The *outer Part* of every *Suit*, is its *Floret*: whoſe *Body* or *Tube* is divided at the top (like that of the *Cowſlip*) into five diſtinct *Leaves*. So that a *Floret*, is the Epitome of a *Flower*: and *f.* 13. b. is all the *Flower* that many *Plants*, as *Mugwort*, *Tanſie*, and others, have. What the Learned Sir *Thomas Brown* obſerveth of the Treat. of the *Quincunx*. number *Five*, as to the *Leaves* of the *Flower*, is ſtill more univerſally holding in theſe of the *Floret*.

19. §. Upon the Expanſion of the *Floret*; the next *Part* of the *Suit* is from within its *Tube* brought to ſight; which we may (with reſpect to that within it) call the *Sheath*. For this alſo, like the *Floret*, *f.* 13. c.

is

is a *Concave Body*; in its ſhape very well reſembling the Fiſtulous Pouches of *Wake-Robin*, or of *Dragon*.

20. §. The *Sheath*, after ſome time, dividing at the top, from within its Concave the Third and innermoſt part of the *Suit*, *ſc.* the *Blade* advanceth and diſplayes it ſelf. This Part is not hollow, as the other two, but ſolid; yet at its Point, is commonly, divided into two halves. *Tab.4.f* 13.d

21. §. About the ſaid Point eſpecially, there appears, *Globulets*, which are of the ſame nature with thoſe of a *Semet*, though not ſo copious. So that all *Flowers* have their *Powders* or *Globulets*. The whole *Attire* may in *After Per*, *Blewbottle*, &c. where the *Suits* are large, be plainly obſerved without a *Glaſs*. The *Parts* of this *Attire*, See in *Tab.* 4. But eſpecially in the *Figures* belonging to the *Second* Part of the *Fourth* Book.

22. §. The uſe of the *Attire*, how contemptibly ſoever we may look upon it, is certainly great. And though for our own uſe we value the *Leaves* of the *Flower*, or the *Foliation*, moſt; yet of all the three *Parts*, this in ſome reſpects is the choyceſt, as for whoſe ſake and ſervice the other two are made. The uſe hereof, as to *Ornament* and *Diſtinction*, is unqueſtionable; but is not all. As for Diſtinction, though, by the help of *Glaſſes*, we may make it to extend far; yet in a paſſant view, which is all we uſually make, we cannot ſo well. As for Ornament, and particularly in reference to the *Semets*, we may ask, If for that meerly theſe were meant, then why ſhould they be ſo made as to break open, or to contain any thing within them? Since their Beauty would be as good if they were not hollow; and is better before they crack and burſt open, than afterwards.

23. §. Other uſes hereof therefore we muſt acknowledge, and may obſerve. One is, for food; for Ornament and Diſtinction to us, and for *Food* to other *Animals*. I will not ſay, but that it may ſerve even to theſe for Diſtinction too, that they may be able to know one *Plant* from another, and in their flight or progreſs ſettle where they like beſt: and that therefore the varieties of theſe ſmall parts are many, and well obſerved by them, which we take no notice of. Yet the finding out of Food is but in order to enjoy it: Which, that it is provided for a vaſt number of little *Animals* in the *Attires* of all *Flowers*, obſervation perſwades us to believe. For why elſe are they evermore here found? Go from one *Flower* to another, great and ſmall, you ſhall meet with none untaken up with theſe Gueſts. In ſome, and particularly the *Sun-Flower*, where the parts of the *Attire*, and the *Animals* for which they provide, are larger, the matter is more viſible. We muſt not think, that *God Almighty* hath left any of the whole Family of his Creatures unprovided for; but as the Great Maſter, ſome where or other carveth out to all; and that for a great number of theſe little Folk, He hath ſtored up their peculiar proviſions in the *Attires* of *Flowers*; each *Flower* thus becoming their Lodging and their Dining-Room, both in one.

24. §. Wherein the particular parts of the *Attire* may be more diſtinctly ſerviceable, this to one *Animal*, and that to another, I cannot ſay: Or, to the ſame *Animal*, as a *Bee*, whether this for the *Honey*, another for their *Bread*, a third for the *Wax*: Or whether all only ſuck from

from hence ſome *Juice*; or ſome may not alſo carry ſome of the *Parts*, as of the *Globulets*, wholly away.

25. §. Or laſtly, what may be the Primary and Private Uſe of the *Attire* (for even this aboveſaid, though great, yet is but Secondary) I now determine not.

CHAP. VI.

Of the FRUIT.

THE general compoſition of all *Fruits* is one, that is, their *Eſſential* and truly *Vital Parts*, are in all the ſame, and but the continuation of thoſe which in the other *Parts* of a *Plant*, we have already obſerved. Yet becauſe by the different *Conſtitutions* and *Tinctures* of theſe *Parts*, divers conſiderably different *Fruits* reſult; I ſhall therefore take aparticular view of the more known and principal of them, *ſc. Apples*, *Pears*, *Plums*, *Nuts* and *Berries*.

2. §. AN APPLE, if cut traverſe, appears conſtitued of four diſtinct *Parts*, the *Pilling*, the *Parenchyma*, *Branchery*, and *Coare*. The *Pilling* is only the ſpreading and dilatation of the *Skin*, or utmoſt part of the *Barque* in the *Branch*. The *Parenchyma*, when full ripe, is a tender delicate Meat. Yet as the *Pilling* is but the Continuation of the utmoſt part of the *Barque*; ſo is this, but the continuance and ampliation, or (as I may call it) the ſwelth and ſuperbience of the *Inner Part* thereof; which upon obſervation of a young and Infant-*Apple* eſpecially, is evident. Thus we ſee the *Pith*, which is often tough; in many *Roots*, as *Parſneps*, *Turneps*, &c. is tender and edible. So here, the *Parenchyma*, though originally no more than the *Barque*, yet the copiouſneſs and purity of its *Sap* being likewiſe effectual to the largneſs and fineneſs of its growth, it thus becomes a ſoft and tender meat. The *Branchery* is nothing elſe but the Ramifications of the *Lignous Body* throughout all the parts of the *Parenchyma*; the greater *Branches* being likewiſe by the *Inoſculations* of the leſs (as in the *Leaf*) united together. The main *Branches* are uſually Twenty: Ten are ſpred and diſtributed through the *Parenchyma*, moſt of them enarching themſelves towards the *Cork* or *Stool* of the *Flower*: The other Ten, running from the *Stalk* in a directer Line, at laſt meet the former at the ſaid *Cork*; and are there oſculated with them. Of theſe latter, five are originated from one; which running along the Center of the *Stalk*, and part of the *Parenchyma* of the *Fruit*, is therein at laſt divided. To theſe the Coats of the *Kernels* are faſtned. So that whereas moſt of theſe *Branches* were originally extended even beyond the *Fruit*, and inſerted into the *Flower* for the due growth there-

thereof; the *Fruit* afterwards growing to ſome head, and ſo intercepting and preying upon the *Aliment* of the *Flower*, ſtarves that and therefrom ſuperſedes the ſervice of the ſaid *Branches* to it ſelf, fifteen for its *Parenchyma*, and five for its *Seed*. The *Coar* is originated from the *Pith*; for the *Sap* finding room enough in the *Parenchyma*, through which to diſpence it ſelf all abroad, quits the *Pith*, which thereby hardens into a *Coar*. Thus we ſee the *Inſertions*, although originate from the *Cortical Body*, yet their *Parts* being, by the *Inoſculations* of the *Lignous*, ſo much compreſs'd and made to co-incide together, they become a *Body* very compact and denſe. And in the *Barque* the ſame thing is effected by *Arefaction* only, or a meer *voydance* of the *Sap*; the *Inner Part* whereof, though ſoft and ſappy, yet its ſuperficial *Rind* is often ſo hard and ſmooth, that it may be fairly writ upon. The *Parts* of an *Apple*, See in the *Figures* belonging to the *Third* Part of the *Fourth* Book.

3. §. IN A PEAR there are five diſtinct *Parts*, the *Pilling*, the *Parenchyma*, *Branchery*, *Calculary*, and *Acetary*. The three former are here and in an *Apple* much alike; ſaving that here the *Inner* or *Seed-Branches* ordinarily ſtand double. The *Calculary* (moſt obſervable in rough-taſted, or *Choak-Pears*) is a *Congeries* of little ſtony *Knots*. They are many of them diſperſed throughout the whole *Parenchyma*: But lying more continuous and compact together towards the Center of the *Pear*, ſurround the *Acetary* there, in a ſomewhat Globular Form. About the *Stalk* they ſtand more diſtant; but towards the *Cork* or *Stool* of the *Flower*, they ſtill grow cloſer, and there at laſt gather (almoſt) into the firmitude of a *Plum-ſtone* it ſelf. Within this lies the *Acetary*; 'tis allways ſour, and by the bounding of the *Calculary* of a *Globular Figure*. 'Tis a ſimple *Body*, having neither any of the *Lignous* branched in it, nor any *Calculous Knots*. It is of the ſame ſubſtantial nature with the outer *Parenchyma*; but whether it be abſolutely one with it, or be derived immediately from the *Pith*, my Enquiries yet made, determine not. *Tab.4.f.14.*

4. §. The Original of the *Calculary* I ſeem to have neglected. But hereof we may here beſt ſay, that whereas all the other *Parts* are *Eſſential* and truly *Vital*; the *Calculary* is not: but that the ſeveral *Knots* whereof it conſiſts, are only ſo many meer *Concretions* or *Precipitations* out of the *Sap*; as in *Urines*, *Wines*, and other *Liquors*, we often ſee. And that the *Precipitation* is made by the mixture and re-action of the *Tinctures* of the *Lignous* and *Cortical Bodies* upon each other: Even as all *Vegetable Nutrition* or *Fixation* of *Parts* is alſo made by the joynt efficiency of the two ſame *Tinctures*, as hath been ſaid. Hence we find, that as the *Acetary* hath no *Branches* of the *Lignous Body*, ſo neither hath it any *Knots*. Hence likewiſe it is, that we have ſo different and contrary a taſt in the *Parenchyma* beyond the *Calculary*, from that in the *Acetary*: For whereas this is ſour, that, wherein the ſaid *Precipitations* are made, is ſweet; being much alike effect to what we find in mixing of *Corals*, &c. with *Vinegar* or other *acid Liquors*. The *Parts* of a *Pear*, See in *Tab.* 4. But eſpecially in the *Figures* belonging to the *Third* Part of the *Fourth* Book.

5. §. IN A PLUM (to which the *Cherry*, *Apricot*, *Peach*, *Walnut*, &c. ought to be referr'd) there are four distinct *Parts*, the *Pilling*, the *Parenchyma*, *Branchery* and *Stone*. The *Pilling* and *Parenchyma* are, as to their Original, with those of an *Apple* or *Pear*, both alike. As likewise the *Brunchery*; but differently ramified. In *Plums* (I suppose all) there are five main *Out-Branches*, which run along the Surface of the *Stone* from the *Basis* to the point thereof, four of them by
Tab. 4. *f.* 15. one *Ridge*, and one by the other opposite to it. In an *Apricot* there is the same number, but the single *Branch* runs not upon the *Surface*, but through the *Body* of the *Stone*. There are likewise two or three smaller *Branches*, which run in like manner under the other *Ridge* for some space, and then advancing into the *Parenchyma*, therein disperse themselves: These latter sort in *Peaches* are numerous throughout.

6. §. But notwithstanding the different disposition of the *Branches* of the *Fruits* aforesaid; yet is there one *Branch* dispos'd in one and the same manner in them all. The entrance hereof into the *Stone* is at its *Basis*; from whence running through its Body, and still inclining
Tab. 4. *f.* 15. or arching it self towards its *Concave*, is at last, about its *Cone*, thereinto emergent, where the *Coats* of the *Seed* are appendent to it. Of the *Seed-Branch* 'tis therefore observable that after its entrance into the *Fruit*, 'tis always prolonged therein to a considerable length; as is seen not only in *Apples*, &c. where the *Seed* stands a good distance from the *Stalk*; but in *Plums* likewise, where it stands very near it; in that here the *Seed-Branch*, as is said, never strikes through the *Stone* into the *Coats* of the *Seed* directly, but runs through a *Chanel* cut in the *Stone*, till it issues, near the *Cone*, into the *Concave* thereof.

7. §. The *Stone* though it seem a simple Body, yet it is compounded of different ones. The Inner *Part* thereof, as it is by far the thinnest, so is it the most *dense*, *white*, *smooth* and *simple*. The Original is from the *Pith*; difficult, but curious to observe: For the *Seed-Branch*, not striking directly and immediately quite through the *Basis* of the *Stone*, but in the manner as is above described, carries a considerable *Part* of the *Pith*, now gather'd round about it, as its *Parenchyma*, along with it self; which upon its entrance into the concave of the *Stone* about its farther end, is there in part spread all over it, as the *Lining* thereof. The outer and very much thicker *Part*, consisteth partly of the like *Precipitations* or concrete Particles, as in a *Pear*; being gathered here much more closely, not only to a *Contiguity*, but a *Coalition* into one entire *Stone*; as we see in *Pears* themselves, especially towards the *Cork*, they gather into the like Stoniness; or as a *Stone*, *Mineral*, or *Animal*, is oftentimes the product of accumulated *Gravel*. But as the *Parenchyma* is mixed with the *Concretions* in the *Calculary*, so is it also, though not visibly, with these in the *Stone*, the *ground* of the *Stone* being indeed a perfect *Parenchyma*; but by the said *Concretions* so far alter'd, as to become dry, hard and undistinguishable from them. All which Particulars, are observable only in the several degrees of *Growth* in the young *Fruit*. And are represented in *Tab.* 4. But especially by the several *Figures* belonging to the *Third* and *Fourth* Parts of the *Fourth* Book.

8. §.

8. §. IN A NUT (to which an *Akern* is analogous) there are three general *Parts*, the *Cap*, *Shell*, and *Pith*. The *Cap* is constituted of a *Pilling* and *Parenchyma*, derived from the *Barque*; and *Ramulets* from the *Lignous Body* of the *Branch*. The *Shell* likewise is not one simple Body, but compounded. The Superficial *Part* thereof is originated from the *Pilling* or *Skin* of the *Cap*, from the inside whereof it is, in a Duplicature, produc'd and spred over the *Shell*. Which, if you look at the *Basis* of the *Shell*, is farther evident: for that being continuous with the *Parenchyma* of the *Cap*, without the interposure of the *Skin*, the said superficial *Part* is there wanting. The thicker and inner *Part* of the *Shell* consisteth of the same *Parenchyma* as that of the *Cap*, with a *Congeries* of *Precipitations* filled up, as in a *Stone*. And as the *Lignous Body* is branched in a *Stone*, so, with some difference, in a *Shell*. The *outer Branches* or *Ramulets* are numerous, each issuing out of the *Parenchyma* of the *Cap*, and entring the *Shell* at the *Circumference* of its *Basis*, and so running betwixt its superficial and inner *Parts* towards the *Cone*, round about. The *Inner* or *Seed-Branch* is single, entring in, as do the other, at the *Basis* of the *Shell*, but at the *Center* thereof: from whence it runs, not through the *Shell*, as in *Plums* through the *Stone*; but through the *Pith*, as far as the *Cone*, where the *Coats* of the *Seed* hang appendent to it. The *Pith* whether derived from the same part both in name and nature in the *Branch* and *Stalk*; or from the *Cortical Body*, I yet determine not. The *Parts* of a *Nut*, See in the *Figures* belonging to the *Third* Part of the *Fourth* Book.

9. §. A BERRY, as a *Gooseberry* (to which *Corinths*, *Grapes Hips*, &c. are to be referr'd) consisteth, besides the *Seed*, of the three general *Parts*, *Pilling*, *Parenchyma* and *Branchery*. The *Pilling* is originated as in the foregoing *Fruits*. The *Parenchyma* is double, as likewise in some other *Berries*. The *outer* is commonly, together with the *Pilling*, call'd the *Skin*, and is that part we spit out, being of a sour tast. Now as the *Pilling* is originated from the *outer*, so this from the *inner Part* of the *Barque*; and accordingly the *Pores* thereof may be observed plainly of a like shape with those both of the *Cortical Body* and *Pith*. The *Inner* or *Pulp* is of a sweet taste, and is the *Part* we eat: It is of a Substance so laxe and tender, as it would seem to be only a thicker or jellied *Juice*; although this likewise be a true *Parenchyma*, something like that of an *Orange* or *Limon*, with its *Pores* all fill'd up with *Liquor*. The *Branchery* is likewise double: The *Exterior* runs betwixt the *Pilling* and *Outer Parenchyma* in arched *Lines*, from the *Stalk* to the *Stool* of the *Flower*. These *outer Branches*, though of various number at the *Stalk*, yet at the *Cork* are usually ten principal ones; five for the five *Leaves* of the *Flower*, and five for the *Attire*. The *Inner main Branches* are two, diametrically opposite to each other, and at the *Cork* with the other inosculated. From these two are branched other smaller, every one having a *Seed* appendent to it, whose *Coats* it entreth by a double *Filament*, one at the *Basis*, the other at the *Cone*. They are all very white and turgent, and by a slaunt cut, may be observ'd concave; thus representing themselves analogous to so many true *Spermatick Vessels*. The

Parts of a *Gooſeberry*, See in the *Figures* belonging to the *Third* Part of the *Fourth* Book.

10. §. The Uſes of *Fruits* are for *Man*, (ſometimes alſo other *Animals*, as are *Akerns* and *Haws*) and for the *Seed*. For *Man*, they are ſo variouſly deſirable, that till our *Orchards* and *Store-Chambers*, *Confectioners-Stoves* and *Apothecaries-Shops*, our *Ladies Cloſets*, their *Tables* or *Hands* are empty of them, I ſhall not need to enquire for what. If it be asked, how the *Fruit* becomes, generally above all the other *Parts*, ſo pleaſant a Meat? It is partly from the *Sap*, the groſſer portion thereof being depoſited in the *Leaves*, and ſo the purer hereunto reſerved. Partly from the *Globular Figure* of the *Fruit*. For the *Sap* being thus in a greater quantity herein, and in all Parts equally diffus'd, the *Concoction* hereof, as in a *Veſſel*, is with greateſt advantage favoured and promoted. Wherefore all *Fruits*, which we eat raw, how ſmall ſoever, are of a *Globular* Form, or thereunto approaching; and the nearer, the delicater; amongſt *Apples*, the *Pipin*; amongſt *Pears*, the *Burgundian*; and amongſt all *Fruits*, the *Grape*; and amongſt *Grapes*, the roundeſt, are of all, the moſt dainty.

11. §. The viſible cauſe of this *Globular Figure*, is the *Flower*; or the Inoſculation of all the main *Branches* at the *Stool* of the *Flower*; and upon the fall of the *Flower*, the obtuſeneſs, and with *Wind* and *Sun*, as it were the *ſeaing* of their ſeveral ends: For thus the *Sap* entering the *Fruit*, being not able to effect, either a *Diſunion*, or a *ſhooting* forth of the ſaid *Branches*, and ſo to carry on their *Growth* in length; they muſt of neceſſity be enarch'd, and with the *Parenchyma* more and more expand themſelves. Whereas were they diſpoſed and qualified otherwiſe, than as is ſaid; inſtead of forming a *Fruit* within bounds, they would run out into all extravagance, and even into another little *Tree* or *Leafy Growth*.

12. §. To the *Seed*, the *Fruit* is ſerviceable; Firſt, in order to its being ſupply'd with a due and moſt convenient *Sap*, the greater part thereof, and that which is leſs elaborated, being, in its paſſage towards the *Seed*, thereinto received; the *Fruit* doing the ſame office to the *Seed*, which the *Leaves* do to the *Fruit*; the *Sap* in the *Fruit* being, in a laxe compariſon, as the *Wine*; and that for the *Seed*, a ſmall part of the higheſt Spirit rectified from it.

13. §. So likewiſe for its Protection, in order to the proſperous carrying on and perfecting of its generation, and ſecurity being perfected. Which protection it gives not only to the Seminal *Sap* and *Seed* it ſelf, but ever alſo to its *Seed-Branch*. Thus we ſee an *Apple*, beſides that it is it ſelf of ample compaſs, for the ſake of its *Seed*, hath likewiſe its *Coar*; as if it were not ſufficient, that the Walls of their Room are ſo very thick, unleſs alſo *wainſcoated*. In a *Pear* again, where the *Parenchyma* is of leſs compaſs than that of an *Apple*, to what protection this affords, that of the *Calculary* is ſuper-added. But in a *Plum*, where the *Parenchyma* is exceeding tender, and in a *Peach*, which hangs late, and till Autumn Froſts approach, we have not only the Rubbiſh of a *Calculary*, but ſtout Stone-Walls. Within which alſo, not only the *Seed* it ſelf, but the *Seed-Branch* is evermore immur'd. Laſtly, in a *Nut*, where the *Shell* being not ſurrounded with a *Parenchyma*, that protection is wanting without, 'tis anſwer'd by an ample

Pith

Pith within it; and the *Seed-Branch* likewise included, not meerly in the *Body* of the *Shell*, as in a *Plum*, but within the *Pith* it self. So neceſſary is this deſign, that what the Hen by Incubation or Hovering, is to the Egg or Chick; that the whole *Fruit*, by comprehenſion, is to the *Seed*.

CHAP. VII.

Of the SEED, in its State of Generation.

AS the Original, ſo the Ultimate end and Perfection of *Vegetation* is the *Seed*. How it is the former, and in its ſtate apt for *Vegetation*, hath already been ſeen. How the latter, and in its ſtate of Generation, we ſhall now laſtly enquire. In doing which, what in the other ſtate, was either not diſtinctly exiſtent, or not ſo apparent, or not ſo intelligible, will occur.

2. §. The two general *Parts* of the *Seed* are its *Covers* and *Body*. The *Covers* in this eſtate are uſually *Four*. The outmoſt, we may call the *Caſe*. 'Tis of a very various form; ſometimes a *Pouch*, as in *Naſturtium*, *Cochlearia*; a *Cod*, as in all *Pulſe*, *Galega*; ſometimes not entire, but parted, or otherwiſe open, as in *Sorrel*, *Knotgraſs*; with many other forms: I think alwaies more heterogeneous to that of the *Seed*, by which it differs from the proper *Coats*. To this the *Caps* of *Nuts*, and the *Parenchyma's* of other *Fruits* are analogous.

3. §. The two next are properly the *Coats*. In a *Bean* eſpecially, and the like; from whence, to avoyd Confuſion, the denomination may run common to the reſponding *Covers* of other *Seeds*. The Colour of the outer, is of all degrees, from White to the Blackneſs of *Jett*. It's Figure ſometimes Kidney'd, as in *Alcea*, *Behen*, *Poppy*; Triangular, as in *Polygonatum*, *Sorrel*; Spherically triangular, in *Mentha*, *Meliſſa*; Circular, in *Leucoium*, *Amaranthus*; Globular, in *Napus*, *Aſperula*; Oval, in *Speculum Veneris*, *Tithymalus*; half Globe, in *Coriander*; that which we take for *one* ſingle round *Seed*, being a Conjugation of *two*; half Oval, in *Aniſe*, *Fennel*; Haſtal, in *Lactuca*; Cylindrical, as, if I miſtake not, in *Jacobæa*; Pyramidal, in *Geranium Althææ fol.* with many other differences. But the Perfection of one or two of the ſaid Figures lieth in the *Caſe*. So that, as all *Lines* and *Proportions* are in the *Leaf* and *Flower*; ſo all Regular *Solids* in the *Seed*; or rather in its *Covers*.

4. §. 'Tis ſometimes gliſtering, as in *Speculun Veneris*; Rough-caſt, in *Catanance*; Studded, in *Behen*, *Balttaria*; Favous, in *Papaver*, *Antirrhinum*, *Lepidum annuum*, *Alcea Veſicaria*, *Hyoſcyamus*, and many more, before the *Seeds* have lain long by; Pounced, in *Phalangium Cretæ*, *Lithoſpermum*; Ramified, in *Pentaphyllum fragiferum Erectum majus*, reſembling

reſembling the *Fibers* of the *Ears* of the *Heart*; ſome juſt *Quinquenerval*, as in *Aniſum*, and many more, the *Lignous Body* being in five main *Fibers* branched therein. The *Figures*, and *Surface*, of Theſe, and other *Seeds*, See in the Tables belonging to the *Fourth* Part of the *Fourth* Book.

5. §. The *Covers* of not only *Quince-Seeds*, and thoſe of *Pſyllium* (more uſually taken notice of) but thoſe alſo of *Horminum*, *Naſturtium*, *Eruca*, *Camelina*, *Ocymum*, and divers others, have a *Mucilage*. Which, though it be not viſible when the *Seeds* are throughly dry; yet lying a while in ſome warm Liquor, or only on the Tongue, it ſwells more or leſs, and upon them all fairly ſhews it ſelf, On that of *Ocymum* it appears grayiſh; on the other, tranſparent; and on that of *Naſturtium Hortenſe* very large; even emulous of the inner Pulp ſurrounding a *Gooſeberry-Seed*. The putting of *Clary-ſeed* into the Eye, may have been brought into uſe from this *Mucilage*, by which alone it may become Medicinal. And thus far of the *Superficies*,

6. §. The *nature* of the outer *Coat* is alſo various, *Membranous*, *Cartilaginous* and *Stony*; the like *Precipitations* being ſometimes made herein, as in a *Stone* or *Shell*; as in that of the *Seeds* of *Carthamum*, *Lithoſpermum* and others. The Deſignment hereof, being either with reſpect to the *Seed* in its ſtate of Generation; as where the *Caſe* is either wanting, or at leaſt inſufficient of it ſelf, there for its due protection and warmth. Or, in its ſtate of *Vegetation*, for the better Fermenting of its *Tinctures* and *Sap*; the Fermentations of ſome *Seeds* not well proceeding, unleſs they lie in their *Stony Casks* in the Ground, like Bottled Liquors in Sand.

7. §. All *Seeds* have their outer *Covers* open; either by a particular *Foramen*, as in *Beans*, and other *Pulſe*, as is ſaid; or by the breaking off of the *Seed* from its *Peduncle* or *Stool*, as in thoſe in *Cucumber*, *Cichory*; or by the entering and paſſage of a *Branch* or *Branches*, not only into the Concave thereof near the Cone, but alſo through the Cone it ſelf; as in *Shells* and *Stones*.

8. §. For the ſake of this *aperture* it is, that *Akerns*, *Nuts*, *Beans*, *Cucumbers*, and moſt other *Seeds*, are in their formation ſo placed, that the *Radicle* ſtill ſtandeth next to it; That So, upon *Vegetation*, it may have a free and ready paſſage into the Mould.

9. §. The Original of the outer *Coat*, though from Parts of the ſame ſubſtantial nature, yet is differently made. In a *Plum*, the *Seed-Branch* which runns, as is deſcribed, through the *Stone*, is not naked, but, as is ſaid, inveſted with a thin *Parenchyma*, which it carries from the *Stalk* along with it; and which, by the *Ramification* of the ſaid *Branch* within the *Stone*, is, in part, dilated into a *Coat*. That of a *Bean* is from the *Parenchyma* of the *Cod*; the ſuperficial part of which *Parenchyma*, upon the large *peduncle* of the *Bean* becoming a thin *Cuticle*, and upon the *Bean* it ſelf a *Cartilaginous Coat*.

10. §. The Original of the inner *Coat* of the *Bean* is likewiſe from the inner part of the ſaid *Parenchyma*; which firſt is ſpred into a long *Cake*, or that which with the *Seed-Branch* maketh the *Penduncle* of the *Bean*; under which *Cake*, there is uſually a black part or ſpot; by the length of which, the inner part of the *Cake* is next inſerted into the outer *Coat*, and ſpred all over the Concave thereof, and ſo becomes the inner.

11. §.

11 §. Of this Inner *Coat* it is very obſervable, That allthough when the *Seed* is grown old and dry, 'tis ſhrunk up, and in moſt *Seeds*, ſo far, as ſcarcely to be diſcern'd; yet in its firſt and juvenile Conſtitution, it is a very Spongy and Sappy body; and is then likewiſe (as the *Womb* in a Pregnant *Animal*) in proportion, very thick and bulky. In a *Bean*, even as one of the *Lobes* it ſelf: And in a *Plum* or *Apricot*, I think I may ſafely ſay, half an hundred times thicker than afterwards, when it is dried and ſhrunk up, and can ſcarcely be diſtinguiſhed from the upper *Coat*. Upon which Accounts it is, in this eſtate a true and fair *Parenchyma*. The Delineation hereof, See in the *Figures* belonging to the *Fourth* Part of the *Fourth* Book.

12. §. In this Inner *Coat* in a *Bean*, the *Lignous Body* or *Seed-Branch* is diſtributed: Sometimes, as in *French-Beans*, throughout the whole *Coat*, as it is in a *Leaf*. In the Great *Garden-Bean*, upon its firſt entrance, it is bipartite, and ſo in ſmall *Branches* runs along the *Circumference* of the *Coat*, all meeting and making a kind of *Reticulation* againſt the Belly of the *Bean*. In the ſame manner the main *Branches* in the outer *Coat* of a *Kernel*, circling themſelves on both hands from the place of their firſt entrance, at laſt meet, and mutually inoſculate; as the *Veins* in the *Kidneys* of a Man or any *Quadrupede*; Or the *Carotick Arteries* in the *Braine*.

13. §. So that all the *Parts* of a *Vegetable*, the *Root*, *Trunk*, *Branch*, *Leaf*, *Flower*, *Fruit* and *Seed*, are ſtill made up of *Two* Subſtantially different Bodies.

14. §. And as every *Part* hath *Two*, ſo the whole *Vegetable* taken together, is a compoſition of *Two* only, and no more: All properly *Woody Parts*, *Strings* and *Fibers*, are *One Body*: All ſimple *Barques*, *Piths*, *Parenchyma's* and *Pulps*, and as to their ſubſtantial Nature, *Pills* and *Skins* likewiſe, all but *One Body*: the ſeveral *Parts* of a *Vegetable* all differing from each other, only by the various *Proportions* and *Mixtures*, and variated *Pores* and *Structure* of theſe *Two Bodies*. What from theſe two general Obſervations might reaſonably be inferr'd, I ſhall not now mention.

15. §. The Fourth or Innermoſt *Cover* we may call the *Secondine*. The ſight of which, by cutting off the *Coats* of an *Infant-Bean*, at the Cone thereof, in very thin Slices, and with great Caution, may be obtain'd. While unbroken, 'tis tranſparent; being torn and taken off, it gathers up into the likeneſs of a Jelly, or that we call the *Tredle* of an Egg, when rear-boyl'd. This *Membrance* in larger or elder *Beans*, is not to be found diſtinct. But (as far as our Enquiries yet diſcover) it may in moſt other *Seeds*, even full grown, be diſtinctly ſeen; as in thoſe of *Cucumber*, *Colocynthis*, *Burdock*, *Carthamum*, *Gromwel*, *Endive*, *Mallows*, &c. 'Tis uſually ſo very thin, as in the above-nam'd, as very difficultly to be diſcover'd. But in ſome *Kernels*, as of *Apricots*, 'tis very thick; and moſt remarquably ſuch, in ſome other *Seeds*. That all theſe have the Analogy of one and the ſame *Cover*, which I call the *Secondine*, is moſt probably argu'd from their alike Natures; being all of them plain ſimple *Membranes*, with not the leaſt *Fibre* of the *Lignous Body* or *Seed Branch*, viſibly diſtributed in them: As alſo from their Texture, which is in all of them more cloſe. See this *Part* in *Tab.* 4. As alſo amongſt the *Figures* belonging to the *Fourth* Part of the *Fourth* Book. *Tab.* 4. *f.* 16.

16. §.

16. §. The *Concave* of this *Membrane* is filled with a moſt tranſparent *Liquor*, out of which the *Seed* is formed; as in cutting a *petite* and *Infant-Bean*, may be ſeen; and yet better in a young *Walnut*. In *Beans* I have obſerved it to turn, upon boyling, into a tender white *Coagulum*.

17. §. Through this *Membrane*, the *Lignous Body* or *Seed-Branches* diſtributed in the inner *Coat*, at laſt ſhoot downright two ſlender *Fibres*, like two *Navel-ſtrings*, one into each *Lobe* of the *Bean*. *Tab.* 4. *f.*18. The places where the ſaid *Fibres* ſhoot into the *Lobes*, are near the *Baſis* of the *Radicle*; and by their *Blackiſhneſs* well enough remark'd: but the *Fibers* themſelves are ſo very ſmall, as ſcarcely to be diſcern'd. Yet in a *Lupine*, of the larger kind, both the *places* where the *Navel-Fibres* ſhoot into the *Lobes* (which here from the *Baſis* of the *Radicle* is more remote) and the *Fibres* themſelves, are fairly viſible. For the *Seed-Branch*, upon its entrance into the *Coat* of the *Lupine*, is preſently divided into two *main Branches*, and thoſe two into other leſs; whereof ſome underly, others aloft, run along the *Coat*, and towards its other end meet and are inoſculated: where about, two oppoſite, *Tab.* 4. *f.*17. ſhallow, round, and moſt minute *Cavities*, anſwerable to two *Specks* of a *Cartilaginous* gloſs, one in either *Lobe*, may be obſerved; which *Specks* are the ends of the ſaid *Navel-Fibres*, upon the ripening of the *Seed* there broken off. Theſe *Fibres* from the *Superficies* of each *Lobe*, deſcend a little way directly down: preſently, each is divided into *Tab.* 4. *f.*18. two *Branches*, one diſtributed into the *Lobes*, the other into the *Radicle* and *Plume*, in the manner as in the *Firſt Chapter* is deſcribed. And thus far the Hiſtory. I ſhall now only with a brief account of the *Generation* of the *Seed*, as hereupon dependent, conclude this Diſcourſe.

An Account of the *Generation* of the *Seed*.

18. §. LET US ſay then, that the *Sap* having in the *Root*, *Trunk* and *Leaves*, paſſed divers *Concoctions* and *Separations*, in the manner as they are ſaid to be perform'd therein; 'tis now at laſt, in ſome good maturity, advanced towards the *Seed*.

19. §. The more copious and cruder part hereof is again ſeparated by a free reception into the *Fruit*, or other *Part* analogous to it: being either ſufficiently ample to contain it, or at leaſt laxe enough for its tranſpiration, and ſo its due diſcharge. The more Eſſential part is into the *Seed-Branch* or *Branches* entertian'd. Which, becauſe they are evermore of a very conſiderable length, and of a Conſtitution very fine, the ſaid *Sap* thus becomes in its Current therein as in the *Spermatick Veſſels*, ſtill more mature.

20. § In this mature eſtate, from the *Seed-Branch* into the *Coats* of the *Seed*, as into the *Womb*, 'tis next delivered up. The meaner part hereof again, to the *Outer*, as *Aliment* good enough, is ſupplied. The finer part is tranſmitted to the *Inner*; which being, as is ſaid, a *Parenechymous* and more ſpatious *Body*, the *Sap* therefore is not herein, as in the *Outer*, a meer *Aliment*; but in order to its being, by *Fermentation*, farther prepared.

21. §. Yet the Outer *Coat*, being on the contray hard and denſe; for that reaſon, as it admitteth not the Fermentation of the *Sap* ſo well within it ſelf; ſo doth it the more promote and favour it in the Inner; being Bounds both to it and its *Sap*; and alſo quickneth the *proceſs* of the whole Work in the formation of the *Seed*.

22 §.

22. §. Nor doth the Outer *Coat*, for the ſame reaſon, more promote, than declare the purity of the *Sap* now contained in the Inner: For being more hard and denſe, and ſo not perſpirable, muſt needs ſuppoſe the Parts of the *Sap* encompaſſed by it, ſince thus uncapable of any evacuation, to be therefore all ſo choice, as not to need it.

23. §. The *Sap* being thus prepared in the Inner *Coat*, as a *Liquor* now apt to be the *Subſtratum* of the future *Seed-Embrio*; by freſh ſupplies, is thence diſcharg'd. Yet that it may not be over-copious; which, becauſe of the laxity of the Inner *Coat*, from whence it iſſues, it might eaſily be: therefore, as the ſaid Inner *Coat* is bounded without, by the upper *Coat*; ſo by the *Secundine*, is it bounded within. Through which *Secundine* the *Sap* being filtr'd, or, as it were, tranſpiring; the depoſiture hereof, anſwerable to the *Colliquamentum* in an Egg, or to the *Semen Mulibre*, into its Concave at laſt is made.

24. §. The other part of the pureſt *Sap* emboſom'd in the *Ramulets* of the *Seed-Branch*, runs a Circle, or ſome progreſs therein; and ſo becomes, as the *Semen Maſculinum*, yet more elaborte.

25. §. Wherein alſo, leſt its Current ſhould be too copious or precipitant, by their *co-arctare* and *divarication* where they are inoſculated, it is retarded; the nobleſt portion only obtaining a paſs.

26. §. With this pureſt *Sap*, the ſaid *Ramulets* being ſupplied, from thence at laſt, the *Navel-Fibres* ſhoot (as the primitive *Artery* into the *Colliquamentum*) through the *Secundine* into the aforeſaid *Liquor* depoſited therein.

27. §. Into which *Liquor*, being now ſhot, and its own proper *Sap* or *Tinctures* mixed therewith, it *ſtrikes* it thus into a *Coagulum*; or of a *Liquor*, it becomes a *Body conſiſtent* and truly *Parenchymous*. And the ſupply of the ſaid *Liquor* ſtill continu'd, and the ſhooting of the *Navel-Fibres*, as is above deſcribed, ſtill carried on, the ſaid *Coagulation* or *Fixation* is therewith likewiſe.

28. §. And in the Interim of the *Coagulation*, a gentle *Fermentation* being alſo made, the ſaid *Parenchyma* or *Coagulum* becometh ſuch, not of any Texture indifferently, but is thus raiſed (as we ſee Bread in Baking) into a *Congeries* of *Bladders*: For ſuch is the *Parenchyma* of the whole *Seed*.

FINIS.

Mo.Bot. Garden,
1902.

FINIS

THE ANATOMY OF ROOTS;

Presented to the ROYAL SOCIETY at several times, in the Years, 1672 & 1673.

With an Account of the

VEGETATION OF ROOTS,

Grounded chiefly hereupon.

The SECOND BOOK.

By *NEHEMIAH GREW* M.D. Fellow of the *Royal Society*, and of the *College* of *Physicians*.

The Second Edition.

LONDON,

Printed by *W. Rawlins*, 1682.

Mo.Bot.Garden,
1902.

THE

ANATOMY

OF

ROOTS.

TO THE

Right Honourable WILLIAM

Lord Vi-Count *BROUNCKER*

THE

PRESIDENT

AND TO THE

Council and Fellows

OF THE

ROYAL SOCIETY.

MY LORD,

IF the Dedication of *Books* were not in uſe; yet here, I think, I might have been a Precedent. The promotion of *Phytological Science* is one Part of *Your* Work; and 'tis *You* have called me to the management of this Part; for ſome time, have intruſted me herein; and by *Your* moſt favourable and candid acceptance of what I have performed thus far, have encouraged me hereunto: I therefore preſent but *Your* Own, into *Your* Hands.

The great Honour and Advantage of *Your* Fellowſhip, I firſt obtained, by Mediation of Dr. *Wilkins*, the late moſt Reverend *Biſhop* of *Cheſter*. Whom I cannot name, without ſaying thus much of him, That He was a Per-

ſon

ſon of that eminent and happy Worth, which, as it was too good,to fear envy; ſo is it too great, to need an Elogie.

With Him, it was, *You* were pleaſed to commit to Me, the further proſecution of this *Work*; the Beginnings whereof, were by *Your Order* formerly made publique. Had I conſulted my own Abilities altogether, I ſhould ſcarcely have ventured upon it; ſeeing very little, for which I could think well of my ſelf, ſaving, That I had learned, upon good grounds, to think of *You* with greateſt Honour. But I alſo conſidered, That to inſiſt hereon too much,might be a reflection upon *Your* Judgments,who had thought fit to make choice of Me. And, That *You* were not more the Patrons of Wit, than of Induſtry; and of All, who ſhall endeavour to find out, or to confirm the Truth of Things. Withal, I looked upon *Nature*, as a Treaſure ſo infinitely full; that as all Men together, cannot exhauſt it; ſo no Man, but may find out ſomewhat therein, if he be reſolved to Try.

In compliance therefore with *Your* Commands, I have hereunto devoted a very conſiderable part of my Time. Theſe,adding force to my own Deſires,of being ſomewhat inſtrumental to the Improvement of Medicinal, and other wholeſom Knowledge: if peradventure, as we increaſe herein, we may become better, and more happy. As to which Improvement, though I could not hope; yet, I would not diſpair. I have already prepared the Soil, and made ſome Plantation: what remaineth behind, and the Vintage of the whole, will depend much upon the continued Influence of *Your* Beams: for how unpromiſing ſoever the Stock may be; yet the Fruit cannot but be ſomewhat matured, upon which *You* are pleaſed to ſhine. I am alſo confident, that the ſame Nobilty and Goodneſs, which accept the endeavours, will likewiſe pardon the faults, of,

My Lord,
Your Lordſhips moſt humbly
and moſt ſincerly
devoted Servant
NEHEMJAH GREW.

September 1.
1673.

THE

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THE

THE ANATOMY OF ROOTS;

PROSECUTED With the bare EYE, AND WITH THE MICROSCOPE.

PART I.

CHAP. I.

Of the ORIGINAL, FIGURES, MOTIONS, and AGES of ROOTS.

BEING TO ſpeak of *Roots*; it is requiſite, for our better underſtanding of what follows, that ſome things, as to their *Original*, *Figures*, *Motions* and *Ages*, be premiſed.

1. §. *Roots*, taken altogether, have a Threefold Original. Either from the *Radicle*; as all *Roots* which come of the *Seed*: or from the *Trunk* or *Caulis*, above ground; as in *Strawberry*, *Chamæmile*, and many other *Creepers*: or from the *Trunk* or *Caulis*, after it is ſunk under ground; as in *Primroſe*, *Biſtort*, and many others; and preſently ſhall be ſhewed how.

2. §. In the Growth of a *Bud*, and of a *Trunk-Root*, there is this obſervable difference; That the former, carries along with it, ſome portion of every *Part* in the *Trunk* or *Stalk*; whereof it is a *Compendium*. The latter, always ſhoots forth, by making a Rupture in the *Barque*, which it leaves behind, and proceeds only from the inner part of the *Stalk*.

3. §. As alſo, That in a *Bud*, the *Lignous Part* is ſpread abroad, ſo as to encompaſs a *Pith*. Whereas in a *Trunk-Root*, it makes a ſolid Thred ſtanding in the Center. Which is the Cauſe of its deſcending into the Ground: as is already, in the *Firſt* Book, and ſhall in This be further ſhewed.

4. §. ROOTS are generally diſtinguiſhed, as to their *Figures*, in being more Entrie, as is that of *Liquiriſh*; or Parted, as of St. *Johnswort*. Parted or Forked, either at the Bottom, as moſt *Roots*; or at the Top, as *Dandelyon*, and ſome others. A thing very odd, and unintelligible, without the knowledge of the *Motions* of *Roots*; whereof preſently.

5. §. Parted, again, are either Ramified, as that of *Cumfry*; or Manifold, as of *Crowfoot*: both are Parted; but the former, by the ſubdiviſion of greater *Branches*, into leſſer; theſe, when divers *Strings*, have all their diſtinct original from one *Head*. Some are Straight, as a *Radiſh*; others Crooked, as *Biſtort*. Smooth, as *Bugloſs*; or Stringy all round about, as *Columbine*. And to *Carnations*, this ſeems to be peculiar, That ſometimes many of the *Strings* run parallell with the *Wood* of the great *Root*, through the *Barque*, or betwixt the *Wood* and the *Barque*.

6. §. Again, ſome are Thick, as *Rhubarb*; Slender, as the *Vine*. Long, as *Fenil*; Short, as a *Turnep*: which are diſtinct from Great and Little; in that theſe, are ſo called with reſpect to ſeveral *Roots*; thoſe, with reſpect to the ſeveral Dimenſions of one. Short, are Stubbed, as *Iris tuberoſa*; or Round, as *Dracontium*. Round are Tuberous, or Simply Knobbed, as *Rape-Crowfoot*; Bulbous, that is Scaled, as ſome Lilys; or Shell'd, as an *Onion*. Where note, That all Bulbous *Roots*, are, as it were, Hermaphrodites, or *Root* and *Trunk* both together: for the *Strings* only, are abſolute *Roots*; the *Bulb*, actually containing thoſe *Parts*, which ſpringing up, make the *Leaves* or *Body*; and is, as it were, a Great *Bud* under ground.

7. §. *Roots*, again, are Even or Uneven; Even, are Cylindrical, as *Eryngo*; or Pyramidal, as *Borage*. Growing ſmaller Downwards, as do moſt; or Upwards, as *Skirrets*. Uneven, are Pitted, as *Potato's*, where the *Eyes* or *Buds* of the future *Trunks* lie inward; or Knotted, as *Jeruſalem-Artichoke*; where they ſtand out. Theſe Differences, are alſo Compounded: ſo ſome *Roots* are both Entire and Smooth, as *Peony*; others Entire, but Stringy, as *Clary*: that is, neither Ramifi'd, nor yet Bruſhy, or divided at the Top into ſeverall ſmall *Strings*; but a Single *Root* ſurrounded with many Hairy *Threds*. Some both Plain in ſome parts, and Knobbed in others, as *Filipendula*, *Lilium non bulboſum*, and others.

8. §. Some alſo have two or more *Roots*; and thoſe of one Kind: of which, ſome are diſtinctly faſtend to the bottome of the *Stalk*, as in *Dogſtones*; ſome ſtand one under another, ſo as only the uppermoſt is faſten'd to the *Stalk*, as in *Dragon*, *Crocus*, and others. And there are ſome, which have not only two *Roots*, at the ſame time; but thoſe alſo of two diſtinct Kinds, as in *Biſtort*; one of them, a ſlender ſtrait Cylindrick and horizontall *Root*; the other large and crooked, and bred of the Deſcending *Trunk*; as in ſpeaking next of the *Motions* of *Roots*, will be underſtood, how. All which, with other Differences

by

by Thoſe that undertake the *Deſcriptions* of *Plants*, are accurately to be Noted. But the Differences, above mentioned, will ſerve for our preſent Purpoſe.

9. §. THE MOTIONS of *Roots* are alſo divers. Sometimes Level, as are thoſe of *Hops*, *Ammi*, *Cinquefoyle*; and all ſuch as properly *Creep*. Sometimes Perpendicular, as that of *Parſnep*: Which is different from Straightneſs; for ſome Straight *Roots*, are Level. Both of them are either Shallow or Deep: ſome run Level, and near the *Turf*, as *Woodbind*, *Wild Anenomy*; others lower, as *Dogs-Graſs*. Some ſtrike down, but a little way, as *Stramonium*; others grow deep, as *Horſe-Radiſh*: Which is different from being Long; for many long *Roots*, are Level, as *Hops*.

11. §. Some again Deſcend, as *Tulips*, and other Bulbous *Roots*, which differs from growing only Downwards; in that here, the *Head* of the *Root* is Immoveable; but in Deſcending, the whole *Root* obteineth different Places, running deeper, time after time, into the *Earth*. Some alſo Aſcend, ſometimes, and in ſome part, appearing above ground, as *Turneps*.

11. §. Theſe *Motions* are alſo Compounded; both in reſpect of the ſeveral Parts of the *Root*, and of ſeveral Times. So the main *Root* of *Primroſe*, is Level; the Strings are Perpendicular. The *Roots* of moſt *Seedlings* grow Downward and Upward, or ſhoot out in length at both Ends, at the ſame time. Thoſe of *Biſtort*, *Iris*, and ſome others, grow, in part, both Downward and Upward at ſeveral times: Whence it is, that *Biſtort* is Crooked, with ſome reſemblance to an S, according to its *Name*; And that ſome Parts of *Iris-Root* appear oftentimes above the ground.

12. §. There is alſo another *Motion*, in ſome *Roots*, not heeded; and that is *Contortion*: whereby, without being moved out of their Place, they are Writhed or Twiſted; as a piece of Cloath is, when the Water is wrung out of it; as in *Carduus*, *Sonchus*, and others: whether always I cannot ſay. This *Mation* cannot be noted, without ſtripping off the *Barque*; whereby the *Veſſels* may be ſeen, ſometimes, to make two or three Circumvolutions. This *Motion* ſeems to be governed by the winding of the *Stalk*; and therefore to begin at the Head, and terminate at the Poynt or lower end of the *Root*, which is immoveable.

13. §. BUT ABOVE all the *Motions* of *Roots*, not obſerved, the moſt remarkable is that of DESCENT. Which, although it hath been noted, by ſome *Botanicks*, of *Bulbous Roots*; yet of theſe only: Whereas it is the Property, of a great many more; and thoſe, of very different Kinds; probably, of the far greater number of *Perennial Roots* of *Herbs*; as of *Arum*, *Rape-Crowfoot*, *Valerian*, *Brownwort*, *Bearſfoot*, *Tanſy*, *Lychnis*, *Sampier*, *Primroſe*, *Ammi*, *Avens*, *Wood-ſorrel*, *Iris*, and others. Of all which *Plants*, it is very obſervable, That their *Root*, is annually *renewed*, or *repaired*, out of the *Trunk* or *Stalk* it ſelf. That is to ſay, The *Baſis* of the *Stalk* continually, and by inſenſible Degrees, deſcending below the ſurface of the *Earth*, and hiding it ſelf therein; is thus, both in Nature, Place, and Office changed into a true *Root*. Which *Root*, by the continuance of the ſaid

Motion of the *Stalk*, alſo *Deſcends*; and ſo, according to the durableneſs of its Subſtance, becomes a ſhorter or longer *Root*; the Elder or Lower Portion thereof, Rotting off, by the ſame Degrees with the Generation of the Upper, out of the *Stalk*. So in *Brownwort*, the *Baſis* of the *Stalk* ſinking down by degrees, till it lies under Ground, becomes the upper part of the *Root*; and continuing ſtill to ſink, the next year, becomes the lower Part; and the next after that, rots away; a new Addition being ſtill yearly made out of the *Stalk*, as the elder Parts yearly rot away. So in *Dragon*, *Crocus*, and the like, where the *Root* is double; the *Baſis* of the *Stalk*, this year; the next, becomes the Upper-*Root*; after that, the Lower-*Root*; and at the length dies and is conſum'd.

Tab. 5. *f.* 6, & 7.

14. §. The Demonſtration hereof, is taken, more evidently, from ſome *Roots*, than from others; as from the Level and Knobed *Roots* of *Wood-ſorrel*, *Primroſe*, &c. For the *Leaves* of thoſe *Plants* rotting off ſucceſſively, and the *Baſes* of thoſe *Leaves* gradually deſcending into the Ground; each *Baſis* is thus nouriſhed with a more copious *Sap*, and ſo ſwelled into ſo many thick *Knots*. It may likewiſe be gather'd in ſome, from the like Poſition of the *Veſſels* or Woody Parts, in the *Root*, as in the *Trunk*; as in *Bares-foot*. As alſo, from the *Root* of the *Iris Tuberoſa*: where, although the *Leaves* fall off cloſe to the Surface of the *Stalk*; yet after that is ſunk down, and ſwell'd into a *Root*, the *Seats* of the periſhed *Leaves*, and the Ends of the *Veſſels* belonging to them, are not obſcurely viſible; whereby the *Root* is wrought, as it were, with ſeveral *Seames* and *Prickt-Lines*; the *Seams* ſhewing the ſetting on of the *Leaves*; and the *Pricks*, the Terminations or broken Ends of the *Veſſels*: which ends, are ſtill more apparent, upon the ſtripping off the *Barque*. I conſidered likewiſe, That as among *Animals*, there are many, which are not Bred of *Eggs*, immediately; but are Transformed, one *Animal* into another: So, it is more than probable, That among *Plants*, there are not a few Inſtances of the like *Transformations*; whereof, this is one.

Tab. 5. *f.* 1, & 2.

Tab. 5. *f.* 4.

15. §. The *Cauſe* of this *Deſcent*, ſo far as it is dependent on the Inward Conformation of the *Root*, I ſhall ſhew in the following Part. But the Immediate Viſible one, are the *String-Roots*, which this kind of *Trunks* frequently put forth: which, deſcending themſelves directly into the Ground, like ſo many *Ropes*, lug the *Trunk* after them. Hence the *Tuberous-Roots* of *Iris* upon the rotting or fading away of the *String-Roots* hanging at them, ſometimes a little Re-aſcend. Hence alſo the *Shape* of ſome *Roots* is Inverted: For whereas moſt are parted downwards, into ſeveral *Legs*; ſome are parted upwards into divers *Necks*, as *Dandelyon*, and others. For theſe *Roots* ſending forth at the top ſeveral *Trunk-Buds*, the ſaid *Buds* ſucceſſively put forth new, and caſt their old *Leaves*; and continually alſo making their Deſcent, are at length formed into ſo many *Necks*, of three, four, five, or more Inches long, under Ground.

Tab. 5. *f.* 5.

16. §. HENCE ALſo we underſtand, in what particular way, ſome *Roots* become *Perennial*. Some are wholly ſo, as thoſe of *Trees*, *Shrubs*, and divers other woody *Plants*. Others, in part, or by a new *Progenies* of *Roots*, from the old Head or Body, in the room of thoſe that die yearly, or after a certain Time; as of *Lilium non bulboſum*,

ſum, *Jeruſalem Artichoke*, *Potato*, *Dog-ſtones*, *Monks-hood*, *little Celandine*, and others. In which *Plants*, one or more of their *Roots* are firm, the other ſpongy and ſuperannuated; and partly, by the ravine of the *Trunk*, and other younger *Roots*, reduced to a Conſumption and Death.

17. §. With theſe, *Tulips*, and other *Bulbous-Roots* conſort: For the ſeveral *Rindes* & *Shells*, whereof chiefly, the *Bulb* conſiſts, ſucceſſively periſh and ſhrink up into ſo many thin and dry *skins*: betwixt which, and in their Centre, other *Leaves* and *Shells*, being ſucceſſively formed, the *Bulb* is thus perpetuated. In the ſame manner the *String-Roots* alſo ſucceed one another annually. So that at the end of divers Years, although it be ſtill looked upon as the ſame *Individual Root*, yet it is, in truth, Another, as to every particle thereof.

18. §. Laſtly, many other *Roots* are perpetuated by the aforeſaid Deſcent of the *Trunk*; out of which, it is ſtill annually Repaired, as by the gradual periſhing of its lower parts, it is Diminiſhed; as hath been ſaid. Whence alſo we ſee the reaſon of the Rugged and Blunt extremities of theſe, and ſome other *Roots*, as of that *Plant* ſuperſtitiouſly called *Devils-bit*: becauſe the end of it ſeems to be bitten off. Yet doth it not appear ſo originally; but the Lower part thereof rotting off, as the Upper deſcends; the living remainder, becometh ſtumped, or ſeemeth Bitten. Thus far of the *Original*, *Shapes*, *Motions*, and *Ages* of *Roots*. *Tab.* 5, *f.* 3.

CHAP. II.

Of the SKIN.

NEXT proceed to the ſeveral *Parts* whereof a *Root* is Compounded. The outer *Part* of all is the *Skin*; which is common to all *Roots*. 'Tis diverſly Coloured: Whiter in *Skirrets*; Yellow, in *Dock*; Red, in *Potato*; Brown, in *Lovage*; Black, in *Bugloſs*. Its Surface, ſometimes Smooth, as in *Horſradiſh*; Rough, as in *Scorzonera*. And the *Skins* of the ſeveral *Sheils* of a *Tulip-Root*, taken up freſh, look as if they were perforated with a great many ſmall holes. 'Tis of various Size; very Thin, in *Parſnep*; ſomewhat Thick, in *Bugloſs*; very Thick in *Iris*. Sometimes it is Opacous, as in *Thiſtle*; and ſometimes Tranſparent, as in *Madder*.

2. §. Every *Root* hath ſucceſſively two kinds of *Skins*: the one, Coëtaneous with the other *Parts*; and hath its original from that which involveth the *Parts* of the *Seed* it ſelf. The other, Poſtnate, ſucceeding in the room of the former, as the *Root* ageth; and is orinated from the *Bark*. So in *Dandelyon*, the old *Skin*, looked upon about the beginning of *May*, ſeems to have been one of thoſe ſeveral

Rings

Rings, which the precedent year compoſed the *Cortical Body* of the *Root :* but by the Generation of a new *Ring*, next the *Wood*, is now thruſt off and ſhrunk up into a *Skin*. So alſo in the *Roots* of *Bugloſs*
Tab. 14, 15. and *Horſe-Radiſh*, as far as the *Bladders* in the former, and the *Veſſels* in the latter are Radiated ; the *Cortical Body* ſeems either annually or oftener, to ſhrink up into another new *Skin*, as, the old ones fall off. And ſometimes, perhaps, as in *Aſparagus*,
Tab. 10. the whole body of the Perpendicular *Roots*, except the woody *Fibre* in the Centre, becomes the ſecond *Skin*. So that the wearing away of the old *Skin*, ſucceeds the derivation of the new one ; as in Deſcending *Roots*, the Conſumption of the Lower *Parts*, doth the Generation of the Upper. Becauſe the *Barque* ſwells, and grows ſometimes faſter than the *Skin* can fall off, or give way to it : therefore are the *Roots* of many *Herbs*, Barque-bound, as well as the *Trunks* of *Trees*.

3. §. This *Skin* is uſually, if not always, compounded of two Kinds of Bodies : which alſo is probable of the Coëtaneous. The one, *Parenchymous*, and frequently conſtructed of exceeding little *Cells* or *Bladders* ; which in ſome *Roots*, as of *Aſparagus*, cut traverſe, and viewed through a *Microſcope*, are plainly viſible. Theſe *Bladders* are
Tab. 10. *Tab.* 14. of different Sizes ; in *Buglos*, larger ; in *Aſparagus* leſs ; and ſometimes they coincide and diſappear. But in theſe, and all other *Roots*, even where theſe *Bladders* appear not, the *Parenchyma* of the *Skin*, is of the ſame Subſtantial *Nature*, with that other more vivid and bulky one of the *Bark*: As is manifeſt, from its being thence Originated ; and alike Conformed, as ſhall be ſeen ; and not only adjacent to it, as a Glove is to the Hand ; but continuous therewith, as the parts of a piece of fleſh, are one with another.

4. §. OF THIS *Parenchymous Body*, the *Skin* conſiſteth chiefly, but not wholly ; there being many *Lignous Veſſels* which are Tubulary, mixed therewith : which, though hardly by the *Microſcope*, yet otherwiſe, is demonſtrable. For in tearing the *Skin*, you ſhall do it more eaſily by the length, than bredth ; becauſe, by the firſt way, the continuity only of the *Parenchyma*, is diſſolved ; but by the latter, both of this, and of the *Veſſels*, theſe being poſited by the length of the *Root* : So that, as by the ſmalneſs of the *Bladders* of the *Parenchyma*, the *Skin* is Denſe ; ſo by theſe *Veſſels*, is it Tough.

5. §. Again, if you cut a *Root* traverſe, and let it lie by for ſome time, all the parts, where there are no *Veſſels*, ſhrink below the ſurface of the cut-end ; but where-ever Theſe are poſited, there is no ſhrinking ; which oftentimes, evidently appears alſo in the *Skin* : becauſe the ſaid *Veſſels*, though, as the *Bladders*, they may coincide ; yet they cannot viſibly ſhorten or ſhrink up in length ; no more than a *Straw*, whoſe ſides may yet be eaſily cruſhed together.

6. §. Further, the *Root* being cut traverſe, if, near the cut-end, you very gently preſs the ſide of the *Root* with the edge of your Nail, the *Sap* will thereupon ariſe ſometimes from the *Skin* ; in the ſame manner, as from any other part of the *Root*, where the like *Veſſels* are poſited. And although the *Sap* may likewiſe be expreſſed from the *Pith*, and other *Parts* where ſometimes, there are none of theſe *Veſſels* ; yet not without a ſolution of there continuity ; which here doth not follow ; as appears, from the diſappearing of the *Sap*, together with the intermiſſion

termiſſion of the preſſure; the ſaid *Veſſels* then dilating themſelves by aMotion of *Reſtitution*, and ſo ſucking up the *Sap* again.

7. §. Hereunto may be added the Teſtimony of ſight; the very *Veſſels* themſelves, in many *Roots*, coming under an apparent view, and ſtanding in the utmoſt ſurface of the *Root* all round about, as in that of Liquiriſh, Columbine, Scorzonera, and others. Which *Experiments*, I have here, once for all, more particularly ſet down; becauſe I ſhall have occaſion, hereafter, to refer to them.

CHAP. III.

Of the BARQUE.

NEXT WITHIN the *Skin* lieth the *Barque*. 'Tis ſometimes Yellow, as in *Dock*; Red, in *Biſtort*; but uſually, and in *Seed-Roots*, I think, always White. It is derived from the *Seed* it ſelf; being but the extenſion or prolongation of the *Parenchyma* of the *Radicle*; One of the three *Organical Parts* of the *Seed*, deſcribed in the *Firſt* Chapter of the *Firſt* Book.

2. §. It is variouſly Sized; ſometimes very Thin, as in *Jeruſalem Artichoke*, *Goats-beard*, and in moſt *Trees*; where it alſo retains the Name of a *Barque* or *Rind*. Sometimes 'tis more Thick, and maketh up the far greateſt protion of the *Root*, as in the String-*Roots* of *Aſparagus*, in *Dandelion*, and others. The thinneſt and the thickeſt ar e all analogous, and obtain the ſame general Uſes. The degrees of its Size, amongſt all *Roots*, may be well reckoned about Twenty, and ſeen in the following examples, *ſc.* *Beet*, *Dropwort*, *Jeruſalem Artichoke*, *Orpine*, *Valerian*, *Goats-beard*, *Nettle*, *Brownwort*, *Columbine*, *Celandine*, *Aſparagus*, *Horſe-Radiſh*, *Peony*, *Bryony*, *Eryngo*, *Borage*, *Lovage*, *Dandelion*, *Parſnep*, *Carrot*, *&c.* In the *Root* of *Beet*, ſcarce exceeding a good thick *Skin*: but in a *Carrot*, half the Semidiameter of the *Root*, or above half an Inch over in ſome places: and that of *Dandelion*, ſometimes, in proportion with the *woody Part*, twice as thick: the reſt of Several intermediate Degrees: And to moſt *Roots*, this is common, To have their *Barque* proportionably thicker, at the bottome than at the top. *Tab.* 7, 8, 9.

3. §. IT IS Compounded of two *Bodies*. The one *Parenchymous*; Continuous throughout; yet ſomewhat Pliable without a ſolution of its Continuity. Exceeding Porous; as appeareth from its ſo much ſhrinking up, in drying. The *Pores* hereof are extended much alike both by the length and bredth of the *Root*; therefore it ſhrinketh up, by both thoſe Dimenſions, more equally. And they are very Dilative; as is alſo manifeſt from its reſtorableneſs to its former bulk again, upon its

its infusion in Water: that is to say, *It is a most curious and exquisitely fine wrought Sponge.* Thus much the Eye and Reason may discover.

4. §. The *Microscope* confirms the truth hereof, and more precisely shews, That these *Pores* are all, in a manner, Spherical, in most *Plants*; and this *Part*, an Infinite Mass of little *Cells* or *Bladders*. The sides of none of them, are Visibly pervious from one into another; but each is bounded within it self. So that the *Parenchyma* of the *Barque*, is much the same thing, as to its Conformation, which the Froth of *Beer* or *Eggs* is, as a fluid, or a piece of fine *Manchet*, as a fixed Body. The Sides also of these *Bladders* are as transparent, as those of Water; or the Bodies of some *Insects*.

Tab. 10, *& sequent.*

6. §. But their Size is usually much smaller; and their Posture more Regular than those in *Bread* or *Water*. In all *Roots* they are so small, as scarcely, without the *Microscope*, to be discerned: yet are they of different Size, both in the same, and in divers *Roots*; the varieties whereof, amongst all *Roots*, may be reduced to about Ten or Twelve according to the *Standard*, in *Tab.* 11. Some of those in *Dandelion*, being of the Smallest; and in *Bugloss*, of the Greatest. They are posited, for the most part, at an Equal Height; and piled evenly one over another: So that, oftentimes, they visibly run in Ranks or trains, both by the length and breadth of the *Roots*, as in the *Root* of *Bugloss*, or of *Dandelion*, split through the middle, may be seen. Although they are usually Spherical, yet sometimes, and in some places, they are more oblonge, as in the outward part of the *Barque* of *Bugloss*. These *Bladders*, are sometimes best seen, after the *Root*, being cut traverse, hath layn by a while, to dry.

Tab. 13, 14.

Tab. 14.

6. §. They are the Receptacles of *Liquor*; which is ever Lucid; and I think, always more Thin or Watery. They are, in all *Seed-Roots*, filled herewith; and usually, in those also which are well grown, as of *Borage*, *Radish*, &c.

7. §. THIS *Parenchymous Part*, in many *Roots*, is of one Uniform *Contexture*; as in *Asparagus*, *Horse-Radish*, *Peony*, *Potato*, and others. In many others, it is, as it were, of a Diversified *Woof*; the *Bladders* being, though every where Regular, yet either in Shape, Size, or Situation, different in some Parts hereof, from what they are, in other intermediate ones. For these Parts, are like so many White *Rays*, streaming, by the Diameter of the *Root*, from the inward Edge toward the Circumference of the *Barque*; as in Lovage, Melilot, Parsnep, &c. cut transverlly, is apparent. They are, though not in direct Lines, continued also by the length of the *Root*; so that they are, as it were, so many *Membrances*, by which the other Parts of the *Barque*, are disterminated.

Tab. 8, 9.

8. §. The Continuation of these Diametral *Rays*, or *Portions*, is divers: sometimes, but half through the *Barque*, or somewhat more, or less, as in *Melilot*. And it is probable, that to the *Roots* of all or most *Trefoyls*, and also of the *Leguminous* Kind, this is proper, To have their Diametral *Rays* come short of the Circumference. Sometimes, they run quite through to the very *Skin*, as in *Lovage*. And I think, in the *Roots* of all Umbelliferous *Plants*: In which therefore, the *Skin* seems to have a closer Communion with the Diametral *Rays*, and to be originated especially therefrom. They usually stand at an Equal Distance in the same *Root*: But with respect to divers *Roots*, their Distance

Tab. 9.

Tab. 8.

ſtance varies; ſo leſs, in *Parſnep*, greater in *Bugloſs*. They are commonly Rectilinear, as in *Lovage*; but ſometimes winding to and fro, as in a *Carrot*. *Tab.* 7, 8. *Tab.* 8.

9. §. They are not always of one Size: in a *Carrot* near the Inner Edge of the *Barque*, exceeding Slender, and ſcarcely diſcernable; in others, Thicker, as in the Three greater ones of *Melilot*, and in common *Chervil*. Both by their Diſtance, and Size, they are alſo leſs or more Numerous; ſome, only as they are nearer; ſome, as ſmaller; others, as both. And 'tis proper, I think, to the *Intybous* kind, either to have none, or but a few. Sometimes they are of the ſame Thickneſs quite through the *Barque* from edge to edge, as in *Marſh-Mallow*. And ſometimes are conſiderably ſpread or dilated as they aproach the *Skin*, wherewith they are joyned, and whereinto they more viſibly run, as in *Parſley*, or the ſmaller part of the *Root* of *Lovage*. And in ſome *Roots*, as of *Scorzonera*, at ſome times of the year, when leſs ſucculent, almoſt the whole *Parenchyma* ſeems to be of the Nature of the Diametral *Rays*, in other *Roots*. The *Bladders* of theſe Diametral *Portions*, are ſometimes, greater than thoſe of the other *Parenchymous Parts*, as in *Parſley*; and I think ſometimes leſs. Yet as there, ſo here, variouſly ſized; to about ſix or eight Degrees; and thoſe of *Parſley* about the third, fourth, and fifth. Their Figure is Sometimes more oblong; and their direction or reſpect more towards the Center of the *Root*. *Tab.* 8, 9. *Tab.* 7. *Tab.* 8.

11. §. As the other *Parenchymous Parts* of the *Barque*, are the Receptacles of *Liquor*; ſo theſe, (where they are) of *Aer*. This is argued, From their being more White, and not Tranſparent, as ſuch *Roots* and *Parts* uſe to be, which are more copiouſly and equally filled up with *Liquor*: as the *Pith* of *Elder*, which, in the old *Stalks*, is White; was once, and by being well ſoaked, will become, again Tranſparent. And from their being more dry and voyd of *Liquor*; whereupon their *Bladders*, which cannot be Vacuities, muſt be filled with more or leſs *Aer*, mixed with the *Sap* or the *Vaporous* parts thereof. This is more obſervable in thoſe Diametral *Portions*, which terminate upon, and run into the *Skin*.

12. §. THE BARQUE is not only of a divers *Woof*, but as is ſaid, of a Compounded Subſtance; there being a certain number of *Lignous Veſſels*, fewer or more, in ſome place or other, mixed with the *Parenchymous Part* above deſcribed; and ſome way or other, are demonſtrable in all *Roots* As by the Toughneſs of the *Barque*, when pulled by the length. By the viſible Continuation of the ſaid *Veſſels* through the length of the *Barque*, in the reſemblance of ſmall *Threds*. And by the riſing up of the *Sap* in the traverſe cut of the *Root*, in ſuch places of the *Barque*, where theſe *Threds* terminate: as the exiſtence of the ſame *Veſſels* in the *Skin*, was proved in the *Precedent* **Chapter.** *Tab.* 6.

13. Theſe Tubulary *Threds*, run not through the *Barque* in direct lines; but are frequently Braced together in the form of *Net-Work*; The *Parenchymous Parts* every where filling up the ſpaces betwixt the Braced *Threds*; as in *Burnet*, *Scorzonera*, &c. the *Barque* being paired or ſtriped off, is apparent. *Tab.* 6.

14. §. They ſeem, at firſt, where they are Braced, to be Inoſculated; ſo as to be pervious one into another. But a more accurate view, eſpecially aſſiſted by a *Miſcroſcope*, diſcovers the contrary. Neither are they woun'd any way one about another, as Threds are in a Rope: nor Implicated, as in ravled Yarn, or the Knots of a Net: but only contiguous or ſimply Tangent, as the ſeveral Chords in the Braces of a Drum: being thus joyned together by the *Parenchymous Parts*, as in ſpeaking of the *Pith*, will be underſtood how. Yet do not always the ſame *Threds* belong and keep entire to one *Brace*; but are freqnently parted into leſſer *Threds*; which are tranſpoſed from *Brace* to *Brace*. Nor do they always, in whole or in part, preſently after their contingence, mutually fall off again; but, oftentimes, run along collaterally joyned together for ſome ſpace.

Tab. 6. 15. §. Theſe *Braces* are of various number in divers *Roots*; more frequent in *Jeruſalem Artichoke*, leſs in *Scorzonera*, more rare in *Cumfry*. The *Threds* likewiſe are variouſly Divaricated; ſometimes more, where the *Braces* are frequent, as in *Jeruſalem Artichoke*; and ſometimes leſs, where the *Braces* are rare, as in *Scorzonera*, *Dandelion*: And in all *Roots*, more frequent towards the Inner Verge of the *Bark*.

16. §. By what is ſaid, it is partly implied, That theſe *Threds*, are not Single *Veſſels*; but a *Cluſter* of them, Twenty, Thirty, or more or fewer of them together. Yet as the *Threds* are not Inoſculated in the *Braces*; ſo neither are the *Veſſels*, in the *Threds*. Nor yet Twiſted; but only ſtand collateral together; as the ſeveral Single *Threds* of the *Silkworm*, do in Sleave-Silk. Neither are theſe *Veſſels* pyramidal, ſo far as the *Glaſs* will diſcover; or, from probable Reaſon, may be conjectured. Nor Ramified, ſo as to be ſucceſſively propagated one from another, after the manner of the *Veins* in *Animals*: but Cylindrical, and Diſtinctly continued, throughout the length of the *Root*; as the ſeveral *Fibres* in a *Tendon* or *Nerve*.

17. §. THESE VESSELS are either themſelves of divers kinds, or ſerve, at leaſt, to conſtitute divers Kinds, in divers *Roots*: of the different Natures whereof, although there may be other ways whereby to judge; yet ſo far as by Inſpection, we may do it, chiefly, by the Diverſity of thoſe *Liquors*, which they ſeverally contain. Sometimes they yield a *Lympha*; and that Thin, as they do in a *Parſnep*; eſpecially thoſe that make a *Ring*, at the inward extremity of the *Bark*. See the Root it ſelf. That this Clear *Sap* aſcendeth only from theſe *Veſſels*, is certain. Becauſe no *Liquor* will do the like, from any *Parenchymous Part*, as *Chap.* 2. hath been ſaid. And becauſe it is of a different nature from the *Sap* contained in the *Bladders* of the *Parenchyma*; although of the ſame *Colour*, yet ſenſibly more *Sweet*.

18. § Sometimes they yield a Thick and Mucilaginous *Lympha*, as in *Cumfry*, as appeareth by its tenacity. From the Mucilaginous *Content* of theſe *Veſſels* it is, I ſuppoſe, that the *Sap* contained in the *Bladders* is rendred of the like nature, ſo far as it approaches hereto, which ſometimes is more, as in *Marſh-mallow*; and ſometimes but little as in *Borage*: For in preſſing out the *Liquor* of this *Plant*, and then heating it over an indifferent fire; thefar greater part hereof remaineth thin; only ſome certain ſtrings and little bits of a gellied ſubſtance are mixed herewith; which as it ſeems, were originally the proper *Liquor* of theſe *Muciducts*.

19. §.

19. §. Oftentimes theſe Succiferous *Veſſels* yield a *Milky* or White *Sap*; and ſometimes Yellow, and of other colours as in *Sonchus*, and moſt *Cichoraceous Plants*; in *Angelica*, and moſt *Umbelliferous*; in *Burdock*, and divers *Thiſtles*, to which that is 'akin: in *Scorzonera*, *Common Bells*, and many other *Plants*, not commonly taken notice of to be *milky*. The *Milky Saps* of all which, although they differ in Colour, Thickneſs, and other Qualities; yet agree, in being more *Oyly* than any of the *Lymphous Saps*. It being the mixture of the *Oyly* parts with ſome other Limpid *Liquor*, but of a different Nature, which cauſeth them to be of a *Milky*, or other *Opacous* Colour, in the ſame manner as common *Oyl*, and a ſtrong *Liquamen* of Tartar, ſhaked in a Bottle together, preſently mix into a White *Liquor*. And although they will, for the greateſt part, ſeparate again; yet ſome of their parts, without any Boiling, or ſo much as the leaſt Digeſtion with Heat, by Agitation only, or ſtanding together for ſome time, incorporate in the form of a Thin *Milky-Sope*, which will alſo diſſolve in *Water*. I ſuppoſe, therefore, That it is the *Volatile Salt*, chiefly, of theſe *Plants*, which being mixed with their *Oyl*, renders this *Liquor* of a White or other Opacous Colour.

20. §. Sometimes the *Oyl* will ſeparate and diſcover it ſelf: for if you cut a *Fenil-Root* traverſe, after it hath layn ſome days out of the Ground; the ſame *Veſſels*, which, in a freſh *Root*, yields *Milk*; will now, yield Oyl: the watery parts of the *Milk*, which in the drying of the *Root* are more evaporable, being ſpent.

21. §. All *Gums* and *Balſams* are likewiſe to be reputed the proper *Contents* of theſe *Veſſels*: for Theſe and *Milks*, are very near akin. So the *Milk* of *Fenil*, upon ſtanding, turns to a Clear *Balſam*; of *Scorzonera*, *Dandelion*, and others, to a *Gum*. In the dryed *Root* of *Angelica*, &c. being ſplit, the *Milk*, according to the Continuation of theſe *Veſſels*, appeareth, as Blood clodders in the *Veins*, condenſed to an hard and ſhining *Roſin*. And the *Root* of *Helenium* cut tranſverſely, preſently yields a curious *Balſame* of a Citrine Colour, and ſometimes of the Colour of *Balſame* of *Sulphur*. I call it a *Balſame*; becauſe it will not diſſolve in Water. Yet not a *Terebinth*; becauſe, nothing near ſo viſcid or tenaceous as that is. But the *Root* of Common *Wormwood*, bleeds, from large *Veſſels*, a true *Terebinth*, or a *Balſame* with all the defining properties of a *Terebinth*; although that word be commonly uſed only for the Liquors of ſome *Trees*. *Tab.* 9. *Tab.* 10. E.

22. §. There is yet another kind of *Sap-Veſſels*, which may be called *Vapour-Veſſels*; as in *Docks*, at leaſt ſome of them. For by the *Sap-Veſſels* it is, that the *Barques* of *Roots* do *Bleed*. Of which, ſome Bleed quick and plentifully, as the *Umbelliferous* and the *Cichoraceous* Kinds. Some, very ſlowly and ſcarce viſibly, as all or moſt *Trefoyls*, and of the *Leguminous* Kind. And ſome ſeem not to *Bleed*, as the *Dock*. Yet that this *Root*, hath alſo *Veſſels* diſtinct from thoſe that carry *Aer*; doth partly appear, from the different Colour they produce where they ſtand; as will better be underſtood anon, in ſpeaking of the Cauſes of the *Colours* of *Roots*. As alſo from the Toughneſs of the *Barque*, in pulling it by the length; neither the *Parenchyma*, nor the *Aer-Veſſels*, being of themſelves *Tough*. But becauſe the *Succus* or *Sap* they carry, ſeems to be a kind of Dewy *Vapour*, therefore, they may not improperly be called *Roriferous* or *Vapour-Veſſels*.

23. §. THE *Sap-Veſſels*, are not only of divers Kinds, in divers *Roots*, but in the ſame. Whether in all, I doubt: but in ſome it is certain they are: For if you cut a *Fenil-Root* traverſe, both *Milk* and *Limpid Sap*, will preſently aſcend, and, upon accurate inſpection, appear thereupon diſtinctly. So the *Roots*, both of *Trachelium* and *Enula*, Bleed both a *Lympha*, and a Citrine *Balſame:* and *Wormwood*, both a *Lympha*, and a *Terebinth*, at the ſame time. So alſo the *Root* of *Dandelion* being cut in *November*, ſeems to bleed both a *Milk* and a *Lympha*; the latter being drowned by the former at another time when it is more copious. Whether all *Roots* have *Lymphæducts*, is doubtful; but 'tis moſt probable, that they have, more or fewer; ſtanding, for the moſt part, in a *Ring*, at the Inner Verge of the *Barque:* the *Sap* whereof, I ſuppoſe, is ſo far of common Nature in all *Roots*, as to be Clear, and leſs Oily.

Tab. 9.

24. §. THE Quantity of theſe *Veſſels* is very different: In *Borage*, *Peony*, *Biſtort*, but few; in *Aſparagus*, fewer: in *Parſnep*, *Celandine*, many; in *Fenil*, *Marſh-mallow*, many more: and betwixt theſe extreams, there are many Degrees, as by comparing the *Roots* of *Horſe-Radiſh*, *Turnep*, *Briony*, *Skirrets*, *Parſley*, *Goats-Beard*, and as many more as you pleaſe, may be ſeen. Amongſt the ſeveral Sorts of *Docks*, they ſeem in *Patience*, to be the feweſt; in *Red-Dock*, the moſt numerous. There are two ways of judging of their Number; Either as their Extremeties are viſible upon the traverſe cut of the *Barque*; or as the *Barque* is diverſly Brittle or Tough; being ſo, from the various Number of theſe *Veſſels* therein, as in the *Second Chapter* hath been ſaid.

Tab. 7,8,9.

25. §. The Quantity of the aſcending *Sap*, is a doubtful argument, whether of the Number, or Size of theſe *Veſſels*. For it is common to moſt *Milky-Roots*, for the *Milk* to aſcend more copiouſly: yet in ſome of them, the *Veſſels* ſeem, in proportion with the *Parenchymous Part*, not to be ſo numerous, as in ſome other *Roots*, where the aſcending *Sap* is leſs; as by comparing the *Lacteals* of *Dandelion*, and the *Lymphæducts* of *Fenil* together, may appear: ſo that it ſhould ſeem, that the bore of the *Lacteal Veſſels*, is greater than that of the *Lymphæducts*.

26. §. THE Situation of theſe *Veſſels*, as they appear, even to the naked Eye, in the tranſverſe Section, is Various and Elegant. Sometimes they are poſited only at the Inner Edg of the *Barque*, where they make a Ring, as in *Aſparagus*. In which place and poſition, they ſtand in moſt, if not in all, *Roots*, how variouſlly ſoever they are poſited alſo otherwiſe. The Common *Crow-Foot* with numerous *Roots*, hath a *Ring* of *Sap-Veſſels* next the *Skin*. So the *Barque* of *Monks-Hood*, is encompaſſed with a tranſparent *Ring* of *Sap-Veſſels*. The *Ring* is either more Entire, as in *Eryngo*, *Brown-Wort*, *Valerian*, *Hop*, *Madder*, *&c.* Or it is a Prick'd *Ring*, as in *Buttyr-Bur*. Sometimes they are chiefly poſtur'd in a Prick-Ring, towards the outward part of the *Barque*, as in *Peony*: and ſome *Roots* are pricked all over the *Barque*, as of *Melilot*. In others, they ſtand not ſo much in Prieks, as Portions or *Colums*, as in *Cumfry-*

Tab. 7,8,9, & 10.

27. §.

27. §. In others, again, they all ſtand in more continued Lines, either Rays or Diametral, as in *Borage*; or Peripherial, as in *Celandine*. The *Vaſcular* Rays are not equally extended in all *Roots*: in *Parſnep*, towards the Circumference of the *Barque*; in *Bugloſs*, about half way. In all *Docks*, and *Sorrels*, the *Rays* are extended through about ¼ of the thickneſs of the *Barque*, towards the Circumference, whereabout, divers of them are always *arched* in, two and two together. In all or many *Trefoyls*, and of the *Leguminous* Kind, they are extended through no more than ⅓d of the *Barque*. In the *Umbelliferous*, they are Ralled in betwixt the Diametral *Portions* of the *Parenchyma*. In *Borage*, the Rays are more Continuous; in a *Carrot*, more Pricked. Here alſo the Pricks ſtand in Even Lines; in *Lovage*, they are Divaricated. Of which, and thoſe of ſome other *Roots*, it is alſo Obſervable, That they are not all meer Pricks, but moſt of them ſmall, yet real Circles; which, after the *Milk* hath been frequently licked off, and ceaſeth to aſcend, are viſible, even without a *Glaſs*. And note, that in obſerving all *Milk-Veſſels*, the *Milk* is to be taken off, not with the Finger but the Tongue; ſo often, till it riſeth no more, or but little. And ſome *Roots* may alſo be ſoaked in Water; whereby the Poſition of the *Milk-Veſſels*, will be viſible by the darker Colour of the *Barque*, where they ſtand. *Tab.* 7, 8, 9. *Tab.* 8.

18. §. The Rays ſometimes, run more Parallel, and keep ſeveral, as in *Monkſhood*; and ſometimes, towards the Circumference of the *Barque*, they are occurrent; as not only in *Docks*, but other *Plants*: In *Eryngo*, in a termination more Circular; and in *Bryony*, angular, or in the form of a *Glory*, as alſo in *Horſradiſh*, through a *Microſcope*. The Peripherial Lines are in ſome, more entire Circles, as in *Dandelion*; in others, made up of ſhorter Chords, as in *Potato*, *Cumfry*, and the ſmaller part of the *Root* of *Monks-hood*. In ſome, the Pricks are ſo exceeding ſmall, and ſtand ſo cloſe, that, to the bare eye, they ſeem to be continous *Rings*, which yet, through the *Microſcope*, appear diſtinct, as in *Marſh-mallow* and *Liquiriſh*. *Tab.* 7, 8, 9. *Tab.* 15. *Tab.* 12.

29. §. Sometimes Columns and Chords are compounded, as in *Burnet*; Pricks and Chords, in *Potato*; Rays and Rings, in *Monkſhood*; where the Ring is Single. In *Fenil*, there is a double or treple order both of Rays and Rings, the *Lymphæducts* ſtanding in Rays and the *Lacteals* in Rings. And in *Marſh-mallow*, the *Veſſels* are ſo poſited as to make both thoſe kinds of Lines at once.

30. §. In *Celandine*, they ſeem all, to the bare eye, to ſtand in numerous Rings lying even one within another. As alſo in *Dandelion*; in which yet, being viewed through a *Microſcope*, there is an appearance of very many ſmall Rays; which ſtreaming from the Inner Verge of the *Barque*, croſs three or four of the ſmaller Rings, and are there terminated. Whence it ſhould ſeem that *Lymphatick* Rays and *Milky* Rings, are in that *Root*, ſo far mixed together. Only the *Lympha*, being confounded with the *Milk*, cannot be diſcerned. And where the *Milky-Veſſels* are evacuated, or at ſuch Seaſons, wherein they are leſs full, divers *Milky Roots* will yield a clear *Liquor* at the Inner Verge of the *Barque*, where, at other times, they ſeem to yield only *Milk*. And this is the Deſcription of the *Barque*. *Tab.* 13.

CHAP.

CHAP. IV.

Of the WOOD.

THAT Portion of the *Root* which ſtandeth next within the *Barque*, and in *Trees*, and *Shrubby Plants*, is the *Wood*; is alſo compounded of Two Subſtantially different Bodies, *Parenchymous* and *Lignous*. The *Parenchymous*, is of the ſame Subſtantial Nature with that of the *Barque*. And is originated from it; being not only adjacent to it, but all round about continuous therewith; even as that, is with the *Skin*; the *Parenchyma* of the *Barque*, being diſtributed, from time to time, partly outward into the *Skin*, and partly inward, into the *Wood*.

2. §. The Poſition of the ſeveral parts hereof, is different. For the moſt part it hath a Diametral Continuation, in ſeveral Portions, running betwixt as many more of the *Lignous*, from the Circumference towards the Center of the *Root*: all together, conſtituting that, which in the *Second Chapter* of the *Firſt* Book, I call the *Inſertment*. In the *Roots* of many *Herbs*, theſe Diametral or Inſerted Portions are more obſervable, as in *Cumfry*; which leadeth to the notice of them in all others, both of *Herbs* and *Trees*. Sometimes part of this *Parenchymous* Body is diſpoſed into *Rings*, as in *Fenil*. The Number and Size of which Rings differ: In *Fenil*, when the *Root* is grown large, they are in ſome places broader, but fewer; in *Beet* they are narrower, but more. The Diametral Portions are here, in like manner, much varied; in *Cumfry*, *Celandine*, larger; in *Beet*, *Bugloſs*, meaner; in *Borage*, *Parſnep*, more, and ſmaller; and in moſt Woody-*Roots*, ſtreaming betwixt the *Pith* and the *Barque*, as ſo many ſmall Rays. Their Continuation is alſo different; in ſome *Roots*, to the Centre, as in *Columbine*; in others not, as in *Parſnep*. And ſometimes different in the ſame *Root*, as in the *Vine*.

Tab. 9.

Tab. 8, 9.

Tab. 17.

3. §. The Contexture of theſe *Parenchymous* Portions is ſometimes Uniform, as in *Bugloſs*, *Peony*; and ſometimes alſo, as it is in the *Barque*, different; in part, more ſappy, and tranſparent; in part, more white, dry, and aery, as in *Carrot*, *Lovage*, *Scorzonera*, and others; which yet cannot be obſerved without a wary view. But their general Texture is the ſame being all made up of many ſmall *Bladders*. Which are here of different Sizes, like thoſe of the *Barque*, but for the moſt part ſmaller. Their Shape likewiſe, is uſually Round; but ſometimes Oblong and Oval, as in *Borage*; or Oblong and Square, as in the *Vine*.

Tab. 17.

4. §. The *Lignous Part*, if not always, yet uſually, is alſo Compounded of Two Kinds of *Bodies*, *ſcil.* *Succiferous* or *Lignous* and *Aer-Veſſels*. The *Lignous* as far as diſcernable, are of the ſame Conformation and Nature with thoſe of the *Barque*, and in the tranſverſe cut of

of the *Root*, do oftentimes, as thoſe, emit a *Liquour*. They are alſo Braced; and many of them run in diſtinct *Threds* or Portions, collaterally together.

5. §. The *Aer Veſſels* I ſo call, becauſe they contain no *Liquor*, bnt an *Aery Vapour*. They are, more or leſs, viſible in all *Roots*. They may be diſtinguiſhed, to the bare Eye, from the *Parenchymous Parts*, by their Whiter Surface; and their ſtanding more prominent, wheras thoſe ſhrink below the tranſverſe level of the *Root*, upon drying. They are frequently Conjugated divers of them together, ſometimes fewer, and for the moſt part ſingle, as in *Aſparagus*; ſometimes many, as in *Horſ-Radiſh*. And their Conjugations are alſo Braced, as the Threds of the *Succiferous Veſſels*. But they are no where Inoſculated: nor Twiſted one about another; but only Tangent or Collateral. Neither are they Ramified, the greater into leſs; but are all diſtinctly continued, as the *Nerves* in *Animals*, from one end of the *Root* to the other. *Tab.* 10, & 15.

6. §. Their Braces, as thoſe of the *Succiferous Veſſels*, are alſo of various number: in *Jeruſalem Artichoke*, *Cumfry*, *Scorzonera*, more rare; in *Borage*, *Burnet*, more frequent; as by ſtripping off the *Barque* of ſuch *Roots*, where it is eaſily ſeparable, may be ſeen. And they often vary in the ſame *Root*; ſo in *Borage*, *Scorzonera*, &c. they are more frequent in the Centre, and next the *Barque*, than in the Intermediate ſpace, as by ſplitting thoſe *Roots* down the middle doth appear. They alſo vary from thoſe of the *Succiferous Veſſels*; thoſe being uſually more frequent, as in *Jeruſalem Artichoke*, than theſe of the *Aerial*. *Tab.* 6. *Tab.* 6.

7. §. Betwixt theſe Braced *Aer-Veſſels*, and the reſt, which make the true *Wood*, run the *Parenchymous Parts* above deſcribed; as they do betwixt the *Succiferous* in the *Barque*: and ſo make up two Pieces of *Net Work*, wherof one is the filling up of the other. *Tab.* 6.

8. §. The Poſition of both theſe Kinds of *Veſſels*, is Various. The *Succiferous* or *Lignous*, are ſometimes poſited in diametral lines or portions; as in the *Vine*, and moſt *Trees*. Sometimes, oppoſitely to the *Aerial*, as in *Beet*; each Ring herein being double, and made both of *Sap*-and *Aer-Veſſels*. *Tab.* 17. *Tab.* 8.

9. §. In *Nettle* the Poſition is very peculiar, from what it is in the *Roots* of other *Herbs*; being curiously mixed; the *Succiferous* running croſs the *Aerial*, in ſeveral, *viz.* *Five*, *Six*, *Seven*, or more *Rings*. In *Bryony* the ſeveral Conjugations of the *Aerial*, are diſtinctly ſurrounded with the *Succiferous*. In *Patience*, the *Succiferous* are diſpoſed, beſides Rays, into many ſmall Rings, of different Sizes, ſprinkled up and down, and not, as in other *Roots* having one common Centre; within divers whereof, the *Aer-Veſſels* are included: eſpecially within thoſe which are drawn, not into *Rings*, but, as it were, into little ſtragling *Hedges*. *Tab.* 8. *Tab.* 7.

10. §. That alſo of the *Aer-Veſſels*, is Various and Elegant: eſpecially in the upper part of the *Root*. In *Ammi*, *Lilium-non-bulboſom*, they make a Ring. In theſe, a Prick'd-Ring; in *Peony*, a Ring of Rays; in *Valerian*, a Ring of Pricks and Rays. In others, they make not Rings, but longer Rays, extended either towards the Centre, as in *Scorzenera*; or meeting in it, as in *Columbine*. In the Common *Dock*, they ſtand more in ſingle Rays: in the other *Species* of *Docks*, both in Rays, and collateral Conjugations between. *Tab.* 7, 8, 9.

11. §.

11. §. In *Beet*, they ſtand in ſeveral Rings; and every Ring, made of Rays. In *Cumfry*, the Rays and Rings are ſeparate; thoſe
Tab. 8, 9. ſtand without, theſe next the Centre. In *Dandelion*, they ſtand altogether, and make a little Rope, in the Center it ſelf. In *Geranium*, and others of that Kindred, they make a little Thred, in the ſame place. And in *Skirret*, they ſtand in two Threds, near the Centre.

12. §. In *Celandine*, they ſtand in almoſt parallel Lines. In
Tab. 8, 9. *Monks-hood*, of a wedged Figure; divided in the ſmaller part of the *Root*, into Three little Wedges, with their poynts meeting exactly in the Centre. In *Cinquefoyle*, and *Strawberry*, they are alſo poſtur'd in three Conjugations, triangularly. In the young *Roots* of *Oak*, they ſtand neither in Radiated, nor otherwiſe ſtrait, but Winding Lines. And in *Borage* the poſition, of many of them, is Spiral. As likewiſe, ſometimes, in *Mercury*, or *Lapathum unctuoſum*. In *Horſe-*
Tab. 15. *Radiſh*, they ſtand more confuſed neither in Rings nor in Rays; yet their ſeveral Conjugations, are radiated: with very many other differences.

13. §. The Quantity of theſe *Veſſels*, as to the ſpace they take up in the *Root*, is to be computed Two ways, By their Number, and Size. Their Number may, in ſome *Roots*, and in ſome meaſure, be judged of, by the bare Eye; having, frequently, a whiter ſurface than the other *Parts*. As alſo their Size; the Bore of theſe *Veſſels* being greater than that of the *Lignous* in all *Roots*; eſpecially in ſome. For if you take the *Roots* of *Vine*, *Fenil*, *Dandelion*, *Plum-tree*, *Elder*, *Willow*, &c. and lay them by, for ſome time, to dry; and then, having cut off a very thin Slice of each, tranſverſely; if you hold up thoſe Slices before your Eye, ſo as the Light may be trajected through the ſaid *Veſſels*, they hereby become viſible, as notably different, both in Number and Size.

14. §. But undeceitful and accurate Obſervation of both their Number, and Size, muſt be made by the *Microſcope*; and ſo they will appear to be much more various. In *Biſtort*, *Skirret*, they are very few; in *Beet*, very many: betwixt which extreams there are all Degrees; as in *Orpine*, *Venus Looking-Glaſs*, *Scorzonera*, Great *Celandine*, *Peony*, *Borage*, *Fenil*, &c. may be ſeen. So their Size, in ſome is extream ſmall, as in *Strawberry*, *Biſtort*, *Valerian*; in others very great, as in *Aſparagus*, *Bugloſs*, *Vine*. They are alſo of ſeveral Sizes in one and the ſame Numerical *Root*; but in ſome, are leſs varied, as in *Li-*
Tab. 10. to the 17. *lium non bulboſum*, *Aſparagus*, *Bugloſs*; in others, more, as in *Bryony*, *Lovage*. Amongſt all *Roots*, they vary by about Twenty Degrees; as by comparing the *Roots* of *Vine*, *Thorn-Apple*, *Bryony*, *Lovage*, *Fenil*, Wild *Carrot*, *Saxifrage*, *Parſley*, *Peony*, *Hore-hound*, *Cinquefoyl*, *Strawberry*, &c. together, may be ſeen. Some of thoſe in the *Vine*, being of the greateſt Size; appearing through a good *Glaſs*, at leaſt one Third of an Inch in Diametre: thoſe in *Strawberry*, and that Kind, of the ſmalleſt; moſt of them appearing, in the ſame *Glaſs*, no bigger, than to admit the poynt of a ſmall Pin, according to the Standard, in *Tab.* 12. See alſo the Figures of ſo many of them as are drawn.

15. §.

15. §. In ſome *Roots*, they are Small, and Few; as in *Jeruſalem Artichoke*; in others Small, but Many, as in *Horſe-Radiſh:* in *Bugloſs*, they are Great, but Few; in the *Vine*, Great and Many. So that the proportion, which thoſe of a *Vine*, their Number and Size being taken together, bear to thoſe of *Jeruſalem Artichoke*, may be, at leaſt, as Fifty, to One. Of the ſmalleſt Kinds, as thoſe of *Cinquefoyl*, *Jeruſalem Artichoke*, and the like; It is to be noted, That they are ſcarce ever viſible in the freſh Slices of theſe *Roots*; but after they have layn by a while, at laſt, by a good *Glaſs*, Clear Light, and ſteddy View, are diſcernable. *Tab.* 11, 14, 15, 17.

16. §. In ſome *Roots*, the greater of theſe *Veſſels* ſtand in or next the Centre, as in *Taraxacum*, or *Dandelion*; in others next the circumference, as in *Horſe-Radiſh*. Sometimes each of them is from one end of the *Root* to the other, of a more equal Size, or more Cylindrical, as in *Marſh-mallow*; but uſually, they widen, more or leſs, from the Top, to the Bottom of the *Root*, as in *Thorn-Apple*: about the Top of which, they are, for the moſt part, but of the Sixth, Seventh, and Eighth, Magnitude; ſome of the Fifth, but none of the Third; but about the Bottome, they are moſt of the Third, and Fifth: whence it is manifeſt, That ſome of them are, in the manner of *Veins*, ſomewhat Pyramidal. Yet is it obſervable, That their ampliation proceedeth not towards, but from their Original, as in *Nerves*. *Tab.* 13, 15.

17. §. Of theſe *Veſſels* Seignior *Malpighi* hath obſerved; *Componuntur* (ſaith he) *expoſitæ fiſtulæ Zona tenui & pellucida, velut argentei coloris lamina, parum lata; quæ, ſpiraliter locata, & extremis lateribus unita, Tubum, interius & exterius aliquantulum aſperum, efficit.*

18. §. To whoſe Obſervation I further add, That the *Spiral Zone*, or *Lamina*, as he calls it, is not ever one Single *Piece*; but conſiſteth of Two or More round and true *Fibres*, although ſtanding collaterally together, yet perfectly diſtinct. Neither are theſe Single *Fibres* themſelves *flat*, like a *Zone*; but of a *round* forme, like a moſt fine *Thred*. According as fewer or more of theſe *Fibres* happen to break off, from their Spiral location, together; the *Zone* is narrower, or broader: uſually, Narrower in the *Trunk*, and Broader in the *Root*.

19. §. Of theſe *Fibres* I alſo Obſerve, That they are not *Inoſculated* ſide to ſide, but are *Knit* together by other ſmaller *Fibres*; thoſe being, as it were, the *Warp*, and theſe the *Woof* of the *Aer-Veſſels*. Yet I think the ſeveral *Fibres* are not interwoven juſt as in a *Web*; but by a kind of Stitch, as the ſeveral *Plates* or *Bredths* of a Floor-Mat. A clear and elegant ſight of theſe *Fibres*, and of their *Interweftage*, by ſplitting a *Vine-Root*, or a piece of *Oak*, may, with a good *Glaſs* in the ſides of their Greater *Aer-Veſſels*, be obtained; having much of the reſemblance of *Cloſe Needle-work*.

20. §. The Spiration of the *Fibres* of theſe *Veſſels*, may more eaſily be obſerved in the *Trunk*, than in the *Root*. And better in younger *Plants*, than other. And not ſo well by Cutting as by Splitting, or by Tearing off ſome ſmall Piece, through which they *run:* their Conformation being, by this means, not ſpoiled. Yet this way, the *Veſſels* are ſeen, chiefly, *Unreſolved*.

21. §. But in the *Leaves* and Tender *Stalks* of all ſuch *Plants*, as ſhew, upon breaking, a kind of *Doune* or *Wool*; they may be ſeen *Reſolved* and Drawn out, and that ſome times even to the naked Eye,

an Inch or two Inches in length. This *Wool* being nothing elſe, but a certain number of *Fibres* Reſolved from their Spiral poſition in theſe *Veſſels*, and Drawn out in Length; and ſo cluſtred together, as ſo many *Threds* or little *Ropes*: appearing thus more or leſs, in the *Leaves* and ſome other *Parts* of moſt *Plants*; but more remarquably in ſome, as in the *Vine*, *Scabious*, and others. As alſo in the Scales of a *Squill*. In which laſt, for example, they are ſo eaſily ſeparable, as further to ſhew, what before was obſerved; *viz.* That the *Plate* or *Zone*, into which the *Aer-Veſſels* are uſually Reſolved, is not one Single Piece, or meer *Plate*; but made up of ſeveral Round *Fibres*, all ſtanding and running parallel, and ſo knit together by other ſmaller ones, tranſverſly, in the form of a *Zone*. For if you break or cut a *Leaf* or *Shell* of a freſh *Squill*, till you come to the *Aer-Veſſels*, and having ſoftly drawn them out, for about an Inch or more (to the naked Eye) in length, you then ſingle out one or two of them from the reſt, and rowl them, as they hang at the *Shell*, eight or nine times round, each *Veſſel* will appear, through a *Glaſs*, to conſiſt of 8, 10, or 12 ſmall *Fibres*; which, in the Unreſolved *Veſſel*, run parallel; but by this means, are all ſeparated one from another. See the *Figures* belonging to the *Third* and *Fourth* Books.

22. §. The Proceſs of their Spiration, is not, ſo far as I have obſerved, accidental, but conſtantly the ſame; *ſcil.* In the *Root*, by *South*, from *Weſt* to *Eaſt*: But in the *Trunk*, contrarily, by *South*, from *Eaſt* to *Weſt*.

23. §. The *Content* of theſe *Veſſels*, is, as hath already been intimated, more *Aery*. The Arguments for which, are, That upon a tranſverſe Cut of the *Root*, the *Sap* aſcendeth not there, where Theſe ſtand. Being alſo viewed through a *Microſcope*, they are never obſerved to be filled with *Liquor*. Beſides a *Root* cut and immerſed in Water, till the Water is in ſome part got into theſe *Veſſels*, and then the *Root* taken out and cruſhed; the other *Parts* will yield *Liquor*, but Theſe, only *Bubbles*: which *Bubbles* are made, by ſome ſmall quantity of *Liquor* mixed with the *Aer*, before contained in the ſaid *Veſſels*. To which, other Arguments will ariſe out of thoſe Things that follow in the *Second* Part. As alſo for this *Content*, its not being a pure or ſimple, but *Vaporous Aer*. Whether theſe *Veſſels* may not, in ſome *Vegetables*, and at ſome times, contain *Liquor*, is doubtful. (*a*) Thus far of the *Lignous Part*.

(*a*) See Book 3.

CHAP.

CHAP. V.

Of the PITH.

WITHIN the *Lignous Part* lyeth the *Pith*. This *Part* is not common to all *Roots*, for ſome have none, as *Nicotian*, *Srtamonium*, and others. Yet many which have none, or but little, throughout all their lower parts, have one fair enough about their tops, as *Mallow*, *Bourage*, *Dandelion*, and the like. See the *Roots*. *Tab. 6.* And in many others there are *Parenchymous Parts*, of the ſame ſubſtantial nature with the *Pith*, diſtributed betwixt the ſeveral Rings of *Veſſels*, and every where viſible, from the top to the bottom, as in *Beet*, *Fenil*, &c. *Tab. 8.*

2. §. The Size of the *Pith* is varied by many Degrees, eaſily reckoned an Hundred; in *Fenil*, *Dandelion*, *Aſparagus*, but ſmall; in *Horſe-Radiſh*, *Valerian*, *Biſtort*, great. The Shape hereof, in the lower parts of moſt *Roots*, is Pyramidal; but at the tops, Various, according to the different Diſtribution of the *Veſſels*, as in *Carrot*, *Hyperbolick*, *Tab. 6.* in *Parſley*, *Oval*; as appeareth, in cutting the *Roots* lenghtways.

3. §. The *Pith*, for the moſt part, eſpecially in *Trees*, is a *Simple* Body: but ſometimes, it is, as the *Barque*, compounded; ſome certain number of *Succiferous Veſſels* being mixed herewith; as in *Jeruſalem Artichoke*, *Horſe-Radiſh*, &c. *Tab. 6, & 8.* upon a traverſe cut, by a ſtrict view, may be diſcerned. Their Poſition is ſometimes Confuſed, as in a *Carrot*; and ſometimes Regular, as in *Parſley*; appearing, by the traverſe cut, in *Tab. 6.* Rings, and in cutting by the length, in Arches. And ſometimes the *Pith* is hollow; as in the *Level-Roots* of *Biſhops-Weed*: theſe *Roots* being made out of the *Stalk*, as in the *Firſt* **Chapter** hath been ſhewed, how. §. 13, 14, 15.

4. §. As all the other Parts of the *Root*, are originated from the *Seed*; ſo, ſometimes, is the *Pith* it ſelf. But ſometimes, it hath its more immediate Derivation from the *Barque*. Hence it is, that many *Roots*, which have no *Pith* in their lower parts, have one at their top, as *Columbine*, *Lovage*, &c. For the *Parenchymous Parts* of the *Tab. 4.* *Barque* being, by degrees, diſtributed into Diametral *Portions*, running betwixt thoſe of the *Lignous Body*, and at length, meeting and uniting in the Centre, they thus conſtitute the *Pith*. In the ſame manner, at the top of ſome *Roots*, the *Pith* is either made or augmented, out of the *Parenchymous Rings* above deſcribed; theſe being gradually diſtributed to, and embodied in the Centre; as in *Fenil*, and ſome other *Roots*, their lower and upper parts compared together, may be ſeen. Even as in *Animals*, one *Part*, as the *Dura Mater*, is the original of divers others.

5. §. From hence, it alſo appears, That the *Pith* is of the ſame Subſtantial Nature with the *Parenchyma* of the *Barque*, and with the Diametral *Portions*; and that therefore they are all one body, differing in no Eſſential Property, but only in their Shape and Place. The ſame is alſo evident from the Continuity of the *Pith* with the Diametral *Portions*, as of Theſe, with the ſaid *Parenchyma*. And from their Contexture, which, by a *Microſcope*, appeareth to be of one and the ſame general kind, in all *Plants*, both in the *Parenchyma* of the *Barque*, in the *Inſertment* or Diametral *Portions*, and in the *Pith*, all being made up of *Bladders*.

Tab. 9, & 15. 6. §. The *Bladders* of the *Pith*, are of very different Sizes; ſeldom leſs, than in the *Barque*, as in *Aſparagus*; uſually much bigger, as in *Horſe-Radiſh*. They may be well reckoned to about fifteen or twenty degrees; thoſe in *Jeruſalem Artichoke*, of the largeſt; in *Valerian*, *Horſe-Radiſh*, of the meaner; in *Biſtort*, *Peony*, of the ſmalleſt. Their Poſition is rarely varied, as it is oftentimes, in the *Barque*; but more uniform, and in the tranſverſe Cut, equally reſpective to all parrs of the *Root*: yet being piled evenly, one over another, in the long cut, they ſeem to run, in Direct Trains, by the length of the *Root*. Their Shape alſo is, uſually more orbicular; but ſometimes, *Tab.* 11. ſomewhat angular, in the larger kinds, as in *Jeruſalem Artichoke*.

7. §. THUS FAR the Contexture of the *Pith* is well diſcoverable in the *Root*. In the *Trunk*, farther, and more eaſily. Whereof therefore, in the next *Book*, I ſhall give a more particular *Deſcription* and *Draught*. Yet ſince I am ſpeaking of it, I ſhall not wholly omit here to obſerve, That the *Sides*, by which the aforeſaid *Bladders* of the *Pith* are circumſcribed, are not meer *Paper-Skins*, or rude *Membranes*; but ſo many ſeveral Ranks or Piles of exceeding ſmall *Fibrous Threds*; lying, for the moſt part, evenly one over another, from the bottom to the top of every *Bladder*; and running croſs, as the *Threds* in the Weavers *Warp*, from one *Bladder* to another. Which is to ſay, That the *Pith* is nothing elſe but a *Rete mirabile*, or an Infinite Number of *Fibres* exquiſitely ſmall, and admirably Complicated together: as by cutting the *Pith* with a *Razor*, and ſo viewing it with a good *Glaſs*, may be ſeen. See the *Figures* belonging to the *Third* Book.

8. §. All *Plants* exhibit this Spectable, not alike diſtinctly; thoſe beſt, with the largeſt *Bladders*. Nor the ſame *Pith*, in any condition; but beſt, when dry: Becauſe then, the *Sap* being voided, the ſpaces betwixt the *Fibrous Threds*, and ſo the *Threds* themſelves, are more diſtinctly diſcernable. Yet is it not to be dryed, after Cutting; Becauſe its ſeveral parts, will thereupon coincide and become deformed. But to be choſen, while the *Plant* is yet growing; at which time, it may be often found dry, yet undeformed; as in the *Trunks* of *Common Thiſtle*, *Jeruſalem Artichoke*, &c.

9. §. Neither are theſe *Threds*, ſo far as I can obſerve, Single *Fibres*; but uſually, conſiſt of ſeveral together. Nor are they *ſimply* Collateral, but by the weftage of other *Fibres*, in their natural Eſtate, knit together; much after the ſame manner as the *Spiral Fibres* of the *Aer-*

Aer-Veſſels. This Connexion I have no where ſo well ſeen, as in the White *Bottoms* of the *Bladders* of a *Bulruſh*, being cut traverſe; wherein they have the appearance, of very Fine and cloſe *Needle-work*.

10. §. The *Fibres* by which the ſaid *Threds* are knit together, I think are all Single: and are ſeldom and ſcarcely viſible, except by obliquely Tearing the *Pith*; by which means, they will appear through the Glaſs, broken off, ſometimes, a quarter or half an Inch, or an Inch in Length; and as ſmall as one Single *Thred* of a *Spiders Webb*. In a *Bulruſh*, they are ſometimes diſcernable in cutting by the Length. Theſe *Fibres*, and the *Threds*, they knit together, for the moſt part; are ſo pellucid, and cloſely ſituate, that they frequently ſeem to make One entire Body, as a picce of *Ice* or a film of *Water* it ſelf: or even as *Animal Skins* ſometimes ſhew, which yet are known to be *Fibrous*.

11. §. The Situation of theſe *Threds*, is contrary to that of the *Veſſels*, as thoſe by the Length, ſo theſe, chiefly, by the Bredth of the *Root*, or horizontally, from one edge of the *Pith* to the other. They are continued circularly; whereby, as oft as they keep within the compaſs of the ſeveral *Bladders*, the ſaid *Bladders* are Round: But where they winde out of one *Bladder*, into another, they mutually Interſect a *Chord* of their ſeveral *Circles*; by which means, the *Bladders* become Angular.

12. §. The Contexture, likewiſe, both of the *Parenchymous Part* of the *Barque*, and of the Diametral *Portions* inſerted betwixt the *Lignous*; is the ſame with this of the *Pith*, now deſcribed; that is, *Fibrous*. Whence we underſtand, How the ſeveral *Braces* and *Threds* of the *Veſſels* are made: For the *Veſſels* running by the length of the *Root*, as the *Warp*; by the *Parenchymous Fibres* running croſs or horizontally, as the *Woof*: they are thus *knit* and as it were *ſtitched* up together. Yet their *weftage* ſeemeth not to be *ſimple*, as in Cloath; but that many of the *Parenchymous Fibres* are *wraped* round about each *Veſſel*; and, in the ſame manner, are continued from one *Veſſel* to another; thereby knitting them altogether, more cloſely, into one *Tubulary Thred*; and thoſe *Threds*, again, into one *Brace*: much after the manner of the *Needle work* called *Back-Stitch* or that uſed in Quilting of Balls. Some obſcure ſight hereof, may be taken in a *Thred* of *Cambrick*, through a *Microſcope*. But it is moſt viſible, in the *Leaves* and *Flowers* of ſome *Plants*. The Delineation of theſe Things I ſhall therefore omit, till we come hereafter to ſpeak of the other *Parts*.

13. §. From what hath been ſaid, it may be conjectured; That the *Aer Veſſels* ſucceſſively appearing in the *Barque*, are formed, not out of any *Fluid Matter*, as are the original ones: But of the *Parenchymous Fibres*; *ſc.* by changing them from a *Spherical* to a *Tubulary Forme*.

14. §. From the precedents, it is alſo manifeſt, That all the *Parenchymous Parts* of a *Root*, are *Fibrous*.

15. §. And laſtly, That the whole Body of a *Root*, conſiſteth of *Veſſels* and *Fibres*. And, That theſe *Fibres* themſelves, are Tubulous,

or,

or ſo many more *Veſſels*, is moſt probable: There only wanteth a greater perfection of *Microſcopes* to determine.

16. §. The *Contents* of the *Pith* are, ſometimes *Liquor*, and ſometimes a *Vaporous-Aer*. The *Liquor* is always Diaphanous, as that of the *Parenchymous Part* of the *Barque*; and in nature, not much differing from it. The *Aer* is ſometimes leſs, and ſometimes more *Vaporous*, than that of the *Barque*. By this *Aer* I mean, that which is contained in the *Bladders*. Within the Concaves of the *Fibres* which compoſe the *Bladders*, I ſuppoſe, there is another different Sort of *Aer*. So that as in the *Bladders* is contained a more *Aqueous*; and in the *Veſſels*, a more *Eſſential Liquor*: So ſometimes, in the ſame *Bladders*, is contained a more *Vaporous*; and in the *Fibres*, a more Simple and *Eſſential Aer*.

An

An Account of the

VEGETATION

OF

ROOTS

Grounded chiefly upon the foregoing

ANATOMY.

PART II.

TO *Philoſophize*, is, To render the *Cauſes* and *Ends* of Things. No man, therefore, that denieth *God* can do this, Truly. For the taking away of the *firſt Cauſe*, maketh all things *Contingent*. Now, of that which is *Contingent*, although there may be an *Event*; yet there can be no *Reaſon* or *End*: ſo that Men ſhould then ſtudy, That, which *is not*. So the *Cauſes* of Things, if they are *Contingent*, they cannot be *Conſtant*. For that which is the *Cauſe* of This, now; if it be ſo *Contingently*, it may not be the *Cauſe* hereafter: and no *Phyſical* Propoſition, grounded upon the *Conſtancy* and Certainty of Things, could have any foundation. He, therefore, that philoſophiſeth, and denieth *God*, playeth a childiſh Game.

Theology the Beginning and End of *Philoſophy*.

2. §. Wherefore *Nature*, and the *Cauſes* and *Reaſons* of Things, duly contemplated, naturally lead us unto *God*; and is one way of ſecuring our Veneration of Him: giving us, not only a general Demonſtration of his *Being*; but a particular one, of moſt of the ſeveral *Qualifications* thereof. For all *Goodneſs*, *Righteouſneſs*, *Proportion*, *Order*, *Truth*, or whatever elſe is Excellent and Amiable in the *Creatures*; it is the Demonſtration of the like in *God*. For it is impoſſible, that *God* ſhould

ſhould ever make any thing, not like Himſelf, in ſome degree or other. Theſe Things, and the very Notions which we have of them, are *Conceptions* iſſuing from the *Womb* of the *Divine Nature*.

3. §. By the ſame means, we have a greater aſſurance of the Excellency of his *Sacred Word*. That He, who hath *Done* all things ſo tranſcendently well; muſt needs *Speak* as well, as he hath *Done*. That He, who in ſo admirable a manner, hath *made* Man; cannot but know beſt, What his true *Principles* and *Faculties* are; and what *Actions* are moſt agreeable thereunto: and, that having adorned him with ſuch *Beauteous* and *Lovely* ones; it is impoſſible, He ſhould ever put him upon the Exerciſe of thoſe *Faculties*, in any way *Deformed* and *Unlovely*. That He ſhould do all things, ſo well *Himſelf*; and yet require his *Creatures*, to do otherwiſe, is unconceivable.

4. §. And as we may come, hereby, to rectifie our Apprehenſion of His *Laws*; ſo alſo, of His *Miſteries*. For there are many Things, of the *Manner* of whoſe Exiſtence, we have no certain Knowledge. Yet, of their *Exiſtence*, we are as ſure, as our *Senſes* can make us. But, we may as well deny, what *God* hath Made, *To be*; as, what he hath Spoken, *To be true*, becauſe we underſtand not *how*. And the knowledge of *Things* being gradually attained, we have occaſion to reflect, That ſome *Things*, we can now well conceive, which we once thought unintelligible. I know, therefore, what I *underſtand* not; but, I know not, what is *unintelligible*: what I know not now, I may hereafter; or if not I, another; or if *no Man*, or other *Creature*, it is ſufficient, *That God fully underſtandeth Himſelf*. It is not, therefore, the *Knowledge* of *Nature*, but they are the *wanton phanſies* of Mens minds, that diſpoſe them, either to Forget *God*, or to Think unduly of Him.

5. §. Nor have we reaſon to fear going *too far*, in the Study of *Nature*; more, than the *entring* into it: Becauſe, the higher we riſe in the true Knowledg and due Contemplation of *This*; the nearer we come to the *Divine Author* hereof. Or to think, that there is any Contradiction, when *Philoſophy* teaches that to be done by *Nature*; which *Religion*, and the *Sacred Scriptures*, teach us to be done by *God*: no more, than to ſay, That the *Ballance* of a *Watch* is moved by the next *Wheel*; is to deny that *Wheel*, and the reſt, to be moved by the *Spring*; and that both the *ſpring*, and all the other *Parts*, are cauſed to move together by the *Maker* of them. So *God* may be truly the *Cauſe* of *This Effect*, although a Thouſand other *Cauſes* ſhould be ſuppoſed to intervene: For all *Nature* is as one Great *Engine*, made by, and held in His Hand. And as it is the Watch-makers *Art*, that the *Hand* moves regularly, from hour to hour, although he put not his Finger ſtill to it: So is it the Demonſtration of *Divine Wiſdome*, that the Parts of *Nature* are ſo harmoniouſly contrived and ſet together; as to conſpire to all kind of Natural Motions and Effects, without the Extraordinary and Immediate Influence of the *Author* of it.

6. §. Therefore, as the *Original Being* of all Things, is the moſt proper Demonſtration of *Gods Power*: So the *ſucceſſive Generations*, and *Operations* of Things are the moſt proper Demonſtration of his *Wiſdom*. For if we ſhould ſuppoſe, that *God* did now make, or do any Thing, by any Thing; then, no *Effect* would be produced by a *Natural Cauſe*: and conſequently, He would ſtill be upon the Work of *Creation*: which yet *Sacred Scripture* aſſureth us, He *reſteth from*. And we might exſpect

the

the Formation of a *Child*, in an *Egg*, as well as in a *Womb*; or of a *Chicken*, out of a *Stone*, as an *Egg*: And all Sorts of *Animals*, as well as *Plants*, might propagate their *Species*, without Coition: and the like. For *Infinite Power*, needeth not make any difference in the Things it undertakes to manage. But in that, these Things are not only *made*, but *so made*, that is, according to such certain Natural Laws, as to produce their *Natural Effects*; here is the Sensible and Illustrious Evidence of his *Wisdom*. Wherefore as the Wisdom of Government, is not seen, by the King his interposing Himself in every Case; but in the contrivance of the *Laws*, and Constitution of *Ministers* in such sort, that it shall be as effectually determin'd, as if he did so indeed: So the more complicated and vastly Numerous, we allow the *Natural Causes* of Things to be; the more duely we conceive of that *Wisdom*, which thus disposeth of them all, to their several *Effects*: All Things being thus, as *Ministers* in the Hands of *God*, conspiring together a Thousand *Ways*, towards a Thousand *Effects* and *Ends*, at one time; and that with the same certainty, as if he did prepose to each, the same Omnipotent *Fiat*, which he used at the Creation of the World.

7. §. THIS *Universal Monarchy*, as it is eminently Visible in all other Particular *Oeconomies*; so is it, no less, in that of *Vegetables*. Infinite Occurrences, and secret Intrigues, 'tis made up of; of which we cannot skill, but by the help of manifold *Means*; and those, in the foregoing *Idea*, have been lately proposed. Wherein, although some *Experiments* have been briefly touch'd: yet that which I have hitherto chiefly prosecuted, hath been the *Anatomical* Part; and that not throughly neither. Notwithstanding, so far as Observations already made will conduct us, I shall endeavour to go. And if, for the better clearing of the way, I have intermixed some Conjectures; I think they are not meerly such, but for which I have layd down some Grounds, and of which, the *Series* also of the following *Discourse*, may be some further proof.

The Divine Wisdom seen in the Growth of *Plants*; if we observe,

8. §. LET US say then, that the *Root* of a *Plant* being lodged in some Soil, for its more convenient growth; 'tis necessary the Soil should be duly prepared for it. The *Rain*, therefore, falling and soaking into the Soyl, somewhat diluteth the Dissoluble *Principles* therein contained; and renders them more easily communicable to the *Root*: Being as a *Menstruum*, which extracteth those *Principles*, from the other greater and useless part of the Soil.

First, How the *Ground* is prepared.

9. §. And the warm *sun*, joyned with the diluting *Rain*, by both, as it were a *Digestion* of the Soil, or a gentile *Fermentation* amongst its several Parts, will follow: whereby the Dissoluble Parts therein, will rot and mellow: that is, those *Principles* which as yet remained more *fixed*, will now be further *resolved and unlocked*, and more copiously and equally spread themselves through the Body of the Soil.

10. §. These *Principles*, being with the growth of *Plants* continually exhausted, and needing a repair; the successions, therefore, of Wet, Wind, and other Weather, beat down and rot the *Leaves* and other *Parts* of *Plants*. Whereby these (as *Weeds* which are wont to be buried under ground) become a *natural Manure*, and Re-impreg-

nate the Soil: Being thus, in part, out of their own Reſolved *Principles*, annually Compounded again.

11. §. Many of theſe *Principles*, upon their *Reſolution*, being by the *Sun* more attenuated and volatilized; continually aſcend into the *Aer*, and are mixed therewith. Where, although they loſe not their *Vegatable Nature*, yet being amongſt other purer *Principles*; themſelves alſo, depoſiting their Earthy feculencies, become more ſubtile, ſimple and Eſſential Bodies.

12. §. And the *Aer* being of an *Elaſtick* or *Springy* Nature, preſſing, more or leſs, upon all Bodies; it thereby forceth and inſinuateth it ſelf into the Soil, through all its permeable Pores. Upon its own entrance, it carries alſo many of the ſaid *Vegetable* and *Eſſential Principles* along with it; which, together with the reſt, are ſpread all over the Body of the Soil. By which means, though a leſs Vehement, yet more Subtil *Fermentation*, and with the leaſt advantage of warmth, continuable, will be effected.

13. §. The *Principles* being thus farther *reſolved* and ſubtilized, would preſently exhale away, if the *Rain*, again, did not prevent. Which, therefore, falling upon and ſoaking through the Ground, is as a freſh *Menſtruum*, ſaturate or impregnate with many of them. And as it ſtill ſinketh lower, it carries them along with it ſelf, from the Superficial, to the Deeper parts of the Ground: thus, not only maturing thoſe parts alſo, which, otherwiſe, would be more lean and cold; but therein likewiſe, laying up and ſecuring a *Store*, more gradually and thriftily to be beſtowed upon the Upper parts again, as they need.

14. §. And *Autumn* having laid up the *Store*, *Winter* following thereupon, doth, as it were, lock the doors upon it. In which time, ſome warmer Intervals, ſerve further and gradually to mature the ſtored *Principles*, without hazard of their being Exhaled. And the *Spring* returning, ſets the doors open again, with warmer and more conſtant *Sun*, with gentle and frequent *Rain*, fully reſolves the ſaid *Principles*; and ſo furniſheth a plentiful Diet, for all kinds of *Vegetables*: being a *Compoſition* of *Water* chiefly, wherein are reſolved, ſome portions of *Earth*, *Salt*, *Acid*, *Oyl*, *Spirit*, and *Aer*; or other Bodies of Affinity herewith.

Then, How the *Sap* is imbib'd, and diſtributed to the ſeveral *Parts*.

15. §. THE ROOT ſtanding in the *Ground* thus prepared, and being always ſurrounded with a *Barque*, which conſiſteth chiefly of a *Parenchymous* and *Spongy* Body; (*a*) it will thus, as *Sponges* do, naturally ſuck up the watry parts of the *Soil* impregnate with the ſaid *Principles*. Which *Principles* notwithſtanding, being in proportion with the watry parts, but few, and alſo more *Eſſential*; (*b*) therefore in this *Parenchymous Part*, are they never much diſcovered, either by *Colour*, *Taſte*, or *Smell*. As it is probable, that ſome diſtilled *Waters*, which diſcover nothing, to Senſe, of the *Plants* from which they are diſtilled, may yet, in part, retain their *Faculties*. And it is known, that many Bodies; as *Crocus Metallorum*, convey many of their parts into the *Menſtruum*, without any ſenſible alteration thereof. So *Froſt* and *Snow* have neither *Taſte* nor *Smell*; yet from their *Figures*, 'tis evident, that there are divers kinds of *Saline Principles* incorporated with them; or at leaſt, ſuch *Principles* as are common to *them* and divers kinds of *Salts*.

(*a*) P. 1. c. 3. §. 3.
(*b*) §. 11, 12

16. §.

16. §. The entrance of this Impregnate Water or *Sap* is not without difference, but by the Regulation of the intervening *skin*; being thereby *strained* and rendred more pure: the *Skin*, according to the thickneſs (*a*) or cloſeneſs thereof, becoming ſometimes only as a *brown paper*, ſometimes as a *Cotton*, and ſometimes as a *Bag* of *Leather* to the tranſient *Sap*, as the nature of it doth require. By which it is alſo *moderated*, leſt the *Barque*, being ſpongy, ſhould ſuck it up too faſt, and ſo the *Root* ſhould be, as it were, ſurcharged by a *Plethora*. And divers of the *Succiferous Veſſels* being mixed herewith (*b*) and lying next the Soil, uſually more or leſs *mortified*, and ſo their *Principles* ſomewhat *reſolved*; the *Sap* is hereby better *ſpecified*, and further *tinctured*; ſuch parts of the *Sap* beſt entring, as are moſt agreeable to thoſe *Principles*; which the *Sap* alſo carries off, in ſome part, as it paſſeth into the *Barque*.

(*a*) P. 1. c. 2. §. 1.

(*b*) P. 1. c. 2. §. 4.

17. §. The *Sap* thus *ſtrained*, though it be *pure*, and conſiſteth of *Eſſential* parts; yet being *compounded* of *heterogeneous* ones; and received into the *Parenchyma* of the *Barque* a laxe and ſpongy Body, they will now eaſily and mildly *ferment*. Whereby they will be yet further prepared, and ſo more eaſily inſinuate themſelves into all the *Bladders* of the ſaid *Parenchyma*; ſwelling and dilating it as far as the *Continuity* of its parts will bear. Whereupon, partly from the continued entrance of freſh *Sap*, and partly by a Motion or Preſſure of *Reſtitution* in the ſwollen and Tenſed *Bladders* of the *Parenchyma*, the *Sap* is forced thence into the other parts of the *Root*.

18. §. And becauſe the *Parenchyma* is in no place openly and Viſibly Pervious, but is every where compoſed of an Infinite Number of ſmall *Bladders* (*c*); the *Sap*, therefore, is not only *fermented* therein, and fitted for Separation; but, as it paſſeth through it, is every part of it, *ſtrained* an Hundred times over, from *Bladder* to *Bladder*.

(*c*) P. 1. c. 3. §. 4.

19. §. The *Sap* thus *fermented*, and *ſtrained*, is diſtributed to the other *Organical Parts*, according as the ſeveral *Principles* of This, are agreeable to thoſe whereof the ſaid *Organical Parts* conſiſt. As the *Sap* therefore paſſeth from *Bladder* to *Bladder*, ſuch *Principles* as are agreeable to thoſe of the *Fibres* of the ſaid *Bladders*, will adhere to, and inſinuate themſelves into the Body of the *Fibres*; *ſc.* *Watry* chiefly, next *Acid*, then *ſpirituous*, *Earthy*, *Aery*, and *Oleous*. (*d*)

(*d*) *Idea*, §. 50, 52.

20. §. And the *Sap* by its continual appulſe and *percolation*, as it leaveth ſome parts upon the ſaid *Fibres*; ſo as it is *ſqueezed* betwixt them from *Bladder* to *Bladder*, it licks and carries off ſome others from them, in ſome *union* together with it; and ſo is *Impregnate* herewith: as *Water*, by paſſing through a *Mineral Vein*, becomes *tinctured* with that *Mineral*.

21. §. The *Sap* thus *Impregnate* with ſome *united Principles* of the *Parenchymous Fibres*, paſſeth on to the *Lignous Veſſels*, whereinto their correſpondent *Principles* alſo enter; *ſc.* *Watry*, *Saline*, *Oleous and Earthy* chiefly. (*e*) And becauſe the *Parenchymous Principles* mixed with them, are in ſome degree *united*, and ſo more ready to *fix*; ſome of theſe therefore will likewiſe enter into the ſaid *Veſſels*. Whereupon, the *Alkali oleoſum* of the one, and the *Acidum ſpirituoſum* of the other, meeting together; Theſe, with the other *Principles*, all *concentre*, and of divers *fluids*, become one *fixed* Body, and are gradually *agglutinated* to the *Veſſels*; that is, The *Veſſels* are now *nouriſhed*.

(*e*) *Idea*, §. 51, 52.

22. §. The ſupply of the *Sap* ſtill continued, the *Principles* thereof will not only enter into the *Body* of theſe *Parts*, but alſo their *Concaves*. (a) P.1.c.5. §. 12. And the *Parenchymous Fibres* being *wrapped* about the *Veſſels*, (a) as often as the ſaid *Fibres* are more *turgid* with their own contained *Fluid*, they will thereby be ſomewhat *ſhortned*, or contract in length; and ſo muſt needs *bind* upon the *Veſſels*, and thereby, as it were, *ſqueeze* ſome part of the *Fluid*, contained both within themſelves and the *Veſſels*, back again into the *Bladders*.

23. §. And the *Sap* herein, being thus *tinctured* with ſome of the *united Principles* of the *Veſſels*, divers of them will now alſo inſinuate themſelves into the *Parenchymous Fibres*, and be incorporated with them: Whereby, the ſaid *Fibres*, which before were only *relaxed* and *dilated*, are now alſo *nouriſhed*, and not till now. Some portion of the *united Principles* both of the *Parenchymous* and *Lignous Parts*, being neceſſary to the true *nutrition* of Each: As the Confuſion and joynt aſſiſtance of both the *Arterious* and *Nervous Fluids*, is to the nouriſhment or coagulation of the *Parts* in *Animals*.

24. §. Some portion of the *Sap* thus doubly *tinctured*, is at the ſame time tranſmitted to, and enters the *Body* of the *Aer-Veſſels*; conſiſting chiefly of *Water*, *Aer*, and *Acid*; and, in like manner, as in the other *Parts* is herein *agglutinated*. And the appulſe and preſſure of the *Sap* ſtill continued, ſome portion hereof is alſo trajected into the *Concaves* of the ſaid *Veſſels*; exiſting therein as a moſt *Compounded Fluid*; partaking, more or leſs, both of the *Principles* and *Tinctures* of the other *Organical Parts*, and of the *Aer-Veſſels* themſelves; being as it were, a *Mixed Reſolution* from them all.

25. §. And the *Parenchymous Fibres* being *wrapped* about Theſe, (b) P.1.c.5. §. 12. as about the other *Veſſels*, (b) and, in like manner, *binding* upon them; they thus frequently *ſqueeze* part of the ſaid contained *Fluid* out again: As neceſſary, though not to the immediate Nouriſhment of the *Parts*, yet the due Qualification of the *Sap*; being a Conſtant *Aerial Ferment*, ſucceſſively ſtored up within the *Aer-Veſſels*, and thence tranſfuſed to the *Sap*, in the other *Organical Parts*.

26. §. And that there may be a better Tranſition of the *Sap* thus *tinctured*, to the ſeveral *Organical Parts*; therefore, none of them are cloſe ſet and compact within themſelves, ſeverally: For ſo, they would be inacceſſible to the *Sap*, and their inward Portions, wanting a due ſupply of *Aliment*, would be ſtarved. But the *Veſſels*, both of *Aer* and *Sap*, being every where divided into *Braced* Portions, and other *Parenchymous* Portions, filling up the ſpaces every where betwixt (c) P.1.c.3. §. 13. & c.4. §. 4,5,7. them (c); there is therefore a free and copious communication of the *Sap*, (and ſo of all the *Tinctures* ſucceſſively transfuſed into it) from *Part* to *Part*, and to every Portion of every *Part*: The *Parenchymous* Portions, running betwixt the *Braces*, as the ſmaller *Veſſels* do throughout the *Viſcera*, in *Animals*. Whereby, none of them want that Matter, which is neceſſary either for their *Nutrition*, or for the good Eſtate of their *Contents*, or for the due period of their Growth.

27. §. For the better *Tempering* of the ſeveral parts of the *Sap*, ſerve the *Diametral* Portions of the *Parenchymous Body* whichrun ſometimes directly through the *Barque*, as in *Lovage*, *Parſley*, &c. is deſcribed (d) P.1.c.3. §. 7,8. and figur'd (d) Which being, all or moſt of them, continued betwixt both the *Succiferous* and the *Aer-Veſſels*, from the Circumference

to

to the Centre; they hereby carry off a more Copious and *Aerial Ferment* from the One, and communicate it unto the Other. For as the *Sap* enters the *Barque*, the more *liquid* part, ſtill paſſeth into the *ſucculent* Portions thereof; the more *Aery*, is ſeparated into thoſe White and Dryer *Diametral* ones; and in its paſſage betwixt the *Portions* of the *Aer-Veſſels*, is all along communicated to them. Yet is it not a pure or *ſimple Aer*, but ſuch as carries a *Tincture* with it, from the *Succiferous Veſſels*. And therefore it is obſervable, That when the *Diametral* Portions are more diſtant, the *Sap-Veſſels* run not in a Straight Line betwixt them, but are Reciprocally ſo inclined, as to touch upon them; as in *Lovage* is viſible: Thereby communicating their *Tincture* to the *Aer*, as it paſſeth by them, through the ſaid *Diametral* Portions.

28. §. By the continual appulſe of freſh *Sap*, ſome, both of the *aery*, and of all the other parts thereof are tranſmitted into the *Pith*; where, finding more room, it will yet more kindly be *digeſted*. Eſpecially having the advantage herein of ſome degree of Warmth; being herein remoter from the *Soil*, and, as it were, *Tunn'd* up within the *Wood*, or the *Maſs* of ſurrounding *Veſſels*. So that the *Pith*, is a *Repoſitory* of better *Aliment* gradually ſupplied to thoſe *Succiferous Veſſels*, which are frequently ſcattered up and down therein, and which aſcend into the *Trunk*. (*a*) But where no *ſucciferous Veſſels* are mixed, herewith, it uſually becomes Dryer, and is repleniſhed with a more *Aerial* and *Warmer Sap*; whereby the growth of the *Caulis* is promoted, as by an *Hot Bed* ſet juſt under it. And in many *Plants* with divers knobbed *Roots*, the younger are more ſucculent, ſerving chiefly to feed the *Stalk*: the Elder are ſpongy and fill'd with *Aer*, for the fermenting of the *Sap*, and more early growth of the *Stalk*: as in little *Celandine*, *Dogſtones* and all of that Kindred. And thus all the *Parts* have a fit *Aliment* provided for their *Nouriſhment*

(*a*) P. 1. c. 5. §. 3.

29. §. IN THIS *Nouriſhment*, the *Principles* of the *Sap* are, as is ſaid, *concentred* and *locked* up one within another: (*b*) Whence it is, that the *Organical Parts*, being cleanſed of their *Contents*, have none of them any *Taſte* or *Smell*, as in the *Piths* of *Plants*, *Paper* and *Linen Cloth* is evident. (*c*) Becauſe till by *Digeſtion*, violent *Deſtillation*, or ſome other way, they are reſolved, they cannot act upon the *Organs* of thoſe Senſes. For the ſame reaſon, they are never *tinctured*, excepting by their *Contents*: and although, to the bare Eye, they frequently ſhew *White*, yet viewed through a *Microſcope*, they all appear *tranſparent*. In like manner, as the *Serum* of *Blood*, *Whites* of *Eggs*, *Tendons*, *Hairs* and *Horns* themſelves are *tranſparent*, and without much *Smell* or *Taſte*, their *Principles* being, in all of them, more or leſs *concentred*: But when ever theſe *Principles*, are forcibly *reſolved*, they are ever variouſly inveſted with all thoſe *Qualities*.

How the ſeveral Parts are Nouriſh'd and Form'd.

(*b*) §. 21.
(*c*) *Idea*, §. 49, 51.

30. §. And as from the *Concentration* of the *Principles*, in every *Organical Part*, the ſaid *Parts* do thus far, all agree: So, from the *Predominion* of the *Principles* of each *Part*, the reſt are controuled, not only to a *Concentration*, but an *Aſſimilation* alſo; whereby, the *Specifick Differences*, of the ſeveral *Organical Parts*, are preſerved. Hence the *ſucciferous Veſſels* are always *Tough* and very Pliable; for ſo are all *Barques*, wherein theſe *Veſſels* abound; ſo is a Handful of *Flax*, which is nothing elſe but a heap of the *ſucciferous Veſſels* in the *Barque* of

that

that *Plant*. For beſides *Water*, and *Earth*, an *Alkaline Salt* and *Oyl* are, as is ſaid, the predominant *Principles* of theſe *Veſſels*. (a) It is then the *Oyl*, chiefly, by which theſe *Veſſels* are *Tough*: for being of a tenacious Nature, by taking hold of other *Principles*, it marries them together; and the *Alkaline Salt* and *Earth*, *concentred* with it, addeth to it more *Strength*. Hence the *Caput Mortuum* of moſt Bodies, eſpecially thoſe that abound with *Oyl* and a *Sal Alkali*, is *brittle* and *friable*; thoſe *Principles*, which were the *Ligaments* of the reſt, being forced away from them. From the ſame Cauſe, the *Parenchymous Parts* of a *Root*, even in their Natural State, are *brittle* and *friable*; *ſc.* Becauſe their *Earthy*, and eſpecially *Oleous* and *Saline Principles* are, as is ſaid, (b) ſo very few. Therefore all *Piths* and more *ſimple Parenchyma's*, break *ſhort*, ſo *Corn*, and the *Roots* of *Potato's*, and divers other *Plants*, being dryed, will eaſily be rub'd to *Meal*; and many *Apples*, after Froſts, eat *mealy*; the *Parenchymous Parts* of all which, are not only by *Analogy*, but in Subſtance or Eſſence, the ſelf ſame Body. (c)

(a) §. 21.

(b) §. 19.

(c) *Lib.* 1. c. 7. §. 14.

31. §. And as the *Conſiſtence* of the ſeveral *Organical Parts*, is dependent on their *Principles*; ſo are their *Figures*. And firſt, the *Succiferous Veſſels*, from their *Alkaline Salt*, (d) grow in Length. For by that Dimenſion, chiefly, This *Salt* always *ſhoots*: And being a leſs moveable *Principle* than the reſt, and ſo apt more ſpeedily to *fix* or *ſhoot*: It thus overrules them to its own *Figure*. And even as the Shape of a *Button* dependeth on the *Mould*, the *Silk* and other Materials wrought upon it, being always conformable thereunto: ſo here; the *Salt* is, as it were, the *Mould*; about which, the other more paſſive *Principles* gathering themſelves, they all conſort and faſhion to it. Hence alſo the ſame *Sap-Veſſels* are not *pyramidal*, as the *Veins* of *Animals*; but of an equal bore, from end to end; the *ſhootings* of the ſaid *Salt*, being alſo figured more agreeably to that *Dimenſion*. And as by the *Saline Principle*, theſe *Veſſels* are *Long*; ſo by the *Oleous*, (e) they are every where *Round*, or properly *Cylindrical*; without ſome joynt Efficacy of which *Principle*, the ſaid *Veſſels* would be *Flat*, or ſome way Edged and *Angular*, as all *ſaline ſhoots*, of themſelves, are; as thoſe of *Alum*, *Vitriol*, *Sal Ammoniac*, *Sea Salt*, *Nitre*, &c. And becauſe the *Spirituous* and more *Fluid* part of the *Principles*, is leaſt of all apt to *fix*; while therefore, the other parts fix round about, This will remain moveable in the *Centre*; from whence every *Veſſel* is formed, not into a *ſolid*, but *hollow Cylinder*; that is, becomes a *Tube*.

(d) *P.* 2. §. 21.

(e) *Ib.*

32. §. The *Lactiferous Veſſels* are *tubulary*, as the *Lymphæducts*, but of a ſomewhat wider *Concave* or *Bore*. For being their *Principles* are leſs *Earthy* and *Oleous*, and alſo more looſely *Concentred*; as from their eaſie corruption or *Reſolution* by the *Aer*, it appears they are: they are therefore more tender, and ſo more eaſily dilative, and yielding to the ſaid *Spiritnous* part in the Centre. And by this means, obtaining a wider *Bore*, they are more adapted to the free motion of the *Milky Content*: which being an Oleous and Thicker *Liquor*, than that in the *Lympheducts*; and having no advantage of *pulſation*, as the *Blood* hath in *Animals*; might ſometimes be apt to ſtagnate, if the *Veſſels*, through which it moves, were not ſomewhat wider.

33. §.

33. §. As the *Saline Principle* is the *Mould* of the *Succiferous*, so is the *Aerial* of the *Aer-Vessels*. (a) Now the Particles of *Aer* strictly so called, at least of that part of it concerned in the Generation of the *Aer-Vessels*, I suppose, are crooked: and that by composition of many of those crooked ones together, some of them become Spiral, or of some other winding *Figure*: and that thereupon dependeth the *Elastick* Property of the *Aer*, or its being capable of *Rarefaction* and *Condensation* by force. Wherefore, the said *crooked* Particles of the *Aer*, first *shooting* and *setting* together, as the *Mould*, the other *Principle* cling and *fix* conformably round about them. So that, as by force of the *Saline Principles*, the rest of them are made to *shoot* out in *Long continued Fibres*; so by force of the *Aerial*, those *Fibers* are still disposed into *Spiral Lines*, thus making up the *Aer-Vessels*. And according as there are fewer of these *Aerial* Particles, in proportion to the *Saline*, the *Concave* of the *Aer-Vessels* is variously wider, or the *Fibres* continue their *shooting* by wider *Rings*; as those that come nearer to a *right Line*, and so are more complient to the *Figure* and shooting of the *Saline* parts. And whereas the *Lymphaducts*, shooting out only in length, are never sensibly *amplified* beyond their original size: These, on the contrary, always, more or less, enlarge their *Diameter*; because their *Fibres*, being disposed into *Spiral Lines*, must needs therefore, as they continue their growth, be still dilated into greater and greater *Rings*. And being at the bottom of the *Root* more remote from the *Aer*, and so having somewhat fewer Particles purely *Aerial*, there ingredient to them, then at the top; they fall more under the government of the *Saline*, and so come nearer to a *right Line*, that is into greater *Circles*; and so the *Aer-Vessels*, made up of those *Circles*, are there generally wider. (b)

(a) P.1.c.4. §.23.& P.2. §.24.

(b) P.1.c.4. §.16.

34. §. By mediation of their *Principles*, the *Parenchymous Parts* likewise of a *Root* have their proper *Contexture*. For from their *Acid Salt* they are *Fibrous*; from their *Oyl*, the *Fibres* are *Round*, and in all parts even within themselves; and from their *Spirit*, it is most probable, that they are also *hollow*. But because the *Spirit* is, here, more copious than the *Aer*; and the *Saline Principle* an *Acid*, (c) and so, more under the government of the *Spirit*, than is an *Alkali*; therefore are not the said *Fibres* continued in *straight Lines*, as the *Sap-Vessels*; or by one *uniform* motion, into *spiral* lines, as the *Fibres* in the *Aerial*; but *winding*, in a circular manner, to and fro a *thousand ways*, agreeable to the like *motions* of the *Spirit*, that most *active*, and here most *predominant Principle*. And the *Spirituous Parts* being, as is said, here more copious and redundant, they will not only suffice to fill up the Concaves of the *Fibres*, but will also gather together into innumerable little spaces, without them: whence the *Fibres* cannot wind close together, as Thred, in a *Bottom* of Yarn; but are forced to keep at some distance, one parcel from another, and so are disposed, as Bread is in baking, into *Bladders*. (d)

(c) §.19.

(d) P.1.c.3. §.4.

35. §. And the *under Fibres* being *set* first, as the *Warp*, the *spirituous* parts next adjacent, will incline also to *fix*, and so govern an *over-work* of *Fibres*, wrapping, as the *Woof*, in still smaller Circles round the other: whereby they are all knit together. (e) For the same reason, the *Lymphaducts*, being first formed, the *Parenchymous Fibres* *set* and *wrap* about These also. (f) And the *Aer-Vessels* being formed

(e) P.1.c.5. §.9.

(f) P.1.c.5. §.12.

formed in the Center, the *ſucciferous* run along thoſe likewiſe (as *volatile Salts ſhoot* along the ſides of a Glaſs, or *Froſt* upon a Window) and ſo are, as it were, Incruſtate about them in a *Ring*.

How the ſeveral *Parts* come to be Situate or Diſpos'd.

36. §. SOME OF THE more Ætherial and Subtile parts of the *Aer*, as they ſtream through the *Root*, it ſhould ſeem, by a certain *Magnitiſme*, do gradually diſpoſe the *Aer-Veſſels*, where there are any ſtore of them, into *Rays*. This Attraction (as I take leave to call it) or *Magnetick power* betwixt the *Aer* and theſe *Veſſels*, may be argued, From the nature of the *Principles* common to them both: From the *Electral* nature of divers other Bodies; the *Load-ſtone* being not the only one which is attractive: And from other Effects, both before (*a*) and hereafter mentioned. Wherefore in the inferiour parts of the *Root*, they are leſs Regular; (*b*) becauſe more remote from the *Aer*. And in the upper parts of many *Roots*, as *Cumfery*, *Borage*, *Parſnep*, where thoſe that are next the Centre are confuſed, or differently diſpoſed; thoſe next the *Barque*, and ſo nearer the *Aer*, are poſtured more Regularly, and uſually into *Rays*. For the ſame reaſon it may be; that even the *Sap-Veſſels* in the *Barque*, as often as the *Aer Veſſels* are more numerous, are uſually diſpoſed into *Rays*, as following the direction of the *Aer-Veſſels*. And that the *Parenchyma* of the *Barque*, is diſpoſed into *Diametral Portions*: and that where the *Aer Veſſels* are fewer or ſmaller, theſe *Portions* are likewiſe ſmaller or none; as in *Chervil*, *Aſparagus*, *Dandelion*, *Orpine*, *Biſtort*, *Horſe-Radiſh*, *Potato's*, &c.

(*a*) *Lib.* 1. *c.*2. §.25. & *c.*4. *Append.* §. 2, 3.

(*b*) *P.*1.*c.*4. §. 10.

Tab. 7, 8, 9.

Tab. 7, 8, 9, &c.

37. §. The ſaid Ætherial parts of the *Aer*, have a Power over the *Aer-Veſſels* not only thus to Diſpoſe them; but alſo to Sollicite and *ſpread* them abroad from the Center towards the Circumference of the *Root*. By which means, thoſe *Roots* which have no *Pith* in their lower parts, obtain one in their upper. (*c*) And the ſame *Pith*, which in the lower part, is ratably, ſmall, in the upper, is more or leſs enlarged. (*d*)

(*c*) *P.*1. *c.*5. §. 1.

(*d*) *Ib.* §. 4.

38. §. The *Spreading* of theſe *Veſſels* is varied, not only according to the *Force* the *Aer* hath upon them, but alſo their own greater or leſs *Aptitude* to yield thereto. As often therefore, as they are Slenderer, they will alſo be more Pliable and receſſive from the Centre, towards the Circumference. Hence, in ſuch *Roots* where they are ſmall, they ſtand more diſtant; as in *Turnep*, *Jeruſalem Artichoke*, *Potato's*, and others; and ſo their *Braces* are fewer: and in the ſame *Root*, where they are ſmaller, their diſtance is greater. Beſides, in theſe ſmaller *Aer-Veſſels*, the *Rings* being leſs, and the *Spiral Fibres* whereof they are made, continuing to *ſhoot*; the ſaid *Rings* therefore, muſt needs be ſo many more, as they are ſmaller; and ſo take up more ſpace by the length of the *Root*; and ſo, not being capable of being crowded in a *right line*, every *Veſſel* will be forced to recede to a *crooked* or *bowed* one.

Tab. 2, & 6.

39. §. The *Sap Veſſels*, being by the *Parenchymous Fibres* knit to *theſe*, will likewiſe comply with Their motion, and ſpread abroad with them. Yet being ſtill ſmaller (*e*) and more pliable than the *Aer-Veſſels*, and ſo more yielding to the intercurrent *Fibres* of the *Parenchyma*, their *braced Threds* will, ſometimes, be much more divaricated, than thoſe of the *Aer-Veſſels*; as in *Jeruſalem Artichoke*. And becauſe the *Succiferous Veſſels*,

(*e*) *P.*1. *c.*3. §. 16.

Tab. 6.

Veſſels, although they are joyned to the *Aerial* by the *Parenchymous Fibres*, (*a*) yet are not continuous with them; neither fall under the like *Attractive Power* of the *Aer*, as the *Aerial* do; the *Aerial* therefore, upon their ſpreading, do not always carry all the *Succiferous* along with them; but often, if not always, leave many of them behind them ſprinkled up and down the *Pith*; as in *Parſley*, *Carrot*, *Jeruſalem Artichoke*, *Turnep*, &c. may be ſeen. (*a*) *P.*1. *c.*5. §. 12. *Tab.* 6.

40. §. The *ſpreading* of the *Aer-Veſſels* ſtill continued, ſeveral of them, at length, break forth beyond the circumference of the *Root*; and ſo are diſtributed, either in the lower parts, into *Branches* and *Strings*; or at the top, into *Leaves*. And leſt they ſhould all ſpread themſelves into *Leaves*, and none be left for the *Caulis*; as where they are very ſmall, or the *Sap-Veſſels* to bound them, are but few, they might; therefore divers of them are, oftentimes, more frequently *braced* in the Centre; for which reaſon, they cannot ſo eaſily ſeparate and ſpread themſelves from thence, but run more inwardly up into the *Caulis*, as in *Borage*. *Tab.* 6.

41. §. FROM THE various *Sizes*, *Proportions*, and *Diſpoſitions* of the Parts, *Roots* are variouſly *ſized*, *ſhaped*, *moved* and *aged*. Thoſe which, by their Annual Growth, are large; have fewer, both *Aerial*, and *Sap-Veſſels*, and a more copious *Parenchyma*. So that the *Aer-Veſſels*, or rather, the *Aery Ferment* contained in them, *volatilizing* only a ſmaller portion of the *Sap*; the ſaid *Sap* is leſs capable of advancement into the *Trunk*; and ſo muſt needs remain and *fix* more copiouſly in the *Root*, which is thereby more augmented. And where the *Sap-Veſſels* alone, are but few, the *Root* is yet, ratably, ſomewhat large: but where they are numerous, it is never ſo, as to its Annual Growth, in any proportion to their Number: Becauſe their *Tincture*, which is *Alkaline*, will go farther in *ſetting* the *Parenchymous Parts*: than the *Tincture* of *Theſe*, which is *Acidulate*, will go, in *ſetting Them*. (*b*) How the whole *Root* is differently ſized and ſhaped. (*b*) *P.* 2. §. 31.

42. §. When the *Aer-Veſſels* are more pliable and ſequent to the Attraction of the *Aer*, and ſo *ſpread* themſelves, and the *Succiferous* together with them, more abroad; in the manner as hath been ſaid; the *Root* alſo will grow more in *Breadth*; the nutrition of the *Parenchymous Parts*, to which the *Veſſels* are adjacent, being thus, by the ſame dimenſion, more augmented; as in *Turnep*, *Jeruſalem Artichoke*, &c. But where theſe are not ſpread abroad, the *Root* is but ſlender; as in *Aſparagus*, *Dandelion*, &c. *Tab.* 2, & 7. *Tab.* 7, & 8.

43. §. If the *Aer-Veſſels* be contracted into, or near the Centre, and are ſomewhat Large or Numerous; and the *Succiferous*, alſo more copiouſly mixed with, or ſurrounding them; the *Root* grows very Long; as do thoſe of *Fenil*, *Vine*, *Liquiriſh*, &c. For the *Aer-Veſſels* containing a more copious *Ferment*, it will well digeſt and mature the *Sap*: Yet the *Succiferous* being over proportioned to them; the *Sap* will not therefore, be ſo far volatilized, as to aſcend chiefly into the *Trunk*; but only to ſubſerve a fuller Growth of their *Veſſels*: which being more numerous, and ſo more ſturdy, and leſs ſequent to the expanſive motion of the *Aerial*; this their own Growth, and conſequently, that of all the other *Parts*, cannot be ſo much in Breadth, as Length. *Tab.* 2, & 17.

44. §. Where the ſame *Aerial Veſſels* are Fewer, or more Contracted, or ſheathed in a Thicker and Cloſer *Barque*; the *Root* is ſmooth, and
Tab. 7, 8. leſs *Ramified*, as in *Aſparagus*, *Peony*, *Dandelion*. But where more Numerous, ſheathed in a Thinner *Barque*, Smaller, or more Dilated;
Tab. 2, & 7. the *Root* is more *Ramified*, or more *Stringy*, as in *Columbine*, *Clary*, *Beet*, *Nicotian*. For being, as is ſaid, by theſe means, more ſequent to the Attraction of the *Aer*; approaching ſtill nearer the circumference of the *Barque*, they at laſt ſtrike through it, into the *Earth*. And the *Parenchymous Fibres* being wrapped about them, and the
(*a*) P. 1. c. 5. §. 12. *Succiferous Veſſels* knit to them by thoſe *Fibres*; (*a*) therefore they never break forth naked, but always inveſted with ſome quantity of theſe *Parts* as their *Barque*: where by, whatever *Conſtitutive Part* is in the *main Body* of the *Root*, the ſame is alſo in every *Branch* or *String*.

45. §. From the ſame Expanſion and Pliability of the *Aer-Veſſels*, the *Root* oftentimes putteth forth *Root-Buds*; which gradually ſhoot up and become ſo many *Trunks*. In the Formation of which *Buds*, they are pliable and receſſive all kinds of ways; being not only invited Outward, toward the Circumference of the *Root*, as in *Root-ſtrings*, but alſo ſpread more Abroad every way, ſo as to make a *Root-Bud*: Where as in the ſaid *Root-ſtrings*; they are always more Contracted.
Tab. 6. Which, in reſpect of the Diſpoſition of the *Parts*, is the principal difference betwixt the *Root* and the *Trunk*, as hath been
(*b*) P. 1. c. 1. §. 2, 3. *Tab.* 11. ſaid. (*b*) Hence, thoſe *Roots*, chiefly, have *Root-Buds*, which have the ſmalleſt *Aer-Veſſels*; (*c*) theſe, as is ſaid, being the moſt pliable and Expanſive.
(*c*) P. 1. c. 4. §. 15. 46. §. But becauſe the expanſiveneſs of the *Veſſels*, dependeth alſo, in part, upon the Fewneſs of their *Braces*; therefore the ſaid *Buds* ſhoot forth differently, in divers *Roots*. Where the *Braces* are fewer, the *Buds* ſhoot forth beyond the Circumference of the *Root*, as in *Je-*
Tab. 6. *ruſalem Artichoke*; where more cloſe, as in *Potato's*, the *Buds* lie a little abſconded beneath it; the *Aer-Veſſels* being here, by their *Braces*, ſomewhat checked and curbed in, while the *Barque* continueth to ſwell into a fuller Growth.

47. §. If the *Aer-Veſſels* are all along more equally ſized, the *Root* is ſo alſo, or *Cylindrical*; as are thoſe of *Eryngo*, *Horſe-Radiſh*, *Marſhmallow*, *Liquiriſh*, &c. But if unequal, growing ſtill *wider* towards the *bottom* of the *Root*; then the *Root* is unequal alſo: But groweth, as is obſervable, quite contrarily to the *Aer-Veſſels*; not Greater, as They do; but ſtill ſmaller, or *pyramidally*; as in *Fenil*, *Borage*, *Nettle*, *Patience*, *Thorn-Apple*, &c. is apparent. For the *Aer-Veſſels* peing conſiderably wider about the *bottome* of theſe *Roots*; they there contein a more Copious *Ferment*: Whereby the *Sap* is there alſo more volatilized, and plentifully advanced to the Upper Parts. Withal, thus receiving into themſelves, and ſo traſmitting to the upper Parts, a more plentiful *Vapour*, they hereby rob the *Parenchymous Parts* of their Aliment, and ſo ſtint them in their Growth.

How *Roots* are diffently Mov'd. *Tab.* 8. 48. §. FROM THE different *Proportions* and *Situation* of the *Parts*, the *Motions* of *Roots* are alſo various. For where the *Are-Veſſels* are ſpread abroad and inveſted with a thinner *Barque*; the *Root* runs or lies *Level*, as in the *level-Roots* of *Primroſe*, *Biſhops-weed*, *Anemone*, &c. may

may be ſeen. So that theſe *Roots*, as by the *Perpendicular Strings*, which ſhoot from them into the *Earth*, and wherein the *Aer-Veſſels* are contracted into their Center, they are Plucked down (*a*): So by the *Aer-Veſſels*, which ſtand nearer the *Aer*, and more under its Attractive Power (*b*) they are invited *upwards*; whereby they have neither *aſcent* nor *deſcent*, but keep *level*, betwixt both. (*a*) *P.*1.*c.*1. §.15. (*b*) *P.* 2. §. 36.

49. §. But if theſe *Veſſels* are Contracted, ſtanding either in, or near the Centre, and are inveſted with a *Barque* proportionably Thick; the *Root* ſtriketh down *perpendicularly*, as doth that of *Dandelion*, *Bugloſs*, *Parſnep*, &c. And therefore the ſaid *Veſſels*, although they are ſpread abroad in the *level Roots*, yet in the *perpendicular* ones of the ſame *Plant*, they are always contracted; as by comparing the *Level* and *Down-right Roots* of *Ammi*, *Primroſe*, *Jeruſalem Artichoke*, *Cowſlip*, and others, is manifeſt. *Tab.* 7, 8.

50. §. If the *Aer-Veſſels* are Contracted, and Environed with a greater number of *Succiferous*, the *Root* grows *deep*; that is, *perpendicular* and *long*. (*c*) *Perpendicular*, from the Contraction of the *Aer-Veſſels*; (*d*) and *long*, from the Predominion of the *Succiferous*, which in their growth, are extended only by that Dimenſion, as in *Liquiriſh*, *Eryngo*, &c. (*c*) *P.*1.*c.*1. §. 9. (*d*) *P.* 2. §. 49.

51. §. If the *Succiferous* are over proportioned to the *Parenchymous Parts*, but under to the *Aer-Veſſels*; the *Root* is *perpendicular* ſtill, but groweth *ſhallow*: The *Succiferous* being ſturdy enough to keep it *perpendicular*; But the *Aer-Veſſels* having a predominion to keep it from growing *deep*; as in *Stramonium*, *Nicotian*, *Beet*, &c. *Tab.* 7.

52. §. If, on the contrary, the *Parenchymous Parts* are predominant to the *Aer Veſſels*; and that, both in the *Root* and *Trunk*; then the whole *Root* changeth place, or *deſcends*. (*e*) For the ſaid *Aer-Veſſels*, having neither in the *Trunck*, nor in the *Root*, a ſufficient Power to Draw it *upwards*; it therefore gradually yields to the Motion of its *String-Roots*; which, as they ſtrike into the Soil, Pluck it down after them. And becauſe the old *Strings* annually rot off, and new ones ſucceſſively ſhoot down into the *Ground*, it therefore annually ſtill deſcendeth lower; as in *Tulip*, *Lily*, &c. may be obſerved. (*e*) *P.*1. *c.*1. §. 10. *Lib.*1. *c.*2.§.25, and 4. *Append.* §. 10. *P.* 2. §. 36.

53. §. Where the *Aer-Veſſels* are much *ſpread* abroad, and alſo *numerous*, the *Root* oftentimes, as to its ſeveral parts, *deſcends* and *aſcends* both at once. So *Radiſhes* and *Turneps*, at the ſame time, in which their nether parts *deſcend*; their upper, (where the ſaid *Veſſels* are more looſely *braced*, and *ſpread* more abroad than in the lower parts) do *aſcend*, or make their Growth *upward*. Hence alſo, the upper part of moſt young *Roots* from *Seed*, aſcends: Becauſe the firſt *Leaves*, being proportionably large, and ſtanding in a free *Aer*, the *Aer-Veſſels* therein, have a dominion over the young *Root*; and ſo themſelves yielding to the ſolicitation of the *Aer*, *upwards*; they draw the *Root*, in part, after them. *Tab.* 2.

54. §. BY THE *Situation* and *Proportions* of the *Parts*, the *Age* of the *Root* is alſo varied. For if the *Sap-Veſſels* have the greateſt Proportion, the *Root*, is *Perennial*, and that to the fartheſt extent, as in *Trees* and *Shrubs*. Becauſe theſe *Veſſels* containing a more copious *Oyl*; (*f*) and their ſeveral *Principles* being more cloſely *Concentred*, they are leſs ſubject to a *Reſolution*, that is, a Corruption or Mortification by the *Aer*. How *Roots* are differently Aged. (*f*) *P.* 2. §. 21.

55. §. If the *Parenchymous Parts* have much the greateſt, the *Root* ſeldom liveth beyond Two Years; but afterwards periſheth either in whole, or in part; as do divers *bulbous*, *tuberous*, and other *Roots*; whether they are more Porous and Succulent, or more Cloſe and Dry. If Porous, all the *Liquid Principles* ſtanding herein more abundant, either by a ſtronger Fermentation, or otherwiſe, Reſolve the *fixed ones* of the *Organical Parts*; whence the whole *Root*, rots; as in *Potato's*. So alſo *Parſneps*, and ſome other *Roots*, which, in a hard and barren *Soil*, will live ſeveral years, in another more rank, will quickly rot. If the *Parenchyma* be Cloſe, then the *Aer*, chiefly, entring in and filling it up, thus mortifies the *Root*; not by Rotting the *Parts*, but over Drying them; as in *Satyrion*, *Rape-Crowfoot*, *Monks-hood*, &c. (*a*)

(*a*) P. 1. c. 1. §. 13, 16. & P. 2. §. 28.

56. §. But if the *Aer-Veſſels* have the *greateſt Proportion*, and eſpecially if they are more *large*, and withall, are *ſpread* more abroad: the *Root* is *Annual*, as in *Thorn-Apple*, *Nicotian*, *Carduus Ben.* &c. And of the ſame Kindred, if any, thoſe are *Annual*, which have the moſt *Aer-Veſſels*. So *Endive* and *Sonchus*, which have ſtore of *Aer-Veſſels*, are both *Annual:* whereas *Cichory*, in which they are fewer, is a *Perennial Root*. For hereby a more copious *Aer* being Tranſfuſed into all the other *Parts*; (*b*) they are thus, by degrees, hardned, and become ſticky; and ſo impervious to the *Sap*, which ought to have a free and univerſal Tranſition from *Part* to *Part*. As *Bones*, by *Precipitations* from the *Blood*, at length, ceaſe to grow. Or the ſame more abundant *Aer*, ſo far *volatilizeth* the *Liquors* in the *Root*, that they are wholly advanced into the *Trunk*, and ſo the *Root* is ſtarved. Whence alſo the *Aer-Veſſels* of the *Trunk*; where they are numerous, and over proportioned to the *Bulk* of the *Root*, as in *Corn*; they ſo far promote the advance of the *Sap*, as to exhauſt the *Root*, ſucking it into a Conſumption and Death.

Tab. 9.

(*b*) P. 2. §. 25, 26.

How the *Contents* of the ſeveral *Parts* are made.

57. §. FROM THE *Principles* of the *Parts*, their *Contents* and the ſeveral *Qualities* hereof are alſo various; (*c*) the *Fluid* of each *Organical Part*, being made, chiefly, by *Filtration* through the ſides thereof; ſuch of the *Principles* in the *Sap*, being admitted into, and tranſmitted through them, as are apteſt thereunto. In the like manner, as when *Oyl* and *Water*, being poured upon a Paper, the *Water* paſſeth through, the *Oyl* ſticks: or as the *Chyle* is ſtrained through the *Coats* of the *Guts*, into the *Lacteal Veſſels:* or as *Water* in *Purgations*, is ſtrained through the *Glands* of the ſame *Guts*, from the *Meſenterical*.

(*c*) *Idea*, §. 54.

58. §. The *Principles* therefore of the *Parenchymous Fibres* being *ſpirituous*, *acid*, and *aerial*, they will alſo admit the like into them; excluding thoſe chiefly which are *Alkaline* and *Oleous*. (*d*) And as by the *Conjugation* of ſuch *Principles* in the *Fibres*, the like are capable of *admittance* into their Body: ſo the *Proportion* and *Union* of the ſame *Principles*, regulates the *tranſmiſſion* hereof into their *Concave*. Wherefore, the predominant *Principles* of the *Fibres* being chiefly *acid*, next *ſpirituous*, and *aery*, the more *aery* ones will be *tranſmitted*. For if more of *them* ſhould *fix* they muſt do ſo by ſimilitude and adheſion: But where there are fewer ſimilary parts to adhere to, fewer muſt adhere. The *Fibres* therefore contain ſo many parts of *Aer*, as to *admit* many

(*d*) P. 2. §. 19.

many more into their Body; but not to *fix* them; which therefore muſt needs, upon admiſſion, paſs through into their *Concave*; where, together with ſome other more *ſpirituous* parts, they make an *Ætherial Fluid.* And becauſe ſome *aqueous* or *vaporous* parts will alſo ſtrain through with them; hence it is, that as more and more of theſe enter, they by degrees ſtill thruſt out the *aery* ones; which quitting the more *ſucculent Fibres* of the *Parenchyma*, are forced to betake themſelves to the *dryer* ones, *ſcil.* all thoſe, whereof the *Diametral Portions* do conſiſt. For the ſame reaſon the *Aery* parts being gradually excluded the *ſucculent Fibres* of the *Barque*; they are forced to recede and tranſmigrate into thoſe of the *Pith.* And the *Fibres* of the *Pith* themſelves being filled, aud the *Aery* parts ſtill forced into them; they at length alſo ſtrain through the *Fibres* into the *Bladders*: whence it comes to paſs, that while the *Barque* is *ſucculent*, the *Pith* is often times filled with *Aer.*

59. §. The *Lymphæducts* being more *earthy*, *Salinous*; *oleous*, and *aqueous*, will both *admit* and copiouſly *fix* the like *Principles*, as their proper Aliment. The *Water* being more *perfluent* than the reſt, will therefore ſtrain, with a lighter *Tincture* of them, into their *Concave.* Eſpecially the *Oleous* parts of theſe being *rampant*, and leſs apt to *fix* and *ſeize* the *aqueous*, upon their entrance, than the *ſaline.* (a) P. 2. §. 21.

60. §. The *Lactiferous*, appearing to be made, chiefly, by the Conſtipation of the *Parenchymous Parts* all round about their Sides; the *Liquor* conteined in thoſe *Parts*, although it may eaſily enough be transfuſed into the Hollow of theſe *Veſſels*; yet ſeems it not, with equal facility, to be refunded thence: So that the *thinner* and more *aqueous* Portion only, paſſing off; the remainder, is, as it were, an *Oleous Elixyr*, or extract, in the form of a *Milk.*

61. §. The *Fluid Ferment* contained in the *Aer-Veſſels*, is alſo in part, dependent on the *Principles* of thoſe *Veſſels*, being in their percolation *tinctured* therewith. But becauſe the percolation is not made *through* the *Body* of the *Fibres* whereof the *Veſſels* are compoſed, but only *betwixt* them; therefore the tranſient *Principles* more promiſcuoſly, yet with an over porportion of dryer Particles, paſs into the *Concaves* of theſe *Veſſels*, and ſo are herein all immerſed in a Body of *Aer.* (b) The *Fibres* themſelves, in the mean time, as thoſe of the *Parenchyma*, admitting and containing a more *Aery* and *Ætherial Fluid.* (b) P. 2. §. 24.

62. §. The *Contents* are varied, not only by the *Nature*, but alſo the *Proportion* and *Situation* of the *Parts*, whereby the ſaid *Contents* are with different Facility and Quantity, communicated one to another. Hence it is, partly, that a *Vine*, or that *Corn*, hath ſo little *Oyl*: *ſc.* Becauſe their *Aer-Veſſels*, in proportion with the other *Parts*, are ſo *Great* and *Numerous:* in *Corn*, the *Stalk* being alſo very hollow, and ſo becoming as it were, one Great *Aer-Veſſel.* For the *Oily* parts of the *Sap*, are ſo exceedingly *attenuated* (c) by the *Aery Ferment* contained in theſe *Veſſels*; that they are, for the moſt part, ſo far *immerſed* in the *Spirit*, or mixed therewith, as not, by being collected in any conſiderable Body, to be diſtinguiſhable from it. And the affinity that is betwixt *Spirits* and *Oils*, eſpecially *Eſſential*, is manifeſt: Both are very inflammable; Both will burn all away; The *Odors*, which we call the *Spirits* of *Plants*, are lodged in their *eſſential Oyl*; Both, being duly (c) P. 2. §. 25, & 56.

duly *Rectified*, will mix as eaſily together, as *Water* and *Wine*. So that, although *Oyl*, by the ſeparation of its *earthy* and *Saline* parts, which give it its ſenſibly *oleous* Body, may not be ſo far *attenuated*, as to *produce a Spirit*; yet that it may ſo far be attenuated, and ſo be mixed therewith, as *not to be diſcerned from it*, as in the forementioned *Plants*, will be granted.

63. §. Hence it is, that the *Lactiferous* ſtanding more remote from the *Aer-Veſſels*, and the *Succiferous* interpoſing; (*a*) the *Liquor*, therefore, contained in them, is not ſo much under the government of the *Aerial Ferment*, and is thence, partly, more *Oily*. For the ſame reaſon, all *Roots* which are *Milky*, ſo far as I have obſerved, have an under-proportion of *Aer-Veſſels*; theſe being either Fewer or Smaller.

(*a*) *Tab.* 9. & 16.

How the *Odours* of *Plants* are made.

64. §. FROM what hath been ſaid, we may receive ſome information, likewiſe, of the *Odours*, *Colours*, and *Taſtes* of *Plants*. And for *Odours*, I ſuppoſe, That the chief Matter of them, is the *Aerial Ferment* contained in the *Aer-Veſſels*. Not but that the *other Parts* do alſo yield their ſmell; but that *theſe* yield the *ſtrongeſt* and the *beſt*, and *immediately* perceptible in *freſh*, *undryed* and *unbruiſed Plants*. For the *Aer* entring into, and paſſing through the *Root*, and carrying a *Tincture*, from the ſeveral *Organical* and *Contained* Parts, along with it, and at laſt entring alſo the *Concaves* of the *Aer-Veſſels*; it there exiſts the moſt *Compounded* and *Volatile Fluid*, of all others in the *Plant*, and ſo the fitteſt matter of *Odour*: and ſuch an *Odour*, as anſwers to that of all the *Odorous* parts of the *Plant*. (*b*) Wherefore the *Organical Parts*, being well cleanſed of their *Contents*, ſmell not at all; Becauſe the *Principles* hereof are, as hath been ſaid, ſo far *fixed* and *concentred* together. Hence alſo the *Contained Parts* themſelves, or any other Bodies, as their *Principles* are any way more *fixed*, they are leſs *Odorous*: So is *Roſin*, leſs than *Turpentine*, and *Pitch*, than *Tar*; and many the ſelf ſame Bodies, when they are *coagulated*, leſs than when they are *melted*. So alſo *Musk*, which is not ſo liquid as *Civet*, is not ſo ſtrong; nor *Ambergreece*, as *Musk*: For although it hath a more excellent ſmell, than *Musk* hath, yet yieldeth it not ſo eaſily; ſince it is a more *fixed* Body, and requireth ſome *Art* to be opened. Hence alſo the *Leaves* of many *Plants* loſe their *Odour* upon *rubbing*: Becauſe the *Aer-Veſſels* being thereby broken, all their *contained odorous Fluid* vaniſheth at once: which before, was only ſtrained gradually through the *Skin*. Yet the *fixed* Parts themſelves, upon drying, are ſo far altered by the *Sun* and *Aer*, as to become reſoluble, and volatile, and thence odorous.

(*b*) P. 2. §. 24.

How their *Colours*.

65. §. SO ALSO of their *Colours*. As whence the *Colours* of the *Skins* are varied. For divers of the *Sap-Veſſels*, together with the *Parenchymous Parts* ſucceſſively falling off from the *Barque* into the *Skin* (*c*) by their proximity to the *Earth* and *Aer*, their *Sulphureous* or *Oleous Principle* is more or leſs *reſolved*, and ſo produceth divers *Colours*. So thoſe *Roots* which turn *purple* any where within, have uſually a *blacker Skin*; the one of thoſe two *Colours* being, by a reſolution and corruption of parts, eaſily convertible into the other, as in *Cumfry*, *Thiſtle*, &c, So the *Milk* of *Scorzonera*, contained in the *Veſſels* of the *Barque*, upon drying, turneth into a *brown Colour*:

(*c*) P. 1. c. 2. §. 2, 4.

lour: Wherefore the *Skin*, in which there are divers of thoſe *Veſſels*, is of the *ſame*. So both the *Milk* and *Skin* of *Lovage* is of a browniſh *yellow*. But *Parſnep* hath a clearer *Sap* in all its *Veſſels*, and a whiter *Skin*. So *Potato's*, being cut traverſe, after ſome time out of ground, have divers *red* ſpecks up and down where the *Veſſels* ſtand, and their *Skin* is accordingly *red*.

66. §. The reaſon, I ſay of theſe *Colours*, is the *reſolution* or *reſeration* of the *Principles* of the ſeveral *Parts*, chiefly, by the *Aer*, and a *lighter mixture* of them conſequent thereupon: whereby the *Sulphureous* or *Oyly Parts*, which were before *concentred*, are now more or leſs *rampant*, diſcovering themſelves in divers *Colours*, according as they are diverſly mixed with the other *Principles*. Hence theſe *Colours* are obſervable, according to the nature of the *Parts wherein* they *are*, or whereunto they are *adjacent*: So where the *Lympheducts* doe run, there is a *Red*, or ſome other *Sulphureous Colour*; the *Oleous Principles* being, as is ſaid, (*a*) more copious in theſe *Veſſels*; as in the *Bark* of *Peony*, the inward parts of *Potato's*, &c. may be ſeen. But the *Parenchymous Parts*, where more remote from the ſaid *Veſſels*, they are uſually *White*, or but *Yellow*: the *Sulphureous Principle* of theſe *Parts*, being, as hath been ſaid, but ſparing. (*b*) The ſame is ſeen in thoſe *Roots* which ſhew both *Red* and *Yellow*: thoſe *Parts*, principally, where the *Succiferous Veſſels* run, being *Red*; but thoſe *Parts*, where only the *Aer-Veſſels* are mixed with the *Parenchymous*, being *Yellow*; as in *Patience*. So likewiſe the *pithy* part of a *Carrot*, where the *Aer-Veſſels* have very few *Succiferous* mixed with them, is *Yellow*; but the *Barque*, where the *Succiferous* are very numerous, is *Red*. For the ſame reaſon, many *Roots*, which are *Whiter* in their upper parts, are *Purple* or *Reddiſh* in their inferiour, as *Avens*, *Strawberry*, &c. Becauſe thoſe lower parts, having lain longer (*c*) under ground (theſe being *deſcending Roots*) their *Principles* are, thereby, ſomewhat more *reſolved*, and ſo the *Oleous*, *ramp* and ſpread all over the reſt in that *Colour*.

(*a*) P. 2. §. 21.

(*b*) P. 2. §. 20.

(*c*) P. 1. §. 13.

67. §. And that the *Reſolution* of the *Sulphureous* and other *Principles* is partly effected by the *Aer*, appears, In that, where the *Aer* hath a free acceſs to the *Succiferous Veſſels*, the *Colours* are there, chiefly produced, or are more conſpicuous. So in *Potato's*, where the *Succiferous Veſſels* are either next to the external *Aer*, as in the *Skin*; or contiguous with the *Aer-Veſſels*, as in the *Ring* within the *Barque*; there, they produce a *Red*: but where more remote from both, as in the middle of the *Barque*, and Centre of the *Root*, there they produce none. Hence alſo it is, that the *Leaves* and *Flowers* of ſome *Plants*, as *Bloodwort*, *Wood-ſorrel*, *Radiſh*, *Jacea*, &c. although *Green* or *White* in the greateſt portion of their *Parenchymous Part*; yet where the *Succiferous* and *Aer-Veſſels* run together, they are of *Red*, *Blue*, and other *Colours*; the *Oleous parts* of the *one*, being *unlocked* and *opened*, by the *aery* of the *other*.

How their *Taſtes*.

68. §. AND LASTLY, of their *Taſts*. Moſt *Roots* which are *acres* or *bitting*, have a very copious *Parenchyma* in proportion with the *Succiferous Veſſels*, as of *Arum*, *Dragon*, and others: Becauſe the *Saline* and other *Principles* are not ſo much *hot*, by any ſufficient quantity of *Sulphureous*, from thoſe *Veſſels*, in which the *Sulphur*, as is ſaid, is more abundant; (*a*) but rendred rather *pungent*, from ſome

(*a*) P. 2. §. 21.

ſome *Spirit* and *Aer*. But divers *Umbelliferous Roots*, eſpecially which abound with *Lactiferous Veſſels*, are *hot*; as *Fenil*, *Lovage*, *Angelica*, &c. Yet is it not their *Oyl* alone that makes them *hot*, but the combination thereof with the *Saline* Parts: as is manifeſt, from the nature of the *Seed* of theſe *Plants*; wherein, as the *Oyl* is moſt copious; So being held to a Candle till they burn, conſtantly *ſpit*; which cometh to paſs, by the eruption of the *Saline* Parts: and is the very ſame effect, with that which followeth upon burning of *Serum* or *Blood*. And therefore, as theſe *Seeds* are more *hot*, they alſo *ſpit* the more; So thoſe of *Cumine*, which, though fullſom, yet are not ſo *hot*, *ſpit* leſs; *Fenil* and *Dill*, which are *hotter*, more; there being a greater quantity of *volatile Salt* contained herein. Hence all *Eſſential Oyls* are *hot*, the *Spirit* and *volatile Salt*, being incorporated herewith. And ſome of them will *ſhoot*, and cryſtallize as *Salts* do, as that of *Aniſe*; which argues a mixture of a conſiderable quantity of *volatile Salt*. As alſo doth the Nature of theſe *Oyls*, in being amicable to the *Stomach*, *Carminative*, and ſometimes *Anodyne*; *ſcil.* as they kill ſome *fetid*, or *corroſive Acid*: for *volatile Salts* themſelves will have the like operation in ſome caſes as theſe *Oyls*.

69. §. Many *Lactiferous Roots*, as *Taraxacum* and others of that kind, are not ſo much *hot*, as *bitter*. For although by the *Lactiferous Veſſels* they are very *Oyly*; yet thoſe *Veſſels* being poſited in *Rings*, and not in *Rays*, and having no *Diametral Portions* running through their *Barque* to the *Aer-Veſſels*; the *Acido-Aerial Parts* do hereby, although not *mortifie*, yet ſo far *refract* the *ſaline*, lightly *binding up* the *Oleous* therewith, as to produce a *bitter Taſte*. So, many *ſweet* Bodies, upon burning, become *bitter*; the *Acid* Parts, now becoming *rampant*, and more copiouſly mixed with the *Oleous*.

ab. 13.

70. The *Roots*, or other Parts, of many *Umbelliferous Plants*, have a *ſweetiſh Taſte*, as both the *Sweet*, and *Common Chervil*; both the *Garden*, and *wild Carrot*; *Parſnep*, *Fenil*, &c. the *Saline Principles* being *concentred* in the *Oyly*, and both of a moderate quantity with reſpect to the reſt. For by the *Oyly*, the *Saline* is rendred more *ſmooth* and amicable; and both being moderate, they are not therefore *hot*, as in ſome other *Umbelliferous Roots*; but by the predominion of the other *Principles*, made *mild*. Hence it is, that *Sugar* it ſelf is *ſweet*, *ſcil.* becauſe it is an *Oleous Salt*; as is manifeſt, from its being highly *inflammable*; its eaſie *diſſolution* by a moderate, *Fire*, without the addition of *Water*; and in that, being melted with *Turpentine*, and other *Oily* Bodies, it will *mix* together with them. So alſo the *Acid Parts* of *Vinegar*, being *concentred* in the *Salino-ſulphureous* of *Lead*, produce a *Sugar*. Hence *Barley*, which upon *Diſtillation* or *Decoction* yeildeth only an *acid*; being turned into *Mault*, becomes *ſweet*. Becauſe, being *ſteeped*, *couched*, and ſo *fermented*, the *oleous* parts are thereby *unlocked*, and becoming *rampant*, over the other *Principles*, altogether produce that *Taſte*. And the *Bile* it ſelf, which, next to *Water* and *Earth*, conſiſteth moſt of *oily* parts, and of many both *ſaline* and *acid* is a *bitter-ſweet*. Wherein, as ſome of the *Saline* and *Acid* parts, ſmoothed by the *Oleous*, produce a *Sweet*: So, ſome of the *Oleous*, impregnated with the *Saline*, and the *Acid*, doe hereby produce a *Bitter*.

THE

THE ANATOMY OF TRUNKS,

With an Account of their

VEGETATION.

Grounded thereupon.

The Figures hereunto belonging, Presented to the ROYAL SOCIETY in the Years, 1673 & 1674.

The THIRD BOOK.

By *NEHEMIAH GREW* M.D. Fellow of the *Royal Society*, and of the *College* of *Physicians*.

The Second Edition.

LONDON,

Printed by *W. Rawlins*, 1682.

Mo.Bot. Garden,
1902.

THE ANATOMY OF TRUNKS, Muscles and Organs of Generation.

Originally Described and Delineated by Dr. Nathaniel Highmore, Physician, and Fellow of the College of Physicians.

Now Revised, Corrected, and Illustrated with Figures thereto belonging, Dedicated to the ROYAL SOCIETY in the Year, 1693 & 1694.

By NEHEMIAH GREW M.D. Fellow of the

LONDON,

Printed by W. Rawlins, 1683.

TO THE

Right Honourable

WILLIAM

Lord Vi-Count *BROUNCKER*

THE

PRESIDENT;

AND TO THE

Council and Fellows

OF THE

ROYAL SOCIETY.

MY LORD,

THE *Commands* I received from *Your Lord-ſhip*, and the *Royal Society*, To proſecute the *Subject* treated of in the Two former *Books*; have produced This which follows. And I humbly ſubmit the ſame to *Your Lordſhips* Judg-

ment: which must needs be Candid and Benign, because it is Great. I have only this to say,

——— Ἐς Τροίαν πειρώμενοι ἦνθον Ἀχαιοί ;

Your Lordship will not disapprove the Enterprise, although it falls short of perfection. It being the result of *Your Lordships* manifold *Virtues* and *Abilities*, That *You* know how far to Encourage the meanest Attempts; as well as rightly to Value and Assist the greatest Performances.

I am,

My Lord,

Your Lordships

most humble

and

most obsequious

Servant

NEHEMJAH GREW.

London,
August 20.
1675.

THE

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THE

THE ANATOMY OF TRUNKS;

PROSECUTED

With the bare EYE,

And with the

MICROSCOPE.

PART I.

CHAP. I.

The Deſcriptions of ſeveral Trunks, *as they appear to the bare Eye.*

TO *the* end we may clearly underſtand, what the *Trunk*, *Stalk*, or *Branch* of a *Plant*, is; I ſhall by theſe *Figures* here before us, Deſcribe the ſeveral *Parts*, whereof it is compounded.

1. §. And for examples ſake, I ſhall in the firſt place, Deſcribe the *Trunks* of ſome *Plants*, as being cut tranverſly, and accurately obſerv'd, they appear to the naked Eye. And ſome others, as by the length. Which having done, I ſhall next proceed to a more particular Deſcription of divers other *Trunks* and *Branches* as they appear through a good *Microſcope*. In both ſhewing, not only what their ſeveral *Parts* are, as generally belonging to a *Branch*; but alſo, by a Comparative Proſpect, in what reſpects they are *ſpecifically* diſtinguiſhed one from another, in the ſeveral *Sorts* of *Branches*.

2. §.

2. §. I SHALL begin where the Work of *Nature* appears leſs Diverſify'd: as in the *Stalk* of *Maze* or *Indian Wheat*. In which, although there are the ſame *Parenchymous* and *Lignous Parts*, as in all other *Plants*; yet is there neither *Barque*, nor *Pith*; the *Veſſels* being diſperſed and mixed with the *Parenchyma*, from the Circumference to the Centre of the *Stalk*: Saving, that in and next the *Skin*, there ſeems to be no *Aer-Veſſels*. Every where elſe, they run up, like fine *Threds*, through the length of the *Stalk*: Each *Thred* being alſo ſurrounded with *Sap-Veſſels*; which in a Slice cut tranſverſly, appear in very ſmall and dark colour'd *Rings*. The like ſtructure may alſo be ſeen in the *Sugar-Cane*, and ſome other *Plants*.

Tab. 18.

3. §. LET the next *Trunk* be that of *Taraxacum*, or *Dandelion*. In a *ſlice* whereof, being cut tranſverſly, is ſeen next the *Skin*, firſt, a ſimple, white, and cloſe *Parenchyma* or *Barque*; made up of *Veſicles*; but ſuch as are exceeding ſmall; and hardly viſible without a *Glaſs*.

Tab. 18.

4. §. Within This, ſtand *Milk-Veſſels* in ſeven or eight diſtinct *Columns*, of different ſize: each *Colum* being alſo made up of ſeven or eight *Arched Lines*. Betwixt theſe *Columns*, run as many *Diametral Portions*, derived from the *Barque*, into or towards the *Pith*.

5. §. Next within Theſe, ſtand the *Aer-Veſſels*. Which are likewiſe divided, by the ſaid *Diametral Portions*, into divers *Arched Lines*. The *ſize* of theſe *Veſſels*, as well as their *number*, is ſmall.

6. §. Within Theſe, ſtands the *Pith*, conſiſting of very ſmall *Veſicles* or *Bladders*, as the *Barque*. 'Tis very ſmall, the *Diameter* hereof, being ſcarce one *fifth*, of that of the *Pith* of *Borage*. But the *Barque* of *Borage* is not half ſo thick as this of *Dandelion*.

7. §. FOR a Third *Stalk*, we may take that of *Borage*; wherein there is ſome further Variety. For in a *ſlice* hereof, cut tranſverſly, there appears, firſt a Tough, yet Thin and Tranſparent *Skin*. Within this *Skin*, and *Continuous* therewith, there is alſo a Thin *Ring* of *Sap-Veſſels*: which, without being cruſhed in the leaſt, do yeild a *Lympha*.

Tab. 18.

8. §. Next ſtandeth the *Parenchyma* of the *Barque*. Which is made up of a great number of very ſmall *Veſicles* or *Bladders*. Upon the inner *Verge* of this *Parenchyma*, ſtandeth another *Ring* of *Sap-Veſſels*: which alſo yield a *Lympha*; and that different, as is probable, from the *Lympha* in the utmoſt *Ring*. Hitherto goes the *Barque*.

9. §. Adjacent to the *Ring* of *Sap-Veſſels*, on the inner *Verge* of *Barque*, ſtand the *Aer-Veſſels* on the outer *Verge* of the *Pith*. Not in a *Ring*; but in ſeveral *Parcels*; ſome *Parcels* or *Conjugations*, in the figure of little *Specks*; others, in little *Arched Lines*, almoſt like an V *Conſonant*. And being viewed in a good *Glaſs*, there appears to be within the compaſs of every larger *Speck or Parcel*, about 20 or 30 *Aer-Veſſels* and within the ſmalleſt, about 8 or 10.

10. §. The *Pith*, in a well grown *Stalk* of this *Plant*; is always *hollow*. But originally, it is *entire*. It is likewiſe wholly made up of a great number of *Veſicles*: of which, through a *Glaſs*, ſome appear *Pentangular*, others *Sexangular*, and *Septangular*. Moſt of them are larger than thoſe of the *Barque*; ſo as to be plainly viſible to a naked Eye.

11. §. A FOURTH *Trunk*, ſhall be that of *Colewort*, which ſeems likewiſe, to have at leaſt, two Sorts of *Lymphæducts*. For being cut tranſverſly, as the former, we may obſerve, next the *Skin*, a very

very close *Parenchyma*, of a darkish Green. Wherewith are mixed some few *Sap Vessels*, which give it that *Colour*.

12. §. Within This, stands a *scalloped Parenchymous Ring*, or a *Ring* of many short and slender white *Arches*. Which all round about the *Barque*, meeting together, run in so many white *Diametral Portions*, or extream small *Rays*, into the *Pith*. *Tab.* 18.

13. §. Betwixt these white *Rays*, and next of all to the said white *Arches*, stand as many small *Parcels* of *Sap-Vessels*, like so many little *Half-Ovals*. Within each of which, is included a white *Parenchyma*.

14. §. On the inner *Verge* of the *Barque*, stands another Sort of *Sap-Vessels*, in one slender and entire *Ring*. And so far goes the *Barque*.

15. §. Next within this *Ring* stand the *Aer-Vessels*, in several *Parcels*, diametrically opposite to the said white *Parenchymous Parcels* next without the *Sap-Ring*.

16. §. Last of all, and more within the *Pith*, stand the same kind of *Sap-Vessels*, as those of the *Half-Ovals*. Both these, by small lines, run one into another; thus, on both sides, hemming in the *Aer-Vessels*, and so making altogether, so many little *Pyramids*.

17. §. LET a *Fifth* be that of *Holyoake*. In which, the Curiosity of *Nature*, is still more copious: presenting us, as it is seems, with Three sorts of *Lymphæducts*; Of which, two yield a *Thin*; the Third, a *Thick Lympha*. For being cut, as before, next to the *Skin*, stands the *Barque*; somewhat close, and, in proportion, *Thick*.

18. §. Towards the inner *Verge* hereof, stand one sort of *Sap-Vessels*, postur'd in short *Rays*. These *Vessels* yield a *Mucilage*. And on the inner *Verge* of the *Barque*, stands a Thin *Ring* of other *Sap-Vessels*, which yield a *thinner Liquor*. *Tab.* 18.

19. §. Next within the *Barque* stand the *Aer-Vessels*, postur'd likewise in short *Rays*, diametrically opposite to those in the *Barque*. In every *Ray*, there are about twelve or sixteen *Vessels*.

20. §. Lastly, and more within the *Pith*, there stand other *Sap-Vessels*, all in very Thin or Slender *Arched-Lines*; thus hemming in the ral *Parcels* of *Aer-Vessels*.

21. §. FOR a Sixth, I will take that of Wild *Cucumer*: Wherein is also found a *Mucilaginous Lympha*. For first of all, next to the *Skin*, there is a *Ring* of *Sap-Vessels*. Which *Ring* is also radiated, the *Rays*, all poynting towards, and most of them terminating on, the *Skin*.

22. §. Next of all, there is a thick, and simple *Parenchymous Ring*. On the inner *Verge* whereof, there are other *Sap-Vessels* standing in *Parcels*, also in a *Ring*. So far goes the *Barque*. *Tab.* 18.

23. §. Next within, stand the *Aer-Vessels*, in as many *Parcels*, contiguous to those of the *Sap-Vessels* aforesaid. To which likewise are adjoyned as many more *Parcels* of *Sap-Vessels* within the *Pith*, opposite to the said *Sap-Vessels* within the *Barque*.

24. §. FOR a *Seventh*, we may, choose that of *Scorzonera*. In which, the *Vessels* are both *Lymphæducts*, and *Lactiferous*. All of them, with the *Aer-Vessels*, in a radiated posture. For first next the outer Edg of the *Barque*, stand the *Lactiferous*, in little *Specks*. Next to these, on the inner Edg of the *Barque*, stand the *Lymphæducts*, in the same form. *Tab.* 18.

25. §. Hereunto adjacent, on the outer Edg of the *Pith*, ſtand the *Aer-Veſſels*, ſome in *Specks*, and ſome in extream ſhort *Lines*; hardly diſtinguiſhed, without a very nice Inſpection.

26. §. Within Theſe, are placed other *Lymphæducts*, oppoſite to thoſe in the *Barque*. And within theſe *Lymphæducts*, ſtill in the ſame radiated Line, run more of the *Milk-Veſſels*.

27. §. AN EIGHTH, may be that of *Burdock*; Wherein firſt, there are a Sort of *Lymphæducts*, which ſtand in *Arched Parcels*, round
Tab. 18. the *Trunk*, adjacent to the *Skin*.

28. §. Within theſe, about the middle of the *Barque*, run the *Milk-Veſſels*, in the form of ſmall round *Specks*.

29. §. Next to theſe on the inner Edg of the *Barque* are placed other *Lymphæducts*. Which, together with more of the ſame in the *Pith*, and the *Aer-Veſſels* betwixt them, ſtand all in Radiated Lines, of ſeveral Lengths, and all ſharpning towards the Centre.

30. §. LET the *Ninth*, be that of *Endive*: In which there is al-
Tab. 18. ſo much curious Work. Next to the *Skin*, there is, firſt, a thick and ſimple *Parenchyma*. Then there is a kind of *Undulated Ring* of *Milk-Veſſels*. Within which ſtand a Sort of *Lymphæducts*, in ſeveral *Parcels*; ſome, in *Arched Half-Ovals*; others, in ſhort ſlender *Rays*. Betwixt theſe *Parcels*, many of the *Milk-Veſſels* likewiſe ſtand.

31. §. Next there is an *undulated Ring* of other *Lymphæducts*, parting as in moſt *Trunks*, betwixt the *Barque* and the *Pith*. Within which, are the *Aer-Veſſels*. And within Theſe, more *Sap-Veſſels*. Both of them, in ſmall *Specks*, anſwerable, or oppoſite to the *Rays* in the *Barque*.

Tab. 18. 32. §. I SHALL give alſo one or two Examples of *Trees*, or *Arboreſcent Plants*; the *Vine* and *Common Sumach*. In a Slice of the former cut tranſverſly, next the *Skin*, there is a Thin *Barque*. In the inner part whereof, adjacent to the *Wood*, ſtand the *Lymphæducts* in ſeveral *Half-Oval Parcels*, oppoſite to ſo many Radiated Pieces of the *Wood*.

33. §. The *Wood* is divided into the ſaid Pieces, by as many *Parenchymous Rays*, inſerted from the *Barque*, and ſo continuous therewith.

34. §. Within theſe Radiated Pieces of *Wood*, ſtand the *Aer-Veſſels*; the largeſt of which, eſpecially if held up againſt the light, are plainly viſible to the bare Eye.

35. §. Within the hollow of the *Wood*, ſtands the *Pith*; in the young Growths always large. In the utmoſt *Verge* whereof, adjacent to the *Wood*, ſtand a few more *Sap-Veſſels* of the ſame Sort with thoſe in the *Barque*.

Tab. 18. 36. §. IN A like Slice of *Common Sumach*, contiguous to the hairy *Skin*, there is a *Ring* of *Lymphæducts*. Next to this a Simple *Parenchyma*. Then ſeveral *Arched Parcels* of *Lymphæducts*. Within theſe, a *Ring* of *Milk-Veſſels*. And then a *Ring* of other *Lymphæducts*. Thus far the *Barque*.

37. §. Within the *Barque*, ſtands the *Wood*, divided into ſeveral *Portions*, by the Diametral *Inſertions* divided from the *Barque*. In the Body of the *Wood*, ſtand the *Aer-Veſſels*, very much ſmaller than in the *Vine*.

38. §.

38. §. The hollow of the *Wood* is filled up with the *Pith.* In the Circumference of which, ſtands a *Ring* of *Lymphædctus*, of the ſame ſort with thoſe next to the *Wood* without.

39. §. All the *Parts* of theſe *Trunks*, may, as I have now deſcribed them, be obſerved without a *Microſcope*: excepting the *Bladders* and number of *Aer-Veſſels.* Yet Three things are hereunto neceſſary; *viz.* a good *Eye*, a clear *Light*, and a *Raſor*, or very keen *Knife*, wherewith to cut them with a ſmooth ſurface, and ſo, as not to Diſlocate the *Parts.*

40. §. UPON *Inſpection* alſo by the length, there are ſome particulars, common, more or leſs, to moſt *Plants*, yet better obſervable in ſome, than in others. As firſt, the *Reticulation* of the *Veſſels*, (formerly deſcribed) not only in the *Wood*, but in the *Barque*: which is evident in a young *Branch* of *Corin*, upon the very Surface thereof, when ſome of the *Veſſels* begin to be caſt off into the *Skin.* And ſo, by ſtripping off the *Skin*, upon the Surface of the *Wood.* *Tab.* 19.

41. §. In cutting by the length, as well as tranſverſly, the young *Fibres*, which grow within the *Wood* in the Edg of the *Pith*, are alſo ſeen. As likewiſe the manner of the Derivation of the *Parts* of the *Bud* from the *Branch* or *Stalk*; as in *Sonchus.* There are alſo many Varieties in the *Pith*, ſuch as thoſe hereafter mentioned (*a*) which fall under obſervation only in cutting by the length. (*a*) *Chap.* 4.

CHAP. II.

Of the Barque, *as it appears through a good Microſcope.*

I NOW proceed to a more particular *Deſcription* of ſeveral *Trunks* and *Branches*, as they appear through good *Glaſſes.*

1. §. Now the *Trunk*, or *Branch* of every *Tree*, hath Three General *Parts* to be deſcribed; *ſc.* the *Barque*, the *Wood*, and the *Pith.* That likewiſe of every *Herbaceous Plant*, hath either the ſame Three *Parts*; or elſe Three *Parts* Analogous; *ſc.* the *Cortical*, the *Lignous*, and the *Pithy Parts.*

2. §. The *Barque* conſiſteth of two *Parts*, *ſc.* the outmoſt or *Skin*, and the *Main Body.* The *Skin* is generally compoſed, in part, of very ſmall *Veſicles* or *Bladders*, cluſter'd together. That is, originally it is ſo; but as the *Plant* grows, the *Skin* dries, and the ſaid *Bladders*, do very much ſhrink up and diſappear.

3. §. Amongſt theſe *Bladders* of the *Skin*, there are uſually intermixed a ſort of *Lignous Fibres*, or *Veſſels*, which run through the length of the *Skin*; as in *Mallow*, *Nettle*, *Borage*, *Thiſtle*, and moſt *Herbs.* Which is argued not only from the Toughneſs of the *Skin* by means of the ſaid *Veſſels*; but in ſome *Plants*, may be plainly ſeen, as in *Teaſle.* In which, *Tab.* 20.

the ſeveral *Fibres*, which run by the length of the *Stalk*, are alſo conjoyned by other ſmaller ones, which ſtand tranſverſly.

4. §. Whether they are *Aer-Veſſels*, or *Sap-Veſſels*, is dubious. For, on the one hand, becauſe they emit no *Sap*, or *bleed* not, and alſo ſtand adjacent to the *Aer*; 'tis probable that they are *Aer-Veſſels*. On the other hand, they may be *Sap-Veſſels*; notwithſtanding that they *bleed* not: Becauſe the non-emiſſion of *Sap* is not an infallible and concluding argument of an *Aer-Veſſel*. For there are ſome *Plants* which *bleed* not. Which yet are furniſhed with *Sap-Veſſels*, as certainly as any others which *bleed*. (*a*)

(*a*) *B.* 2. *P.* 1. *c.* 3. §. 22.

5. §. The *Skin* of the *Trunk* is ſometimes viſibly porous. But no where more, than in the better ſort of walking *Canes*; where the *Pores* are ſo big, as to be viſible even to the naked Eye: like to thoſe, which are obſervable in ſeveral parts of the Ball of the *Hand*, and upon the ends of the *Fingers* and *Toes*.

Tab. 20.

6. §. THE *Main Body* of the *Barque* conſiſteth likewiſe of two *Parts*, ſc. *Parenchyma*, and *Veſſels*. The *Parenchyma* is made up of an innumerable company of ſmall *Bladders* cluſter'd together. Differing in nothing from thoſe aforeſaid in the *Skin*; ſaving, that they are much larger; and generally rounder.

Tab. 22. & *Sequent.*

7. §. This *Parenchyma* of the *Barque* is the ſame, as to its *Subſtance*, both in the *Root* and *Trunk*. Yet as to the *Texture* of its *Parts*, in the *one*, and in the *other*, there is This obſervable difference, *viz.* That in the *Barque* of the *Root*, cut tranſverſly, the ſaid *Parenchyma* (as hath been ſhew'd) is uſually, more or leſs, diſpoſed into *Diametral Rays*; running through the *Barque*, after the ſame manner, as do the the *Hour-Lines* through the Margin of the *Dial-plate* of a *Clock* or *Watch:* as in *Marſh-Mallow*, *Lovage*, *Melilot*, and others. Whereas here in the *Barque* of the *Trunk*, the ſaid *Parenchyma* is rarely thus diſpoſed into *Dimetral Rays*: Nor when it is, are thoſe *Rays* continued to the Circumference of the *Barque*; as in the *Barque* of the *Root* they frequently are. So in *Rhus* or *Sumach*, although part of the *Parenchyma* be diſpos'd into *Diametral Rays:* yet are thoſe *Rays* extended not half way through the *Barque*. So alſo in *Fig-tree*, *Worm-wood*, *Thiſtle*, and others. What is further obſervable in the *Texture* of the *Parenchyma*, I ſhall ſhew in the deſcription of the *Pith*.

Tab. 7,8,9.

Tab. 22. & *Seq.*

Tab. 31,34, &c.

8. §. THE *Veſſels* of the *Barque*, are, as I ſhall alſo ſhew, diverſifyed many ways. But there are ſome Things, wherein, in all Sorts of *Plants*, they agree. *Firſt*, in ſtanding, moſt numerouſly, in or near, the inner Margin of the *Barque*. *Secondly*, in being always, and only *Sap-Veſſels*. I have viewed ſo many, that at leaſt, I can ſecurely affirm thus much, That if there be any Heteroclital *Plants*, wherein they are found otherwiſe, there is not *One*, in *Five Hundred*. *Thirdly*, in being always *Conjugated* or *Braced* together in the form of *Net-work*. Although the Number and Diſtances of the *Braces*, are very different: as I have already ſhewed in the *Anatomy* of *Roots*.

Chap. 3. *Tab.* 6.

9. §. THE Properties, whereby the ſaid *Veſſels* of the *Barque* are ſpecificated and diſtinguiſhed one from another, both in the ſame *Plant*, and in the ſeveral Species of *Plants*, are very many. Which Properties, are not Accidental, but ſuch as ſhew the Conſtant and Univerſal Deſign of *Nature*. All which ſhall be demonſtrated by the *Deſcription* of ſeveral *Quarters* of the *Slices*, of ſo many Kinds of

Branches

Branches, cut Tranſverſly: and by the ſeveral *Figures* which repreſent them.

10. §. FIRST then, for the *Eleven* firſt *Quarters*, the *Veſſels* of the *Barque* are only of *Two Kinds*. And theſe, in the firſt *Eight*, ſeem to be *Roriferous* (deſcribed alſo in the *Anatomy* of *Roots*) (*a*) and thoſe which are common to moſt, if not to all *Plants*, ſc. the *Lymphæducts*. Yet in all the *Eight*, they are, in reſpect both of their *Proportion*, and *Poſition*, very different. So in *Hazel* and *Aſh* they are but few. In *Holly* and *Barberry* more. In *Apple*, *Pear*, *Plum*, *Elm*, ſtill more numerous. And of thoſe three *Fruits*, in an *Apple*, or *Plum*, more than in a *Pear*. *Tab.* 22. & *ſeq.* (*a*) *P.* 1. *c.* 3. §. 22.

11. §. Again, as their *Proportion*, ſo likewiſe their *Poſition* is divers. For in *Holly*, the *Lymphæducts* or inner *Veſſels* next to the *Wood*, ſtand in *Rays*. Yet ſo numerous and cloſe together, as to make one Entire *Ring*. In *Hazel*, they ſtand more in Oblong *Parcels*. In *Barberry*, they ſtand likewiſe in *Parcels*, but they are ſo many *Half-Ovals*. The utmoſt *Veſſels* or *Roriferous* of all Three, make a *Ring*. *Tab.* 22, 23, 24.

12. §. Again, in *Apple*, *Pear*, and *Plum*, the *Lymphæducts* are *Radiated*. The *Roriferous* are neither *Radiated*, nor make an *entire Ring*; but ſtand in *Peripherial Parcels*. Much after the ſame manner, they alſo ſtand in *Elm*. In *Aſh*, the *Veſſels* make Two *Rings*; but neither of them *Radiated*: the inmoſt *Ring* or *Lymphæducts*, conſiſting of *Arched Parcels*, and the utmoſt or *Roriferous Veſſels*, of *Round* ones. And whereas in all the foregoing, the *Lymphæducts* are ſtill contiguous to the *Wood*; and the *Roriferous* more or leſs, diſtant from the *Skin*: here, on the contrary, the former are diſtant from the *Wood*, and the latter contiguous to the *Skin*. *Tab.* 25, *to* 28. *Tab.* 29.

13. §. And that theſe *Veſſels* in each *Barque* of the ſaid Eight *Branches*, are of Two diſtinct Kinds, ſeems evident, as from ſome other reaſons, ſo from hence; In that their *Poſitions* are altogether Heterogeneous: Yet in both Conſtant, Regular and Uniform. I ſay, there ſeems to be no Reaſon, why the ſelf *ſame Kind* or Species of *Veſſels*, ſhould have a different, yea a contrary *Poſition* in one and the ſame *Plant*; and that Contrariety, not *Accidental*, but *Regular* and *Conſtant*.

14. §. FOR the *Three* next *Quarters* ſc. the *Ninth*, *Tenth* and *Eleventh*, the *Veſſels* of the *Barque* are alſo different in *Number*, *Poſition*, *Size* and *Kind*. In *Pine*, which is the *Eleventh*, they are fewer. In *Walnut* the *Ninth*, more. In *Fig*, the *Tenth*, moſt numerous. *Tab.* 30, 31, 32.

15. §. So for their *Poſition*. In *Pine*, the inmoſt make a *Radiated Ring*. The utmoſt ſtand *ſtragling* up and down, without any certain order. In *Wallnut* the inmoſt make alſo a *Radiated Ring*; The utmoſt make a Double *Ring*; not *Radiated*, but of *Round Parcels*. In *Fig*, the inmoſt make alſo a *Radiated Ring*. But the utmoſt make a *Double* and ſometimes *Treble Ring*, not of *Radiated*, nor *Round*, but *Arched Parcels*.

16. §. Thirdly, they are alſo different in *Kind*. Thoſe, I think, of the two former, *Wallnut* and *Fig*, are thus different: thoſe certainly, of the *Fig*, are ſo; being *Lymphæducts* and *Lacteals*. The *Lymphæducts* make the inmoſt *Radiated Ring*. The outmoſt which make the other *Rings* in *Arched Parcels*, are the *Lactifers*.

17. §. That they are diſtinct *Kinds* of *Veſſels*, is evident for two Reaſons. *Firſt*, from their *Poſition* in the *Barque*; which is altogether

ther different, as hath been ſaid. *Secondly*, from the moſt apparent Diverſity of the *Liquors* or *Saps*, which they contain, and which, upon cutting the *Branch* tranſverſly, do diſtinctly *Bleed* from them. Which is one way, whereby we do diſtinguiſh the *Veſſels* of *Animals* themſelves. As in the *Liver*, it were hard to ſay, which is a *Blood-Veſſel*, and which is a *Bile-Veſſel*, where they are very ſmall, if it were not for the *Contents* of them both.

18. §. Thoſe in the *Barque* of *Pine*, are likewiſe of Two *Kinds*. The inmoſt are *Lymphæducts*, as in the two former. The utmoſt are not *Milk-Veſſels*, but *Gum-Veſſels*, or *Reſiniferous*; which ſtand ſtraggling, and ſingly, about the midle of the *Barque*. Out of theſe *Veſſels* all the clear *Turpentine*, that drops from the *Tree*, doth iſſue.

19. §. Few, but very great. So that beſides the difference of their *Number* and *Poſition*, and of the *Liquors* which they contain, and *Bleed*; there is yet a Fourth, and that is, their *Size*. Moſt of theſe *Turpentine Veſſels*, being of ſo wide a *bore*, as to be apparent to the naked Eye: and, through a good *Glaſs*, above $\frac{1}{3}^{d}$ of an Inch in Diametre. Whereas that of the *Lymphæducts*, can hardly be diſcovered by the beſt *Microſcope*.

20. §. The ſame *Turpentine-Veſſels* of *Pine*, are likewiſe remarkably bigger, not only than the *Lymphæducts*, but many times, than the *Milk-Veſſels* themſelves: as thoſe of the *Fig*, which, in compariſon, are exceeding ſmall; every *Arch*, not being a *ſingle Veſſel*, but a *Parcel* or *Cluſter* of *Veſſels*; Whereas one ſingle *Gum-Veſſel* in *Pine*, is ſometimes as big as two whole *Arched Cluſters*, that is, as ſome Scores of the *Milk Veſſels* in a *Fig-tree*. And the ſaid *Gum-Veſſels* of *Pine*, being compared with the *Lymphæducts* of the ſame *Tree*, one *Gum-Veſſel*, by a moderate eſtimate, may be reckoned *three* or *four hundred* times *wider* than a *Lymphæduct*. The like prodigious difference may be obſerved in the *Size* of the ſeveral *Kinds* of *Veſſels* of many other *Plants*.

21. §. THE *Three* next *Quarters* of *Branches*, are of *Oak*, *Common Sumach*, and *Common Wormwood*. In the *Barque-Veſſels* whereof, there is obſervable ſome farther Variety. For in all or in moſt of the above named, there are only Two *Kinds* of *Veſſels* in the *Barque*. But in Each of theſe, there are, at leaſt, Three *Kinds*.

22. §. And firſt, in that of *Oak* there are *Lymphæducts*, *Roriferous*, and a Sort of *Reſiniferous*. The inmoſt or *Lymphæducts*, make a *Radiated Ring*, contiguous to the *Wood*. The utmoſt or the *Roriferous* make alſo a *Ring*, but not *Radiated*. Thoſe which are a ſort of *Roſin-Veſſels*, ſtand in Round *Parcels*; the greater *Parcels* betwixt the Two *Rings* of *Roriferous* and *Lymphæducts*; and the leſſer, betwixt the *Roriferous* and the *Skin*. *Tab.* 33.

23. §. That theſe laſt are different *Veſſels* from both the other, ſeems evident, from the difference of their *Poſition*, as aforeſaid. And that they are a ſort of *Reſiniferous*, is argued from hence; In that, not only *Galls* are very full of *Roſin*, but that the *Barque* of *Oak* it ſelf is alſo ſomewhat *Reſinous*. For the conveyance of whoſe *Reſinous* parts, it is moſt unlikely that any other *Veſſels* ſhould ſubſerve, but a peculiar *Kind*; which may therefore be properly called *Reſiniferous*.

Tab. 34. 24. §. The next is a *Branch* of *Common Sumach*. In the *Barque* whereof, there are likewiſe Three *Kinds* of *Veſſels*. Firſt of all, there is a thick *Radiated Ring* of *Lymphæducts*; ſtanding on the inner *Margin*

gin of the *Barque*, contiguous with the *Wood*. These *Vessels* exhibit their *Lympha* very apparently. A second kind of *Vessels*, sc. *Roriferous*, are situate towards the outer *Margin* of the *Barque*, and are composed into distinct *Arched Parcels*, all standing in a *Ring*.

25. §. Betwixt these Two *Kinds* stand the *Milk-Vessels*. Every single *Milk-Vessel* being *empaled* or hemmed in with an *Arch* of *Roriferous*. The *Milk-Vessels* are extraordinary large, almost as the *Gum-Vessels* of *Pine*; so as distinctly to be observed without a *Microscope*; after they are evacuated of their *Milk*; and without difficulty will admit a *Virginal Wyer*; being two or three hundred times as big as a *Lymphæduct*. Besides these Three sorts of *Vessels*, there is also a *Ring*, adjacent to the *Skin*; which seems to be another sort of *Roriferous*.

26. §. The Last, is a *Branch* of *Common Wormwood*. In the *Barque* whereof, there are likewise Three *Kinds* of *Vessels*. First of all, there is a thin *Radiated Ring* of *Lymphæducts*, contiguous with the *Wood* or on the inner *Margin* of the *Barque*. Yet the *Ring* is not entire, but made up of several *Parcels*; which are intercepted by as many *Parenchymous* inserted into the *Pith*. *Tab.* 35.

27. §. A Second Sort of *Vessels*, which seem to be *Roriferous*, are situate about the middle of the *Barque*: and are composed into *Arched Parcels*, which likewise stand all even in a *Ring*.

28. §. Beyond these *Arches*, and towards the outer *Margin* of the *Barque*, stand a Third Sort of *Vessels*. Different from the *Milk-Vessels* in *Sumach*, both as to their *Situation*, *Size* and *Content*. For in *Sumach*, the *Milk-Vessels* stand within the *Arched Lymphæducts*: whereas these in *Wormwood*, stand without them. Likewise, being the *Vessels* of an *Herb*, they are far less; *sc.* about the compass or width of a small *Wheat-straw*. Their *Content*, is not a *Milk*, but a *liquid*, most *Oleous* and *viscid Gum*. Or which, for its pleasant *Flavour* may be called an *Aromatick Balsom*. For it perfectly giveth whatever is in the *Smell* and *Taste* of *Wormwood*: being the *Essence* of the whole *Plant*, which nature treasureth up in these *Vessels*. So that they are, in all respects, analogous to the *Turpentine Vessels* in *Pine*. There are divers other *Herbs* and *Trees*, which in the like *Vessels*, contain a *Turpentine*, or rather *Aromatical Balsom*; as *Angelica*, *Helenium* and others; the *Vessels* being so very large, that they may be easily traced with a knife, in cutting by the length of a *Branch* or *Stalk*.

29. §. Whether in some *Plants*, there are not more *Sorts* of *Vessels*, in the *Barque*, than have been now mentioned, I cannot say: Though we have not much reason to doubt of it. Because we see, there is so great variety in the *Viscera* of *Animals*. For what the *Viscera* are in *Animals*; the *Vessels* themselves are in *Plants*.

30. §. CONCERNING the *Form* and *Texture* of the *Lymphæducts*, there are some things, which though they are best observed in the *Wood*, yet in regard I am now describing the said *Vessels*, I shall here therefore add. I have already said, and shewed, in the former *Books*, That the *Lignous* and *Towy Parts* of all *Plants*, are *Tubulary*. And that the *Lympha* is conveyed, by the length of a *Plant*, through an innumerable company of small *Tubes* or *Pipes*.

31. §. The *Question* may be yet further put: If the *Towy Parts* of the *Barque* are made of *Tubes*, What are these *Tubes* themselves made up of? *I answer*, That these *Tubes* or *Lymphæducts*, are not only themselves

themſelves *Organical*; but their very *Sides* alſo, ſeem to be compoſed of other *Parts*, which are *Organical*, *ſc.* of *Lignous* or *Towy Fibres*. *Tab.* 40. Which *Fibres*, ſtanding cloſe or contiguous in a round *Figure*, they make one *Tubulary Body*, which I call the *Lymphæduct* of a *Plant*. And it is probable, That theſe *Fibres* themſelves, are alſo *Tubulary*. That is, that a *Lymphæduct*, is a ſmall *Tube*, made up or compoſed of other, yet much ſmaller *Tubes*, ſet round together in a *Cylindrick Figure*. As if we ſhould imagine a company of *Straws*, which are ſo many ſmall *Pipes*, to be joyned and ſet round together, ſo as to make another greater *Pipe*, anſwerable to a *hollow Cane*. The *Cane*, I ſay, is as the *Lymphæduct*; and the *Straws* are as the *Fibres* whereof it is compoſed. By which alſo appears, the admirable ſmallneſs of theſe *Fibres*. For there are ſome *Lymphæducts*, which may be reckoned fifty times ſmaller than a *Horſe-Hair*. Allowing therefore but Twenty of the aforeſaid *Fibres* to make a *Thred* ſo big as one *Lymphæduct*; then one of the ſaid *Fibres*, muſt be a Thouſand times ſmaller than a *Horſe-Hair*. That theſe *Fibres*, whereof the *Lymphæducts* are made, are themſelves made up of other *Fibres*, is not altogether improbable.

32. §. Theſe *Fibres*, although parallel; yet are they not *coaleſcent*, but only contiguous; being contained together in a *Tubulary Figure*, by the Weftage of the *Cortical Fibres*, as in *Chapter* the *Fourth* will better be underſtood.

33. §. The firſt notice I took of the *Compoſition* and *Texture* of theſe *Veſſels*, ſo far as the beſt *Glaſſes* yet known, will admit; was in a very *white* and *clear* piece of *Aſh-wood* torn, with ſome care, by the length of the *Tree*, and objected to a proper *Light*. They ſeem alſo ſometimes diſcernable in ſome other *clear Woods*, as in very *white Fir*, *&c.* And having formerly demonſtrated, that the *Lignous Part* of a *Plant*, is annually made or augmented out of the inner part of the *Barque*, wherein the *Lymphæducts* always ſtand: we may reaſonably ſuppoſe the ſame *Lymphæducts* to have the like Conformation in the *Barque*, as in the *Wood*.

34. §. And I am the rather induced to believe, that I am not miſtaken in this Deſcription, upon theſe two Conſiderations. *Firſt*, that herein the Analogy betwixt the *Veſſels* of an *Animal* and a *Plant*, is the more clear and proper. For as the *Sanguineous Veſſels* in an *Animal* are compoſed of a number of *Fibres*, ſet round, in a *Tubulary Figure*, together: ſo are theſe *Lymphæducts* of a *Plant*. *Secondly*, in that herein, there is a more genuine reſpondence betwixt theſe, and the other *Veſſels* of a *Plant* it ſelf; *ſc*, the *Aer-Veſſels*; which are made up of a certain number of *Round Fibres*, ſtanding collaterally, or ſide to ſide as I have already obſerved in the *Anatomy* of *Roots*. So that it is the leſs ſtrange, that the *Lymphæducts* ſhould be made up of *Fibres*, ſince the *Aer-Veſſels* are eviden tly ſo made. Only with this difference, that whereas in the *Aer-Veſſels*, the *Fibres* are poſtured or continued *Spirally*: here, in the *Lymphæducts*, they ſtand and are continued only in *ſtraight Lines*.

35. §. THE STRUCTURE of the *Lactiferous* and *Gum-Veſſels*, which *Tab.* 20. have a very ample *Bore*, is more apparent. And, by the beſt *Glaſſes* I have yet uſed, they ſeem to be made, chiefly, by the Conſtipation of the *Bladders* of the *Barque*. Thatis to ſay, That they are ſo many *Chanels*,

Chanels, not made or bounded by any walls or ſides proper to themſelves, as a *Quil* thruſt into a *Cork*, and as the *Aer-Veſſels* are in the *Wood:* but only by the *Bladders* of the *Parenchyma*; which are ſo poſtured and crouded up together, as to leave certain *Cilyndrick Spaces*, which are continued by the length of the *Barque.*

36. §. One difference betwixt the *Veſſels* or *Chanels* now deſcrib'd, and the Tubulary *Hollows* and other *Apertures* in the *Pith*, is this; That theſe never exiſt originally with the *Pith*; but are ſo many *Ruptures* ſupervening to it in its Growth. Cauſed, partly, by the Stretch or Tenter it ſuffers from the Dilatation of the *Wood:* (*a*) and partly, the drying, and ſo the Shrinking up of its *Bladders*, and of the *Fibres* whereof they are compoſed. Whereas the ſaid *Veſſels* in the *Barque*, are many of them originally formed therewith. And thoſe which are *poſt-nate*, not made by any *Rupture*, but only ſuch a Diſpoſition of the *Parenchymous Fibres*, and Conſtipation of the *Bladders*, as is thereunto convenient.

(*a*) *B.* 1. *c.* 3. §. 22, & 23.

37. §. In paring the *Barque* of a *Branch* of *Pine*, *Sumach*, &c. they appear, neither *parallel*, nor any where *Inoſculated:* but run, with ſome little obliquities, diſtinct one from another, through the length of the *Branch*: and ſo, we may believe, through the length of the *Tree.*

CHAP. III.

Of the WOOD.

THE next general *Part* of a *Branch*, is the *Wood*; which lyeth betwixt the *Barque* and the *Pith.* And this likewiſe evermore conſiſteth of Two General *Parts*, *ſc.* of a *Parenchymous Part*, and that more properly called *Lignous.* The *Parenchymous Part* of the *Wood*, though much diverſifyed, yet in the *Trunks* of all *Trees* whatſoever, hath this property, To be diſpoſed into many *Rays*, or *Diametral Inſertions*, running betwixt ſo many *Lignous Portions*, from the *Barque* to the *Pith*: as in any of the *Quarters* here before us may appear.

2. §. But theſe *Inſertions* are much diverſifyed, according to the ſeveral *Sorts* of *Plants.* So in *Barberry*, *Aſh*, *Pine*, *Worm-wood*, they are leſs numerous. In *Elm*, *Wallnut*, *Fig*, *Sumach*, they are more. And in *Holly*, *Pear*, *Plum*, *Apple*, *Oak*, *Hazel*, are moſt numerous. *Tab.* 22, to 35.

3. §. The ſame *Inſertions*, in *Barberry*, *Wormwood*, and ſome in *Oak*, are very Thick. In *Pine*, *Fig*, *Aſh*, of a middle *Size.* In *Pear*, *Holly*, and moſt of them in *Oak*, are exceeding Small. Again, in *Barberry*, *Elm*, *Aſh*, *Sumach*, *Fig*, they are of an Equal *Size.* In *Holly*, *Hazel*, *Pear*, *Plum*, *Oak*, they are very Unequal: ſome of thoſe in *Holly*, being *Four* or *Five* times thicker than the reſt; in *Plum*, *Six* or *Seven* times; and in *Oak*, *Ten* times at leaſt. *Ibid.*

4. §. In ſome *Plants*, they are Equidiſtant; in others, not: in ſome, the Great ones are Equidiſtant; in others, the Leſſer; in others, both; in ſome, neither. Which *Varieties* are not accidental; but conſtant to the *Species* in which they are ſeverally found.

5. §. They are not always viſibly continued from the Circumference to the Centre of the *Wood:* but in ſome *Branches*, as of *Sumach*; and in moſt *Trunks* of many years growth, declining, in ſome places, under or over, from a Level, are thereby, upon a Tranſverſe Section, in part cut away. *Tab.* 34.

6. §. They have yet one more Diverſity, which is, That in divers of the aforeſaid *Branches*, they run not only through the *Wood*; but alſo ſhoot out beyond it, into ſome *Part* of the *Barque*, as in *Elm*, *Sumach*, *Wormwood*, &c. Whereas in *Pine*, and ſome of the reſt they either keep not diſtinct from the other parts of the *Parenchyma* of the *Barque*; or are ſo ſmall, as not to be diſtinguiſhed there form. *Tab.* 28, 34, 35. *Tab.* 32.

7. §. The *Texture* likewiſe of theſe *Inſertions* is ſomewhat various. For in *Wormwood*, and moſt *Herbs*, they are manifeſtly compoſed of ſmall *Bladders:* differing in nothing from thoſe of the *Barque* or *Pith*, ſaving, in their being much leſs. Yet in *Herbs*, they are much larger than they are in *Trees*. And in many *Trees*, as *Apple*, *Pear*, *Plum*, *Pine*, &c. they are either quite loſt, or ſo ſqueezed and preſſed together by the hard *Wood* ſtanding on both ſides, as to be almoſt undiſcernable. *Tab.* 35. *Tab.* 36, 37.

8. §. So that although the *Parenchyma* of the *Barque* or *Pith*, and the *Inſertions* in the *Wood*, are of the ſame *Specifick* Nature or Subſtance: yet there is this difference betwixt them; That the *Fibres* of the former, are ſo Netted together, as to leave ſeveral round Vacuities; or to make a great many little *Bladders*, whereas, in the latter, they are uſually ſo far crowded up, as to run (as when a Net is ſtretched out) like a *Skein* of *Parallel Threds*.

9. §. Of theſe *Inſertions* in the *Wood*, it is futher obſervable, That they do not only run betwixt the *Lignous Portions*; but that many of their *Fibres* are likewiſe all along diſtributed to the ſeveral *Fibres*, of which the *Lignous Portions* conſiſt, and are interwoven with them; both together thus making a piece of *Linſy-Woolſy Work*, or like many other *Manufactures* in which the *Warp* and the *Woof* are of different Sorts of *Stuff:* as in the end of the *Fourth Chapter* is further explained. *Tab.* 40.

10. §. THE WOOD is likewiſe compounded of Two Sorts of *Bodies*; That which is ſtrictly *Woody*; and the *Aer-Veſſels* mixed herewith. The true *Wood* is nothing elſe but a maſs of antiquated *Lymphæducts*, *viz.* thoſe which were originally placed on the inner Margin of the *Barque*. For in that place, there grows, every year, a new *Ring* of *Lymphæducts*. Which loſing its original ſoftneſs by degrees, at the latter end of the year, is turned into a dry and hard *Ring* of perfect *Wood*.

11. §. So that every year, the *Barque* of a *Tree* is divided into Two Parts, and diſtributed two *contrary* ways. The outer Part falleth off towards the *Skin*; and at length becomes the *Skin* it ſelf. In like manner, as hath been obſerved of the *Skin* of the *Root*. Or as the *Cuticula* in *Animals*, is but the effloreſcence of the *Cutis*. I ſay, that the elder *Skin* of a *Tree*, is not originally made a *Skin*; but was once, ſome of the *midle* part of the *Barque* it ſelf, which is annually caſt off, and

and dryed into a *Skin:* even as the very *Skin* of an *Adder*, upon the gradual generation of a new one underneath, in time, becomes a *Slough*. The inmoſt portion of the *Barque*, is annually diſtributed and added to the *Wood:* the *Parenchymous Part* thereof making a new addition to the *Inſertions* within the *Wood*; and the *Lymphæducts* a new addition to the *Lignous pieces* betwixt which the *Inſertions* ſtand. So that a *Ring* of *Lymphæducts* in the *Barque* this year, will be a *Ring* of *Wood* the next; and ſo another *Ring* of *Lymphæducts*, and of *Wood*, ſucceſſively, from year to year. So the *Table*, for an *Apple-Branch*, ſheweth a quarter of a *Slice* of a *Branch* cut tranſverſly, of Three years growth: That of *Barbery*, of Two; That of *Sumach*, of One only; That of *Elm*, of Five. *Tab.* 25. 24, 34, 28.

12. §. Hereby two things maybe the better noted. Firſt, the difference betwixt the degrees of the *annual* growths of ſeveral *Trees*: three years growth in an *Oak*, being as thick as five in an *Elm*. Secondly, the difference betwixt the *Annual* growths of the *ſame Tree*; being not of a conſtant proportion, but varying in thickneſs, as it ſhould ſeem, according to the *ſeaſon* of the year: whereby it may appear, what *ſeaſon*, or kind of year, doth moſt of all favour, the latitudinal growth, or the *thickening* of any *Tree*. *Tab.* 33, 28.

13. §. The *Lymphæducts* thus antiquated or turned into *Wood*, do rarely, if ever, *Bleed:* but only tranſmit a kind of *Dewy* or *Vaporous Sap*. And ſome of them, as in the *Heart* of ſome *Trees*, it is probable, That they tranſmit not any *Sap*, either in the form of a *Liquor*, or a *Vapour*: and ſo being gradually deprived of their *Watery Parts*, become the *Heart*.

14. §. There is this further variety in the *Wood*; repreſented in *Walnut*, *Fig* and *Oak*. That ſome certain parcels hereof, make either ſeveral ſmall and white *Rings*, as in *Oak*; or elſe divers white and crooked *Parcels*, tranſverſe to the *Inſertions*, as in *Wallnut* and *Fig*. For it ſeemeth, that, at leaſt, in many *Trees*, ſome portion of all the *Kinds* of *Veſſels* in the *Barque*, are not only annually diſtributed to the *Wood*, but do likewiſe therein retain the ſame, or ſomewhat like *Poſition*, which they originally had in the *Barque*. So that as all thoſe bigger aud darker Portions of the *Wood*, were originally, the *Radiated Lymphæducts* of the *Barque*: ſo the little white *Circles*, or *Parcels* of *Circles*, in the ſame *Wood*, were originally another ſort of *Sap-Veſſels* in the *Barque*, *ſc.* thoſe which have a circular Poſition therein. *Tab.* 30, 31, 33.

15. §. In the *Branches* of *Fir*, *Pine*, and others of the ſame *Kindred*, there are ſome few *Turpentine-Veſſels* ſcattered up and down the *Wood*; and repreſented by the larger Black Spots. Which *Veſſels* are *eadem numero*, the ſelf ſame, which did once appertain to the *Barque*; and do even here alſo in the *Wood*, contain and yield a liquid *Turpentine*. Only, being pinched up by the *Wood*, they are become much ſmaller *Pipes*. *Tab.* 32.

16. §. THE *Aer-Veſſels*, with the *Inſertions*, and true *Wood*, altogether make up That, which is commonly called, The *Wood* of a *Tree*. The *Aer-Veſſels* I ſo call, not in that they never contain any *Liquor*; but, becauſe all the principal time of the growth of a *Plant*, when the *Veſſels* of the *Barque* are filled with *Liquor*, theſe are filled only with a *Vegetable Aer*.

17. §. In almoſt all *Plants*, not one in ſome hundreds excepted, this is proper to the *Aer-Veſſels*; To have a much more ample *Bore* or *Ca-*

vity, than any other in the *Wood*. In the *Wood*, I ſay; for in the *Barque*, there are many *Sap-Veſſels* bigger than the biggeſt *Aer-Veſſels* that be.

18. §. The Varities hereof are very many; in reſpect both of their *Number*, *Size*, and *Poſition*; being, as to theſe, the ſame, in no two *Sorts* of *Plants* whatſoever. Firſt in reſpect of their *Number*. So in *Hazel*, *Apple*, *Pear*, they are very numerous; but in different degrees: and are repreſented in the *Figures* already referred to, by all the black ſpots in the *Wood*. In *Holly*, *Plum*, *Barberry* ſomewhat numerous. In *Oak*, *Aſh*, *Walnut* fewer. In *Pine*, and others of that *Kindred*, very few; *ſc.* fewer than in any other kind of *Plant*.

Tab. 23, 25, 26. 22, 24, 27. 29, 30, 33. 32.

19. §. Secondly, in reſpect of their *Size*; which from the firſt or greateſt, to the leaſt, may be computed eaſily to about Twenty Degrees. Thus, many of thoſe in *Elm*, *Aſh*, *Wallnut*, *Fig*, *Oak*, are very large. In *Barberry*, *Plum*, not ſo large. In *Hazel*, *Sumach*, ſmaller. In *Holly*, *Pear*, of a ſtill ſmaller *Size*. So that many of thoſe in *Elm*, or *Oak*, are Twenty times bigger, than thoſe in *Holly* or *Pear*.

Tab. 28, 33. 22, 26.

20. §. In an ordinary joynted *Cane*, they are ſo wide, that if you take one a yard, or a yard and ½ long, and putting one end into a Baſin of Water, you blow ſtrongly at the other; your Breath will immediately paſs, through the *Aer-Veſſels*, the length of the *Cane*, ſo as to raiſe up the Water into a great many *Bubbles*.

21. §. And as they have a different Size in divers Kinds of *Plants*; ſo likewiſe, according to the place where they ſtand, in the ſelf ſame. So in *Holly*, *Hazel*, *Apple*, their *Size* is more equal throughout the bredth of the *Tree*. But in *Barberry*, *Elm*, *Oak*, *Aſh*, very different: Not fortuitouſly, but always much after the ſame manner. For in all the laſt named *Branches*, the *Aer-Veſſels* that ſtand in the inner *margin* of each annual *Ring*, are all vaſtly bigger, than any of thoſe that ſtand in the outer part of the *Ring*.

Tab. 22, 23, 25. 24, 28, 29. 33.

22. §. Thirdly, theſe *Aer-Veſſels* are alſo different in their *Situation*. So in *Apple*, *Wallnut*, *Fig*, they are ſpread all abroad in every annual *Ring*; not being poſited in any one certain *Line*. In others, they keep more within the compaſs of ſome *Line* or *Lines*; either *Diametral*, or *Peripherial*. So in *Holly* they are *Radiated*, or run in even *Diametral Lines* betwixt the *Pith* and the *Barque*. So alſo are ſome of of them in *Hazel*; and ſome few in *Wallnut*.

Tab. 25, 30, 31. *Tab.* 22. 23, 32.

23. §. Whether they ſtand *Irregularly*, or are *Radiated*, it is to be noted, That Nature, for the moſt part, ſo diſpoſeth of them, that many of them may ſtill ſtand very near the *Inſertions*. So in *Apple*, ſhe will rather decline making an even *Line*; or in *Holly*, will rather break that *Line* into *Parcels*, than that the *Aer-Veſſels* ſhall ſtand remote from the *Inſertions*. To what end this is done, ſhall be ſaid hereafter.

24. §. Again, in *Aſh*, the *Aer-Veſſels* are none of them *Radiated*, but moſt of them ſtand in *Circles* on the inner *Margin* of every annual *Ring*. Which *Circle* is ſometimes very thick, as in *Aſh* and *Barberry*. In others but thin, the *Veſſels* ſtanding, for the moſt part, ſingle throughout the *Circles*; as in *Elm*. Sometimes again, they both make a *Circle*, and are alſo ſpread abroad; as in *Pear* and *Plum*.

Tab. 24. 29. 28. 26, 27.

25. §. Thoſe likewiſe which are ſpread abroad, are ſometimes *Regularly* poſited. So in *Barberry*, beſides thoſe larger, that make the *Circle*, there are other ſmaller ones, that ſtand, in oblique *Lines*,

Tab. 24.

athwart

athwart one another; almoſt like a *Bend*, or ſometimes, an entire or broken *Saltyr* in an *Eſcutcheon*. In *Oak*, they make rather certain *Columns*, in the poſture of the *Pale*. And in *Elm*, they make, as it were, many *croſs Parcels*, in the poſture of the *Feſs*. *Tab.* 33. 38.

26. §. This great difference in the *Size* and *Poſition* of the *Aer-Veſſels*, in the ſame individual *Plant*, is one ground, for which, I think it probable, That there are *divers Kinds* of *Aer-Veſſels*, as well as of *Sap-Veſſels*. Even as in *Animals*, there are divers *Kinds* of *Organs* for *Spiration*, and the ſeparation of *Aer*: *Fiſhes* having their *Branchiæ*; *Land-Animals* their *Lungs*; and thoſe in *Frogs*, &c. being of a ſomewhat peculiar *Kind*.

27. §. THE *Form* and *Texture* of theſe *Veſſels*, and the various ways whereby they may be beſt obſerved, I have already deſcribed and ſhewed in my *Anatomy* of *Roots*. As to their *Form*, one thing remarqued was this; That they are never *Ramified*, but diſtinctly continued from one end of a *Plant*, ſmall or great, to the other: as the *Nerves* are in *Animals*. A further and eaſie proof whereof, may be made, only by holding up a piece of an ordinary *Cane*, about ½ a foot long, cut very ſmooth at both ends, againſt a full light: whereupon, if you keep it in a ſtraight *Line* betwixt the *Light*, and the caſt of your *Eye*, and then look ſteadily, you may ſee quite through it, that is, through the *Aer-Veſſels*, which run ſtraight along the *Cane* from end to end. *P.* 1. *c.* 4.

28. §. As to their *Texture*; whereas, oftentimes, the *Aer-Veſſels* appear to be *unroaved* in the form of a very ſmall *Plate*, it is to be noted, That it is not only of different bredth, in divers *Plants*, and uſually much broader in the *Root*, than in the *Trunk*: but alſo, that in the *Trunk*, many times, the ſaid *Veſſels* are unroaved or reſolved, not in the form of a *Plate*, but of a *Round-Thred*. The Cauſes of which Diverſity, are principally Three; *viz.* The *Weſtage* of the *Fibres* of which the *Aer-Veſſels* conſiſt; The deference betwixt the ſaid *Fibres*, or betwixt the *Warp* and the *Woof*; And the different *Kinds* of *Woof*.

29. §. By the *Weſtage* of the *Fibres*, it is, That the *Veſſels*, oftentimes, *unroave* in the form of a *Plate*. As if we ſhould imagine a piece of fine narrow *Ribband*, to be woun'd ſpirally, and Edg to Edg, round about a Stick; and ſo, the Stick being drawn out, the *Ribband* to be left in the *Figure* of a *Tube*, anſwerable to an *Aer-Veſſel*. For that which, upon the *unroaving* of the *Veſſel*, ſeems to be a *Plate*, or one ſingle *Piece*, is, as it were, a *Natural Ribband*, conſiſting of ſeveral Pieces, that is, a certain number of *Threds* or *Round-Fibres*, ſtanding parallel, as the *Threds* do in an *Artificial Ribband*. And as in a *Ribband*, ſo here, the *Fibres* which make the *Warp*, and which are Spirally continu'd; although they run parallel, yet are not coalleſcent; but conteined together, by other Tranſverſe *Fibres* in the place of a *Woof*. *Tab.* 39.

30. §. And as the ſaid *Fibres* are tranſverſly continued, thereby making a *Warp* and *Woof*: So are they (as in divers woven *Manufactures*) of very different *Bulk*; thoſe of the Former, being much bigger, and therefore much ſtronger, than thoſe of the Latter. By which means, as *Cloth* or *Silk* will often Tear one way, and not another; ſo here, while the *Warp* or thoſe *Fibres* which are Spirally continued;

tinued, are uſually *unroaved* without breaking; thoſe ſmaller ones, by which they are *ſtitched* or *woven* together, eaſily tear in ſunder all the way.

31. And becauſe the *Fibres* of the *Woof*, are themſelves alſo of different *Bulk*; therefore it is, That where they are more ſturdy, as uſually in the *Root*, they require a greater quantity of *Warp*, that is, a broader *Plate*, to overmatch them. Whereas, where they are more extream ſmall, as in the *Trunk* and *Leaves*, one *Thred* of the *Warp*, that is, one *Spiral Fibre*, will be ſtrong enough of it ſelf, and ſo, ſometimes, be ſingly *unroav'd*.

32. §. From the extream Tenuity of theſe *Fibres*, it is, That they are very rarely diſcern'd, and not without the greateſt difficulty. As alſo, from their great Tenderneſs; whereby not enduring to be drawn out, they all break off cloſe to the Sides of the *Spiral ones*. In the *Pith*, the like Tranſverſe *Fibres* are a little more viſible: which firſt conducted Me to the notice of them here alſo.

33. §. All the *Fibres* of the *Aer-Veſſels*, both the *Warp* and the *Woof*, are of the ſame Subſtantial Nature with the *Pith* and the other *Parenchymous Parts* of a *Plant*. From whence it is, That whereas the *Towy Parts* of a *Plant*, whereof all *Linen Manufactures* are made, are very *Strong* and *Tough*; theſe, as is aboveſaid, are extream *Tender* and *Brittle*, like thoſe of the *Pith* and all the *Pithy Parts*. To which therefore, the *Aer-Veſſels* are tobe referr'd. And the *Content* of both, is oftentimes the ſame.

34. §. From whence, we have a further proof of what I have formerly aſſerted; which is, That in all *Plants*, there are *Two* Subſtantially different *Parts*, and no more than *Two*, *viz.* the *Pithy*, and the *Towy* or *Lignous Parts*.

B. 1. *c.* 7. §. 13, 14.

35. §. From hence alſo we have ſome ground to conjecture, That ſo many of the *Aer-Veſſels*, at leaſt, which are not formed with the ſeed, but *poſt-nate*, are originated from the *Parenchymous Parts*; which ſeem by ſome alteration in the *Quality*, *Poſition* and *Texture* of the *Fibres*, to be Transformed into *Aer-Veſſels*, as *Caterpillars* are into *Flies*. And as the *Pith* it ſelf, by the Rupture and Shrinking up of ſeveral *Rows* of *Bladders*, doth oftentimes become Tubulary: So is it alſo probable, that in the other *Parenchymous Parts*, one ſingle *Row* or *File* of *Bladders* evenly and perpendicularly piled; may ſometimes, by the ſhrinking up of their Horizontal *Fibres*, all regularly breakone into another and ſo make one *continned Cavity*; or a *Tube*, whoſe *Diametre* is the ſame with that of the *Bladders*, wherof it is compoſed. All which, will appear more probable, and what hath been ſaid, be yet better underſtood, when we come, in the next *Chapter*, to the Deſcription of the *Pith*.

CHAP.

CHAP. IV.

Of the PITH.

THE Third General *Part* of a *Branch* is the *Pith*. Which though it have a different name from the *Parenchyma* in the *Barque*, and the *Insertions* in the *Wood*; yet, as to its *Substance*, it is the very same with them both. Whereof there is a double evidence, *sc.* their *Continuity*, and the sameness of their *Texture*. Their *Texture* shall be shewed presently. As to their *Continuity*, it is to be noted, That as the *Skin* is continuous with the *Parenchyma* of the *Barque*; and this *Parenchyma* likewise, with the *Insertions* in the *Wood*; so these *Insertions* again, running through the *Wood*, are also continuous with the *Pith*. So that the *Skin*, *Parenchyma*, *Insertions*, and *Pith*, are all *One entire piece of Work*; being only filled up, in divers manners, with the *Vessels*.

2. §. The *Size* of the *Pith* is various, being not the same in any two *Branches* here represented. In *Wormwood*, *Sumach*, *Fig*, *Barbery*, 'tis very large; *sc.* betwixt 5, and 7 *Inches Diametre*, as it appears through the *Microscope*. In *Pine*, *Ash*, *Holly*, *Walnut*, not so large; from 3 *Inches Diameter* to 4. In *Oak*, *Apple*, *Pear*, *Hazel*, lesser, scarce from 2, to 3. In *Damascene*, not above an *Inch* and half. And in *Elm*, scarce an *Inch Diameter*. Note also, that of all *Plants*, both *Herbs*, and *Shrubs*, have generally the largest *Piths*, in proportion with the other *Parts* of the same *Branch*, as in *Sumach*, *Fig*, *Barbery*, is manifest. *Tab.* 24, 31, 34, 35. 22, 29, 30, 32. 23, 25, 26, 35. 27. 28.

3. §. It is also worth the noting, That wheras, in most *Plants*, the *Barque* and *Wood* do both grow thicker every year: the *Pith*, on the contrary, groweth more slender; So that in a *Branch* of one years growth, it is apparently more ample, than in one of two; and in a *Branch* of two, than in one of three; and so on.

4. §. The *Pith*, for the most part, if not always, in the *Branch*, as well as the *Root*, is furnished with a certain number of *Sap-Vessels*. They are here usually so postur'd, as to make a *Ring* on the *Margin* of the *Pith*. Where they are more numerous, or large, they are more evident; as in *Walnut*, *Fig*, *Pine*, and others. They are also of divers *Kinds*, answerable to those in the *Barque*; as in *Wallnut*, *Lymphæducts*; in *Fig*, *Lacteals*; in *Pine*, *Resiniferous*. *Tab.* 30, 31, 32.

5. §. The *Parenchyma* of the *Pith* is composed of *Bladders*. Which are the very same with those in the *Barque*, and oftentimes in the *Insertions* within the *Wood*. Only these in the *Pith*, are of the largest *Size*; those in the *Barque*, of a lesser; and those of the *Insertions* least of all: for which reason they are less obvious than in the *Pith*.

6. §. The *Bladders* of the *Pith*, though always comparatively Great; yet are of very different *Sizes*. Being easily distinguished, even as to their *Horizontal Area*, to *Twenty* Degrees. Those of *Fig*, *Barberry*, and some others, are somewhat large. And of many *Herbs*, as *Tab.* 24, 31.

of

Tab. 39. of *Thiſtle*, *Borage*, and others, three times as big again; appearing in the *Microſcope*, like to the largeſt *Cells* of an *Hony-comb*. Thoſe of *Plum*, *Worm-wood*, *Sumach*, leſs. Of *Elm*, *Apple*, *Pear*, leſſer. Of
Tab. 32. *Holly* and *Oak*, ſtill leſs. So that the *Bladders* of the *Pith* in *Borage* or Common *Thiſtle*, are of that *Size*, as to contain, within the compaſs only of their *Horizontal Area*, about twenty *Bladders* of the *Pith* of *Oak*. Wherefore one whole *Bladder* in *Thiſtle*, is, at leaſt an hundred times bigger, than another in *Oak*.

7. §. Of the *Size* of theſe *Bladders* of the *Pith*, 'tis alſo to be noted, That it doth not at all follow the *Size* of the *Pith* it ſelf; but is ſtill varied, according as Nature deſigneth the *Pith* for various uſe. Thus, whereas the *Pith* of *Sumach*, is Larger than that of *Barberry*; it might be thought, that the *Bladders*, whereof it is compoſed, ſhould be likewiſe Larger: Yet are they Three times as Small again in
Tab. 24, *Sumach*, as they are in *Barberry*. So the *Pith* of *Plum*, is far Leſs, than
34. that of *Pear*; yet the *Bladders* of the former are Four or Five times
26, 27. as big, as thoſe of the latter. So the *Pith* of *Hazel* is almoſt Three
22, 23. times as Little again, as that of *Holly*; yet the *Bladders* in *Hazel*, are Ten times bigger, than in *Holly*.

8. §. The *Shape* of the *Bladders* hath alſo ſome Variety. For although, for the moſt part, they are more round; yet oftentimes they are angular: as in *Reed-graſs*, a *Water-plant*; where they are *Cubical*; and in *Borage*, *Thiſtle*, and many others, where they are *pentangular*, *ſexangular* and *ſeptangular*.

9. §. Of the *Texture* of the *Bladders*, 'tis alſo to be noted, that many times, the *Sides* of the greater *Bladders* are compoſed of leſſer; as is often ſeen in thoſe of *Borage*, *Bulruſh*, and ſome other *Plants*. In the ſame manner, as the *Sap-Veſſels*, are but greater *Fibres* made up of leſſer.

10. §. The *Pith*, though always originally compoſed of *Bladders*, and ſo *One Entire Piece*; yet in proceſs, as the *Plant* grows up, it hath divers openings or *Ruptures* made in it: oftentimes very regularly, and always for good uſe, and with conſtancy obſerved in the ſame *Species* of *Plants*. In *Sharp-poynted Dock*, many of the *Pores* are conſiderably pro-
Tab. 19. longed by the length, like ſmall *Pipes*. In *Walnut* it ſhrinketh up into tranſverſe *Filmes* or *Membranes*; as likewſe ſometimes in *Spaniſh-Broom*. Sometimes the *Pith* is hollow or Tubulary: either throughot the *Trunk*, as in *Thiſtle*, *Endive*, *Scorzonera*, *Marſh-Mallow*: or ſo, as to remain entire at every joynt; as in *Sonchus*, *Nettle*, *Teaſle*; in which it is divided as it were into ſeveral *Stories*: and divers other ways.

11. §. I SHALL conclude this diſcourſe with a further illuſtration of the *Texture* of the *Pith*, and of the whole *Plant*, as conſequent thereupon. I ſay therefore, (and have given ſome account hereof in the *Anatomy* of *Roots*) That as the *Veſſels* of a *Plant*, *ſc.* the *Aer-Veſſels* and the *Lymphæducts* are made up of *Fibres*; according to what I have in this Diſcourſe above ſaid; ſo the *Pith* of a *Plant*, or the *Bladders* whereof the *Pith* conſiſts are likewiſe made up of *Fibres*. Which is true alſo of the *Parenchyma* of the *Barque*. And alſo of the *Inſertions* in the *Wood*. Yea, and of the *Fruit*, and all other *Parenchymous Parts* of a *Plant*. I ſay, that the very *Pulp* of an *Apple*, *Pear*, *Cucumber*, *Plum*, or any other *Fruit*, is nothing elſe but *a Ball of moſt extream ſmall tranſparent Threds or Fibres, all wrapped and*

ſtich'd

ſtitch'd up (though in divers manners) *together.* And even all thoſe *Parts* of a *Plant*, which are neither formed into viſible *Tubes*, nor into *Bladders*, are yet made up of *Fibers*. Which, though it be difficul to obſerve, in any of thoſe *Parts* which are cloſer wrought and principally in the *Inſertions* of ſome *Trees*: yet in the *Pith*, eſpecially of ſome *Plants*, which conſiſteth of more open *work*, they are more viſible. Which introduceth the obſervation of them in all other *Parenchymous Parts*. So in the *Pith* of a *Bulruſh* of the *Common Thiſtle*, and ſome other *Plants*; not only the *Threds* of which the *Bladders*; but alſo the ſingle *Fibres*, of which the *Threds* are compoſed; may ſometimes with the help of a good *Glaſs*, be diſtinctly ſeen. Yet one of theſe *Fibres*, may reaſonably be computed to be a Thouſand times ſmaller than an *Horſe-Hair*. *Tab.* 38.

12. §. The *Fibroſity* of the *Parenchyma* is alſo viſible in ſome *Woods*, in which, it is apparently mixed with the *Lignous Parts*, not only by *Inſertions*, but *per minimas Partes organicas*. That is to ſay, The *Parenchymous Fibres*, like ſmaller *Threds*, are either *wraped round about* both the *Lignous* and the *Aer-Veſſels*, or at leaſt *interwoven* with them, and with every *Fiber* of every *Veſſel:* as in very white *Aſh* or *Fir-Wood*, with an advantagious poſture and light, may be obſerved. *Tab.* 39.

13. §. WHENCE it follows, that the whole *Subſtance*, or all the *Parts* of a *Plant*, ſo far as *Organical*, they alſo conſiſt of *Fibres*. Of all which *Fibres* thoſe of the *Lymphæducts*, run only by the *Length* of the *Plant*: thoſe of the *Pith*, *Inſertions*, and *Parenchyma* of the *Barque*, run by the *breadth* or horizontally: thoſe of the *Aer-Veſſels*, fetch their Circuit by the *Breadth*, and continue it by the *Length*.

14. §. By which means, the ſaid *Parenchymous Fibres*, in fetching their *horizontal Circles*, do thus *weave*, and make up the *Bladders* of the *Pith*, in *Open-Work*. And the ſame *Fibres* being thence continued; they alſo *weave* and make up the *Inſertions*, but in *Cloſe-Work*. Betwixt which *Inſertions*, the *Veſſels* being likewiſe tranſverſly interjected, ſome of the ſame *Fibres wrap* themſelves alſo about theſe; thus *tying* many of them together, and ſo making thoſe ſeveral *Conjugations* and *Braces* of the *Veſſels*, which I have formerly deſcribed. And as ſome of theſe *Horizontal Fibres* are *wraped* about the *Veſſels*; ſo alſo about the *Fibres*, whereof the *Veſſels* are compoſed. By which means it is, that all the *Fibres* of the *Veſſels* are *Tacked* or *Stitched* up cloſe together into One Coherent Piece. Much after the ſame manner, as the *Perpendicular Splinters* or *Twigs* of a *Basket*, are, by thoſe that run in and out *Horizontally*. And the ſame *Horizontal Fibres*, being ſtill further produced into the *Barque*; they there compoſe the ſame *work* over again (only not ſo *open*) as in the *Pith*. *Tab.* 40.

15. §. SO THAT the moſt unfeigned and proper reſemblance we can at preſent, make of the whole *Body* of a *Plant*, is, To a piece of *fine Bone-Lace*, when the Women are working it upon the *Cuſhion*, For the *Pith*, *Inſertions*, and *Parenchyma* of the *Barque*, are all extream Fine and Perfect *Lace-Work*: the *Fibres* of the *Pith* running *Horizontally*, as do the *Threds* in a Piece of *Lace*; and bounding the ſeveral *Bladders* of the *Pith* and *Barque*, as the *Threds* do the ſeveral *Holes* of the *Lace*; and making up the *Inſertions* without *Bladders*, or with very ſmall ones, as the ſame *Threds* likewiſe do the *cloſe* Parts of

the *Lace*, which they call the *Cloth-Work*. And laſtly, both the *Lignous* and *Aer-Veſſels*, ſtand all *Perpendicular*, and ſo croſs to the *Horizontal Fibres* of all the ſaid *Parenchymous Parts*; even as in a Piece of *Lace* upon the *Cuſhion*, the *Pins* do to the *Threds*. The *Pins* being alſo conceived to be *Tubular*, and prolonged to any length; and the ſame *Lace-Work* to be wrought many Thouſands of times over and over again, to any thickneſs or hight, according to the hight of any *Plant*. And this is the true *Texture* of a *Plant*: and the *general compoſure*, not only of a *Branch*, but of all other *Parts* from the *Seed* to the *Seed*.

An

An Account of the VEGETATION OF TRUNKS Grounded upon the foregoing ANATOMY.

PART II.

HAVING before given the *Anatomy* of *Trunks*; I ſhall next proceed to ſee, what *Uſe* may be made thereof; and principally, to explicate the manner of their *Vegetation*. In doing which, that former *Method*, which I uſed in ſhewing the manner of the *Growth* of *Roots*, I ſhall not exactly follow. For ſo, in regard the *Organical Parts* of the *Root* and *Trunk* are the ſame, and conſequently their *Nutrition* and *Conformation* are effected in the ſame way; I ſhould hereby be obliged to a nauſeous and unprofitable repetition of many things already ſaid. The Explication therefore of all thoſe Particulars, which more eſpecially belong to the *Trunk*, or are more Apparent therein, and not ſpoken of, or not ſo fully, in the former *Books*, will be my preſent Task. The chief *Heads* whereof, ſhall be theſe Seven following, *viz.*

FIRST, the *Motion* and *Courſe* of the *Sap*.
SECONDLY, The *Motion* and *Courſe* of the *Aer*.
THIRDLY, The *Structure* of the *Parts*.
FOURTHLY, The *Generation* of *Liquors*.
FIFTHLY, The *Figuration* of *Trunks*.
SIXTHLY, The *Motion* of *Trunks*.
SEVENTHLY, And laſtly the *Nature* of *Trunks* as variouſly fitted for *Mechanical Uſe*.

CHAP. I.

Of the Motion *and* Courſe *of the* Sap.

FIRST, as to the *Courſe* of the *Sap*, there are Three *Parts* in which it *moveth*; *ſc.* the *Pith*, the *Wood*, and the *Barque* First the *Pith*; in which the *Sap* moveth the *Firſt year*, and *only the Firſt year*. Or, it is *Proprium quarto modo*, to the *Pith* of every *Annual Growth*, and to the *Pith* of ſuch a *Growth* only, *To be ſucculent*. That is, whether of a *Sprout* from a *Seed*, or of a *Sucker* from a *Root*, or of a *Cyon* from a *Branch*; The *Pith* is always found the *Firſt year* full of *Sap*. But the *Second year*, the ſame individual *Pith*, always becomes *dry*, and ſo it continues ever after.

2. §. One cauſe whereof is, that the *Lymphæducts* in the *Barque*, being the firſt year adjacent to the *Pith*; they do all that time, tranſfuſe part of their *Sap* into it, and ſo keep it always *Succulent*. But the ſame *Lymphæducts*, the year following, are turned into *Wood*; and the *Veſſels* which are then generated, and carry the *Sap*, ſtand beyond them, in the *Barque*. So that the *Sap* being now more remote from the *Pith*, and intercepted by the new *Wood*, it cannot be transfuſed, with that ſufficient force and plenty as before, into the *Pith*; which therefore, from the firſt year, always continues dry.

3. §. THE SECOND *Part* in which the *Sap moves*, *ſub forma liquoris*, is the *Wood*. Which yet, it doth not in all *Plants*, but only in ſome; and viſibly, in very few; as in the *Vine*: In a *Vine*, I ſay, the *Sap* doth *viſibly aſcend* by the *Wood*. And this it doth, not only the firſt year, but every year, ſo long as the *Vine* continues to grow. But although this *aſcent*, in or through the *Wood*, be every year; yet it is only in the *Spring*, for about the ſpace of a Month; *ſc.* in *March* and *April*.

4. §. There are many other *Trees*, beſides the *Vine*, wherein, about the ſame time of the year, the *Sap aſcendeth*, though not ſo copiouſly, yet chiefly, in the *Wood*. For if we take a *Branch* of two or three years growth, ſuppoſe of *Sallow*, and having firſt cut the ſame tranſverſely; if the *Barque* be then alſo tranſverſely, and with ſome force, preſſed with the back of the knife, near the newly cut end; the *Sap* will very plainly riſe up out of the utmoſt *Ring* of *Wood*. And if it be preſſed in the ſame manner, or a little more ſtrongly, about an Inch lower, the *Sap* will aſcend out of every *Ring* of *Wood* to the Center. Yet at the ſame time, which is to be noted, there *ariſeth* no *Sap* at all out of the *Barque*.

5. §. Whence appears the Error of that ſo Common Opinion, That *the Sap always riſeth betwixt the Wood and the Barque*. The contrary whereunto is moſt true, That it never doth. For the greater part of the year, it riſeth in the *Barque*, *ſc.* in the inner *Margin* adjacent

cent to the *Wood*, and in *Spring*, in or through the *Wood* it ſelf, and there only.

6. §. THE THIRD *Part* in which the *Sap* aſcends, is the *Barque*, as was above hinted, and may be obſerv'd in almoſt any *Branch*, if cut croſs, in the *late Spring* and in *Summer*; either as the *Sap* iſſueth ſpontaneouſly, or upon preſſing, as aforeſaid. So that when the *Sap* ceaſeth to aſcend, *ſub forma liquoris*, by the *Wood*, then it begins to aſcend by the *Barque*.

7. §. Beſides the difference of *Time*, the *Organical Parts* likewiſe, in which theſe two *Saps* aſcend, are divers. For in the *Barque*, it aſcendeth *viſibly*, only in the *Succiferous*, whereas in the *Wood*, it aſcendeth only by the *Aer-Veſſels*.

8. §. FROM what hath been ſaid, we may underſtand, what is meant by the *Bleeding* of *Plants*. If we take it generally, it properly enough expreſſes, *The eruption of the Sap out of any Veſſels*. And ſo, almoſt all *Plants*, in *Summer* time, do *Bleed*, that is, from *Sap-Veſſels*, either in the *Barque*, or in the *Margin* of the *Pith*: the *Saps* they *Bleed*, having either a *Sower*, *Sweet*, *Hot*, *Bitter*, or other *Taſt*. At which time, the *Veſſels* alſo, in the *Barque* of a *Vine-Branch*, do *Bleed* a *Sower Sap*.

9. §. But that which is *vulgarly* called *Bleeding*, as in a *Vine*, is quite another thing; both as to the *Liquor* which iſſueth, and the *Place* where it iſſues: that is to ſay, it is neither a *Sweet*, nor *Sower*, but *Taſteleſs Sap*; iſſuing, not from any *Veſſels* in the *Barque*, but from the *Aer-Veſſels* in the *Wood*. So that there is as much difference betwixt *Bleeding* in a *Vine*, or the *Riſing* of the *Sap* in any other *Tree*, in *March*, and in *July*; as there is betwixt *Salivation* and an *Hæmorrhage*; or betwixt the *Courſe* of the *Chyle* in the *Lactiferous Veſſels*, and the *Circulation* of the *Blood* in the *Arteries* and *Veins*.

10. §. NOW the Cauſe from whence it comes to paſs, that the *early Spring-Sap* of a *Vine*, and other *Trees*, aſcendeth by the *Wood*, is, In that the *Generation* of the young *Sap-Veſſels* in the *Barque*, by which the *Sap* aſcendeth all the *Summer*; is, in the beginning of *Spring*, but newly attempted. So that the *Sap* having not yet theſe *Veſſels* to receive it, it therefore (*pro hac vice*) runs up the *Aer-Veſſels* in the *Wood*. But ſo ſoon as the ſaid *Veſſels* in the *Barque* begin to be conſiderably encreaſed, the *Sap*, declining the *Aer-Veſſels*, betakes it ſelf to *Theſe*, as its moſt proper *Receptacles*.

11. §. THE CAUSE alſo, why the *Veſſels* of almoſt all *Plants*, upon cutting, do yield *Sap*, or *Bleed*; is the *Preſſure* which the *Parenchyma* makes upon them. For the *Pith* and other *Parenchymous Parts* of a *Plant*, upon the reception of *Liquor*, have always a *Conatus* to *dilate* themſelves. As is manifeſt from *Sponges*, which are a Subſtance of the ſame Nature, and have a ſomewhat like ſtructure. As alſo from *Cork*, which is but the *Parenchyma* or *Barque* of a *Tree*. I ſay therefore, that the *Parenchyma* being fill'd and ſwell'd with *Sap*, hath thereby a continual *Conatus* to *dilate* it ſelf; and in the ſame degree, to preſs together or contract the *Veſſels* which it ſurroundeth. And the ſaid *Veſſels* being cut, their actual *Contraction* and the *Eruption* of the *Sap*, do both immediately follow.

12. §. IT may be alſo noted, That the *Trunk* or *Branch* of any *Plant* being cut, it always *bleeds* at both ends, or upwards and downwards, alike

alike freely. Which, as well as divers other *Experiments* plainly ſhews, That in the *Sap-Veſſels* of a *Plant*, there are no *Valves*.

13. §. FROM what we have now above, and elſewhere formerly ſaid, we may alſo underſtand the *manner* of the *Aſcent* of the *Sap*. As to which, I ſay, *Firſt*, That conſidering to what heigth and plenty, the *Sap* ſometimes aſcends; it is not intelligible, how it ſhould thus aſcend, by virtue of any one *Part* of a *Plant*, alone; that is neither by virtue of the *Parenchyma*, nor by virtue of the *Veſſels*, alone. Not by the *Parenchyma* alone. For this, as it hath the Nature of a *Sponge* or *Filtre*, to ſuck up the *Sap*; ſo likewiſe, to ſuck it up but to a certain heigth, as perhaps, about an Inch, or two, and no more.

14. §. Nor by the *Veſſels* alone, for the ſame reaſon. For although we ſee, that ſmall *Glaſs-Pipes* immerſed in Water, will give it an aſcent for ſome Inches; yet there is a certain *period*, according to the *bore* of the *Pipe*, beyond which it will not riſe. We muſt therefore joyn the *Veſſels* and the *Parenchyma* both together in this Service; which we may conceive performed by them in the manner following.

15. §. Let A B be the *Veſſel* of a *Plant*. Let C E D F be the *Bladders* of the *Parenchyma*, wherewith, as with ſo many little *Ciſterns*, *Tab.* 39. it is ſurrounded. I ſay then, that the *Sap*, in the *Pipe* B A, would, of it ſelf, riſe but a few Inches; as ſuppoſe, from D to L. But the *Bladders* D P, which ſurround it, being ſwelled up and turgid with *Sap*, do hereby preſs upon it; and ſo not only a little contract its bore, but alſo transfuſe or ſtrain ſome *Portion* of their *Sap* thereinto: by both which means, the *Sap* will be forced to riſe higher therein. And the ſaid *Pipe* or *Veſſel* being all along ſurrounded by the like *Bladders*; the *Sap* therein, is ſtill forced higher and higher: the *Bladders* of the *Parenchyma* being, as is ſaid, ſo many *Ciſterns* of *Liquor*, which transfuſe their repeated Supplies throughout the length of the *Pipe*. So that by the ſupply and preſſure of the *Ciſterns* or *Bladders* F D, the the *Sap* riſeth to L; by the *Bladders* Q L, it riſes to M; by the *Bladders* N M, it riſes to I; by the *Bladders* O I, it riſes to K; by the *Bladders* P K, it riſes to E; and ſo to the top of the *Tree*. And thus far of the *Motion* of the *Sap*.

CHAP.

CHAP. II.

Of the Motion *and* Courſe *of the* Aer.

THE NEXT enquiry to be made, is, into the *Motion* and *Courſe* of the *Aer*. Where this queſtion will firſt of all be asked; *ſc.* Which way the *Aer* firſt *enters* the *Plant*; whether at the *Trunk*, *Leaves*, and other *Parts* above ground; or at the *Root*? I anſwer, *That it enters in part, at them all.* For the *Reception*, as well as *Extramiſſion* whereof, the *Pores* are ſo very large, in the *Trunks* of ſome *Plants*, as in the better ſort of thick walking *Canes*, that they are viſible, to a good Eye, without a *Glaſs*; but with a *Glaſs*, the *Cane* ſeems, as if it were ſtuck top full of holes with great *Pins*: being ſo large, as very well to reſemble the *Pores* of the *Skin* in the end of the *Fingers* and *Ball* of the *Hand*. *Tab.* 19.

2. §. In the *Leaves* of *Pine*, they are likewiſe through a *Glaſs*, a very Elegant Show; ſtanding all moſt exactly, in *rank* and *file*, throughout the length of the *Leaves*. The *Figure* whereof ſhall be given hereafter, when we come to the *Anatomy* of the *Leaf*.

3. §. But although the *Aer* enters, in part, at the *Trunk* and other *Parts*, eſpecially in ſome *Plants*; yet its *chief* entrance, is at the *Root*. Even as ſome Parts of *Aer*, may continually paſs into the *Body* and *Blood*, by the *Habit*, or *Pores* of the *Skin*; but the chief entrance hereof, is at the *Mouth*. And what the *Mouth* is, to an *Animal*; that the *Root* is to a *Plant*.

4. §. Again, if the chief entrance of the *Aer*, were at the *Trunk*; then, before it could be mixed with the *Sap* in the *Root*, it muſt deſcend; and ſo move not only contrary to its own Nature, but likewiſe in a contrary Courſe to the *Sap*, throughout the *Plant*. Whereas, by its *Reception* at the *Root*, and ſo its *Tranſition* from thence; it hath a more natural and eaſie motion of Aſcent. For while the *Sap* aſcends, that the *Aer*, in the ſame *Plant*, ſhould continually deſcend, cannot reaſonably be ſuppoſed.

5. §. The ſame is further argued, From the fewneſs and ſmallneſs of the *Diametral Portions* in the *Trunk*, in compariſon with thoſe in the *Root*. In which *Nature* hath plainly deſigned the ſame, for the *Separation* of the *Aer* from the *Sap*, after they are both together received thereinto. So that the *Reception* and *Courſe* of the *Aer*, is made on this manner following.

6. §. THE *Aer* being a *ſpringy* Body, it inſinuates into all the *Holes* and *Cranies* of the *Earth*; and ſo is plentifully mixed therewith. Whereupon, as the *Sap* enters the *Root*, more or leſs *Aer* ſtill intrudes it ſelf together with it. The *Liquid* Portion of the *Sap*, ſwells and fills up the *Succulent Parts* of the *Barque*. The *Aery* Part, is, as was ſaid, ſeparated from the *Liquid*, into the *Diametral* Portions. Which running

running from the *Barque* towards the Centre of the *Root*, and ſo paſſing along betwixt the *Aer-Veſſels*; do hereby convey the *Aery* Part of the *Sap* from the *Barque*, into the ſame.

7. §. Being thus received into the *Aer-Veſſels*, and the *Reception* thereof, by the ſame means continued; it is by them advanced into the *Trunk*. In which advance, it is again, more or leſs, disburſed into all the *Parts* of the *Trunk*, as it goes. *Partly*, inwards to the *Pith*. From whence, the *Pith* is always, at length, filled with *Aer*. *Partly*, into the *Inſertions*; by which it is conveyed outward into the *Barque*. Wherein, it is in ſome part, transfuſed through the *Sap*: and ſo the reſt, with part of the *Sap*, remitted, in *perſpirations*, back again into the *Aer*.

8. §. So that, whereas the *Diametral Portions* in the *Root*, do ſerve to convey the *Aer* from the *Sap* in the *Barque*, into the *Aer-Veſſels*, in the *Wood:* on the contrary, the *Inſertions* here in the *Trunk*, ſerve to convey the *Aer* from the *Aer-Veſſels* in the *Wood*, into the *Sap*, in the *Barque*. Wherefore, as the *Aer-Veſſels advance* the *Aer*, or the *Aery Part* of the *Sap*, and ſo convey it by the *length* of the *Trunk*; ſo the *Inſertions filter* it, and convey it by the *breadth*.

9. §. AND that the *Inſertions* have this *Office* or *Subſervience* unto both *Kinds* of *Veſſels*; doth yet further appear, if we conſider, That the *Aer-Veſſels* are always ſo poſtured, as to touch upon the ſaid *Inſertions*, or at leaſt to ſtand very near them. For either they are large, and ſo do frequently touch upon them on both ſides; as in *Tab.* 28. *Elm*, *Aſh*, *Wallnut*, &c. Or if they are ſmall; then they either run 29. along in even lines collateral and oftentimes contiguous with the ſaid 22. *Inſertions*, as in *Holly*: or at leaſt, are reciprocally, ſome on one ſide, and ſome on another, inclined to them; as in *Apple*. By all which 25. means, the *Aer* is more readily conveyed from the *Veſſels* into the *Inſertions*.

10. §. A further evidence hereof is this, That generally, the bigger and the more numerous the *Aer-Veſſels* be; the bigger, or at leaſt, the more numerous alſo are the *Inſertions:* Eſpecially, if the compariſon be made (as in all other caſes it ought to be, as well as here) betwixt the ſeveral *Species* of the ſame *Kind*. So *Corin*, which hath *Tab.* 17. ſmall *Aer-Veſſels*, hath alſo very ſmall *Inſertions*. But the *Vine*, hath both very large: and ſo for others.

11. Wherefore, the *Inſertions* miniſter betwixt the *Aer-Veſſels*, and the *Succiferous*; in the ſame manner, as the *Veſiculæ* of the *Lungs*, do betwixt the *Bronchiæ* and the *Arteries*. That is to ſay, as in an *Animal*, the *Bronchiæ* depoſite the *Aer* into the *Veſiculæ* of the *Lungs*; which adminiſter it to the *Arteries*: ſo in a *Plant*, the *Aer-Veſſels* depoſit the *Aer* into the *Inſertions*, that is into the *Veſiculæ* of the *Inſertions*; by which it is gradually *filtred* off into the *Barque* and the *Sap-Veſſels* therein.

CHAP.

CHAP. III.

Of the Structure *of the* Parts.

A THIRD enquiry, is into the *Generation* and *Structure* of *Parts*. The manner whereof I have already endeavoured to *explicate* (a) from the *Anatomy* of the *Root*, throughout all particulars. Some whereof I ſhall yet further clear. (a) *Lib.* 2. *P.* 2.

1. §. As *Firſt*, the *Union* of the *Barque* to the *Body* of the *Tree*, Contrary to the common Opinion, *That they are not continuous*; but that the *Barque* only ſurrounds the *Body*, as a *Scabbard* does a *Sword*, or a *Glove* the *Hand*. As alſo ſeemeth to be proved, by the eaſy *Slipping* of the *Barque* of *Willow*, and moſt other *Trees*, when full of *Sap*, from the *Wood*.

2. §. But, notwithſtanding this, they are as truly continuous, as the *Skin* of the *Body* is with the *Fleſh*: *ſc.* by means of the *Parenchyma*; which is one entire *Body*, running from the *Barque* into the *Wood*, and ſo uniting both together; as in a *Branch* of *Vine* or *Corin-Tree*, when the *Barque* is ſtripped off, is apparent; the Spaces between the ſeveral *Parts* of the *Wood*, being filled up with the *Parenchymous*, inſerted from the *Barque*. *Tab.* 19.

3. §. Now the reaſon why the *Barque* nevertheleſs ſlips ſo eaſily from the *Wood*, is plain, *viz.* Becauſe moſt of the young *Veſſels* and *Parenchymous Parts*, are there every year ſucceſſively formed; that is, betwixt the *Wood* and *Barque*: where the ſaid *Parts* newly formed, are as tender, as the tendereſt *Veſſels* in *Animals*. And we may imagine, how eaſie it were at once to tear or break a thouſand *Veſſels* or *Fibres* of an *Embrio*, of a *Womb* or *Egg*.

4. §. THE ſame *Veſſels* of the *Barque* being always *braced*, and gradually falling off, together with the *Parenchyma*, into the utmoſt *Rind*: Hence it is, that the *Barques* of many *Trees*, are as it were, latticed with ſeveral *Cracks* of divers *Sizes*, and ſometimes in the *Figure* of *Rombs*: the ſaid *Fiſſures* repreſenting the *Poſition* and *Tract* of the *Veſſels* in their *Braces*. Hence alſo it is, that the *Barque* of ſome *Trees*, as of *Corin*, *Cherry*, &c. falleth off in *Rings*, *ſc.* becauſe the *Sap-Veſſels* are poſited in the ſame manner in the *Barque*. *Tab.* 19.

5. §. The *Sap-Veſſels*, as they are generated at the inner *Verge* of the *Barque*: ſo likewiſe, in a ſmall quantity, at the utmoſt *Verge* of the *Pith*. Theſe being not only fed with a more vigorous *Sap*, but with great caution, ſecured within the *Wood*, for the propagation of the ſucceeding *Buds*.

6. §. Hence alſo it is, that is, by the annual accretion of theſe *Veſſels*, that the *Pith* is ſometimes leſs in the *Trunk*, than in the *Branches*; and leſs in the elder *Branches*, than in the youuger; and ſometimes 'tis allmoſt wholly filled up. By which means, as the *Branches* carry every year a greater burthen; ſo they become ſtill more ſturdy the better to ſupport it. *Tab.* 18.

7. §. SOMETIMES alſo the *Pith* breaks and ſhrinks up, thus making the *Trunk* a *Pipe*. The cauſe whereof, is either the *Largeneſs* of its *Pores*, or the *Thinneſs* of the *Sides* of the ſaid *Pores*; upon both

which accounts, the *Pith* doth more eaſily tear, and upon tearing ſhrink up, and ſo become hollow: as in *Cichory*, *Lampſana*, *Sonchus*, *Teaſel*, *Brownwort*, and others; wherein the *Pores* of the *Pith* are *Large*, and the *Sides* of the *Pores*, *Thin*. Whereas, upon contrary accounts, the *Piths* of moſt *Trees*, remain perpetually entire.

8. §. THE Reaſon why *Plants* are made thus to become *hollow*, is *partly*, for the *ripening* of the *Fruit* or *Seed*; which is the better effected by a more plentiful ſupply of *Aer* continually received into their hollow *Trunks*. For by means of that *Aer*, part of the *Sap*, is dryed up, and the remaining part of it made warmer, and ſo ſooner matured.

9. §. *Partly*, for the better determining the due *Age* of the *Plant*. Hence it is, that the greater part of *Annual Trunks*, are hollow: the *Aer* contained in that hollow, drying up the *Sap*, and ſhrinking up the *Sap-Veſſels* ſo far, as to hinder the free motion of the *Sap* therein; from whence the *Plant* muſt needs periſh. So that as the *Content* of the *Aer-Veſſels*, is a kind of *Vegetable Aer*, whoſe Office is to *Attenuate*, and *Ferment* the *Juyces* of *Plants*: ſo the *Content* of theſe *Cavities*, cometh nearer to a more common *Aer*, deſigned chiefly, ſo ſoon as it is convenient, to *dry* them up.

10. §. AGAIN, as to the *Aer-Veſſels*, divers queſtions may be asked. As how it comes to paſs, that they are generally leſs in the *Trunk* of the ſame *Plant*, than in the *Root*? The Cauſe whereof is, that here in the *Trunk* they are more under the power of the *Aer*; both that which entreth in at the *Trunk*, and that which of its own *Nature* aſcendeth up into it from the *Root*. For the *Aer*, as we have elſewhere ſaid, is the *Mould* of the *Aer-Veſſels*; to whoſe crooked or at leaſt, *Acid Parts*, the *Saline*, and other *Principles* concurring to their generation, do conform. To which they do beſt, the ſmaller they are: the *Fibres* of the larger *Aer-Veſſels* making greater *Circles*, and ſo coming nearer to a *right Line*, anſwerable to the *Figure* of the Particles, not of the *Aerial*, but of the *Saline Principle*.

11. §. Wherefore as the *Aer-Veſſels* may be obſerved ſtill to be dilated or widened towards the lower parts of the *Root*; the *Aerial Principle* being there leſs predominant, and the *Saline* more: So towards the upper part of the *Trunk*, to be contracted or grow ſmaller; the *Aerial Principle* being here more predominant, and the *Saline* leſs.

12. §. FOR the ſame cauſe it may be obſerved, That the *Aer-Veſſels* of the Second years Growth, and the ſeveral years ſucceeding, are uſually nearer of one Size, than thoſe of the *Second* and *Firſt*; all being under a leſs power of the *Aer*, than the *Firſt*. For the firſt year the *Pith* being full of *Liquor*, the *Aer-Veſſels* themſelves, are the only *Repoſitories* of the *Aer*. Whereas after the firſt year, the *Pith* becoming dry, or another great *Repoſitory* for the *Aer*; the *Aer-Veſſeles* are henceforth filled with a moiſter or more *Vaporous* and *Saline Aer*, and ſo made to grow wider.

13. §. Hence the very *Size* of the *Pith*, hath much *influence* upon the *Aer-Veſſels*, and the manner of *Nutrition*, and the *Generation* of *Liquors* in *Plants*.

14. §. BUT for the moſt part, the *Aer-Veſſels* are ſomewhat, more or leſs, amplified in every new *Annual Ring*; or at leaſt to a certain number of years. Probably, becauſe in the elder *Branches*, the *Spiral Fibres*, of which the *Veſſels* conſiſt, are more bulky; and ſo make a

Veſſel

Veſſel of a wider, as a more agreeable bore. Nature obtaining hereby, that the Quantity of *Aer*, ſhall always be anſwerable to the Growth of the *Plant*, or at leaſt, be ſufficient to maintain its *Vegetable Life* and *Vigour*.

15. §. And therefore, as is above hinted, it ſeems likely, That after a certain number of years, the *Aer-Veſſels* are no longer amplified, but ſtand at a ſtay, and perhaps may grow ſmaller, according as the *Tree* is leſs or more *Longæve*; and that after this period, it is ſome way or other in its Declining State.

16. §. LASTLY, from the *Content* and *Governing Principle* of the *Aer-Veſſels*, the *Time*, when they begin every year to be formed, or to appear, is always *later*; at leaſt with reſpect to the *ſeaſon* of the *Tree*. So that whereas the *Sap-Veſſels* begin to be formed in *Spring*: theſe, not till the latter end of *Summer*, or there about; at leaſt not till about that time to *appear*. That is, when the *Sap* begins to decreaſe, and to grow more *Aery*; and ſo more fit matter for the *Generation* of the ſaid *Aer-Veſſels*.

CHAP. IV.

Of the Generation *of* Liquors.

UPON the *Structure* and *Formation* of the *Parts*, dependeth the *Generation* of *Liquors*, as was lately intimated. The *manner* whereof I have formerly ſhewed, in diſcourſing of the *Root*. Yet ſome things I ſhall here further *explicate*. And *Firſt*, what we have formerly aſſerted, *ſc.* That the concurrence of two *ſpecifically* diſtinct *Fluids*, is as neceſſary to *Nutrition* in *Plants*, as in *Animals*. Which appears, as from divers other conſiderations, ſo from the very *Structure* of a *Plant*: where in all the *Organical Parts*, or the *Parenchyma* and the *Veſſels*, are every where mixed together *per minima*, that is, *per minimas partes organicas*, or *Fiber* with *Fiber* of ſeveral *Kinds*. Every ſmall part of a *Tree*, or of the *Barque* of a *Tree*, being as I may ſay, a ſort of *Linſy-Woolſey*. So that there is not the leaſt part of the *Sap*, which is not impregnate with divers *Eſſential Tinctures*, as it is continually *filtred* from the *Fibres* of *one Kind*, to thoſe of another; ſtanding every where *woun'd* and *ſtitch'd* up together for the ſame purpoſe.

2. §. FROM the ſpecial *Nature* and *Structure* of the *Parts*, the *Liquors* of *Plants* are likewiſe *ſpecified*. The *Veſſels* being the chief *Viſcera* of a *Plant*. For all *Liquors* in a *Plant*, are certainly made by that *Plant*. And ſince the *Plant* hath no *Viſcera* (ſo called) I would then know, what its ſeveral *Liquors* are made by? If in the *Parenchyma*, ſurely by that *Parenchyma*. If in the *Veſſels*, by the *Veſſels*. And if of divers *Kinds* by divers *Kinds* of *Veſſels*. So that what the *Viſcera* are in *Animals*, the *Veſſels* themſelves are in *Plants*. That is to ſay, as the *Viſcera* of an *Animal*, are but *Veſſels conglomerated*: ſo the *Veſſels* of a *Plant*, are *Viſcera drawn out at length*.

3. §. AGAIN, as the *ſpecifying* of the *Sap* dependeth chiefly on the ſpecial *Nature* of the *Parts*: ſo partly, upon the *Structure* of the *Whole*. Whereby every *Part* is ſtill better accomodated with its own *Juyce*. Thus the *Aer-Veſſels* are neceſſary, not only and barely for a *ſupply* of *Aer*; but alſo by their *Number*, *Size*, and *Poſition* to *adjuſt* the quantity of that *Aer*, to the government of *Nutrition*, and the *Generation* of the *Specifick Liquors* of every *Plant*. Which is evident from hence, in that they do not follow the *Size* of the *Plant*; but are great and many, in ſome ſmall *Plants*; and ſmall and few, in ſome others that are large. So *Vines*, and *Corn*, as we have formerly obſerved, have proportionably a great number of *Aer-Veſſels*, and thoſe very large. By which means the *Sap* is *attenuated* and leſs *Oyly*, and more copiouſly impregnated with a *Subtle*, *Volatile* and *Winy Spirit*.

4. §. For the ſame reaſon, the *Stalk* of *Maze* or of *Indian Wheat*, which when it is *Green* yieldeth a very ſweet *Juyce*; and the *Canes*, whereof *Sugar* (which aboundeth with a *volatile* and *inflammable Spirit*) is made; theſe, I ſay, obtain the like over proportion of *Aer-Veſſels*, to what we ſee in moſt other *Plants*. Hence alſo it is, that none of the ſaid *Plants* have any conſiderable *Barque*; that ſo the attenuating and ſubtilizing *Aer*, may have a more eaſie and plentiful admiſſion at the *Trunk* alſo. For which reaſon likewiſe the *Pores* of the *Skin* of ſome *Canes* are, as hath been ſaid, remarkably wide.

5. §. Hence alſo it is obſervable, that of the ſame *Species* or *Kindred*, thoſe *Plants* which have the moſt, and eſpecially the largeſt *Aer-Veſſels*; have alſo the greateſt abundance either of a *ſweet*, or of a *winy Liquor*. So in *Apple*; they are larger than in *Crab*; In *Warden*, larger than in *Quince*; and in *Pear-Tree*, larger than in *Warden*. So alſo in *Corin*, larger than in *Gooſeberrey*; and in *Vine*, larger than in *Corin*: and ſo in others.

6. §. AND as the *Aer-Veſſels*, by their *Multitude* and *Largeneſs*, are accommodated to the better making of a *Winy Sap*: ſo by their *fewneſs* and *ſmallneſs*, of an *Oylie*. As is remarkably ſeen in *Fir*, and other *Reſiniferous Trees*: theſe having, if not the *ſmalleſt*, yet the *feweſt Aer-Veſſels* of all other *Trees*.

7. §. IF it be asked, how a *Plant* comes to have any *Oyl* at all in any *Part*? Since we ſee, that the *Sap* by which the *Root* is fed, ſeemeth to be nothing elſe but *Water*: and that many *Plants* which yield a great deal of *ſtillatitious Oyl*, as *Mint*, *Rue*, and others, will yet grow in *Water*: I ſay, if it be enquired how this *Water*, is made *Wine* or *Oyl*? I anſwer, that there is no ſuch matter. But that the *Oyl*, and all other *Vegetable Principles* are actually exiſtent in, and mixed *per minima*, though in an extraordinary ſmall proportion, with the *Water*. Even as we ſee the diſtilled *Waters* of *Aniſe Seeds*, *Penyroyal*, and the like to be impregnated with their own *Oyls*, which give the *Taſte* and *Smell* to ſuch *Waters*.

8. §. Wherefore, as a certain quantity of any *Salt* may be diſſolved in *Water*; beyond which, it will not mix therewith, but remains under its own *Form*: So is there a certain proportion of *Oyl*, though far leſs, which may alſo be perfectly mixed with *Water*; and is certainly ſo, more or leſs, with all the *Water* in the world. But if that proportion, or degree of impregnation be once exceeded; the particles of *Oyl* do then, and not till then, gather into a body, and appear under their own *Form*.

9. §.

9. §. I ſay therefore, that all kinds of *Vegetable Principles*, are either in or together with the *Water*, with leſs difference firſt received into a *Plant*. But when they are once therein; they are then *ſeparated*, that is to ſay, *filtred*, ſome from others, in very different *Proportions* and *Conjunctions* by the ſeveral *Parts*; the *Watery* by one *Part*, the *Aery* by another, the *Oyly* by another, and ſo the reſt: and ſo every *Part* is the *Receptacle* of a *Liquor*, become peculiar, not by any *Transformation*, but only the *Percolation* of *Parts* out of the *common Maſs* or *Stock* of *Sap*. And ſo all thoſe parts of the *Sap*, which are *ſuperflous* to any kind of *Plant*, are at the ſame time, diſcharged back by *Perſpirations*, into the *Aer*.

10. §. AND, that *Nature*, in the various *Percolations* and *Sepations* of the *Sap*, may ſtill the better anſwer her end; hence, it is, that ſhe carefully ſeeth, not only to the ſpecial *Nature* and *Proportion* of the *Organs*, by which ſhe doth her work; but likewiſe to their very *Poſition*. Thus it is obſervable, That whereas the *Lymphæducts*, which carry a more *Watery Liquor*, are ſtill placed on the inner *Verge* of the *Barque*, next to the *Aer-Veſſels*: the *Lactiferous* and *Reſiniferous Veſſels* of *Plants*, to whoſe *Oylie Liquor* a mixture of much *Aer* is incongruous; do uſually ſtand, neither on the inner, nor the outer verge of the *Barque*; but in the *midle*. By which means, they are at the greateſt diſtance, and ſo moſt ſecure, from the *Aer*; either that which enters the *Barque* at the Circumference, or from the *Wood* and *Pith*.

11. §. AND becauſe the *Reſinous Liquors* of *Plants* are more *Oily*, than their *Milky*; their ſecurity therefore, from the approach of the *Aer*, is yet further contrived. In that in *Pine*, and other *Reſinous Trees*, the *Diametral Inſertions* are never found; or at leaſt, not *viſible*: which yet in other *Trees*, are *conſpicuous*; being thoſe *Parts*, whoſe office it is, to introduce the *Aer* from the *Aer-Veſſels* into the *Barque*.

12. §. AGAIN, the *Milky Liquors* of *Plants* being thinner than the *Reſinous*, and having a conſiderable quantity of *Water* mixed with their *Oyl*; hence it is, that in *Milky Plants*, as in *Rhus*, there are a greater number of *Lymphæducts*; and thoſe ſtanding nearer to the *Milky Veſſels*, than they do in *Pine* and the like, to the *Reſinous*. By which means they are better fitted to affuſe their *Aqueous Parts* more plentifully to the ſaid *Milky Liquor*.

13. §. FROM the *Mixture* of *Watery Parts* with the *Oylie*, it comes to paſs, that whereas all *Lympha's*, *Mucilages*, and *Roſins* are tranſparent; the *Aquæ-oleous Liquors* of *Plants* are *Milky* or white. or otherwiſe *Opacous*. For the ſame thing is the cauſe of the whiteneſs of *Vegetable*, as of *Animal-Milk*: that is to ſay, a more copious mixture of *Watery* and *Oily Parts per minima*, or into one Body. For even the *Serous* and *Oylie Parts* of *Animal Milk*, when throughly ſeparated one from the other, they become very tranſparent. So the *Stillatitious Oyl* of *Aniſe Seeds*, is moſt tranſparent and *limpid*, even as *Water* it ſelf: yet there is a known ſort of *White Aniſe-Seed Water*, as it is commonly called: that it is to ſay, wherein the *Oyl*, in diſtillation, ariſeth and is mixed more plentifully with the *Water*. And the *Water*, wherein the ſtillatitious *Oyl* of any *Vegetable* is diſſolved, becomes a perfect white *Milk*; as in this *Honourable and Learned Preſence*, I have formerly had occaſion to ſhew the Experiment. (*a*)

(*a*) See the *Diſcourſe of Mixture*

14. §.

14. §. AND that the *Milky Liquors* of all *Vegetables* whatsoever, are more *Oylie* than their *Lympha's*, is most certain. For all those *Gums*, which dissolve either in *Oyl* or in *Water*, as *Galbanum*, and the like, are originally the *Milky Juyces* of *Plants*. And if you take the *Milk* of any *Plant*, as for instance, the *Milk* of common *Sumach*, or of any *Taste*, *Bitter*, *Astringent*, *Hot*, *Cold*, or any other whatsoever; and having well *dryed* it, and then fired it at a candle; it will thereupon burn with a very bright and durable flame, even like that of *Tar* or *Turpentine* it self.

15. §. FROM what hath been said, we may likewise gather the most genuine import of the word *Gum*, and the distinction thereof both from a *Rosin* and a *Mucilage*. First, a *Rosin*, is originally a *Turpentine*, or *Acidoleous Liquor*, having an exceeding small quantity of *Watery Parts* mixed therewith; and which, for that reason, will not be dissolved in *Water*, but only in *Oyl*. Of this kind are *Mastick*, *Benzoine*, *Taccamahacca*, and divers others, commonly, in our *Bils* to *Apothecaries*, called *Gums*. Yet in strict speaking they are all so many *Rosins*.

16. §. Secondly, a *Gum*, and every *Oylie Gum*, is originally a *Milky Liquor*, having a greater quantity of *Water* mixed with its *Oyly Parts*; and which for that reason, will be made to dissolve either in *Water* or *Oyl*. Of this kind are *Sagapen*, *Opopanax*, *Ammoniac*, and others.

17. §. The third sort of *Gum*, is that which is *Unoylie*, and which therefore dissolveth only in *Water*, as *Gum-arabick*, the *Gum* of *Cherry-Tree*, and others such like. This *Gum*, though commonly so called, yet is properly but a dryed *Mucilage*: being originally nothing else but the *Mucilaginous Lympha* issuing from the *Vessels* of the *Tree*. In like manner, as it doth from *Cumfry*, *Mallow*, and divers other *Plants*: and even from the *Cucumer*. The *Vessels* whereof, upon cutting cross, yield a *Lympha*, which is plainly *Mucilaginous*, and which being well dryed, at length becomes a kind of *Gum*, or rather a hardened *Mucilage*. In like manner, the *Gums* of *Plum-tree*, *Cherry-tree* and the like, are nothing else but *dryed Mucilages*. Or, if we will take the word in its widest sense, then all *Gums* are originally, either a *Terebinth*, or a *Milk*, or a *Mucilage*.

18. §. I have likewise made divers Observations of the *Tasts*, *Smells*, and *Colours* of *Plants*, and of their *Contents*, since those I last published: and that both for the finding out the true *Causes* of their *Generation*, and also the applying of them unto *Medical* and other *Uses*. Of which hereafter.

CHAP.

CHAP. V.

Of the Figuration *of* Trunks.

THE *Fifth Head*, ſhall be, of the *Figuration* of *Trunks*. Which alſo, as well as the *making* of *Liquors*, dependeth upon the *Structure* of the *Parts*. As *Firſt*, almoſt all *Shrubs* (*cæteris paribus*) have a greater number of *Aer-Veſſels*; and thoſe of a ſmaller Size; and conſequently much ſpread abroad, as moſt eaſily yielding to the *magnetick* Power of the *Aer*, according as we have more fully demonſtrated, in ſpeaking of the *Vegetation* of *Roots*: as in *Elder*, *Hazel*, *Fig*, *Sumach*, and the like. By which ſpreading, the ſaid *Aer-Veſſels* do ſooner, and more eaſily ſtrike into the *Barque*, and ſo produce collateral *Buds* and *Branches*, and that upon the firſt riſing of the *Body* from the *Root*: that is, the *Plant* becomes a *Shrub*.

2. §. BUT if the ſaid *Aer-Veſſels* are very large, they will not yield ſo eaſily to ſhoot out collaterally; and ſo the *Trunk* grows up taller and more entire: as in *Oak*, *Wallnut*, *Elm*, &c. wherein they are exceeding large, is ſeen. Hence alſo the *Vine*, if ſupported, will grow to a prodigious length. And *Hops* and *Bryony*, are ſome of the talleſt, amongſt all *Annual Growths*: the *Aer-Veſſels* of all which, are very large. Whereas *Borage*, and many other like *Plants*, although the *Pores* of their *Parenchyma*, are vaſtly wide, and filled with *Sap*; yet becauſe their *Aer-Veſſels* are ſmall, they are therefore but *Dwarf-Plants*. Wherefore the tallneſs or advancement of a *Plant* or *Tree*, dependeth not upon the *Plenty* of *Sap*, how great ſoever, but on the *Largeneſs* of the *Aer-Veſſels*.

3. §. AGAIN, as a *Plant* or *Tree* grows either *Shrubby*, or *Tall* and *Entire*, according to the *Size* of the ſaid *Veſſels*: ſo from their *Poſition*, doth it grow *ſlender* or *Thick*. So, where they keep more within the compaſs of a *Ring*, as in *Elm*, and *Aſh*, the *Tree*, in proportion, uſually grows taller, and leſs thick. But where the ſaid *Veſſels* are ſpread more abroad, and eſpecially are poſtured in *Rays*, as they are in *Oak*, the *Tree* grows very thick. Becauſe the ſaid *Veſſels* thus ſtanding all along nearer to the *Inſertions*, there is a more ready and copious paſſage of the *Aer* out of the one into the other; and ſo the *Diametral* growth of the *Wood* is more promoted.

4. §. LASTLY, from the ſame general cauſe it is, That the *Trunks* of *Vegetables* are either *Round* or *Angular*. Thoſe of all *Trees* are *Round*. Becauſe the *Barque*, being here thicker, and the *Aer-Veſſels* bound up with a greater quantity of *Wood*; the *Aer* hath not ſufficient power to move them, and the *Barque* with them, into thoſe various *Poſitions* or *Figurations*, as the *Trunks* of *Herbs* do yield to.

5. §. Yet the cauſe of the various *ſhapes* of the *Trunk*, is not the *Aer* alone; but partly, the *Principles* of the *Plants* themſelves, in conjuction therewith; according to the predominion whereof, and chiefly of ſome certain kind of *Salt* or *Salts*, as I ſhall hereafter (*a*) more particularly explicate) the *Trunk* is *Square*, *Triangular*, *Pentangular*, or otherwiſe *Figured*. And thus much in general of the *Figuration* of *Trunks*.

(*a*) *B.4. P. 1. Ch. 6.*

CHAP.

CHAP. VI.

Of the Motions *of* Trunks.

THE *Motions* alſo of *Trunks* are various. Principally *Four*; *ſc. Aſcending*, *Deſcending*, *Horizontal*, and *Spiral*. The cauſe of the *Aſcent* of a *Plant*, is a certain *Magnetick Correſpendence* betwixt the *Aer* and the *Aer-Veſſels* of a *Plant*; the *Motion* and *Tendency* whereof, the whole *Plant* follows. This I have aſſerted, and I think, clearly demonſtrated in my *Firſt* and *Second* Books of the *Anatomy* of *Plants*. I will here add this plain *Experiment*.

2. §. Take a Box of *Moulds*, with a hole bored in the bottom, wide enough to admit the *Stalk* of a *Plant*, and ſet it upon ſtilts half a yard or more above ground. Then lodg in the *Mould* ſome *Plant*, for Example a *Bean*, in ſuch ſort, that the *Root* of the *Bean* ſtanding in the *Moulds* may poynt upwards, the *Stalk* towards the ground. As the *Plant* grows, it will follow, that at length the *Stalk* will riſe upward, and the *Root*, on the contrary, arch it ſelf downward. Which evidently ſhews, That it is not ſufficient, that the *Root* hath *Earth* to ſhoot into, or that its *Motion* is only an *Appetite* of being therein lodged, which way ſoever that be: but that its nature is, though within the *Earth* already, yet to change its *Poſition*, and to *move Downwards*. And ſo likewiſe of the *Trunk*, that it riſes, when a *Seed* ſprouts, out of the Ground, not meerly becauſe it hath an *Appetite* of being in the open *Aer*; for in this Experiment it is ſo already; yet now makes a new *Motion* upwards.

3. §. BUT although the *Natural Motion* of the *Trunk* be to *Aſcend*; yet is it forced oftentimes to *Deſcend*. For the *Trunk-Roots* growing out of ſome *Plants* near the ground, and ſhrinking thereinto, like ſo many *Ropes*, do pluck the *Trunk* annually lower and lower into the ground together with them; as may be ſeen in *Scrophularia*, *Jacobæa*, and many other *Plants*.

4. §. IF theſe *Trunk-Roots* break out only about the *bottom* of the *Trunk*, as in the aforeſaid *Plants*, then the *Trunk* gradually *Deſcends* into the *Earth*, and is turned into a *Root*. But if itbe very *ſlender*, and the *Trunk-Roots* break forth *all along* it, then it *Creeps* horizontally; the ſaid *Roots* tethering it, as it trails along, to the ground; as in *Strawberry*, *Cinquefoyl*, *Mint*, *Scordium*, &c.

5. §. AS to their *Spiral Motion*, it is to be noted; That the *Wood* of all *Convolvula's* or *Winders*, ſtands more cloſe and round together in or near the Center, thereby making a round, and ſlender *Trunk*. To the end, it may be more tractable, to the power of the external *Motor*, what ever that be: and alſo more ſecure from breaking by its winding *Motion*.

6. §.

6. §. Wherefore, *Convoluta's* do not wind by any peculiar Nature or *Genius*, which other *Trunks* have not; but becauſe their *Parts* are diſpoſed ſo, as to render them more ſequaceous to the external *Motor*. Even as the *Claſpers* of a *Vine*, having the like *Structure*, have alſo a *Motion* of *Convolution*: whereas the *Branches* themſelves upon a contrary account, move in a *ſtraight Line*.

7. §. The *Convolution* of *Plants*, hath been obſerved only in thoſe that Climb. But it ſeems probable, that many others do alſo *wind*; in which, the main *Stalk*, is as the *Axis* to the *Branches* round about. Of which number, I conceive, are all thoſe whoſe *Roots* are twiſted; a *Motion* we obſerved in ſpeaking of the *Root*. Whether it be ſo, or not the Experiment may eaſily be made by tying a *Thred* upon any of the *Branches*; ſetting down the reſpect it then hath to any Quarter in the *Heavens*: for, if it ſhall appear in two or three Months, to have changed its Situation towards ſome other Quarter; it is a certain proof hereof. And that hereby the *Roots* of many *Plants* become twiſted; the *Motion* beginning in the *Stalk*, and ending at the bottom of the *Root*, which ſtands always fixed in the ſame place. *B. 2. P. 1. Ch. 1.*

8. §. The *Convolution* of *Trunks*, is made not *one*, but *divers* ways; ſome moving by *South* from *Eaſt* to *Weſt*; and others from *Weſt* to *Eaſt*. Wherefore it ſeemeth, that as the *Efficient Cauſe* of *Convolution*, is not within the *Plant*, but external: ſo alſo, that it is not *One*, but that there are *Two Great Efficients* of this *Motion*; *ſc.* the *Sun* and the *Moon*. Some winding together with the *Sun*, in its *Diurnal Motion*, (or, if the the Earth moves, then, Inclining to the *Sun*) by *South* from *Eaſt* to *Weſt*. And others winding with the *Moon*, in its *Monthly Motion*, from *Weſt* to *Eaſt*.

9. §. This poſſibly, may alſo be one *ſenſible* way of diſtinguiſhing betwixt *Solar*, and *Lunar Plants*. Thus far, in general, of the *Motions* of *Trunks*.

CHAP. VII.

Of the Nature *of* Timber *or* Trunks, *as they ſerve for* Mechanick Uſe.

THE laſt thing I purpoſed to ſpeak of, is, Thoſe ſeveral *Qualities* of *Timber* or of *Trunks*, by which they are fitted for *Mechanical Uſe*. As *Hardneſs*, *Softneſs*, *Faſtneſs*, *Cleveſomeneſs*, *Toughneſs*, *Brittleneſs*, *Durableneſs*, or any of the ſame *Qualities* compounded. The *Viſible Cauſes* whereof are obſervable, *Partly*, in the *Structure* of the ſeveral *Parts*; *ſc.* the *Inſertions*, *Sap-Veſſels* and *Aer-Veſſels*; as to the *Number*, *Size*, or *Poſition* of any of them. And *partly*, in the *Nature* of the *Parts*; I mean ſuch as is *manifeſt to ſenſe*. According to our clear and diſtinct obſerving of all which Cauſes, we may underſtand, Wherefore any *Wood* is made uſe of for any certain purpoſe. And alſo, wherein fitly to apply it to further *Uſe*. In order to which, a

compleat Hiſtory of the *Mechanical Uſes* of *Vegetables* would very much conduce. I ſhall for the preſent give ſome *Inſtances.*

2. §. AS *Firſt*, ſome *Woods* are *ſoft*, as *Deal*, and *Sallow*. Yet from different Cauſes. *Deal*, from the great *Poroſity* of the *Wood* it ſelf, or the large *Pores* amongſt the *Sap-Veſſels.* But *Sallow*, from the great number of *Aer-Veſſels* ſpread all over it. And therefore, though they are both *ſoft*, yet will not ſerve for the ſame purpoſes; *Sallow* being well wrought upon, which way ſoever you cut it: but *Deal*, eſpecially the white *Deal*, if it be cut croſs, it tears, and will never poliſh or work ſmooth.

3. §. Again, in *Sallow*, by the equal ſpreading of the *Aer-Veſſels*, the *Softneſs* is equal or alike in all *Parts.* For which cauſe it maketh an excellent *Coal* for *Painters Scribets.* Becauſe it doth not only make a *light Stroak*, but every where *certain*; and ſo doth not diſturb the even *Motion* of the *Hand.* For the ſame cauſe, *Shoomakers* alſo make uſe of it for their *Carving-boards.* Becauſe being every where equally ſoft, it turns not the edge of their *Knives*, Which *Deal* would preſently do; becauſe though very ſoft in ſome places, yet in others 'its hard; that is to ſay, on the inner *Verge* of every annual *Ring* of *Wood*, where the old *Sap-Veſſels* grow much more compact and cloſe together.

4. §. AGAIN, ſome *Woods* are *ſoft*, but not *faſt*; others are *both*, as *Linn:* its *Softneſs*, depending on the numerouſneſs and equal ſpreading of the *Aer-Veſſels:* its *Faſtneſs*, on the cloſeneſs of the true *Wood*, and the ſhortneſs, and ſmallneſs of the *Inſertions.* For which cauſe, it is of excellent uſe for many purpoſes; and particularly, for *ſmall Sculpture:* ſuch as may ſometimes be ſeen for the Frames of *Looking-Glaſſes*, or of ſmaller *Pictures* in *Water-Colours.*

5. §. SOME *Woods*, again, are *faſt*, and *hard*, as *Elm.* Its *hardneſs* depending upon the cloſeneſs of the *Wood.* Its *faſtneſs*, *Partly*, upon the ſame cauſe; and *partly*, on the ſmalneſs of the *Inſertions*; as alſo on the fewneſs of the *Aer-Veſſels* in proportion with the *Wood*; and on the *thwart* and *croſs Poſition* of many of them. Hence it is, that *Elm*, of all others, is the moſt *Croſs-grain'd Timber*; that is, cleaveth ſo unevenly, to and fro, according to the *croſs Poſition* of the ſaid *Veſſels.*

6. §. Hence alſo it cleaveth the *moſt Difficultly.* Even then, when it is without any *Knots.* For which reaſon it is always uſed, as beſt for the *Hub* of a *great Wheel.* As alſo for *Water-Pipes*, and for *Pumps.* Not becauſe it is the moſt *durable Wood*; but becauſe it will not *ſplit* or *crack*, either in the *working*, or *afterwards.* For the very ſame reaſon, it is uſed for *Coffins*; that is, becauſe, it will not *ſplit* in working: not becauſe it will endure longeſt under ground; for *Pales* are always made of *Oak.* So alſo the *Ladles* and *Soles* of a *Mill-wheel* are always made of *Elm*; as alſo the *Keel* of a *Boat*, *ſc.* leſt they ſhould *ſplit:* but the other *Parts* are made of *Oak.*

7. §. It may here alſo be noted, That the *Planks* commonly called *Groaning-Boards*, lately expoſed, as a kind of *Prodigy*, to the view and hearing of many People, were of *Elm.* The *Aer-Veſſels* of this *Wood*, being, though not more numerous, yet more ample, than in any other *Timber.* So that upon the application of the *Red-hot-Iron*, as was uſual, and thereby the *Rarifaction* of the *Aer* and *Watery Parts* in the *Timber*; every *Veſſel* became, as it were a little *Wind-Pipe* for their

their *Expiration.* And as a great many Drops falling together in a ſhowr of Rain; ſo a great many of theſe *Pipes* playing together, might make a kind of big or groaning noyſe.

8. §. AS *Elm*, of all *Woods*, is one of the *faſteſt*; So, on the contrary, of all *hard Woods*, *Oak* is the moſt *Cleaveſome*, or *ſplitteth* the moſt *eaſily*. The cauſe whereof is, *partly*, the *Largeneſs* of the *Inſertions*; and *partly*, the *Diametral* or *Radiated Poſition* of moſt of the *Aer-veſſels*: upon both which accounts, wherever a *crack* is once begun, 'tis eaſily continued throughout the *Diameter* of the *Trunk*.

9. §. AGAIN, ſome *Woods* are *hard*, *faſt*, and *tough*. So is *Aſh*, and eſpecially *Beech*. *Hard* and *faſt*, from ſome of the ſame Cauſes, as *Elm*. *Tough* not from the *Structure*, but from the *Nature* of the *Parts*; whoſe *Principles* are united in a more exact proportion. Wherefore *London-Cars* have the *Rings* of their *Wheels* of *Beech*; becauſe it *tears* more difficulty than even *Aſh* it ſelf. Whence alſo for *large Screws*, there is no *Wood* like it. But for *Small Screws*, of about an *Inch Diameter*, *Birch* is the beſt; as being, though not ſo *hard*, yet more *tough*.

10. §. THE more *Brittle* a *Wood* is, 'tis likewiſe uſually the more *durable*. So *Oak*, which, with reſpect to its *hardneſs*, is not a *tough*, but very *brittle Wood*, is almoſt as *durable* as any. Whereas *Beech*, *Birch*, and the like, although very *tough*; yet for *Duration*, are of no ſervice; for there are no *Woods* will rot ſooner: and therefore, though ſtrong enough, yet unfit to make any *Standing Parts* of *Building*, or of *Furniture*; eſpecially in wet and moiſt places. Becauſe, theſe *Woods*, having a leſs proportion of *Oyl*, than there is in *Oak*; they are apter to imbibe the moiſture even of a *dank Aer*; by which moiſture, they either *Rot*, or breed *Worms*, which deſtroy them.

11. §. HENCE it is, that what we call the *Heart* of *Timber*, as it is more *brittle*, ſo alſo more *durable*; *ſc.* Becauſe more *Oylie*. So that which is called the *Sap* of *Oak*, is much more *tough* than the *Heart*, although the *Heart* be more *durable*. That is to ſay, the older the *Wood* is, the *Watery Parts* are the more evapourated, whilſt the *Oylie* ſtill remaine, as a kind of *Tincture* or *Extract* in the *Wood*. Even as we ſee, that the older *Seeds* of any one *Kind*, are more *Oylie* than thoſe that are green and young. So that the *Oylie* or *Roſinous Parts* of the *Sap*, are a kind of *Embalming* to the *Heart*, or older *Part* of a *Tree*, ſecuring it from the deſtructive impreſſions of the *Aer*. For which Cauſe it is, that *Oak*, *Yew*, *Cocus*, *Guajacum*, &c. which are *Oylie Woods*, have always much *Heart*, whereas *Birch*, *Alder*, *Beech*, *Maple*, which are very *Unoylie*, have never any *Heart*.

12. §. FROM hence likewiſe we may underſtand the Cauſe of the *Toughneſs* of *Flax*: what we call *Flax*, being only the *Sap-Veſſels*, or *Lignous Fibres* of the *Barque*. And generally, the *Barque* of any *Tree*, as of *Willow* (whereof are uſually made a ſort of *Ropes*) is very *tough*. The *Veſſels* being here younger, and leſs *Oylie* than in the *Wood*. So likewiſe *Hemp*, is nothing elſe but the *Sap-Veſſels* of the *Barque* of the *Plant* ſo called. And *Scotch-Cloath*, is only the *Houſewifery* of the ſame *Parts* of the *Barque* of *Nettle*.

13. §. WHENCE it is very probable, that there are many other *Plants*, as well as the above named, whereof might be made good *Tow*. And of ſome, eſpcially in ſome reſpects, better than of *Flax* it ſelf. Becauſe that even *Hemp*, although it will not make ſo

fine a *Staple*, as *Flax* (for all our fine *Hollands* are made of *Flax*) yet *Flax*, which is but of the ſame fineneſs as *Hemp*, will never, by all the Art yet known, be made ſo white as *Hemp* is made. The *Qualities* therefore of the beſt *Tow*, that can be in Nature, are that the *Staple* be *long*, *ſmall*, *tough*, and *white*. So that if in the *Barque* of any *Plant*, we can find theſe *Qualities*, or any of them, to excell; we may be ſure, it will be of better uſe, in ſome reſpects, for the making of *Cloath*, or other purpoſe, than *Flax* it ſelf.

14. §. I WILL conclude with one *Inſtance* more, and that is as to *Grafting*. The good and happy ſucceſs whereof, doth certainly depend upon the ſuitableneſs or reſpondence betwixt the ſeveral *Parts* of the *Stock* and *Cyon*; as the *Barque*, *Wood*, and *Pith*; and that both as to the *Number*, *Size*, and *Poſition* of the ſaid *Parts*, and of their ſeveral *Pores* or *Veſſels*: according to the degrees whereof, the *Conjunction* (*cæteris paribus*) will be more or leſs proſperous. So that of all ſuch *Conjunctions* as are found to be apt and taking, and which ſome have learned not without long Practice and Experience; another, only by comparing the *Branches* of *Trees* together, may with little trouble, and in much leſs time, inform himſelf. By the ſame means, ſome *Conjunctions* which ſeem to be ſtrange, as *Quince* and *Pear*, *White Thorn* and *Medlar*, &c. do yet, by the reſpondence of their *Parts*, as well as by *Experience*, appear to be good. And there is no doubt, but that many *Conjunctions* not yet tryed, or not known to have been ſo, may upon the ſame ground, be tryed with good ſucceſs.

15. §. The chief Uſe of *Grafting* and *Inoculation*, is, That they *Accelerate* the growth of *Good Fruit*. The *Cauſe* whereof, is the *Knot*, which is always made in the *Conjunction*. By means of which, all the *Sap* is ſtrained, and ſo aſcendeth up into the *Graff* or *Bud*, both *Purer* and in leſs *Quantity*; and is therefore better and ſooner concocted. Hence, the ſmaller the *Fruit* of any *Tree*, though it be not the beſt, yet the *Sap* being there, in *leſs Qantity*, is the *ſooner ripe*. On the contrary, where the *Sap* aſcendeth too freely, it doth not only *retard* the growth of the *Fruit*, but produceth *Barrenneſs*; as is ſeen in thoſe *luxuriant Branches*, where it runs all up to *Leaves*. Hence alſo *Vines*, by *Bleeding*, become more *Fruitful*: that is, by the Effuſion of *Part* of the *Sap*, there is a more eaſier *melioration* of that which remains. Even as *Phlebotomy* doth oftentimes produce a more healthful and better *Habit* of our own *Bodies*. To conclude, the *leſſening* the *Quantity*, and thereby the *melioriation* of the aſcending *Sap*, by *Knots*, is *Natures* own contrivance; as is ſeen in *Sugar-Cane*, *Corn*, and other *Plants*.

THE

THE
ANATOMY
OF
LEAVES, FLOWERS,
FRUITS and SEEDS.

In Four Parts.

The FOURTH BOOK.

By *NEHEMIAH GREW* M.D. Fellow of the *ROYAL SOCIETY*, and of the *COLLEGE* of *PHYSICIANS*.

LONDON,

Printed by *W. Rawlins*, 1682.

Mo.Bot. Garden,
1902.

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To

To the Honourable

Robert Boyle Esq;

SIR,

AFTER *I had finished the foregoing* Books, *In which, I conceive, as far as* Glasses *will yet lead us, I have clearly De-scrib'd and Delineated the* Structure *of a* Plant; *and have endeavour'd, in some part, to Unfold the* Reason *and* Scope *of* Nature *there-in: I was willing to sit down, and leave what remained, to the* Improvements *of the Present and Succeeding* Ages.

But in Discourse upon this Subject, You *have been pleased frequently to insist, That I should by no means omit, to give likewise, some Examples of the* Mechanisme *of* Nature *in all the other* Parts. *The Performance whereof therefore, next to the* Obedience *I owe to the* Royal Society, *is to be looked upon, as a Due to the Authority which Your Judg-ment hath over me.*

This I have said, that, if what is herein done, shall prove acceptable unto Learned Men; *they may know, To whom they are oncemore to give their Thanks: After they have so often done it, upon (a better score) the Publishing of Your own Ex-cellent Works. In which, there seems to be a Question, Whe-ther Your Continual Endeavours, to enlarge the Bounds of* Natural Knowledge, *or Your Successes therein, have been the Greater. So that, whereas* Nobility *in some, doth*

only

only ſerve to lift them, like Jupiter's Satellits, *out of ſight:* You, *by giving a greater Light, have drawn all Mens Eyes upon* You. *And whileſt there are many, in all* Ages, *fond of Preheminency in the Conduct of* Popular Affairs; *who yet rarely hit the Mark they aim at; or aim at That they pretend:* You *have thought fit, rather to ſeparate* Your Self, *to that more Innocent, and more Noble Sort of* Wiſdom, *which lieth, not in the* Arts *of* Conceiling, *but in* Diſcovering, *the Truth of Things.*

That we may have many to imitate You *herein, cannot but be heartily wiſh'd by all, who regard the Honour of their own Country; as it is, with much Zeal, by*

Sir,

Your moſt obedient

Servant

NEHEMJAH GREW.

THE

THE ANATOMY OF LEAVES,

PROSECUTED

With the bare EYE,

And with the

MICROSCOPE.

Read before the *Royal Society*, *Octob.* 26. 1676.

PART I.

CHAP. I.

Of the Protections *and* Folds *of* Leaves.

IN THE *General Anatomy* of *Plants*, I have aſſigned one whole *Chapter* (*a*) to the *Germen* and *Leaf*. Since then, I have occaſionally made divers *Remarques* of the ſame; both with the Naked Eye, as there, and alſo with the *Microſcope*. The *Principal* whereof, I ſhall here ſet down; without repeating any from thence; or obliging my ſelf ſtrictly to the *Order* there uſed.

(*a*) *Lib.* 1. *Ch.* 4.

2. §. That which in a *Germen*, firſt occurs to the *Eye*, is the *Protection* of the *Leaves*, or the various *Methods* which Nature takes to preſerve them from the *Injuries* both of the *Ground*, and of the *Weather*. To the Inſtances formerly given, I ſhall add theſe that follow.

3. §. AND *First*, it is obſervable of the young *Buds* of *Ammi*, that leſt they ſhould be bruiſed, or ſtarved, upon their firſt *Eruption* from under the Ground; they are couched, as *Firn* is rowl'd, inward; each *Bud*, againſt the *Baſe* of the *Stalk* of the foregoing *Leaves*, and moſt exactly laid up within the *Membranes* thence produced: Juſt as the Child in the Womb, lies with his *Head* againſt his *Knees*; or as it is afterwards embraced with the *Armes* of the Nurſe. And it is a general Rule of Nature, where the *Stalks* of the *Leaves* are ſo long, that they cannot lap one over another, and where no other ſpecial *Protection* is provided; for the bottoms of the *Stalks* to be produced into broad *Membranes*, as Blankets to the ſucceeding *Buds*; as in *Crowfoot*, *Dovesfoot*, *Claver*, *Cransbill*, *Strawberry*, *Yarrow*, and others. And ſometimes inſtead of two *Skins* lapped one over another, there is one entire *Skin*, produced from the *Stalk*, in which as within a *Secundine*, the *Bud* is ſafely ſhrowded; and which, in its Growth, it gradually breaks open.

4. §. THE ſame is alſo obſervable in *Dock*, *Sorrel*, *Biſtort*, and all other *Plants* of this Kindred; with this difference, That every *Veil* or *Secundine* is not here produced from the *Stalk* of the *Leaf*; but hath its *Original Diſtinct* from it. And whereas in the former, every *Bud* hath only one to it ſelf: in theſe *Plants*, every leſſer *Leaf*, together with its own proper *Veil*, is always incloſed, with the next greater *Leaf*, in another *Veil* common to them both; and both theſe with the next, in another; and ſo on to the greateſt. Theſe *Veils* are extream thin, and have very few *Veſſels*; being ſo many meer tranſparent *Skins*. For which reaſon, there is always found a *Mucilage* or clear *Gelly*, between every *Leaf*, and its *Veil*, and between *Veil* and *Veil*. The one, thus preſerving the other, (as do the *Humors* and *Membranes* of the Eye) from drying and ſhrinking up, and thereby from becoming uſeleſs for the *Protection* of the *Plant*.

Tab. 41.

5. §. THE *Orchis*, and other *Plants* of this kindred, becauſe they *Spring* and *Flower* early, when the mornings are cold, have a double *Sheath*, or *Blanket* over all. The *Buds* of ſome *Herbs* (as of *Plantain*) having no *Hairs* growing on them, are covered with *Hairy Thrums*. And the *Nettle* hath *Baſtard-Leaves*, or *Interfoyls* between *Leaf* and *Leaf*, for the preſervation of its *Stings*.

Tab. 41.

6. §. ANOTHER Sort of *Protection* is ſeen in *Wild Clary*, *White Archangel*, and other *Plants* of a like Shape. In which, the greater *Leaves* do ſtill cover and incloſe the leſſer, not by being lapped over them, as where the *Leaves* are more numerous, is uſual; but by a *Double Fore-Curl* at the bottom of every two greater *Leaves*; by which the little *Under-Bud* is embraced, and ſo kept ſafe and warm.

Tab. 42.

7. §. THE *Leaves* of *Onions* are all *Pipes* one within another. Theſe *Pipes* are every where entire, ſaving about the middle, where they have a ſmall *Aperture*; common to all of them, even the moſt minute in the Centre: not being a forced *Crack*, but a *Door* originally formed, for the iſſuing of every leſſer *Pipe*, out of a greater.

Tab. 41.

8. §. THE LAST I ſhall give, is that which is remarkable in *Common Sumach*. The *Buds* whereof, being exceeding tender, Nature appears ſollicitous in a peculiar manner, for their preſervation. For whereas in other *Plants*, they are well enough ſecured only by ſtanding behind the *Stalks* of the elder *Leaves*: here they are lodged within the very

very *Body* of the *Stalk*; as entirely, as a *Kernel* is within an *Apple*, or a *Fœtus* in the *Womb*. From whence it comes to pass that the *Basis* of every *Stalk* is extreamly swelled, as going Great with a *Bud*.

9. §. UPON THE removal of those *Parts*, which are contrived for the *Protection*; the *Foulds* and *Composture* of the *Leaves* do next appear: all which are most aptly suited both to the *Number* and *Shape* of the *Leaves*, and also their *Position* upon the *Branch*. In the *First* Book (*a*) I have given Examples of these *Eight Sorts*, sc. the *Plain Lap*, the *Plicature*, the *Duplicature*, the *Multiplicature*, the *Single Roll*, the *Double Back-Roll*, the *Double Fore-Role*, and the *Treble-Roll*. To which I shall add *Four* or *Five* more. (*a*) *Ch.* 4. *Tab.* 42.

10. §. And *First*, in some *Plants*, as *Ground-Ivy*, *St. Johns Wort*, and divers others, where the *Leaves* are small, pretty numerous, and grow by pairs, they have no *Fould*, but stand Flat and Tangent, like a pair of *Battledores* clapt together.

11. §. They have the like *Posture* in *Baum*; saving, that here the Edges of the *Leaves* are a little *curled* backward. Not *Rolled*, a *Curl* being but the beginning of a *Roll*. So the several *Labels* of a *Grounsel-Leaf* are all laid in a *Back-Curl*.

12. §. The *Leaves* of some *Plants*, as *Horehound*, *White Lamium*, *Nettle*, and others, are likewise only Tangent, but are set with a *Fore-Curle*. And the several *Labels* or *Scallops* of the *Leaf* of *Common Crowfoot*, are all *Curled* Inward. But those of *Hepatica aurea*, are composed into *Double Fore-Rolls*.

13. §. THE *Leaves* of *Sage*, *Scabious*, *Red Lamium*, *Lychinis Sylvestris*, and others, are neither couched one over another, as in the *Bow-Lap*; nor plated, as in the *Flat Lap*; but being loosely foulded, of every pair of *Leaves*, the half of one is reciprocally received between the two halfs of another, and may therefore be called the *Cleep*. A *Position* very well suited to the Smalness of their Number, and the Equality of their Size, not so well agreeing with the *Bow-Lap*; and the somewhat inward Posture of the *Fibres*, not allowing the *Flat Lap*. Sometimes, as in *Syringa*, where the *Leaves* are broader, the *Cleep* is joyned with a *Fore-Curle*. *Tab.* 42.

14. §. THE last I shall mention, is the *Plaite-Roll*, as in the *Lapathum Alpinum*, which some call *English Rhubarb*. The *Leaves* whereof are so very large, and the *Fibres* so prominent; that besides and under the two *Back-Rolls*, they are also laid in several *Plaits*, and under those *Plaits*, again with lesser ones, all most exquisitely Tucked up between the said *Fibres*: So, as neither to bruise the same, nor yet to leave any Vacuity: whereby every *Leaf*, and the whole *Bud*, lie close and round within their *Veils*.

CHAP. II.

Of those things which appear upon the Surface *of the* Leaf.

THESE are *Globular Excrescences*, *Spots*, *Hairs*, *Thorns* and *Prickles:* of all which, except *Spots*, I have spoken in the *Appendix* to the *Chapter* of *Leaves* in the *First* Book.

2. §. Of the *Globulets*, it may here be further noted, That those which are white, and lie sometimes like a fine Powder upon the *Leaf*, were once transparent, as in *Bears-Ear*; their cleer *Liquor* beeing now evaporated to an *Extract* or *White Flowers*. This, if licked off, will give you the *Tast* of the more *Essential Content* of the *Plant*; different from that perceived in chewing the *Leaf*. *Tab.* 43.

3. §. For the observing of them, it may also be noted, That although they often grow on both sides the *Leaf* alike; yet sometimes, as in *Ground-Ivy*, only or chiefly on the Back-Side. And that in many *Plants*, where the elder *Leaves* have none; on the young *Buds* they are very numerous; as in *Corin Tree*, *Sorrel*, and others.

4. §. AS for *spots*, the smaller ones are observable not only in *St. Johns-worts*, (in which *Plant* only they are commonly taken notice of) but also in *Rue*, *Ground-Ivy*, *Pympernel* or *Anagallis*, and divers other *Plants*, when held up against the *Light*. The original whereof seems to be, at least in some, from the *Globulets* above mentioned; that is, when they break and dry away. So the *Spots* of *Rue-Leaves*, which in the *Reflection* of *Light* look *black*, but upon the *Trajection* thereof are *transparent*, are so many little *Holes*, pounced half way through the thickness of the *Leaf*, and seem as made, by the breaking and drying away of as many *Globulets*. Whence also, as the *Globulets* are best seen in the younger *Leaves*, so these *Spots* in the elder. *Tab.* 43.

5. §. BESIDES these, and some others (as those in *Ladies-Thistle*) which are Natural to the *Leaf*; there are also some *Spots*, or rather *Streaks*, which are *Adventitious*; as those in the *Leaves* of *Sonchus*. The Cause whereof, is a small flat *Insect*, of a grey *Colour*, and about $\frac{1}{6}^{th}$ of an Inch long. Which neither ranging in bredth, nor striking deep into the *Leaf*; eats so much only as lies just before it, and so runs scudding along betwixt the *Skin* and the *Pulp* of the *Leaf*; leaving a whitish *Streak* behind it, where the *Skin* is now loose, as the measure of its Voyage. *Tab.* 43.

6. §. THE Original and several kinds of *Thorns*, I have describ'd in the above said *Appendix*. I only add, that the very *Leaves* of some *Plants*, if they stand till the second year, are changed into so many *Thorns*, as in the *Furz*.

7. §.

7. §. They are of Uſe, not only for the *Protection* of the *Bud*; but likewiſe, for the ſupport of the *Plant*; as is obſervable in thoſe *Climbers*, which are neither ſtrong enough to ſtand of themſelves; nor yet, from their fragility, are capable of winding about another, without being torn all to pieces. For which end alſo, theſe *Thorns* grow not like *Buds*, erected; but poynt all downwards, like ſo many *Tenters* or *Hanging-hooks*: as in the *Bramble*, chiefly on the *Stalks*; and in *Clivers*, alſo on the *Leaves* themſelves; whereby they catch at any Thing that ſtands next them; and ſo, although ſuch ſlim and feeble *Plants*, yet eaſily climb to a very great hight. *Tab.* 42.

8. §. OF THE ſeveral *Figures* of *Hairs*, and their Uſe, I have alſo ſpoken. As to one Uſe, *ſc.* the *Protection* they give to the *Leaf*, I ſhall here further note, That the deſign of *Nature*, is the more evident if we conſider, That all *Leaves* are not alike *Hairy*, nor at all times, nor in every part: but differently, according to their *Age*, *Subſtance*, *Texture*, and *Foulding* up. Their *Age*; for there are many young *Buds* covered with a thick warm *Hair*, which afterwards dries up and diſappears, as uſeleſs; as thoſe of the *Vine*, *Golden Liverwort*, &c. Their *Subſtance*; ſo thoſe *Buds* which are tendereſt, and would ſooner feel the cold, if naked, have the fulleſt *Hair*; as of *Thiſtle*, *Mullen*, *Burdock*, and others. Their *Structure*; therefore thoſe *Leaves*, whoſe *Fibres* ſtand more prominent or above their *Surface*, leſt the cold ſhould nip them, are covered with greater Store of *Hair*; as in *Moth-Mullen*, *Garden-Clary*, and the like. And their *Fould*; it being obſervable, That thoſe *Leaves* which are folded up inward, have little or no *Hair* on their inner, but only on their Back-Sides, which are open to the *Aer*; as is viſible in *Corin*, *Warden*, *Golden Liverwort*, and others. *B.* 1. *Ch.* 4. *Tab.* 43.

9. §. Add hereto, That where there is Store of *Hair*, Nature is the leſs ſollicitous for other *Covers*; and where there is not, ſhe is more. So the *Leaves* of *Beans* and *Peaſen*, of *Nettle*, *Plantain*, &c. not being *Hairy*, have each a *Surfoyl*, or elſe certain *Hairy Thrums*, to protect them. And thoſe *Plants* which have neither, are ſuch as have a *Hotter Juyce*, and ſo leſs ſubject to the impreſſions of *Cold*, as *Speerwort*, *Scurvygraſs*, *Watercreſs*, *Fenil*, and moſt of the *Umbelliferous* Kind.

10. §. *Hair* is of uſe to preſerve young *Buds*, not only, from the cold *Aer*, but alſo from too much *Wet*; which, if it were contiguous, eſpecially in *Winter*, would often rot and deſtroy them. But being made to ſtand off in drops at the ends of the *Hair*, doth not hurt, but refreſh them. Thus doth *Nature* make the meaneſt Things ſometimes ſubſerve to the beſt Ends.

CHAP.

CHAP. III.

Of the Figure *of the* Leaf; *and the Apparent* Position *of the* Fibres.

THAT which in the *Leaf* offers it self next to be obſerved, is its *Figure.* This is infinitely varied with the ſeveral Kinds of *Plants*: and there are ſome, which have *Leaves* (beſides the two firſt *Diſſimilar* ones) of Two Kinds or Two diſtinct *Figures*; as the *Bitter-Sweet*, the common *Little Bell*, *Valerian*, *Lady-Smocks*, and others. For the *Under Leaves* of *Bitter-Sweet*, are Entire; the Upper, with two *Lobes*: the Under *Leaves* of the *Little Bell*, like thoſe of *Pancy*; the Upper, like thoſe of *Carnation*, or of *Sweet-William.* And in ſome *Plants*, Nature affecteth a Kind of *Irregularity*; the *Leaves* whereof are of no one certain *Figure*; as in *Dragon*, *Peony*, *Biſhops-Weed*, &c.

2. §. BUT the *Leaves* of moſt *Plants*, have a Regular *Figure*; and this Regularity, both in Length and Circuit, always defineable. In *Length*; by the Proportion between the ſeveral *Leaves* upon one *Stalk*, or between the ſeveral *Lobes* upon one *Leaf.* So the *Leaves* of *Clematis Sylv. major*, which ſtand by Ternaries, ſhorten by equal *Proportions*, that is to ſay, if, the chief *Fiber* of each, be divided into equal *Parts*; their ſeveral Lengths are not as Ten, Eight, and Four; but as Ten, Eight, and Six. So the *Lobes* and *Fibers* of *Clematis Virginiana Hederæ folio*, of *Artemiſia*, &c. ſhorten in like manner by equal Proportions. The ſame is obſervable in meaſuring, upon a *Gooſeberry-Leaf*, from the Poynt of the firſt *Lobe*, to the firſt *Angle*; from thence, to the ſecond Poynt; from thence, to the ſecond Angle; and from thence to the third Poynt.

Tab. 46.

Tab. 46.

3. §. But in many, the Proportion is different. So in the *Leaves* of the *Leſſer Maple*; the ſhortning of the *ſmaller Lobes*, with reſpect to the middelmoſt; is not Equal, but Double to that of the middlemoſt, with reſpect to the Greater. For if their chief *Fibres* be divided into Equal Parts, they are as Eleven, Nine, and Five. On the contrary, in the *Leaves* of *Althæa fruticoſa Pentaphylloidea*, the middlemoſt *Lobes* ſhorten by a greater Proportion than the Leaſt; all three being as Ten, Fourteen, and Twenty.

4. §. WITH reſpect to the *Circumference*, the *Figure* of moſt *Leaves* is very Complex. Yet Two things are evident. Firſt, that all Regular *Leaves*, are defined or meaſured out by *Circles*; that is, by the *Arches* or *Segments* of ſeveral *Circles*, having either the ſame, or divers *Centers* and *Diameters.* Secondly, That the Length of the *Leaf*, or of the chief *Fiber* thereof, is the *Standard Meaſure* for the *Diameters* of theſe *Circles:* theſe being either its full Length, or certain equal parts ſubſtracted, or multiplied; as half its Length, or its Length and half, &c.

5. §.

5. §. TO make this appear, I ſhall give ſeveral Inſtances: of ſome, where both the Edges are of one Meaſure; and of others, where they are different. And of both kinds, where they are meaſured by fewer, and where by more *Circles*.

6. §. The *Leaf* of *Lagopus major fol. pennat.* is meaſured by One *Circle*, the ſame on both Edges, whoſe *Diametre* is Thrice the Length of the *Leaf*.

7. §. That of *Syderitis Salviæ fol.* by Two *Circles*: the *Diameter* of the Lower, being Twice the Length of the *Leaf*; of the upper, the Length and half. In both theſe the *Circles* are drawn Outward; that is, with their Centers ſome where upon the middlemoſt or chief *Fiber* of the *Leaf*. *Tab.* 44.

8. §. That of *Orange-Tree*, is alſo meaſured by Two *Circles*: but one of them repeated with *Oppoſite Centers*. That next the *Cone* of the *Leaf*, is drawn Inward; that is, with the *Center* no where upon the *Leaf*, but without it. The *Diameter* hereof is juſt the Length of the *Leaf*. The midle part of the Edge is meaſured by the ſame *Circle*, only drawn Outward. The lower *Circle* next the *Stalk*, is drawn Inward, as the upper; and its *Diameter* Three times the Length of the *Leaf*. *Tab.* 44.

9. §. The *Leaf* of the *Venetian Vetch*, is meaſured by Three *Circles*. That next the *Cone*, drawn Inward; the *Diameter* whereof, is Twice the Length of the *Leaf*; the next is drawn Outward; whereof the *Diameter*, is juſt the Length. The third or lowermoſt, is drawn alſo Outward; and its *Diameter*, half the Length. So that they all leſſen by an Equal Proportion. *Tab.* 44.

10. §. The *Leaf* of *Great Laſerwort*, is alſo meaſured by Three *Circles*; all drawn Outward, and one of them Repeated. The *Diameter* of that next the *Cone*, is Half the Length of the *Leaf*; of the next, Thrice the Length; of the Third, juſt the Length; the lowermoſt, is the ſame with the Firſt. *Tab.* 45.

11. §. That of *Broad Leav'd Laſerwort*, is alſo meaſured with Three *Circles*; and one of them repeated with *Oppoſite Centers*. The *Diameter* of the Firſt, is Half the Length of the *Leaf*; of the Second, Twice the Length; of the Third, juſt the Length: all of them drawn Outward. That next the *Stalk*, is the ſame with the Firſt; only drawn Inward. *Tab.* 44.

12. §. The *Figure* of the *Leaf* of the *Cornelian Cherry*, is exactly that of the foregoing, Inverted: the ſame meaſure there beginning at the *Baſe*, and ending at the *Cone*; which here begins at the *Cone*, and ends at the *Baſe*: as by comparing their Draughts together may be obſerv'd. *Tab.* 44.

13. §. IN ALL, the foregoing Examples, both the Edges of the *Leaves* have the ſame *Meaſure*. But they have oftentimes, different ones; as in theſe that follow.

14. §. The *Leaf* of *Althæa fruticoſa*, is meaſured by Three *Circles*. The left Edge (as the *Leaf* lies with the backſide upward) by One *Circle*, but Twice repeated. For the *Diameter* of the Firſt, is the Length of the *Leaf*; the Second is the ſame, but drawn upon another Center; the Third alſo the ſame, but drawn Inward. The right Edg, is meaſur'd by Two *Circles*: the *Diameter* of the Firſt, being the Length of the *Leaf*; of the Second, Half the Length. *Tab.* 45.

15. §.

15. §. That of *Black Poplar*, by Three; and each Edge by Three repeated. On the left, the *Diameter* of the First, is the Length of the
Tab. 45. *Leaf*; of the Second, Half the length; of the Third, the Length and Half. The *Measure* of the right Edge, is that of the left, Inverted: the same *Measure* there beginning at the *Base*, and ending at the *Cone*; which here begins at the *Cone*, and ends at the *Base*.

16. §. That of *Doronicum*, is measured by Three *Circles*, whereof, one is repeated Once; and another Thrice. The right Edge by Two, and One repeated. For the *Diameter* of the First or that next the *Cone*; is the Length of the *Leaf*; the next is the same, but drawn Outward;
Tab. 45. the *Diameter* of the Third, is Half the Length. The left Edge, by Three *Circles*; whereof One is repeated on the same Edge, and Two, the same, as on the other. For the *Diameter* of the first, is the Length of the *Leaf*; of the Second, Four times the Length; the Third, the same as the First; and of the Fourth, Half the Length.

17. §. Lastly, that of *Mountain Calamint* is measured by Four
Tab. 45. *Circles*. The left Edge, by Three *Circles*, of which, the lowermost is once repeated: the right Edge also by Two; whereof the nether is likewise once repeated.

18. §. It may seem, even from these Instances, no very unobvious Conclusion; That all *Crooked Lines*, *Spiral*, *Helick*, *Elliptick*, *Hyperbolick*, *Regular*, or *Irregular*; are made up of the *Arches* of *Circles*, having either the same, or divers *Centers* and *Diameters*. And, as otherwise, so from the *Contemplation* of *Plants*, men might first be invited to *Mathematical* Enquirys.

19. §. TOGETHER with the *Figure* of the *Leaf*, the *Position* of the *Fibers*, as it is apparent before Dissection, is observable; especially on the back of the *Leaf*. Whereof I shall add, to what I have said in the *First* Book, the following *Remarques*.

20. §. First, that there are some *Leaves*, in which the first Collateral *Fibres* make *Right Angles* with the Great one in the midle: as the *Great-Maple*, the *Great Celandine*, *Chondrilla*, and the rest, or many, of the *Intybous* Kind; with some few others. But that generally all the chief *Fibers* of a *Leaf*, make *Accute Angles* together: both where they stand collateral with the midle *Fiber*, as in *Strawberry*; and where they all part at the *Stalk*, as in *Mallow*.

21. §. Again, that of these, there are some few, any two of whose
Tab. 46, & 47. Defining *Fibres* making two *Rays* of equal Length, take in One Eighth Part of a *Circle*, as in *Mallow*; and in some one Tenth: but in most they take in either one Twelfth part, as in *Holy-Oak*; or one Sixth, as in *Sirynga*. So that where the *Fibres* stand Collateral with one in the the midle, if you suppose them to be drawn out at *Opposite Angles*; or where the chief *Fibers* part at the *Stalk*, you only take in the *Stalk*; you will thereby divide a *Circle* into Eight, Twelve, or Six equal Parts; as in *Sirynga*, the *Vine* and others. And so likewise, where there are
Tab. 46, 47. several *Sprigs* upon one *Stem*, as in *Fenil*, *Hemlock*, and the like: as will best be understood by the *Figures*.

CHAP.

CHAP. IV.

Of the Parts *and* Texture *of the* Leaf.

I COME next to obſerve the ſeveral *Parts*, whereof the *Leaf* is compoſed: and firſt the *Skin*. This being ſtript off the *Leaf*, although to the bare Eye it looks no otherwiſe than a *Skin* of *Iſinglaſs*: yet being viewed through a good *Glaſs*, with a clear and true Light, and in an advantagious Poſition; it appears to conſiſt not only of *Organical Parts*, as do the *Skins* of *Animals*; but theſe alſo Regularly mixed together; that is, of *Parenchymous* and *Lignous Fibres*, all very curionſly interwoven as it were, into a piece of admirably fine white *Sarcenet*: as in *Flag*, *Tulip*, and the like. *Tab.* 48.

2. §. From hence, it is eaſy to conceive how the *Skins* of all *Plants*, as well as thoſe of *Animals*, are perſpirable; *ſc.* between the ſeveral *Fibers* of which they conſiſt. But as the *Skins* of *Animals*, eſpecially in ſome *Parts*, are made with certain open *Pores* or *Orifices*, either for the Reception, or the Elimination of ſomething for the benefit of the *Body*: ſo likewiſe the *Skins*, of at leaſt many *Plants*, are formed with ſeveral *Orifices* or *Paſs-ports*, either for the better *Avolation* of *Superfluous Sap*, or the *Admiſſion* of *Aer*.

3. §. THESE *Orifices* are not in all *Leaves* alike; but varied in *Bigneſs*, *Number*, *Shape*, and *Poſition*: Serving to the different *Nature* of the *Plant*, or *Leaf*; and giving the *Leaf*, as it were, a different *Grain*. *Princes Feather*, *i. e.* a Sort of *Sanicle*, they ſtand only on the Edges of the *Leaf*; but are very ample. In the *White Lily*, they are *Oval*, very white, and each ſurrounded with a ſlender white *Border*. They ſtand about a 6th or 8th part of an Inch diſtant, as they appear through a good *Glaſs*, all over the *Leaf*, but not in any regular Order. Theſe *Orifices* are the cauſe of the Greyiſh *Gloſs* on the upper ſide the *Leaf*: for the Back-ſide, in which there are none of them, is of a dark *Sea-Green*. *Tab.* 48.

4. §. In the *Leaf* of *Pine*, they are alſo *Oval*, and about the ſame *Bigneſs* and *Number*, as in that of a *Lily*; yet without a Border. But their *Poſition* is very Elegant, ſtanding all, moſt exactly, in *Rank* and *File* from one end of the *Leaf* to the other. *Tab.* 48.

5. §. NEXT TO the *Skin*, lies the *Pulpy* part of the *Leaf*; which by the ſame latitude, as *Uſe* hath taught us in many other Words, I call the *Parenchyma*. This *Parenchyma* or *Pulp* of the *Leaf*, like the *Pith*, and all other *Parenchymous Parts* of a *Plant* is made up of incomparably ſmall *Cylindrick Fibres*: and theſe *Fibres*, in moſt *Leaves*, woven and woun'd up into little *Bladders*.

6. §. The *Bladders* are here of ſeveral Sizes, as in the *Pith*: but generally more viſible in the *Stalk*, than in the *Body* of the *Leaf*. Varied, as in the *Pith*, ſo here, not according to the *Size*, but the *Nature* of the *Leaf*. So in *Common Dock*, and *Moth Mullein*, both Great *Tab.* 49.

Leaves, they are Small; in *Wild Clary*, a Leſſer *Leaf*, they are very Large. In the *Body* of the *Leaf*, ſometimes the *Sides* of the greater *Bladders*, are made up of leſſer ones; as in *Borage*. *Tab.* 50.

7. §. In ſome *Leaves*, theſe *Parenchymous Fibres* are all drawn cloſe up together. In the Former, they are as the *Threds* in the *Open-work* of *Bone-Lace*; in Theſe, as the ſame *Threds*, in the *Cloth-work*.

8. §. The *Pithy Part*, in the *Stalk*, and almoſt up to the Top of the chief *Fiber*, in many *Leaves*, is Tubular; even whilſt they are yet Young and Sappy: as in *Sweet Chervil*, *Hemlock*, *Endive*, *Cichory*, *Lampſana*, *Dandelion*, *Burdock*, *Daiſye*, *Scorzonera*, and others. And ſometimes the ſaid *Pithy Part* is opened into ſeveral little *Pipes*, like ſo many *Aer-Veſſels*, above $\frac{1}{3}$ a Foot long; as in the *Common Dock* and the *Little Spurge*, by ſome called *Wart-Wort*.

9. §. THE *Strings* of the *Leaf*, or thoſe *Fibres* which are viſible to the bare Eye, are compoſed of *Veſſels* of the Two General Kinds, *ſc.* for *Sap*, and for *Aer*. They are joyntly diſtributed throughout the *Leaf*: Yet not ſo, as to run meerly parallel; as in *Animals*, every *Artery* hath its *Vein*: but the *Aer-Veſſels* are every where Incloſed, or as it were *ſheathed* in the *Sap-Veſſels*.

10. §. THEIR *Poſition* is various and regular, not only in the *Body* of the *Leaf*, as is above ſhewed; but likewiſe in the *Stalk*: of which alſo I have given ſeveral Inſtances in the *Firſt* Book. I ſhall here note, and more particularly deſcribe, One or Two more. In the *Stalk* of a *Mallow-Leaf*, they ſtand in Six Oblong *Parcels* of equal Size, and in a *Ring* near the Circuit. Whereby the *Stalk* is ſtronger, the Growth hereof, before and behind, more equal, and ſo the poſture of the *Leaf* more erect. *Tab.* 49.

11. §. In *Dandelyon*, they ſtand in *Five Parcels*: of which the Greater ſtands a little *behind* the Centre of the *Stalk*; figured into a very ſmall *Half-Moon* or *Semi-Tube*, whoſe *Diametre*, through a *Glaſs*, is not above $\frac{1}{3}^{th}$ of an Inch. The other Four, are extream ſmall *Cylinders*. Altogether make an *Angle*, twice as big as that of a V Conſonant. Whereby, although the *Stalk* be ſtrong enough to ſupport the younger *Leaves*; yet thoſe which are grown longer, and ſo not only by their *Bulk*, but their farther Extenſion from the Center of *Gravity*, are become more weighty; commonly lie flat on the Ground. *Tab.* 49.

12. §. In *Wild Clary*, they ſtand alſo in *Five Parcels*, the Greater ſtands not *behind*, but *before* the *Center*; making an *Arch*, whoſe *Chord* in a *Glaſs*, is above $\frac{1}{3}$ an Inch long; and belongeth to a *Circle*, whoſe *Diameter* is an Inch and half. The other Four, are ſmall *Cylinders*, alſo different from thoſe in *Dandelion*; the two bigger, there ſtanding hindmoſt; but here, the two Leſs, and the two Bigger, within the two round *Ridges* of the *Stalk*. *Tab.* 49.

13. §. From hence it is, that the *Leaves* of this *Plant* have not only a *Prone* or *Horizontal Poſture*, but alſo make that *Forceable Preſſure* on the Ground, which can by no means be imputed to their *Weight*. For the *Great Arched-Fibre* ſtanding before the *Centre* of the *Stalk*, and the two Longer Round ones being uppermoſt, in the *Ridges* of the *Stalk*; they put on the upper parts thereof to a more full and forward Growth, and ſo to bow the *Leaf* back-ward. And the *Fibrous Arch* being, though broad, yet almoſt flat, doth hereby the more eaſily yield to that *Motion*.

14. §.

14. §. In *Borage*, and *Moth-Mullen*, they ſtand alſo in *Five Parcels*. In the former, the largeſt maketh ſtill a more bulky *Arch*, than that of *Clary*; being thicker, as broad, and of a leſſer *Circle* or more bowed. But in *Mullein*, it maketh almoſt an entire Oval. *Tab.* 49.

15. §. By means of this *Figuration*, a ſufficient number of *Veſſels* for ſuch large *Leaves*, are not only more conveniently Diſtributed into them; but alſo ſtand more ſafely in the *Stalk*. For were the *Arch* contracted into a *ſolid Cylinder*, it could not ſo preſently be reſolved into ſmall *Fibers*. And were it laid into a flat *Plate*, or ſtraight out, either the *Figure* of the *Stalk*, and ſo of the *Leaf*, muſt be altered; or elſe, the two ends of the *Plate*, would come too near the Circumference of the *Stalk*, and ſo be more liable to the *Impreſſions* of the *Weather*: as may be obſerved in cutting the *Stalk* tranſverſly, and by the *Figures*.

16. §. IN the *Body* of the *Leaf*, beſides the *Poſitions* of the *Fibrous Strings* or *Threds*; above expeſſed, there is one *Thred*, bigger or leſs, which in all *Plants*, runs round the Edge of the *Leaf*, and hems in all the reſt; but can hardly be well obſerved in any, without ſtripping off the *Skin* of the *Leaf*. When the *Fibres* of the *Leaf*, are bigger, or leſs tender, as in *Holly*, the *Skin* and the *Pulp* are ſometimes found either rotted off, or eaten away with *Inſects*; whereby, both the ſaid ſurrounding *Fiber*, and the reſt, are all very fairly viſible. *Tab.* 50.

17. §. THE *Veſſels* ſeem to be continu'd, in the *Leaf*, by being Ramified out of Greater into Leſs, as *Veins* or *Arteries* are in *Animals*. But if the *Skin* and *Pulp* of the *Leaf*, as ſuppoſe a *Borage-Leaf* be taken off, and the *Veſſels* laid bare; by the help of a good *Glaſs*, it will appear; That they are all of the ſame Size, every where in the *Leaf*; and alſo continued throughout the ſame, all ſeveral and diſtinct *Pipes* one from another, as the *Threds* in a *Skein* of *Silk*. And that therefore the *Diſtribution* of the *Threds* which the *Veſſels* compoſe, is not the Ramifying of Greater *Pipes* into Leſs; but the dividing a greater Cluſter of *Pipes*, into ſeveral leſſer Cluſters, till at laſt they come to be ſingle; as in the *Diſtribution* of the *Nerves*. *Tab.* 50.

18. §. The *Veſſels* ſeem alſo to be Inoſculated, not only ſide to ſide, but the ends of ſome into the Sides of others. But neither is this ever really done: the leſſer *Threds*, being only ſo far diducted, as ſometimes to ſtand at *Right-Angles* with the greater. So that they are Inoſculated only End to End or Mouth to Mouth, after they are come at laſt to their final diſtribution. *Tab.* 50.

19. §. The *Aer-Veſſels*, are not only, as is ſaid, Exiſtent in the *Leaves* of all *Plants*; but are herein alſo diſcoverable without the help of *Glaſſes*: For upon breaking the *Stalk* or chief *Fibers* of a *Leaf*; the likeneſs of a fine *Woolly* Subſtance, or rather of curious ſmall *Cobwebs*, may be ſeen to hang at both the broken Ends. This is taken notice of, only in ſome few *Plants*, as in *Scabious*, where it is more viſible. But may alſo be ſeen more or leſs, in moſt other *Plants*, if the *Leaves* be very tenderly broken: as I have noted near twenty years ſince; and thence conjectur'd them a Sort of *Veſſel* common to *Plants*. Now this fine *Wool*, is really a *Skein* of *Aer-Veſſels*, or rather of the *Fibers* of the *Aer-Veſſels*, unroaved from their *Spiral Poſition*, and ſo drawn out in Length. As they appear thus unroaved and drawn out at Length, both to the bare Eye, and through a good *Microſcope*, I have repreſented in two Exemples, the one a *Scabious Leaf*, the other that of a *Vine*. *Tab.* 51, & 52.

20. §. THE *Weftage* of the *Strings* and *Parenchymous Fibers* together, is here made in the ſame manner, as hath been deſcribed in the *Anatomy* of the *Root*, and *Trunk:* the former being in ſome Sort as the *Warp*, the latter as the *Woof* of the *Leaf.*

21. §. And one Example we have (it may be more than one) wherein Nature ſhews, though not a greater, yet a different *Art*; and that is the *Palm-Net.* For whereas in other *Plants*, the *Webb* is made betwixt the *Lignous-Strings* and the *Fibers* of the *Parenchyma*, only viſible through a *Microſcope:* here the ſaid *Strings* themſelves are Interwoven, and the *Weftage* apparent to the bare Eye. Of theſe *Palm-Nets* or *Sacks*, there are ſeveral Sorts. One of them is compoſed in this manner. It hath a Fivefold *Series* of *Lignous Strings* or *Fibers.* The greateſt whereof ſwell out above the reſt; and like ſo many *Ribs*, are obliquely produced on both hands, ſo as to encompaſs the *Sack.* Along each of theſe *Ribs*, on the inſide the *Sack*, runs a ſmall *Whitiſh Line*; being a *Thread* of *Aer-Veſſels* growing thereto. Betwixt theſe *Ribs* or larger *Strings*, there are others much leſs, Two or Three betwixt *Rib* and *Rib*, *Parallelly* interjected. On the inſide, there is a Third *Series*, which is alſo obliquely produced; but tranſverſly to the former. The Fourth and Fifth, conſiſt of the ſmalleſt *Strings*; not only Tranſverſly produced, but alſo Alternately, from the outſide to the inſide of the *Sack*, *& vice verſa.* By theſe two laſt, all the reſt are moſt elaborately woven into one entire and ſtrong piece of Work.

CHAP. V.

Of the Duration *of* Leaves, *and the* Time *of their* Generation.

AN *Evergreen*, is one degree above a *Plant* which is ſimply *Perennial:* of This, only the *Trunk* and *Buds* live all the *Winter*; of That, alſo the Expanded *Leaves.* And an *Evergrow*, is a degree above an *Evergreen*: here, the *Buds* and young *Sprigs*, do only *live*; there, they *grow* and are put forth.

2. §. An *Evergreen*, is made ſuch, either by the *Toughneſs* of the *Skin*, and *Cloſeneſs* or *Denſity* of the *Parenchyma*, whereby the *Leaf* is better able to endure Cold; as in *Holly*: or by the extream *Smalneſs* or *Fewneſs* of the *Aer-Veſſels*, whereby the *Sap* is leſs dryed up, and ſo ſufficient, even in *Winter*, for the Nouriſhment of the *Leaf*; as in *Box*, and *Yew*, as alſo *Fir*, and all *Reſiniferous Plants.*

3. §. The perpetual Growth of a *Plant*, ſeemeth to depend chiefly on the Nature of the *Sap.* For all *Juyces* will not ferment alike, nor with the ſame degree of *Heat.* So that whereas many *Plants* require a greater *Heat*, as that of *Summer*, for the fermenting and diſtribution of their *Juyces*, and ſo their growth; the *Warmth* of *Spring* is ſufficient for many others; and for ſome few, that of *Winter* it ſelf.

4. §. AS TO the *Time* wherein the *Leaves* are formed; Firſt, it is very probable, That in thoſe *Plants* which have *Leaves* (beſides the *Diſſimilar*) of Two diſtinct *Figures*, as hath the Little Common *Bell*,

Bell, and ſome others; the *Under-Leaves*, which differ in Shape from the reſt, are all at firſt formed in the *Plume*, before it begins to *ſprout*; and the reſt afterwards; That is to ſay, that the former *Leaves*, are all formed (out of *Sap* from the *Trunk*) with the *Seed* it ſelf, and ſo compoſe one Principal *Part* thereof, *ſc.* the *Plume*: the latter, not till after the *Seed* is ſow'n, and ſo the *Plume* ſupply'd with *Sap* immediately from the *Root*. Which *Sap*, it ſeems, is ſo far different from the former, as ſometimes to produce a different Sort of *Leaves*.

5. §. SECONDLY, of the *Buds* of all *Trees*, and of *Perenni-Stalks*, it appears, That they conſiſt of a great number of *Leaves*, all perfectly formed to the Centre; where, notwithſtanding, they are ſometimes, not half ſo big as a *Cheeſe-Mite*. So that all the *Leaves* which ſtand upon a *Branch* or *Cien* of one whole Years Growth, were actually exiſtent in the *Bud*. It is alſo very obſervable, That although theſe *Buds* begin to be expanded not till *Spring*, yet are they entirely Formed, as to all their *Integral Parts*, in the *Autumn* foregoing. So that the whole Stock of *Leaves* which grow upon a *Tree*, or any *Perennial Stalk*, this year; were made, or actually in being, the laſt year. A greater *Heat*, more ſubtilized *Aer*, and better concocted *Juyce*, being requiſite for their *Generation*, than for their bare *Expanſion* and *Growth*.

6. §. LASTLY, of all *Annual Plants*, in which there are ſeveral Succeſſive *Generations* of *Buds*, one under another in one year; although I have not made the Remarque, yet am apt to believe, That as the *Leaves* in every *Bud* are all formed together, as in other *Plants*: ſo likewiſe, that the Succeſſive *Generations* of the *Under-Buds*, begin at certain ſtated *Terms*: as in ſome *Plants*, at every *New Moon*; in others, at the *Full Moon*; and in ſome perhaps; with both, or every Fourt'night.

CHAP. VI.

Of the Manner *of the* Generation *of the* Leaf. *Where alſo, that of the* Two General Parts *of a* Plant, *ſc. the* Lignous *and* Parenchymous, *is further explain'd.*

THE *Viſible Cauſes* of the *Figures* of *Leaves*, have been formerly mentioned. It may here be further noted, That the greater *Fibers* of the *Leaf*, being never Braced in the *Stalk*; it is a good preparative for their better ſpreading in the *Leaf*. As alſo, that the ſame is much favour'd, by the extream ſmalneſs of the *Aer-Veſſels* herein: whereby they are more eaſily divaricated, in the leſſer *Fibers*, and ſo the *Leaf* dilated. *B.* 1. *Ch.* 4.

2. §. BUT theſe and the like are to be reckoned a ſecondary *Order* of *Cauſes*; which ſerve rather to carry on and improve, that which *Nature* hath once begun. And therefore, we muſt not only conſider the viſible *Mechaniſm* of the *Parts*; but alſo the *Principles* of which they are compoſed; wherewith, Nature ſeems to draw her firſt *Strokes*. *Idea*, §. 53.

3. §.

Lib. 2. *P.* 2. §. 31, &c.

3. §. Now of theſe, I have formerly, and as I conceive upon good ground, ſuppoſed, the chief Governing *Principle*, to be the *Saline*, whether *Alkaline*, *Acid*, or of any other Kind: being in ſome ſort as the *Mold* of a *Button*, to which the other *Principles*, as its *Attire*, do all conform. Or the *Salts* are, as it were, the *Bones*; the other *Principles*, as the *Fleſh* which covers them.

4. §. A further Argument hereof may be deduced from the *Cuticular* and other *Concretions*, commonly called *Mothers*, in Diſtill'd *Waters*, *Vinegar*, and other *Liquors*. For in theſe *Concretions*, there is allways a tendence to *Vegetation*; and many of them are true *Vegetables* in their Kind; as ſhall hereafter be ſeen. Now the *Liquors*, in which theſe are generated, do always, wholly or in part, loſe their *Taſt* and *Smell*, and ſo become *Vapid*. The more ſenſible *Principles* therein having made their *Tranſit* from the *Fluid*, into the *Concrete Parts*. So, I have known, ſometimes, *Vinegar* it ſelf, to become by theſe *Concretions*, almoſt as *Taſtleſs* as Common *Water*. Whereby it ſeems evident, That of *Vegetable Principles*, there are ſome, more Maſterly than others: and that of theſe, the *Saline* is the chief. The ſame is likewiſe argued, from the frequent Experiment of many good Husband-men; that moſt *Bodies* which abound with *Salt*, are the greateſt *Nouriſhers* of *Plants*.

5. §. This *Saline Principle*, as is above hinted, is to be underſtood, a *Generik* Name, under which divers *Species* are comprehended; and of ſome whereof, it is always compounded, as in other *Bodies*, ſo in *Plants*. As ſhall be made to appear, by divers Experiments, when we come, hereafter, to ſpeak of *Vegetable Salts*. Whereby we are conducted, yet further to enquire, What are the *Principles* of this *Principle*?

6. §. NOW theſe ſeem to be Four; a *Nitrous*, an *Acid*, an *Alkaline*, and a *Marine*. The *Admixture* of the Firſt, is argu'd from the Place, which Nature hath aſſigned for the *Generation* and *Growth* of moſt *Plants*, *ſc.* neither in *Caverns* under Ground, as for *Minerals*; nor above it, as for *Animals*; but the Surface of the Earth, where this Sort of *Salt* is copiouſly bred. And doth therefore prove, not only a *Mixture*, but a good Proportion hereof with the other *Principles* of a *Plant*. Hence it is, that *Dew* or *Water* on *Windows* or Plain and Smooth *Tables*, by virtue of a *Nitro-Aerial Salt*, is often frozen into the reſemblance of little *Shrubs*. And the like *Figure* I have often ſeen in a well filtred *Solution* of the *Salt* of any of our *Purging Waters*, as of *Epſom*, &c. being ſet to *ſhoot*. Produced, as I conceive, by the *Nitre*, which with the *Rain* or other *Waters*, is waſhed down from the *Surface* of the *Earth*, and ſo mixed with the *Mineral Salts*.

7. §. The other Three *Salts* are exhibited, by the ſeveral ways of Reſolving the *Principles* of a *Plant*. Many *Plants*, even in their *Natural Eſtate*, do yield an *Acid Juyce*. And the *Juyces* of many more, by *Fermentation*, will become *Acid*. And moſt, by *Diſtillation* in a *Sand-Furnace*, yield an *Accid Liquor*.

8. §. By *Calcination*, all Sorts of *Plants*, yield more or leſs, both of a *Fixed* and a *Volatile Alkaly*: the former, in the *Aſhes*; the latter, in the *Soot*. And, at leaſt the generality, by *Fermentation* alſo, yield a *Volatile* one; or ſuch a kind of *Salt*, which, whether we call an *Urinous*, or otherwiſe, hath the like *Odour* and *Taſt* with that of *Urine*, *Harts-Horn*, *Soot*, and the like.

9. §.

9. §. The *Marine*, is obtained no other way, that I know of, but from a Solution of the *Alkaline*, upon its being expoſed to the *Aer*. The proceſs wherof, I ſhall particularly ſet down in a following *Diſcourſe*. Of theſe *Salts*, mixed in a certain proportion, together, and alſo Impregnated with ſome of the other *Active Principles* of a *Plant*, and not without an *Admixture* of ſome *Parts* from the *Aer*; I ſuppoſe, that which I call the *Eſſential*, is produced: of which, I ſhall alſo give an account in the ſame *Diſcourſe*.

10. §. ALL THE Four *Salts* above mentioned, ſeem in their *Order*, to have a ſhare in the *Formation* of a *Leaf*, or other *Part* of a *Plant*: And firſt of all, the *Marine*. For all *Generations* are made in ſome *Fluid*: But in every *Fluid* there is a perpetual *Inteſtive Motion* of *Parts*. So that the firſt Intention of *Nature* is, That ſome of thoſe *Parts* be diſpoſed to *Reſt*. Now of all the *Principles* of a *Plant*, there are none hereunto more diſpoſed, than their *Salts*; whoſe *Particles*, being figu'rd with plain Sides, as often as they touch Side to Side, like two *Marbles* exquiſitely poliſhed, they will adhere together. And the *Particles* of *Marine Salt*, being *Cubick*; and ſo, with reſpect to their *Figure*, of greater *Bulk* than thoſe of any other *Salt*; they will hereby, be moſt and firſt of all diſpoſed to *Reſt*; and ſo become, as it were, the Foundation of the following *Superſtructure*.

11. THE Second Intention of Nature is, That the *Particles* be brought to *Reſt*, in a certain *Poſition*, agreeable to the *Figure* of the *Parts* which are to be formed. And therefore in the next place, all thoſe *Parts* of a *Plant* which are truly *Lignous*, by the *Marine Salt*, with the aſſiſtance of the *Alkaline*, but eſpecially of the *Nitrous*, are made to ſhoot out in Length, or into an innumerable company of ſmall *Cylindrick Fibres*: theſe *Salts* being, altogether, ſturdy enough to reſiſt thoſe *Impulſes* which might incline them to conform to any other *Figure*. *Tab.* 53.

12. §. THE next Intention is, That theſe *Fibres*, at the ſame time in which they are formed, may likewiſe receive ſuch a *Poſture* as will beſt anſwer the indented *Shape* of the *Leaf*. Which *Poſture*, although in the *Growth* of the *Leaf* it is much Govern'd by the *Aer-Veſſels*; yet in the *Generation* hereof, ſeems to be firſt determined by the foremen-tioned *Salts*, according to their ſeveral *Angles*, whereby they are diſ-ferently applicable one to another.

13. §. Now all the *Sides* of the *Marine Salt*, and the *Sides* and the *Ends* of the *Nitrous*, properly ſo called, ſtand at *Right Angles*. And it is very probable, from the *Figure* of the *Cryſtalls* in *Spirit* of *Blood*, and ſome other *Bodies*, that the *Particles* of the *Alkaline* are Square at one End, and Poynted at the other. And thoſe of the *Acid*, at both; And that, withal, they are Shorter and more Slender. *Tab.* 53.

14. §. It ſhould therefore ſeem, That where the *Alkaline Salt* is any way predominant, and that the *Particles* thereof are placed End to End; there the *Lignous Fibres* (as the larger ones in many *Leaves*) declining their parallel *Growth*, begin to ſhoot out obliquely, or at *Angles* one with another, and thoſe *Acute*. *Tab.* 53.

15 §.

15. §. If the ſame *Salt* be predominant, and ſome of its *Particles* placed, with the Pointed End of one, to the Side of another, or the Square End of one, to the Poynted End of another; there the ſaid *Fibres* begin to ſhoot at *Angles* leſs *Acute*. *Tab.* 53.

16. §. But if either the *Marine* or *Nitrous Salt* is predominant; or ſome *Particles* of the *Alkaline*, are placed with the Square End of one, to the Side of another; there the *Fibres* begin to make, not *Acute*, but *Right Angles*; as do the greater *Fibres*, in ſome *Leaves*; and the ſmaller, in all. *Tab.* 53.

17. §. IN the ſame manner, the *Fibre* in the Circumference of the *Leaf* is alſo governed; the *Particles* of the ſaid *Salt*, being reduceable, not only to any *Angle*, but alſo to any *Circle*, or other *Crooked Line*, as they are variouſly applyed. For if the *major part* be applied End to End, and only every Third or Fourth applied End to Side, they produce a great *Circle*. But if the Poynted End of each, be ſet to the Side of another, they make a leſs. And if the Application be the ſame, but to the contrary Side, they thence begin a new *Circle* with the ſame *Diameter*, but with another *Center*, anſwerable to the intended *Shape* of the *Leaf*. *Tab.* 53.

18. §. AFTER the ſame manner, the *Aer-Veſſels* may be formed by the *Particles* of the *Acid Salt*. Which, without being ſuppoſed to be crooked (as thoſe of the *Aer*, at leaſt the compounded ones, probably be) only by applying the leſſer Side of one, to the greater Side of another, will alſo be reduced to any either *Circular* or *Spiral Line*. And ſo, likewiſe, for the production of the winding *Fibres*, which compoſe the *Bladders* of the *Pith* and other *Parenchymous Parts* of a *Plant*. *Tab.* 53.

19. §. Thus doth *Nature* every where γεωμετρεῖν. For what She appears in Her *Works*, She muſt needs be alſo in their *Cauſes*.

THE

THE ANATOMY OF FLOWERS,

PROSECUTED

With the bare EYE,

And with the

MICROSCOPE.

Read before the *Royal Society, Novemb.* 9. 1676.

The SECOND PART.

By *NEHEMIAH GREW* M.D. Fellow of the *ROYAL SOCIETY*, and of the *COLLEGE* of *PHYSICIANS*.

LONDON,

Printed by *W. Rawlins*, 1682.

Mo.Bot. Garden, Dd
1902.

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THE

THE ANATOMY OF FLOWERS.

PART II.

CHAP. I.

Of the EMPALEMENT.

INEXT proceed to the *Flower*. Where I intend not to repeat thoſe things, which have been by Me already noted in the *Firſt* Book. And the foregoing Diſcourſe of *Leaves*, will excuſe me from divers particulars, common to *Theſe* and the *Flower*. I ſhall here therefore remarque ſome things not before mentioned, or but *in tranſitu*, and ſuch as are moreparticular to the *Flower*. *Ch.* 5.

2. §. And Firſt, it may be noted; That where the *Leaves* of the *Flower* are few; thoſe of the *Empalement* or *Green Border*, are either of the ſame Number, or juſt half as many, whether even, or odd. So in *Leucanthemum* and *Chickweed*, there are Five *Leaves*; in the former Five *Empalers*; in the latter, Ten. In Great *Celandine*, there are Four *Leaves*, and but Two *Empalers*; and ſo in *Poppy*. The *Arithmetick* of *Nature* being every where ſuitable to Her *Geometry*.

3. §, Of this *Part* of the *Flower* it is likewiſe obſervable, That it is rarely, if ever, entire or one piece, but parted into divers little *Leafy Pales*, eſpecially in all *Flowers* with the *Florid Attire*, as of *Marigold*, *Daiſy* and the like; being ſo numerous, as to make a *Double*, and often a *Treble*, *Quadruple* or *Quintuple Border*. Whereby they are aptly deſigned, not only to *protect* the *Leaves* of the *Flower* in the *Bud*; and after their Expanſion, to keep them tite: but alſo, by receding, *Bredthways*, one from another, and ſo making a greater *Circle*, gradually to give way for the full Growth and ſafe ſpreading of the *Attire*. Which, in regard it conſiſts of *Parts* ſo exquiſitely tender, were

it pinched up too close, would be killed or spoyled before it came to the *Birth*. As *Teeming Women*, gradually slaken their *Laces*; or as *Taylors* use to split their *Stomachers* into several *Lappets*, to spread, as their *Belly* rises.

4. §. Nor is the *Posture* of the *Parts* in the *Empalement* less suitable: not being filed one just over another, but alternately. Whereby the *Pales* or *Pannciles* of every *Under-Order*, serve to stop up the gaps made by the *Recess* of the *Upper*. And so, notwithstanding they all make more roome, yet all conspire to keep the *Aer* out.

5. §. It is also worth the notice, That, for the same purpose, the Edges at least, of the several *Pales*, are neither *Fibrous*, nor *Pulpy*; but so many extream fine transparent *Skins*, as in *Chamemile*. Whereby they close so exactly one over another, that it is impossible for any *Aer* to creep in, or any *Steams* useful to the *Attire* or *Seed*, over hastily to perspire. As we use, when we have put a *Cork* into a *Bottle*, to tie a *Bladder* over it.

CHAP. II.

Of the FOLIATURE.

Tab. 54. *Ch.* 5. THE *Leaves* of the *Flower* are folded up in such Sort, as is most agreeable to their own *Shape*, and that of their incloſed *Attire:* whereof I have given Instances in the *First* Book. I shall here add some further *Remarques*.

Tab. 54. 2. §. The *Leaves* of the *Flower* of *Blattaria*, although of different *Size* and *Shape*; are so lapped one over another, as to make an *Equilateral Pentangle*.

Tab. 54. 3. §. The *Spiral Fold*, which is proper to the *Flower*, and never seen in the *Green Leaves*; as it is it self immediately visible on the *Surface*, so by cutting off the top of the *Flower* before it is expanded, seems also to make a *Helix*; as in *Perwincle*, the larger *Convolvulus*, &c.

4. §. In some *Flowers*, where the *Attire* is lofty or spreading, as in *Holioak*, together with the *Spiral Fold*, the *Leaves* are all at the top tacked down a little; thereby making a blunter *Cone*, and so a more ample *Pyramid* for the incloſed *Attire*.

Tab. 54. 5. §. In *Poppy*, although the *Leaves* are extraodinary broad, yet being but few, and incloſing a small *Attire*; they could not be well reduced to any regular *Fold*, without leaving such a *Vacuity*, as by being filled with *Aer*, might be prejudicial to the *Seed*. For which reason, they are cramb'd up within the *Empalement* by hundreds of little *Wrinckles* or *Puckers*; as if Three or Four fine *Cambrick Handcherchifs* were thrust into ones *Pocket*.

6. §.

6. §. In *Ladies-Bower*, the *Leaves* are neither laped one over another, as is moſt uſual; nor ſet Edge to Edge, as ſometimes, but Side to Side, anſwerable to their *Shape*, and the *Diſtribution* of their *Fibres*. Their broad *Tops* being alſo rowled up ſo as to make a *Cone*. In *Ladys-Looking-Glaſs*, they ſtand alſo Side to Side, but in a different manner: in the Former with the Sides ſtanding inward, but here, bearing outward. *Tab.* 54.

7. §. In the *Marvel* of *Peru*, the *Fold* is likewiſe very peculiar. For, beſides the ſeveral *Plates*, about Six, whereby the *Flower* is gathered in the Midle; the *Top* of it is alſo gathered up by as many diſtinct *Plates*, underneath the former; and theſe *rowled* or *wreathed* up together ſo exactly, that the like could hardly be imitated by a very *dextrous Hand*. *Tab.* 54.

8. §. OF the *Hairs* upon *Flowers* and their *Uſe* to the *Attire*, I have alſo ſpoken in the *Firſt* Book. I ſhall here add, That they are likewiſe of *Uſe* to the *Leaves* themſelves, that is, for their cloſer and faſter *Conjunction*. For of ſome *Flowers* it is obſervable, That they are all over *ſmooth*, ſaving on their Edges, which are border'd with *Fringes* of *Hair*; as of *Spaniſh Broome*, *Dulcamara*, and others: In which, the *Hairs* on the Edge of one *Leaf*, are ſo complicated, or at leaſt indented, with thoſe of another, that all the *Leaves* ſeem to be but one piece. *Nature* ſeeing it fit, by this meanss to tie them together, leſt they ſhould be expanded before it be due time. *Ch.* 5. *Tab.* 55.

9. §. Many *Flowers* inſtead of *Hairs*, are beſet round about, with a great Number of ſmall *Parts*, not ending in a *Poynt*, but having a *Head*. Sometimes oval, as in *Snap-Dragon*, like the *Horns* of a *Butterfly*, or a *Plummers Sodering-Iron*. But uſually *Globular*, as in *Deadly Nightſhade*, like ſo many little *Muſhrooms* ſprouting out of the *Flower*.

10. §. Out of theſe *Heads*, doth ſometimes iſſue a *Gummy* or *Balſamick Juyce*. From whence proceeds that *Clammineſs* of ſome *Flowers*, whereby, being handled they ſtick to our *Fingers*, as do thoſe of *Blataria*, and of *Marigold*; and thoſe of *Colus Jovis*, where the ſaid *Heads* are ſo *ſoft* and *ſucculent*, that they reſemble ſo many little *Drops* of *Balſame*. The *Clammineſs* which is felt upon freſh *Carduus*, may perhaps proceed from the like *Cauſe*.

11. §. THE *Number* of the *Leaves* of the *Flower* hath been noted by the Learned Sir *Thomas Brown*, to be uſually *Five*. And this Nature ſo far affecteth, that many times where the *Leaves* of the ſame *Flower* are of a different *Size*, yet they keep to this *Number*, as in *Blattaria*. Treat. of the *Quinc.* *Tab.* 54.

12. §. I alſo add, That even thoſe *Flowers*, which are not properly parted into *Leaves*, have yet their *Tops* uſually divided into *Five* great *Scallops*; as thoſe of *Toad-Flax*, *Snap-Dragon*, *Coded-Arſmart*, *Clary*, *Broom*, and others. And when the *Flower* hath more than *Five*, even many times *Five Leaves*; yet the *Top* of each *Leaf* is indented into *Five Parts*; as in *Scorzonera*, *Cichory*, and all the *Intybous Kind*, with many others. *Tab.* 54.

13. §. From whence and other like *Inſtances*, it may ſeem, That there is ſome certain *Species* of *Salt* in *Nature*, and that in moſt *Plants*, of whoſe *Agency* there are ſtill ſome *Footſteps* or other in the *Flower*.

14. §.

14. §. The *Number* of the *Leaves*, as hath been ſaid, is commonly *Five*. Yet ſome *Flowers* have fewer, and ſome more, and that with Conſtancy, in divers *Numbers*, from *One* to *One* and *Twenty*; perhaps in all, ſo far. The *Flower* of *Acanthus Syriacus*, is in a manner one ſingle *Leaf*, that of *Monks-Rubarb*, *Three-Leav'd*; of *Poppy*, *Croſs-wort*, *Radiſh*, and many others, *Four-Leav'd*; the greater *Number* of *Flowers*, *Five-Leav'd*; of *White Hellebore*, *Tulip*, *Onion*, and moſt *Plants* with *Bulbous Roots*, *Six-Leav'd*; of *Wild-Crowfoot*, *Seven-Leav'd*; of *French Marigold*, commonly *Eight-Leav'd*; of *Flower-de-luce*, *Nine-Leav'd*; of *Chickweed*, *Ladies-Mantle*, *Ten-Leav'd*; of St. *James's Wort*, *Thirteen-Leav'd*; and I think of *Febrifuga*, *Cotula*, *Ageratum*, *Corn-Marigold*, with others; and of *Chamemile*, *Buphthalmum*, and ſome few more, the *Leaves* are commonly *One* and *Twenty*. In that of St. *James's Wort*, the *Number* is ſo conſtant that there is ſcarce *One Flower* in *Forty*, wherein the *Leaves* are more or fewer than *Thirteen*. Divers of which *Numbers*, ſeem alſo to have ſome relation to the *Number* 5. For 9, is Twice; 13, Thrice; and 25, Five times 5 running into it ſelf.

Tab. 55.

15. §. THE *Conſtituent Parts* of the *Flower* are the ſame as thoſe of the *Leaf*, *ſc.* the *Parenchyma* or *Pulp*, and the *Veſſels*. But in the *Baſis* or bottom of the *Flower*, the *Parenchyma* is commonly much more *ſpongy* and *dry*, than in the *Leaves*; conteining, after the *Flower* is open'd, little or no *Sap*, but only a dry and warm *Aer*. Which ſtanding continually under the *Seed*, haſtens the *Maturation* or due *Exiccation* thereof: as we uſe to dry *Maulted Barly* over a warm *Kiln*.

16. §. The *Veſſels* of the *Flower*, are both for *Sap* and for *Aer*, as well as in other *Parts*. And both of them ſometimes, even in the *Skin* of the *Flower*; as may be argued from its being ſtained with divers *Colours*; produced as hath formerly been ſhewed, by the mixed *Tinctures* of the ſaid *Veſſels*. Theſe *Colours*, in many *Flowers*, as *Tulips*, as they are in the *Skin* it ſelf, ſo therein only; the *Pulp* of the *Leaf* being white.

B. 2. *P.* 2. §. 65, 66, 67.

17. §. The *Lignous* or *Sap-Veſſels* are fewer, and the *Aer-Veſſels* ſmaller in the *Flower*, than in the *Leaf*. And therefore it is very difficult to obſerve the latter by *Glaſſes*; eſpecially the *Proportion* which they hold to the other *Parts*. But if you break the *Leaves* of ſome *Flowers*, with very great gentleneſs; they may hereby be *Unroaved* or *drawn out*, as in the *Green Leaves*, to ſome viſible length; and their different *Number* in divers *Flowers* may be diſcerned.

18. §. THE *Uſe* of the *Flower* or of the *Foliature* whereof we are ſpeaking, is various; as hath formerly been ſhewed. I now only add, That one *Uſe* hereof ſeemeth to be, for the *Separation* of the more *Volatile* and ſtronger *Sulphur* of the *Plant*. That ſo the *Seed*, which lyeth within or next it, may be ſo much the milder, and the *Principles* thereof more fixed and concentred. And this, both for its better *Duration* till the time of *Sowing*; and alſo, that its *Fermentation*, when it is ſow'n, may not be too hot and precipitate; but ſuitable to ſo ſlow and equal a motion, as is the *Vegetation* of a *Seed*.

B. 1. *Ch.* 5.

19. §. And that this *Sulphur* is ſeparated and diſcharged by the *Flower*, ſeems evident, not only from the *Strength* of its *Odour*, above that of the other *Parts*; but likewiſe, in that many times where there is no *Flower*, or that very ſmall, the *Seed*, that is its *Cover*, as in the *Umbelliferous*

belliferous Kind, is the more odorous. And therefore alſo, the *Vine* hath no *Flower*, partly, that the moſt *Volatile Spirit* and *Sulphur* might all run into the *Fruit*.

20. §. THE *Figure* of the *Flower*, although it is often much more complex, than that of the *Leaf*: yet there is no doubt, but that the *Meaſure* hereof may be defined in ſome way, anſwerable to that exemplified in the foregoing Part. The difference is only this, That whereas the *Green Leaves*, and the Plain *Leaves* alſo of the *Flower*, are all meaſured by the *parts* of ſeveral *Circles*: thoſe *Flowers* which are *Bellyed*, and thoſe *Leaves* of the *Flower* which are not *Plain*, but *Convex*, are all meaſured by the *parts* of ſeveral *Spheres*. And as the *Diametres* of thoſe *Circles*, bear a certain proportion to the midle *Stemm* of the *Leaf*; ſo the *Axes* of theſe *Spheres*, to an imaginary one in the *Centre* of the *Flower*.

21. §. NOW the reaſon why the *Figure* of the *Flower* is more *multiplex*, than that of the *Leaf*; may be, *partly*, becauſe it is under the Command and Government of thoſe *Salts*, which are here more *refined* and *depurate*, than in the *Leaf*; and ſo more free to lay the Foundation of any kind of *Figure*, for which, of their own *Nature*, they are adapted. *Partly*, for that as the *Nitrous* and *Alkaline Salts* are chiefly regnant in the *Leaf*; ſo in the *Flower*, in which the *Parenchymous Part* hath a greater (*a*) proportion than in the *Leaf*; it is moſt reaſonable, to aſſign the *Predominion* to the *Acid* (*b*): the *Particles* whereof, both as they are leſs, and alſo poynted at both ends, (*c*) ſeem to be more eaſily applicable one to another for the making of any Sort of *Line* or *Figure*.

(*a*) §. 17.
(*b*) *Idea*, §. 52.
(*c*) *P.* 1. *Ch.* 6. §. 13.

CHAP. III.

Of the Attire, *and firſt of that ſort which may be called* Seminiform.

WITHIN the *Foliature* ſtands the *Attire*; which is of Two general *Kinds*, every where Various and Elegant; according to the *Deſcription* I have given of them in the *Firſt* Book. I ſhall here add ſome further *Remarques*. *Ch.* 5.

2. §. And firſt, of that Sort of *Attire*, which may be called *Seminiform*; being uſually, as it were, a little *Sheaf* of *Seed-like Particles*; ſtanding on ſo many *Pedicills*, as the *Ear* doth upon the *End* of the *Straw*.

3. §. Of their *Colour* it is obſervable, That for the moſt part, they are *White* or *Yellow*; ſometimes *Blew*; but never *Red*, let the *Flower* or *Foliature* be of what *Colour* it will. Neither doth their *Colour* allways follow that of the *Foliature*, although that be not *Red*. Whereby it appears, how very Curious and Critical *Nature* is, in the *Separation* of the *Juyces* in *Plants*: that ſuch ſmall *Parts* as theſe of the *Attire*, and ſo near the *Leaves* of the *Flower*, ſhould yet receive a different *Tincture*.

4. §.

4. §. Theſe *Parts* differ alſo in their *Poſition*; ſtanding ſometimes
Tab. 55. double upon each *Pedicil*, as in *Toad-flax*, *Snapdragon*, and ſome others; but uſually ſingle, as in *Blattaria*, *Clematis Auſtriaca*, &c. Sometimes faſtned to their *Pedicils* at their middle, ſtooping down after the manner of *Poppy* and other hanging *Flowers*; as in *Spaniſh-Broom*, *Hyſop*, *Scabeous*, *Behen*, &c. Sometimes they ſtand erected, as in *Clematis Auſtriaca*, *Ladyes-Looking-Glaſs*, *Rape-Crowfoot*, &c. Thoſe of *Coded Arſmart* have no *Pedicils*, but ſtand upon a large *Baſe*.

5. §. Of the *Pedicils* themſelves, it is to be noted, That they are rarely faſtned to the *Top* of the *Repoſitory* or *Caſe* of the *Seed*, but round about the *Bottom*. *Partly*, That hereby they may the better intercept and ſeparate the *Incongruous Parts* of the *Sap* from the *Seed*. Yet in the *Coded Arſmart* they ſtand at the *Top*. Which is not the only thing peculiar in that *Plant*; it being the property thereof, to ejaculate its *Seed*, upon the leaſt touch. Which property ſeemeth to depend, *partly*, upon the *Poſition* of the ſaid *Pedicils*, as ſhall be ſhewed in ſpeaking of the *Seed*.

6. §. Theſe *Seed-like Parts* are alſo of different *Number*. In *Great Celandine*, *Roſe*, *Rape-Crowfoot*, numerous; in *Great Plantaine*, and ſome other *Herbs*, much more conſpicous than the *Foliature* it ſelf. In *Germander-Chickweed*, they are always *Two*, and no more. Sometimes they follow the number of the *Leaves*, eſpecially in the number 5; as in *Blattaria*, *Black Henbean*, &c. In *Stichwort* and *Lychnis Sylveſtris*, they are 10, juſt double to the number of the *Leaves*.

7. §. They differ alſo in their *Bigneſs*, being in ſome ſmaller *Flowers*, large; as in *Borage*, *Ladys-Looking-Glaſs*, and others: and in ſome larger *Flowers*, leſs; as in the *Roſe*.

8. §. But eſpecially in their *Shape*, which is always very Elegant, and with much Variety. In *Borage*, like the point of a *Spear*. In *Blattaria*, like a *Horſe-ſhooe*. In *Clematis Auſtriaca*, like the *Spatula*, wherewith *Apothecaries* make their *Mixtures*. In *Mallow*, like a *Head-Roll*. In *Hyſop*, they have one *Cleft* before; in *Blattaria*, one round about; in *Water Bettony*, one at the *Top*; in *Scabious*, they have a double *Cleft*,
Tab. 56. one on each ſide; and ſo in St. *Johns Wort*, *Hyoſcyamus*, and others; before they open, in the *Shape* of a double *Purſe*.

9. §. Theſe *Parts*, are all hollow; each being the *Theca* or *Caſe* of a great many extream ſmall *Particles*, either *Globular*, or otherwiſe *Convex*; but always regularly *figur'd*. They are all crowded together, and faſtned in cloſe *Ranks*, without any *Pedicils*, to the Inſides of the *Theca*, like other leſſer *Seeds* within a greater; or after the ſame manner as in *Hyoſcyamus* and ſome other *Plants*, the true *Seeds* themſelves
Tab. 55, 56. grow all round about cloſe to the *Bed* of the *Caſe*; as in *Clary*, and the *Figures* now referred to, may be ſeen. And when they are ripe, the *Caſe* alſo opens and admits them to the *Aer*, as the *Seed-Caſe* doth the *Seed*. The whole *Attire*, together with the *Foliature* and *Seed-Caſe*,
Tab. 57. See in one Example, amongſt the *Figures*.

10. §. The *Colour* of theſe ſmall *Particles* conteined in the *Theca*, is alſo different. But as That is uſually *White* or *Yellow*, ſo are Theſe: ſometimes *Blewiſh*; but never *Red*. And ſometimes not of the ſame *Colour* with that of the *Theca*. Which further ſhews how ſcrupulous *Nature* is, in differencing the *Tinctures* of the ſeveral *Parts*.

11. §.

11. §. They are alſo of different *Bigneſs* and *Figure*. Thoſe in *Snap-dragon*, are of the ſmalleſt *Size* I have ſeen; being no bigger through a good *Microſcope*, than the leaſt *Cheeſe-Mite* to the naked Eye. In *Plantain*, alſo through a *Glaſs*, like a *Scurvy-graſs-ſeed*. In *Bears-foot*, like a *Muſtard-ſeed*. In *Carnation*, like a *Turnep-Seed*. In *Bindweed*, like a *Peper-Corn*. In all theſe of a *Globular Figure*. *Tab.* 58.

12. In *Devils-bit*, they are alſo *Round*, but depreſſed, like the *Seed* of *Gooſ-graſs*, or a *Holland Cheeſe*. In the *Bean* and all ſorts of *Puls*, and *Trefoyls*, as alſo in *Blew-bottle*, &c. they are *Cylindrick*. In *Orange Lilly*, *Oval*, one 5th of an Inch long, like an *Ants-Egg*. In *Deadly-Night-ſhade*, alſo *Oval*, but ſmaller at both Ends. And thoſe of *Pancy*, *Cubick*. In all theſe and the former, they are *Smooth*. *Tab.* 58.

13. §. But in *Mallow*, *Holyoak*, and all of that kind, they are beſet round about with little *Thornes*; whereby each looks like the *Seed-Ball* of *Roman Nettle*, or like the *Fruit* of *Thorn-Apple*, or the *Fiſh* called *Piſcis orbis minor*, or the *Murices*, uſed antiently in *Wars*. They are alſo very great, ſhewing, through a *Glaſs*, of the bigneſs of a large *White Peaſe*; being 200 or 300 times biger than thoſe in *Snapdragon*; of which there are about a *Thouſand* in each *Theca*, that is, in the ſpace of about 1000th *Cubical Part* of an Inch. *Tab.* 58.

15. §. In ſome *Plants*, as in *Deadly Night-ſhade*, where theſe *Partiales* are *White*, they ſeem, by a very good *Glaſs* and advantagious *Poſition*, to be compoſed of *Parenchymous* and *Lignous Fibres*, ſtitched up together, as in the other *Parts*.

15. §. In *Colocynthis*, (and with ſome *Analogy* in *Wild Cucumer*, and I ſuppoſe all of that kind) the *Attire* is very peculiar, not conſiſting of ſeveral little *Thecæ*, upon ſo many *Pedicils*, as is deſcribed; but is all one entire *Part*, like a thick *Columna* in the midſt of the *Flower*; having ſeveral little *Ridges*, and *Furrows* winding from the *Top* to the *Bottom* round about. In the midle of each *Ridge* runs a *Line*, where the *Skin*, after ſometime, openeth into two *Lips*, preſenting the *Globular Particles* conteined in the hollow of every *Ridge*.

16. §. Where the *Attire* conſiſts of ſeveral *Seed-like Parts*, as is deſcribed; there, another *Part* diſtinct, like a little *Columna* or *Pinacle*, ſtands on the *Top* of the *Uterus* or true *Seed-Caſe*. Which is alſo regularly and variouſly *Figured*. In *Bindweed*, it hath a round *Head*, like that of a great *Pin*. In the *Common Bell*, St. *Johns wort*, it is divided into *Three Parts*. In *Gerarium*, into *Five*; In *Aſarum*, into *Six*. Sometimes, the *Head is Smooth*, and ſometimes beſet with little *Thorns*, as in *Hyoſcyamus*. Of the *Uſe* of theſe *Parts*, anon. *Tab.* 56, 57.

CHAP. IV.

Of the FLORID ATTIRE.

IN THIS *Attire* there is alſo much Elegant Variety, according to the *Deſcription* we have given of it in the *Firſt* Book. It always conſiſts of ſeveral *Suits*; Ten, Twenty, Fourty, a Hundred, or more, according to the *Bigneſs* of the *Flower*. And every *Suit* moſt commonly, of three diſtinct *Parts*, all of a Regular, but Different *Figure*. The utmoſt Part, is always like a little *Flower* with Five *Leaves* and a *Tubular Baſe*, like that of *Cowſlip*. So that every *Flower* with the *Florid Attire*, Emboſomes, or is, a *Poſy* of perfect *Flowers*. *Tab.* 59.

2. §. In ſome *Flowers*, every one of theſe *Florets*, is encompaſſed with an *Hedg* of *Hairs*; and every *Hair* branched on both ſides almoſt like a *Sprig* of *Fir*; as in *Aſter Atticus*, *Golden-Rod*, and others. *Tab.* 59.

3. §. The *Baſe* of the *Floret* is uſually *Cylindrick*, but ſometimes Square, as in *French Marigold*. And the *Leaves* hereof which, for the moſt part, are Smooth on the Inſide, in the ſame *Flower* are all over *Hairy*. And the Edges of theſe little *Flowers*, are frequently *Ridged*, or as it were, *He m'd*, like the Edge of a *Band*. *Tab.* 60.

4. §. The midlemoſt of the Three *Parts*, which I call the *Sheath*, is uſually faſtened towards the *Top*, or elſe at the *Bottom* of the *Floret*. This is rather indented, than parted into *Leaves*. The *Surface* ſeldom Plain or Even, but wrought with Five *Ridges*, and as many *Gutters* running almoſt Parallel from the *Top* to the *Bottom*. *B.* 1. *Ch.* 5. *Tab.* 60, 61, 62.

5. §. The *Inmoſt Part*, which I call the *Blade*, runs through the hollow of the Two Former, and ſo is faſtned, with the *Floret*, to the convex of the *Seed-Caſe*. The *Head* and *Sides* of this *Part*, is always beſet round about with *Globulets*, commonly through a *Glaſs*, as big as a *Turnep-ſeed*, or a great *Pins-Head*. In ſome *Plants* growing cloſe to the *Blade*, as in the common *Marigold*; in the *French*, and others, upon *Pedicils* or little ſlender *Stalks*. Theſe, as the *Blade* ſpringeth up from within the *Sheath*, are ſtill rubed off, and ſo ſtand like a *Powder* on them both. And ſometimes, as in *Cichory*, they ſeem to grow on the Inſide the *Sheath*, if it be ſplit with a ſmall *Pin:* as alſo in *Knap-weed*, in which they are numerous. Yet in the *Seed-like Attire*, always more numerous, than in the *Florid*. *B.* 1. *Ch.* 5. *Tab.* 60, 61, 62.

6. §. The *Head* of the *Blade* is always divided into *Two*, and ſometimes into *Three Parts*, as in *Cichory*; which, by degrees, curl outward, after the manner of *Scorpion-Graſs*. *Tab.* 58, &c.

7. §. The *Deſcription* now given, agrees principally to the *Corymbiferous Kind*, as *Tanſy*, *Chamemile*, and the like. But in *Scorzonera*, as alſo *Cichory*, *Hawk-Weed*, *Mouſear* and all the *Intybous* Kind, with many more

more, the *Attire* is not ſeparate from the *Foliature*, ſo as to ſtand within that in one entire *Poſy*; but every *Leaf* of the *Flower* hath its own *Attire* apart. For the ſake of which, the *Baſis* of every *Leaf* is formd into a little *Tube* or *Pipe*, whereby it emboſomes its own *Attire* within it ſelf. Conſiſting commonly of *Two Parts*, a *Sheath* and a *Blade*: the *Leaf* it ſelf anſwering to the *Floret* in other *Flowers*. *Tab.* 62.

8. §. In ſome *Plants*, beſides the *Attire* or *Poſy* in the midle of the *Flower*; the *Leaves* alſo have each their own to themſelves, as in *Marigold*: yet this, as I take it, conſiſting only of one ſingle *Part*, which anſwers to the *Blade*; the *Leaf* it ſelf being as the *Sheath*. *Tab.* 61.

9. §. In many *Plants*, this *Florid Attire* is very large; ſo that not only the *Suits*, but alſo the ſeveral *Parts* whereof every *Suit* conſiſts, being throughly ripe and well blown open, are all viſible to the bare Eye, as in *Knapweed*, and all the *Thiſtle Kind*. This *Attire* is all the *Flower*, that this ſort of *Plants* have; being, though *Empal'd*, yet without any *Foliature*. *Tab.* 61.

10. §. And ſometimes, there is little or no *Flower* beſides this *Attire*, although extream ſmall, as in *Golden Rod*, *Wormwood* and others. Where it may be noted, That the *Medicine* called *Wormſeed* or *Semen Santonici*, is no Sort of *Seed*, but the *Buds* of ſmall *Flowers*, or of the *Florid Attire* of that *Plant*.

CHAP. V.

Of the Uſe *of the* Attire.

OF the *Secundary Uſe* hereof, I have ſpoken in the *Firſt* Book; and particularly, of the *Globulets* or ſmall *Particles* within the *Thecæ* of the *Seed-like Attire*, and upon the *Blades* of the *Florid*, I have conjectur'd, That they are that *Body* which *Bees* gather and carry upon their *Thighs*, and is commonly called their *Bread*. For the *Wax* they carry in little *Flakes* in their *Chaps*: but the *Bread* is a Kind of *Powder*; yet ſomewhat moiſt, as are the ſaid little *Particles* of the *Attire*. *Ch.* 5.

2. §. But the Primary and chief *Uſe* of the *Attire* is ſuch, as hath reſpect to the *Plant* it ſelf; and ſo appears to be very great and neceſſary. Becauſe, even thoſe *Plants* which have no *Flower* or *Foliature*, are yet ſome way or other *Attir'd*; either with the *Seminiform*, or the *Florid Attire*. So that it ſeems to perform its ſervice to the *Seed*, as the *Foliature*, to the *Fruit*.

3. §. In diſcourſe hereof with our Learned *Savilian* Profeſſor Sir *Thomas Millington*, he told me, he conceived, That the *Attire* doth ſerve, as the *Male*, for the *Generation* of the *Seed*.

4. §. I immediately reply'd, That I was of the ſame Opinion; and gave him ſome reaſons for it, and anſwered ſome *Objections*, which might oppoſe them. But withall, in regard every *Plant* is ἀῤῥενόθηλυς or *Male* and *Female*, that I was alſo of Opinion, That it ſerveth for

the *Separation* of ſome *Parts*, as well as the *Affuſion* of others. The ſum therefore of my Thoughts concerning this *Matter*, is as follows.

5. §. And Firſt, it ſeems, That the *Attire* ſerves to diſcharge ſome redundant *Part* of the *Sap*, as a *Work* preparatory to the *Generation* of the *Seed*. In particular, that as the *Foliature* ſerveth to carry off the *Volatile Saline Sulphur*: So the *Attire*, to minorate and adjuſt the *Aereal*; to the end, the *Seed* may become the more *Oyly*, and its *Principles*, the better fixed. And therefore the *Foliature* generally hath a much ſtronger *Odour*, than the *Attire*: becauſe the *Saline Sulphur* is ſtronger, than an *Aerial*, which is too ſubtile to affect the Senſe. Hence alſo it is, that the *Colour* of the *Parts* of the *Attire*, is uſually *White*, or *Yellow*, never *Red*: the former, depending upon a greater participation of *Aer*; the latter, of *Sulphur*. I add further, That the moſt *Volatile* and *Aerial Sulphur*; being by means of theſe *Parts* much diſcharged; it may hereby come to paſs, not only that the *Seed* is more *Oylie*, and its *Principles* more fixed; but alſo, that the *Body* or *Parenchyma* thereof, is ſo compact and cloſe: For although it conſiſts of *Bladders*, yet ſuch, as are Twenty times ſmaller than in any other *Part* of a *Plant* of the like bigneſs. Whereas, were the *Aer* copiouſly mixed with the *Sap* here, as in the *Pith*, *Fruit*, and other *Parenchymous Parts*; it would give ſo quick a *Ferment* to the *Sap*, as to dilate and amplify the *Bladders* of the *Seed*, beyond its preſent compact and durable *Texture*; and ſo expoſe it, either to a precipitant *Growth*, or ſudden *Rot*. Wherefore, as the *Seed-Caſe* is the *Womb*; ſo the *Attire* (which always ſtands upon or round about it) and thoſe *Parts* of the *Sap* herinto diſcharged; are, as it were, the *Menſes* or *Flowers*, by which the *Sap* in the *Womb*, is duly qualified, for the approaching *Generation* of the *Seed*.

6. §. And as the young and early *Attire* before it opens, anſwers to the *Menſes* in the *Femal*: ſo is it probable, that afterward when it opens or cracks, it performs the *Office* of the *Male*. This is hinted from the *Shape* of the *Parts*. For in the *Florid Attire*, the *Blade* doth not unaptly reſemble a ſmall *Penis*, with the *Sheath* upon it, as its *Præputium*. And in the *Seed-like Attire*, the ſeveral *Thecæ*, are like ſo many little *Teſticles*. And the *Globulets* and other ſmall *Particles* upon the *Blade* or *Penis*, and in the *Thecæ*, are as the *Vegetable Sperme*. Which, ſo ſoon as the *Penis* is exerted, or the *Teſticles* come to break, falls down upon the *Seed-Caſe* or *Womb*, and ſo Touches it with a *Prolifick* Virtue.

7. §. *Conſentaneous* hereto it is alſo obſervable, That thoſe *Herbs* generally have the *Seed-like Attire*, which either produce a greater Quantity of *Seed*, or a *Perennial Root*: and that there is no *Tree*, with the *Florid Attire*. As if the other, becauſe it contains a far greater Proportion of the abovefaid *Particles*, that is, of *Sperm*; 'tis able to beget a more *Numerous*, *Vivaceous*, or *Gigantick Birth*.

8. §. That the ſame *Plant* is both *Male* and *Female*, may the rather be believed, in that *Snails*, and ſome other *Animals*, are ſuch. And the *Parts* which imitate the *Menſes*, and the *Sperm*, are not preciſely the ſame: the former, being the External *Parts* of the *Attire*, and the *Sap*, which feeds them; the latter, the ſmall *Particles* or moyſt *Powder* which the External incloſe.

9. §.

9. §. And that these *Particles*, only by falling on the *Uterus*, should communicate to it or to the *Sap* therein, a *Prolifick Virtue*; it may seem the more credible, from the manner wherein *Coition* is made by some *Animals*; as by many *Birds*, where there is no *Intromission*, but only an *Adosculation* of *Parts*: And so in many *Fishes*. Neither in others, doth the *Penis* ever enter any further than the *Neck* of the *Womb*. Nor doth perhaps the *Semen* it self: or if it doth, it can by no means be thought, bodily or as to its gross *Substance*, to enter the *Membranes*, in which every *Conception*, or the *Liquor* intended for it, before any *Coition*, is involved; but only some subtle and *vivifick Effluvia*, to which the visible *Body* of the *Semen*, is but a *Vehicle*. And the like *Effluvia* may be very easily transfused from the above said *Particles* into the *Seed-Case* or *Womb* of a *Plant*.

10. §. If any one shall require the Similitude to hold in every Thing; he would not have a *Plant* to resemble, but to be, an *Animal*.

CHAP. VI.

Of the Time *of the* Generation *of the* Flower.

THE *Time* in which the *Flower* is Generated or Formed is a Providence in Nature, whereof, I do a little wonder, that no one, amongst so many observers of *Plants*, hath ever yet taken any notice. It is therefore to be remarked, That all *Flowers* are formed or perfectly finished, in all their *Parts*, long before they appear in sight; usually Three or Four Months, and sometimes half a year, or more. And that in all *Perennial Plants*, those *Flowers* which appear and are called the *Flowers* of any one year; are not formed in that year; but were actually in *Being*, and entirely formed in all *Parts*, the year before; as in many *Herbs*, and in all *Shrubs* and *Trees*.

2. §. This will best be seen by some Instances. So the *Flower* of *Mezereon*, which opens in *January*, is entirely formed about the midle of *August* in the year foregoing. At which time, the *Green Leaves* of the *Bud* being cautiously removed, the *Leaves* of the *Flower*, and the *Thecæ Seminiformes* or *Seed-like Attire*, encompassing the *Seed-Case*, through an indifferent *Glass*, are all distinctly visible. *Tab. 63.*

3. §. The like may be seen in *Sirynga*, and other *Shrubs*, and in *Trees*. In as many of which, as are *Frugiferous*, the *Fruit* also, which answers to the *Seed-Case* in other *Plants*, is about the same time entirely formed.

4. §. And so in *Herbs*; as the *Flower* of *Asarum*, which appeareth in *April* or *May*, is entirely formed in *August* or *July* of the foregoing year. For there are here, as well as in *Trees*, Two Sorts of *Buds*; some which are composed only of *Green Leaves*; and some which also contein a *Flower* and the *Seed-Case*. So in *Bears-foot*, by some called the *January Rose*, the *Flower-Buds*, which open in *January* are all formed in or before the Month of *August* in the year preceding. *Tab. 64.*

5. §.

Tab. 63.

5. §. The ſame may alſo be ſeen about the end of *Auguſt* or the beginning of *September* in a *Tulip-Root*. In which, the Two Inmoſt *Shells* dryer than the reſt, ſtand hollow, with the little young *Flower* (which appears in *March* or *April* following) incloſed now in their *Centre*. Being thus kept *warm* and *dry*, leſt it ſhould either periſh, or be precipitated upon the *Winter*, by ſprouting too ſoon.

6. §. From hence it is plain, That although the *Flower* appears before the *Seed*; yet if the compariſon be made betwixt the *Flower* and *Seed* of the ſame year; the *Seed* is firſt formed, and afterward the *Flower*. That is, the *Seed*, for which Nature chooſes the Firſt-born *Sap*, is formed in the fore part of the year: which work being finiſhed, out of the leſs *fœcund part* of the *Sap*, the *Flowers* intended for the *Sire* and *Matrix* of the next years *Seed*; is afterwards produced.

7. §. THE true *Time* of the *Generation* of the *Flower* being know'n, it may alſo be an Inducement to make Tryal, for the bringing of many *Flowers* to grow fairly in *Winter*, which are uſed to grow, that is, to appear, only in the *Spring* and *Summer*: *ſc.* by keeping the *Plants* warm, and thereby enticing the young lurking *Flowers* to come abroad.

The Appendix.

Being a Method *propoſed, for the ready finding, by the* Leaf *and* Flower, *to what Sort any* Plant *belongeth.*

ALTHOUGH many have beſtowed extraordinary Care and Induſtry upon the ſearching out, and Deſcription of *Plants*; and for the reducing of them to their ſeveral *Tribes*: yet I will take leave, here to propoſe a ſhort *Method* whereby Learners, ſeeing a *Plant* they know not, may be informed to what Sort it belongs, and ſo be directed where to find it deſcribed and diſcourſed of. For, except they have a Maſter to conduct them, which few have; they muſt needs, by ſeeking at random, loſe a great deal of time, which by a regular Enquiry might be ſaved. Beſides, that what is learned by their own Obſervation, will abide much longer on their mind, than what they are only Poynted to, by another.

2. §. Now the moſt *Philoſophick* way of diſtinguiſhing or ſorting of *Plants*, were by the *Characteriſtick Properties* in all *Parts*, both *Compounded*, *Conſtituents*, and *Contents*. But of the *Compounded*, the *Seeds*, and ſome other *Parts*, are oftentimes very *minute:* and the *Roots* always lie hid. As alſo the *Conſtituent Parts*, every where, without cuting and the uſe of *Glaſſes*. Nor can the *Contents* be accurately obſerved otherwiſe. So that for the *Uſe* here intended, thoſe *Properties* are the fiteſt to be inſiſted upon, which are the moſt *Conſpicuous*, and in thoſe *Parts*, where the Learner may the moſt readily and without any difficulty take notice of them; as in the *Flower* and *Leaf*. The *Flower* hath Varieties enough of it ſelf. But in regard it is often wanting, when the *Green Leaf* is not; it is therefore convenient, that he be aſſiſted by

by both, and that the Varieties of both be distinctly reduced unto *Tables*. Which may be done, after the following, or some other like manner.

3. §. And First for the *Leaves*. The most obvious *Varieties* of which, are in their *Position*, *Size* or *Shape*.

4. §. *Leaves* are fastned with, or without a *Stalk*. Without, only close to the *Branch*, as in *Southistle*; or surrounding it, as in *Thorow-Wax*.

5. §. Both these ways, they stand either singly, that is, but one at the same height; or more together.

6. §. More together, in Even or Odd Numbers. In Even Numbers, commonly Two and Two, as in *Sage*, *Polium*; Sometimes Four, as in *Cross-wort*, *Madder*, *Herb True-Love*, *Pomum Majæ*; or more, as, I think, in *Woodrose*, &c. In Odd Numbers, Three, as in all *Trefoyls*, *Strawberries*; Five, in *Pentaphil*, *Castanea Equina*; Seven, in *Tormentil*.

7. §. The *Sizes* of *Leaves* are innumerable. It is therefore necessary to reduce them to a Standard. And so, they may be reckoned, Three; *Small*, *Mean* and *Great*: with respect to the *Length* of the *Leaf*, the *Breadth*, or both. From one Inch and under, all *Leaves* may be accounted *Small*; from one Inch and over, to five Inches, *Mean*; from five and over, *Great*.

8. §. The *Shapes* of *Leaves* are also numberless. But the most obvious distinctions which they admit of, are such as these;

9. §. *Leaves* are *Membraneous*, as the greater part; *Squameous*, as *Abies*, or *Filamentous*. Which are *solid*, as in *Fenil*, *Meum*, *Buphthalmum*, *Chamemile*, *Groundpine*; or *hollow*, as in *Onion*.

10. §. *Membraneous*, have all their main *Fibres* produced either from the *Stalk*, as in *Holyoak*; or from the middle *Stem* of the *Leaf*, as in most. From the midle *Stem*, reciprocally, as in *Scabious*, or oppositely, that is, one over against another, as in *Rose*: and both ways, at *Acute Angles*, as in most; or *Right*, as in *Dandelion*.

11. §. Again, they are different with respect to the *Top*, the *Bottom*, and the *Sides*. The *Top* is *Thorny*, as in *Furz*; or *Unarmed*. *Unarmed*, either *Produced*, that is, *Poynted*, or at least, *Roundish*, as in *Lamium*, *Ironwort*; or else *Reduced*, as in *Woodsorrel*. And so the *Bottom*, is either *Reduced* towards the *Top*, as in *Ground-Ivy*; or *Produced* upon the *Stalk*, as in *Poplar*, *Bay*, &c.

12. §. The *Sides* or *Edges* of the *Leaf*, are either of one and the same *Measure*, as commonly; or of divers, as in *Doronicum*. Both ways they are Even, as in *Syringa*, *Mous-ear*; or Uneven. The Uneven, are *Prickly*, as *Holly*, *Eryngium*, *Thistle*; or Unarmed. Unarmed, are Insected, or Resected. Insected deeply, that is, Lobed, as *Golden Liverwort*, *Clematis Peregrina*; or with shallow *Insections*, as in most. And so, Indented, or Scallopped: the former, when the *Angle* is made with Straight *Lines*, as in *Dandelion*; the latter, with Crooked, as in *Thalictrum*. Resected, that is, both Lobed, and Insected, or when upon the greater *Insections*, there are other lesser ones, as in *Wild-Clary*, *Lovage*, *Masterwort*.

13. §. THE most Conspicuous Varieties of *Flowers*, are in their *Position*, *Size*, *Shape*, and *Colour*.

14. §. Most are fastned with *Stalks*; but many without. Sometimes, they are placed round about the *Branch*, that is, Coronated, as in

in *Pulegium*; and ſometimes, all on one ſide; either in *Ranks* only, as in *Bawm*; or in *Rank* and *File*, as in *Foxglove*. In *Saxifraga Aurea*, they grow on the *Leaf*.

15. §. Again, they either ſtand Singly, as in *Corn Marigold*; or Cluſtur'd. And ſo, either all upon one *Branch*, or on ſeveral little *Ramificated Sprigs*. On one *Branch*, prolonged like a Tail, as in *Blattaria*; or Contracted. And ſo, either without *Stalks*, that is, *Capitated*, as in *Scabious*; or with *Stalks*, that is, *Umbellated*, as *Fenil*, &c. On ſeveral *Sprigs*, as in *Tanacetum*, *Yarrow*.

16. §. The *Sizes* of *Flowers*, as of the *Leaves*, may be reduced to Three. From ½ an Inch and under, in *Diameter* or *Length*, may be accounted *Small*. From ½ an Inch and over to an Inch and ½, may go for *Mean*. And from an Inch and ½ and over, *Great*.

17. In reſpect of the *Shape*, *Flowers* are *Open* or *Belly'd*. *Open* have both *Leaves* and *Attire*, as moſt; or elſe are all *Attire*, as of *Burdock*, *Beta Cretica*.

18. §. The *Open*, conſiſt of a Certain Number of *Leaves*, *One*, *Two*, *Three*, *Four*, *Five*, *Six*, *Seven*, *Eight*, *Nine*, *Ten*, *Thirteen*, or *One* and *Twenty*. Uncertain, commonly called *Double*. Thoſe of a Certain *Number*, either *Uniform*, that is, all of a certain *Size* and *Shape*, as uſually; or *Biform*, or *Triform*, as in *Iris*, *Blattaria*. And theſe again, Even *Edged* or *Notched*; with *Three Poynts*, as in *Marigold*; or *Five*, in *Cichory*.

19. §. The *Belly'd*, are either ſo in whole; or in Part, that is, with the *Top* divided into *Leaves*, and the *Bottom*, *Hollow*: The former, are alſo Even *Edged*, as in *Convolvulus*; or *Notched*, as in *Trachelium*. The latter have their *Leaves* diſtinguiſhed as before. Their *Bottom* or *Baſe*, either faſtned to the *Seed-Caſe*, as in *Snap-dragon*; or ſtanding below it. And ſo, either Straight, as I think in *Toad-flax*; or Crooked, as in *Violet*, *Lark-heel*.

20. §. In all theſe, the *Attire* is either *Seminiform*, or *Florid*. And both, *Cluſtur'd*, or *Divided*; as in *Mallow*, *St. Johns wort*; *Starwort*, *Hawkweed*.

21. §. The *Colours* of the *Flower*, are *White*, as in *Water-Crowfoot*; *Red*, as *Lychnis*; *Blew*, as *Borage*; *Purple*, as *Stock-July-Flower*; *Black*, as in ſome *Anemones*; *Yellow*, in *Wall-Flower*; *Tawny*, in *Colus Jovis*; *Green*, in *Laureola*. Which are either *Single*, or *Mixed*: *Two* together, as in *Butyr-Bur*, *White* and *Red*; in *White Hellibore*, *White* and *Green*; in *Monks Rubarb*, *Red* and *Green*; &c. Or *Three* together, as in *Pancy*, *Yellow*, *Blew*, and *Black*, i. e. *atro-purpureus*.

22. §. How far theſe, and ſome other like *Diſtinctions*, being reduced to *Tables*, would ſerve for the finding out of any Sort of *Plant*, may be conceived, if we conſider, how great a Variety, a few *Bells*, in the ringing of Changes, will produce. And the ſearch will be eaſy, and ſucceſsfull, if in every foregoing *Table*, reference be made to thoſe that follow; and in the *Tables* conteining the laſt *Diviſions*, the Names of the *Plants* therein poynted out, be expreſſed.

THE

THE

ANATOMY

OF

FRUITS,

PROSECUTED

With the bare EYE,

And with the

MICROSCOPE.

Read before the *Royal Society, in the Year* 1677.

The THIRD PART.

By *NEHEMIAH GREW* M.D. Fellow of the *ROYAL SOCIETY*, and of the *COLLEGE* of *PHYSICIANS*.

LONDON,

Printed by *W. Rawlins*, 1682.

Mo.Bot. Garden, Ff
1902.

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THE

THE ANATOMY OF FRUITS.

PART III.

CHAP. I.

Of the APPLE; *and of the* LIMON, *and* CUCUMER, *the* Fruits *of* Plants *vulgarly called* POMIFEROUS.

THE *Deſcription* and *Uſe* of *Leaves* and *Flowers*, together with the *Figures* thereto belonging, were preſented to this *Honourable Society*, the laſt year. I ſhall conclude this Subject with *Fruits* and *Seeds*; beginning with *Fruits*, which will take up the preſent Diſcourſe.

2. §. And Firſt, I ſhall deſcribe the Compounding *Parts* of ſome, more generally known. Which having done, I ſhall next obſerve the *Uſes* of the ſame; either for the *Fruit* it ſelf, or for the *Seed*. Some of the *Deſcriptions*, the Reader may be pleaſed to compare with thoſe in the *Firſt* Book. *Ch.* 6. I begin with the *Apple*; to which I ſhall ſubjoyn the *Limon*, and *Cucumer*, commonly reduced to the *Pome Kind*.

3. §. AN APPLE, beſides the *Skin*, conſiſteth of a *Parenchyma*, *Veſſels*, and *Coar*. The *Parenchyma* or *Pulp*, is the ſame with that of the *Barque* of the *Tree*. As is apparent, not only from the viſible continuation thereof from the one, through the *Stalk*, into the other: but alſo from the Structure common to them both; being both compoſed of *Bladders*. In which, notwithſtanding, there is this difference,

That whereas in the *Barque*, they are *ſpherical*, and very ſmall, moſt of them, through a good *Glaſs*, not exceeding $\frac{1}{16}^{th}$ of an Inch in *Diametre*, and ſome of them, leſs: here, they are oblong and very large, moſt of them about $\frac{1}{3}^{d}$ of an Inch in Length, or more, according to the largeneſs and tenderneſs of the *Fruit*; being all uniformly tenter'd or ſtretched out, by the *arching* of the *Veſſels*, from the *Coar* towards the Circumference of the *Apple*. *Tab.* 65.

4. §. The *Veſſels*, as in the other *Parts* of a *Plant*, are *Succiferous*, and for *Aer*. Both the *Branches* of the former, and the ſingle *Veſſels* of the latter, are extream ſmall. They run every where together, not collateral, as *Veins* and *Arteries* do in *Animals*; but the latter, ſheathed in the former. *Tab.* 65.

5. §. They are diſtributed into Twenty principal *Branches*. The Ten outmoſt, a little within the *Apple*, are diverted from a ſtraight *Line*, into ſo many great *Arches*; from which a few ſmall *Fibres* are without any order diſpearſed through the *Apple*. The Five middlemoſt, and the Five inmoſt, run in a ſtraight *Line* as far as the *Coar*, and are there diverted into as many leſſer *Arches*; the former, at the outer, and the latter at the iner *Angles* of the *Coar*. Upon theſe Five inmoſt hang all the *Seeds*. *Tab.* 65.

6. §. Theſe Ten, and the other Ten aboveſaid, do all meet together at the top of the *Apple*, where originally, they all ran into the *Flower*. But betwixt them, there are ſcarce any intercurrent *Fibres*; ſo that they appear every where disjunct from the bottom to the top of the *Apple*. *Tab.* 65.

7. §. A LIMON hath a Threefold *Parenchyma*; which ſeem to be derived one from another: the *Texture*, upon every derivation, being ſomewhat altered, and ſo made more cloſe and elaborate. The utmoſt, called the *Rind*, hath the moſt open, and the courſeſt *Texture*; being compoſed of the largeſt *Threds*, and thoſe *Threds* woven up into larger *Bladders*. Thoſe little *Cells*, which contein the *Eſſential Oyl* of the *Fruit*, and ſtand near the Surface of the *Rind*, are ſome of the ſaid *Bladders* much more dilated. *Tab.* 66.

8. §. From this utmoſt *Parenchyma*. Nine or Ten *Inſertions* or *Lamells* are produced, betwixt as many *Portions* of the *Pulpy Part*, towards the Centre, where they all unite into one *Body*, anſwerable to the *Pith* in the *Trunk* or *Root* of a *Tree*; and is a conſpicuous demonſtration, of the communion betwixt the *Barque* and the *Pith*; which there, is much more obſcure and difficult to obſerve. At the bottom, but eſpecially the top of the *Fruit*, the *Pith* is ſo far expanded, as without the mediation of any *Lamels*, to be joyned to the *Rind*. *Tab.* 66.

9. §. Throughout this *Parenchyma*, the *Veſſels* are diſpearſed. But the chief *Branches* ſtand on the iner Edge of the *Rind*, and the outer Edge of the *Pith*, juſt at the two extremities of every *Lamel*. From thoſe *Branches* on the Edge of the *Pith*, other little and very ſhort ones ſhoot into the *Pulp* of the *Fruit*, upon which the *Seeds* are appendant. In the Centre of the *Pith*, are Eight or Nine, in a *Ring*, which run through the *Fruit* up to the *Flower*. *Tab.* 66.

10. §. Between the *Rind* and the *Pith* and thoſe ſeveral *Lamels*, which joyn them together, ſtands the ſecond Sort of *Parenchyma*, different from the former, in being ſomewhat cloſer, and finer wrought Divided, by the *Lamels*, into ſeveral diſtinct Bodies; every one of them a great and entire *Bag*.

11. §.

11. §. Within every great *Bag*, is conteined a Third *Parenchyma*, which is alſo a Cluſter of other little *Bags*, about the bigneſs of an *Oate*, all disjoyned one from another, and having their diſtinct *Stalks*, of ſeveral *Lengths*, by which they are all faſtned to the utmoſt Side of the great *Bag*, wherein they are conteined. Within each of theſe leſſer *Bags* are conteined many hundreds of *Bladders*, conſiſting of moſt extream fine *Threds* woven up together into that *Figure*. Within theſe *Bladders* lies the *Acid Juyce* of the *Limon*. *Tab.* 66.

12. §. A CUCUMER, hath alſo a Threefold *Parenchyma*. The Utmoſt, is derived, from the *Barque*. In this, being expoſed for ſome time to dry, and then cut tranſverſly with a *Raſor*; not only the *Bladders*, but alſo the *Threds* whereof the *Bladders* conſiſt, through a good *Microſcope*, are apparent.

13. §. Throughout this *Parenchyma* the *Sap-Veſſels* are diſperſed; near the Circumference, in Ten or Twelve very large *Branches*. Each of theſe larger *Branches*, emboſoms another of *Aer-Veſſels* in its Centre. Adjacent to the Midle *Parenchyma*, they ſtand in *Cluſtres* of much ſmaller *Branches*, but more numerous. *Tab.* 66.

14. §. Out of all theſe *Sap-Veſſels*, iſſues a tranſparent and viſcous *Mucilage*; which being dryed, becomes as hard and tough as *Gum Tragacanth*. Analogous to which, I ſuppoſe, is the truly purgative part of *Elaterium*.

15. §. The Midle *Parenchyma* is derived from the *Pith*; and divided into Three *Colums*, ſtanding triangularly, and having each of them a *Triangular Figure*. Within theſe *Colums* ſtand a diſtinct Sort of *Sap-Veſſels*: from whence, ſeveral ſmall and ſhort *Fibres* ſhoot into the Inmoſt *Parenchyma*, whereupon the *Seeds* do hang. So that theſe *Columns* are as it were the *Beds* on which the *Seeds* grow. With each of the *Seed-Branchs* or *Fibres*, goes ſome part of the ſaid *Parenchyma* or *Colum*, out of which, the *Covers* of the *Seed* are formed. *Tab.* 66.

16. §. The Inmoſt *Parenchyma* wherein the *Seeds* lie, and which anſwers to the *Pulp* of a *Limon*, ſeems likewiſe to be derived from the *Colums*, that is, to be originally thence produced upon the *Seed-Fibres*, and afterwards ſpread and augmented into a *Pulp*. By Three *Inſertions* from the *Colums*, and as many from the Utmoſt *Parenchyma*, and theſe re-inſerted; it is divided into Six *Triangular Bodies*; and every *Triangle*, into Three *Ovals*. *Tab.* 66.

17. §. A near reſemblance betwixt the *Garden* and *Wild Cucumer*, with reſpect to the Inward *Structure*, as well as the Outward *Figure*, may be obſerved: Both of them having a Threefold *Parenchyma*. Yet with this difference, That the Three *White Triangular Bodies* or *Colums* in the one, is anſwered by a *White Ring* or *Tube* in the other. *Tab.* 66.

CHAP.

CHAP. II.

Of the PEAR *and* QUINCE.

APEAR, beſides the *Skin*, conſiſteth of a Twofold *Parenchyma*, of *Veſſels*, *Tartareous Knots* or *Grains*, and a *Coar*. The *Skin* is lined with a great number of the ſaid *Tartareous Grains*, through a *Glaſs*, about the bigneſs of ſmall *Shot*: whereby it looks withinſide, like the *Skin* of the *Scate* and ſome other *Fiſhes*. Beſides thoſe which grow to the *Skin*, there *Tab. 67.* are alſo many more ſtanding near adjacent to it all round about the *Fruit*: altogether about $\frac{1}{3}^{d}$ of an Inch in thickneſs, through a *Microſcope*; as in a Slice of a *Pear* cut tranſverſly is apparent. Somewhat more or leſs, as I take it, according to the Delicacy or Harſhneſs of the *Fruit*; as more in a *Burgamy*, or other ſoft and ſweet *Pear*, than in thoſe which are called *Strangulatoria*. As all *Vinous Liquors*, and thoſe eſpecially which are the moſt *Tartareous*, become more ſoft and ſweet, according as they caſt off their *Tartar*, in a greater quantity, upon the Sides of the *Veſſel*.

2. §. The Outer *Parenchyma*, is of the ſame Original, and general Structure, as in an *Apple*. But the *Bladders*, anſwerable to the Shape of this *Fruit*, not altogether ſo long, with reſpect to their Bredth. *Tab. 67.* Throughout this *Parenchyma*, are alſo diſperſed many ſmall *Tartareous Grains*; moſt of them ſomewhat round, as thoſe next the *Skin*, and of a like *Size*; but nothing near ſo numerous.

3. §. The *Bladders* here, have alſo a different *Poſition* from that they have in an *Apple*: there, they are all ſo ſtretched out, as to have reſpect to one common Centre, which is that of the *Apple* it ſelf. But here, they every where bear a reſpect to the ſaid *Tartareous Grains*, every *Tab. 67.* *Grain* being the Centre of a certain Number of *Bladders*; like a *Star*, in the midle of its *Vortex*. Whereby, ſo many of the *Tartareous parts* of the *Sap*, as cannot well be thrown off upon the *Skin*, are more commodiouſly diſcharged, upon every little *Knot* or *Grain*, nearer hand.

4. §. Throughout this *Parenchyma*, the *Veſſels* likewiſe are diſperſed. Of the Two general Kinds, for *Sap*, and for *Aer*. The *Aer-Veſſels*, are here extream ſmall, as well as in an *Apple*; yet one degree, larger. They are both together diſtributed into Fifteen principal *Tab. 67.* *Branches*. The Five Utmoſt make as many *Arches*, but commonly not near ſo deep as in an *Apple*. From theſe, ſome ſmall *Fibres*, yet a little more numerouſly than in an *Apple*, are diſperſed throughout the *Parenchyma*. The Ten Inmoſt run along to the *Seed*, and from thence, with the other Five, to the *Flower*.

5. §. Next the *Coar*, ſtands the Inner *Parenchyma*, in divers reſpects different from the Outer. The *Bladders* of the latter, as hath been ſaid, large and long; of the former, ſmall and round, anſwerable to thoſe of the *Pith*, of which it ſeems to be derived. Throughout that, the

the *Veſſels* and *Tartareous Grains* are diſperſed; in this, there are neither. The *Effect* whereof is, that is ſweet, this ſower; for which reaſon, I have taken leave to name it, the *Acetary*. *Tab. 67.*

6. §. Betwixt this and the outer *Parenchyma*, the ſaid *Tartareous Grains* begin, firſt to ſtand nearer together, to grow biger, and of a more unequal Surface; and by degrees, to unite into a *Body*, in ſome *Pears*, and eſpecially towards the *Cork*, almoſt as hard as a *Plum-Stone*; which I have thereupon, named the *Calculary*. So that a *Pear*, is Natures *Preface* or *Introduction* to a *Plum*. *Tab. 67.* *B. 1. Ch. 6.*

7. §. This *Tartareous Body*, and thoſe ſmall *Grains* above ſaid, I have formerly ſuppoſed, to be precipitated out of the *Sap*, by virtue of the *Veſſels*. Which is not only argued from their growing, where the *Veſſels*, only in the outer *Parenchyma*: but in that the very *Bounds* or *Figure* of the *Calculary*, is determined by the *Situation* of the chief of thoſe *Veſſels*; as in cuting a *Pear* ſmoothly through the Centre and by the Length, is apparent. *B. 1. Ch. 6.* *Tab. 67.*

8. §. The *Coar* as well as the *Acetary*, ſeems to be derived from the *Pith*. And is therefore leſſer here, than in an *Apple*, where the whole *Pith* of the *Stalk*, goes to the making of the *Coar* only.

9. §. In moſt *Pears*, at the bottom of the *Coar*, and a little below the Centre of the *Fruit*, there is a kind of ſmall *Umbelical Knot*; from whence is extended a ſtraight *Chanel* or *Ductus*, which opens at the midle of the *Cork* or *Stool* of the *Flower*, ſcarce wide enough to admit the ſmalleſt *Pin*. Made for the *Uſe* hereafter mentioned. *Tab. 67.*

10. §. A QUINCE, is nearly allyed to a *Pear*. The differences betwixt them are theſe; In the *Quince*, the outer *Parenchyma* is more cloſe, that is, the *Bladders* are ſmaller. The *Veſſels* more numerous, and more deeply enarched; the *Calculary* greater, and more ſpread; according to the *Shape* of the *Fruit*: but the *Acetary*, leſs: The *Coar* ſtands higher or nearer to the *Cork*; divided, not into Five, but Four *Cells*. And the *Ductus* from the bottom of the *Coar* to the top of the *Fruit*, much more open and obſervable. *Tab. 67.*

CHAP. III.

Of the PLUM, *and ſome other* Fruits *of the ſame Kindred.*

A PLUM conſiſteth of a *Parenchyma*, the Two general Kinds of *Veſſels*, and a *Stone*. All which I have already deſcribed in the *Firſt* Book. I ſhall here add, and further clear ſome things. And Firſt, it is to be noted, That, in Proportion to the *Bulk* of the *Fruit*, there are more *Veſſels* in a *Plum*, than in an *Apple*, *Pear*, or *Quince*. As alſo, That in *Plums*, all the *Veſſels* are braced together into one Uniform Piece of *Net-Work*, every where terminating at an equal diſtance from the *Circumference*, *ſc.* $\frac{1}{8}$th of an Inch or thereabout. And as for the *Bore* of the *Aer-Veſſels*, although the *Glaſs* I uſed, when I examined this *Fruit*, would not reach it; yet *Ch. 6.* *Tab. 68.*

is it to be presumed, that they bear a just Proportion to those in the *Trunk* of the same *Tree*; and that therefore they are here larger, than in an *Apple* or *Pear*. The *Skin* likewise of a *Plum*, is more *fibrous*, *thick*, and *tough*, than in those *Fruits*. The Ends of these Diversities, we shall presently speak of.

2. §. Of the *Stone*, amongst other particulars wherein the con-
B.1. Ch.6. trivance of Nature is very admirable, I have formerly shewed, That it is composed of Two or rather Three distinct *Bodies*. One of them, the *Lining*; which answers to the *Coar* in a *Pear*. And is originated from the *Parenchyma*, which the *Seed-Branch* brings along with it, through the *Chanel* in the *Side*, and at last into the *Hollow*, of the *Stone*; and is there spread all over it: as when a small *Glass-Pipe*, is blown and expanded into a *Bubble*. Or as if a *Bladder*, being stretch-
Tab. 68. out, and put through the *Neck* of a *Bottle*; were then blown up, so as to be every where contiguous to the *Sides*, and become, as it were, the *Lining* of the *Bottle*.

3. §. The *Foundation* or *Ground* of the Outer and more Bulky *Part* of the *Stone*, is the Iner *Part* of the *Parenchyma*; and answers
Tab. 68. to the *Acetary* in a *Pear*. As the *Fruit* grows, the *Tartareous Parts* of the *Sap*, being continually precipitated upon this *Parenchyma*, it is hereby petrify'd. As will best be seen, by comparing the several *Ages* of the same *Fruit* together. And in some *Stones*; on the Surface
Tab. 68. whereof, some of the said *Tartareous Parts* appear in distinct *Grains*. So that whereas in a *Pear*, the *Calculary* and the *Acetary* are distinct, here in a *Plum*, they are thrown one into the other. Or, as some *Mineral Waters* only make a Crust about a Stick or other Bodies immersed in them; but others, by sinking into these Bodies, do hereby petrify them: So in a *Pear*, the *Tartareous Parts* of the *Sap*, only make a *Crust* about the *Acetary*; but in a *Plum*, they sink into the Body thereof, or that *Part* of the *Parenchyma*, which stands in the place of it, whereby it is converted into a *Stone*. The *Figures* of *Stones* shall hereafter be spoken of, when I come in the next Part, to the *Covers* of the *Seed*.

4. §. AN APRECOCK is of the *Plum-Kind*. But some things are herein better observed. As first, the *Position* of the *Bladders* of the *Parenchyma*. For the *Tartareous Parts* of the *Sap* not being here dispersed, in little *Grains*, throughout the *Fruit*, as in a *Pear*; but all thrown off into the *Stone*: the *Bladders* therefore are so dispo-
Tab. 68. sed, as not to have respect to several *Centres*, as in a *Pear*; but only the *Stone*, to which they all do most exactly radiate; thereto conveying the *feculent Sap*, in so many little *Streams*. This is best seen, when the *Fruit* is full ripe.

5. §. In this *Fruit*, while it is young, the gradual transmutation of the Inner *Part* of the *Parenchyma* into a *Stone*, is also more apparent. And so are the Three *Coats*, which serve for the *Generation* of the *Seed*; being now all very distinct; and remarkable, not only for their *Bulk*; but also, the *Analogy* which they bear to the Three *Membranes* in many *Viviparous Animals*. Whereof I shall give a more particular *Description*, when I come, in the following Part, to the *Covers* of the *Seed*.

6. §. A PEACH hath a much bigger Stone, than either a *Plum*, or an *Aprecock*: and hath therefore, when full ripe, and especially in hot

hot Countries, a more defecated or better fined *Juyce*. For the reason why the *Stone* is so great, is because the *Vessels* run so very numerously through the Body of it; and so cause a more copious precipitation of the *Lees* of the *Sap* thereinto.

7. §. A CHEERY is likewise near related to a *Plum*. But the *Bracement* or *Reticulation* of the *Vessels*, is here carried out further, so as to be all round about contiguous to the *Skin*. And as the *Aer-Vessels* in the *Branch* of a *Cherry-Tree*, are larger than those of an *Apple-Branch*, but less than those of a *Plum-Branch*; so may they be presumed, to bear the same Proportion here in the *Fruit*, *Tab. 69.*

8. §. A WALNUT, is a *Nuciprune*; or betwixt a *Plum* and a *Nut*, as a *Bat* is betwixt a *Beast* and a *Bird*. For the *Rind*, answers to the *Pulp*; and the *Shell*, as the *Stone*, is also lined. But the *Seed-Vessels*, which in a *Plum* run through a *Chanel* made on purpose in the *Stone*; do here enter, as in a *Nut*, at the *Centre* of the *Shell*. By which means, they are invested with a more fair *Parenchyma*; which Nature hath provided, as her *Cloth*, for the making of the *Coats* wide enough for so vast a *Kernel*.

CHAP. IV.

Of the GRAPE, *and* HAZEL-NUT; *with some other* Fruits, *analogous to each of them.*

A GRAPE, is a *Plum* with two *Stones*; for their thickness, as hard as any other. The *Distribution* of the *Vessels* is also somewhat different. For the principal *Fibres* running up directly betwixt the *Stones*; and the smaller, making only one single *Net*, near the Circumference; they all meet together at the *Top* of the *Grape*. It is also to be noted, That many *Lignous Fibres* are visibly mixed with the *Skin* it self: whereby it becomes very thick and tough. And as the *Aer-Vessels* in the *Trunk* of a *Vine*, are greater than in that of an *Apple*, *Pear*, or *Plum*: So is it to be presumed, that in a *Grape*, they are greater than in the *Fruits* of those *Trees*. *Tab. 69.*

2. §. The *Parenchyma* or *Pulp* of a *Grape*, seems to be derived, not from the *Barque*, as in an *Apple*; nor partly from the *Barque*, and partly from the *Pith*, as in a *Gooseberry*: but wholly from the *Pith*; at least, as far as the *Reticulation* of the *Fibres*; and the *Skin* only from the *Barque*; whereby the *Pulp* becomes so tender and delicate a *Meat*.

3. §. A GOOSBERRY, hath a Threefold *Parenchyma*. The Utmost is derived from the *Barque*; of a *Greener Colour*, and very *sappy*. The midlemost, from the *Pith*; somewhat *white*, and more *dry*, as the *Diametral Insertions* in some *Roots*. In both of them, the *Bladders* are very conspicuous, above what they are in any *Fruit*, I at present think of; so as to be visible to a good Eye without a *Glass*. *Tab. 69.*

Tab. 69. 4. §. Betwixt theſe Two *Parenchymas*, do run moſt of the principal *Fibres*, or *Vaſcular Threds*. From which ſeveral ſmaller ones are branched into the Inmoſt *Parenchyma*; upon which, the *Seeds* do hang.

5. §. Each of theſe ſmaller *Branches* is inveſted with ſome part of the midle or white *Parenchyma*. Serving partly to make the *Covers* of the *Seed*; and partly, the *Pulp*, that is, the Inmoſt and fineſt *Parenchyma* of the *Berry*, in which the *Seed* lies.

A *White* CORIN, without taking off the *Skin*, ſheweth not unpleaſantly how the *Seeds* are faſtned. For as the *Trunk* of the *Tree* continues not to any conſiderable Length, entire, as in a *Plum*, but is preſently divided into ſeveral *Boughs*; nor are the Edges of the *Leaf* entire, as alſo in a *Plum*, but ſlit into ſeveral *Lobes*; and the *Fruit*, into a great many *Corins* in a *Bunch*: So again, the *Seeds* do hang upon the *Fibres*, like Two other *Bunches*, in every *Corin*. As by *Refraction*, Objects of all *Sizes* are repreſented on the *Walls* of the *Eye*. The *Operations* of *Nature* being every where Uniform: and ſometimes the ſame in ſmall, tranſcribed from a greater *Copy*.

Tab. 69. 7. §. A NUT, is a *Plum* inverted, or turned inſide outward. For the *Shell*, ſtanding naked, includes the *Parenchyma*: the bearded *Cap*, not preciſely anſwering to *that*, but to the *Empalement* of the *Flower*; which likewiſe in many other *Plants*, out-lives the *Foliature* and Emboſomes the *Uterus* of the *Seed*. And whereas the *Stone* of a *Plum* is not Faced, but Lined with a *Parenchyma* derived at ſecond hand from the *Pith*: The *Shell* of a *Nut* is not Lined, but Faced with the iner *Skin* of the *Cap*.

8. §. AN AKERN, is the *Nut* of an *Oak*. Yet with this difference; That beſides the *Cup*, it ſtands in, it hath only a *Leathern* or *Parchment Cover* inſtead of a *Shell*. From whence it come to paſs, that whereas the *Kernel* of a *Nut* is ſweet; that of an *Akern*, is of a very rough *Taſt*: the *Auſtere Parts* of the *Sap*, which in a *Nut* are drained off into the *Shell*, being here imbibed by the *Kernel* it ſelf.

CHAP. V.

Of the SEED-CASE *or* MEMBRANEOUS UTERUS.

THE forementioned *Fruits*, I ſhall ſubjoyne, in ſome Examples, the *Deſcription* of the *Seed-Caſe*, which is analogous to the *Fruit*. For the *Fruit*, ſtrictly ſo called, is, *A Fleſhy Uterus, which grows more moiſt and Pulpy, as the Seed ripens*. But the *Seed-Caſe*, whether it be called a *Cod*, *Pod*, or by any other name, is, *A Membraneous Uterus, which as the Seed ripens, ſtill grows the more dry and hard*: as in moſt *Plants*.

2. §. THE SEED-CASE, is either originally open; Or only when the *Seed* is ripe; Or never opens at all, till the *Seed* be ſown. Of the firſt Sort, is that of *Luteola*; as alſo of *Clary*, *Sage*, *Hyſop*, and the

the like: wherein one and the ſame *Part*, is both the *Empalement* of the *Flower*, and when that is gone, ſurvives as the *Caſe* of the *Seed*.

3. §. Of the Laſt, is that of *Myagrum Monſpermon*, *Lithoſperme*, all the *Stones* of *Fruits*, with divers others. And ſome *Caſes*, which are ſoft, as, I think, that of *Garden Radiſh*. The former, by cleaving in ſome *part* or other; theſe only by roting under Ground.

4. §. THAT of *Garden Radiſh*, is a Light and Spongy or Pithy *Body*; originally, every where entire. But, as it ripens, breaks within, into ſeveral White and Dry *Membranes* round about the *Seed*. By the Length and about $\frac{1}{8}$th of an Inch diſtant from the *Sides* of the *Caſe*, do run a pair of little *Vaſcular Ropes*. Some ſmaller *Fibres* are from theſe tranſmitted to the *Sides* of the *Caſe*; by which they are kept tite and ſteady. Upon divers others produced towards the *Centre*, hang the *Seeds*, like Two *Ropes* of *Onions*. *Tab.* 70.

5. §. Of thoſe which open ſo ſoon as the *Seed* is ripe; ſome are made to open at the *Top*, as *Popy Heads*; Some on the *Side*, as moſt *Cods*; and ſome at the *Bottom*, as that of *Coded Arſmart*.

6. §. THE *Popy-Head*, is a little *Dove Coat*; divided by Eight or Ten *Partitions*, into ſo many *Stalls*. On both *Sides* the *Partitions*, hangs a moſt numerous *Brood* of *Seeds*. The *Partitions* and *Sides* of the *Head*, are made of the *Barque*, and Lined with the *Pith*. While young, they are very *thick* and *ſpongy*; and together with the *Seeds*, do then fill all up. The *Head* is then alſo every where entire; but as it dries, it gradually opens at the *Top*, into ſeveral *Windows*, one for every *Stall*: which are all covered with a very fair *Canopy*. A *Fabrick* deſigned for ſeveral purpoſes, as ſhall hearafter be ſaid. *Tab.* 70.

7. §. Of thoſe which open on the *Side*; ſome are made to open, only on One *Side*; ſome, on both *Sides*; ſome, with Three *Sides*; ſome, with more; and ſome horizontally or round about.

8. §. THE COD of *Garden Bean* (and ſo the reſt of the *Leguminous* kind) opens on one *Side*. It hath a Twofold *Parenchyma*. The Utmoſt derived from the *Barque*: in which ſtand all the *Veſſels*, in ſeveral *Parcels*; one whereof, at the *Back* of the *Cod*, is much larger than the reſt, ſhaped like a *Copula* uſed in *Schemes*; from whence ſhoot thoſe leſſer *Fibres* upon which the *Beans* do grow. *Tab.* 70.

9. §. The Inner *Parenchyma* is derived from the *Pith*. Upon its Nativity, and for ſome time afterwards, entire and wholly compoſed of *Bladders*, as the Outer. From the *Baſe* of the *Cod* they are gradually enlarged, ſo as to compoſe this *Parenchyma* into a very ſoft and delicate *Sponge*. In which (the *Cod* being well grown) the very *Threds* whereof the *Bladders* were woven, are many of them ſo looſe and ample, as eaſily to be drawn out (as in the uroaving of *Knit-work*) to a conſiderable Length, fairly viſible through an ordinary *Glaſs*. *Tab.* 70.

10. §. This may further confirm all that I have formerly ſaid of the *Fibrous Texture* of the *Pith*, and of all the other *Parenchymous Parts* of *Plants*. *B.* 2. *P.* 1. *Ch.* 5. & *B.* 3. *P.* 1. *Ch.* 4.

11. §. THE *Seed-Caſe* of *Medica*, is a *Cod* wound up: in the *Echinata*, *Spirally*; in the *Tornata*, by an *Helix*. Not finiſhed all together; but, upon the fall of the *Flower*, beginning to wind, continues its *Circles*, till it be come to its full *Growth*.

12. §. THE *Seed-Case* of *Yellow Henbean* opens on both *Sides*. On the *Top*, is erected a *Colum*, about ½ an Inch long; which, as the *Case* swells, gwros leſs, and at laſt falls off. On the *Sides* of the *Uterus* or *Case*, Two *Vaſcular Fibres* run oppoſitely from the bottom to the top, and ſo into the *Colum*. Along the *Tract* of theſe *Fibres*, the *Case*, as it ages, gradually cleaves on both *Sides* aſunder. *Tab. 70.*

13. §. The *Case* is lined with a dry and thin *Parchment*, as ſmooth as *Glaſs*. In the *Centre* of the *Case*, ſtands a great *Parenchymous Boſs*, which is, as it were, the *Bed* or *Placentula* of the *Seeds*; which lie all over it, as in a *Strawberry*. And ſo in many other *Plants*. Throughout this *Bed*, the *Veſſels* for the *Generation* and *Nouriſhment* of the *Seeds*, are diſtributed; one very ſmall *Fibre*, ſhooting, from the direct ones, obliquely into each *Seed*. *Tab. 70.*

14. §. THE *Seed-Case* of *Tulip*, opens with Three *Sides*; being, when young, a *Priſm* or long *Triangle*. From the midle of each *Side*, a *Partition* or *Boord* is produced; all three meeting in the *Centre* of the *Case*; and ſo parting it into Six *Stalls* for the *Seed*. The inſides hereof, are, lined with a thin ſmooth and gloſſy *Parchment*, like that in *Hen-bean*; derived from the *Pith*; as the outſide, from the *Barque:* and ſo in many other *Seed-Caſes*. *Tab. 71.*

15. §. The *Veſſels*, after they riſe above the *Stalk*, are diſpoſed with great *artifice*. For firſt, they are divided into Three principal *Branches*, which run a long the Three *Angles* of the *Case*; where the Three *Sides*, as it ages, gradually cleave aſunder. From theſe chief *Branches*, at the Three *Angles*, divers leſſer ones run horizontally, and meet at the midle of each *Side*. From whence again, many yet ſmaller ones are produced through the bredth of each *Partition* to their Edges in the *Centre* of the *Case*. Where, once more, they are diſtributed into very fine and ſhort *Threds*, whereupon hang the *Seeds*. *Tab. 71.*

16. §. THE *Seed-Case* of *Stramonium* or *Thorn Apple*, is divided into Four *Cloſets:* Not open one into another, as in *Poppy*, *Tulip*, &c. but ſo many diſtinct *Incloſures*. In the midſt of each *Cloſet* ſtands a *Colum*, joyned to the *Side* of the *Cloſet* by a *Wall* or *Lamine*. Through the Length of the *Colums* run ſeveral greater and leſſer *Branches* of *Veſſels*, from whence others are obliquely produced, upon which the *Seeds* grow. *Tab. 71.*

17. §. THE *Seed-Case* of *Anagallis* or *Pimpernel*, is a little *Globe*; which opens not by its *Meridian* or *Vertically*, as do the former; but by its *Horizon*. For divers very ſmall *Fibres*, being produced from the *Stalk* to the midle of the *Case*; do there fetch a *Circle*, and ſo divide it exactly into Two *Hemiſpheres:* the Uppermoſt of which, when the *Seeds* are ripe, falleth off; and ſo the wind ſowes them. *Tab. 71:*

18. §. THE *Seed-Case* of *Coded Arſmart*, neither opens at the *Top*, nor on the *Sides*, as do all the former; but at the *Bottom*. It is compoſed of Four *Sides:* the Outer Part of which, is ſofter and more *ſucculent*; the Inner a tite and ſtrong *Membrane*. In the *Centre* of the *Case*, is erected a *Pole* or *Colum* upon which the *Seeds* do all hang very looſely. *Tab. 71.*

19. §. From this *Mechaniſm*, the manner of that violent and ſurpriſing *Ejaculation* of the *Seeds*, is intelligible. Which is not a motion originally in the *Seeds* themſelves; but contrived by the *Structure* of the *Case*. For the *Seeds* hanging very looſe, and not on the *Sides* of the

the *Caſe*, as ſometimes, but on the *Pole*, in the *Centre*, with their thicker end downward, they ſtand ready for a diſcharge: and the *Sides* of the *Caſe* being lined with a ſtrong and Tenſed *Membrane*, they hereby perform the office of ſo many little *Bows:* which, remaining faſt at the *Top*, and (contrary to what we ſee in other *Plants*) opening or being *lett off* at the *Bottom*, forceably curle upward, and ſo drive all the *Seeds* before them.

CHAP. VI.

Of the USE of the Parts *to the* Fruit.

IN the forgoing *Deſcriptions*, I have already mention'd the *Uſe* of the *Parts* in ſome particulars. I ſhall now a little further explain the manner of their ſervice, both to the *Fruit*, and to the *Seed*.

2. §. And firſt, the *Veſſels* ſerve for the *Figuration* of the *Fruit*. So in an *Apple*, the Ten great and utmoſt *Branches* ſerve not only to nouriſh and feed it; but alſo, by the *Arched Lines* they draw, to direct and govern the *Growth* thereof into an orbicular *Figure*. The *Dilatation* of theſe *Veſſels*, not being hindred by any *Braces* or *Conjunction* with the *Interior* ones. By the *Slenderneſs* of the *Aer-Veſſels*, as in the *Root*, ſo here in the *Fruit*, much promoted. And by their *Saline Principle*, firſt begun.

3. §. The Five midlemoſt and the Five Inmoſt ſerve together, to figure the *Coar*; the former bounding the Outer, the Latter, the Iner *Angles*. For were they only Five, or were all Ten in the ſame *Circle*, they would only make a round *Cavity* like that of a hollow *Pith*. Hence it is that *Apples*, in which ſome ſmall *Threds* of the *Veſſels* ſtrike out into the *Circumference*, are very Uneven with divers *Knobs* and *Ridges*. But *Plums*, *Cherries*, &c. where the *Veſſels* all terminate at an Equal diſtance from the *Skin*, are Even all round about.

4. §. The *Bulk* of the *Fruit* dependeth alſo on the *Braces* of the *Veſſels*. For in *Plums* and *Cherries*, they are more numerous; but in *Apples* and *Pears* they are very looſe one from another, and ſo have liberty left them to ſpread abroad.

5. §. As alſo on their *Size*; that is, on the *Size* of the *Aer-Veſſels*. Which, the leſs they are themſelves, they ſerve to make a bigger *Fruit*. As the leſs they are in any *Root*, they ſerve to make it the more ample. For the leſs they are, the more pliable to the *Attraction* of the *Aer:* and in their *Growth* muſt make ſo many more ſpiral *Rings:* by both which means, they make the greater *Arches*. And therefore a *Pear* is commonly a ſmaller *Fruit* than an *Apple*; a *Plum* than a *Pear*; and a *Grape*, than a *Plum*; in all which the *Aer-Veſſels* are ſtill greater and greater.

6. §.

6. §. From the ſame Cauſe, it is alſo moſt agreeable, That the *Fruit* ſhould not come before the *Leaves* or *Flower*, but laſt of all. For the *Aer-Veſſels*, as hath been often noted, are not exactly *Cylindrick*, but tapered; that is, not only the *Fibres* conſiſting of divers of theſe *Veſſels*, but the *Veſſels* themſelves, as they aſcend into the *Trunck*, *Branches*, *Leaves*, *Flower*, and *Fruit*, grow ſtill more and more ſlender. So that the ſmalleſt coming laſt, and being the moſt pliable; they are alſo beſt accommodated for the *Expanſion* of the *Parenchyma* into that we call the *Fruit*.

7. §. It is likewiſe a proper Queſtion to be asked, How it comes to paſs, That ſome *Plants* bear a *Fruit*, and not all? I anſwer, That as the *Size* of the *Aer-Veſſels* conduceth to the *Bulk* of the *Fruit*, and the Order of its Growth: So the *Number* of them, to their being, or not being, any *Fruit* at all. For the *Fruit*, as we have already defined it, is an *Uterus*, which grows moyſter and ſofter, as the *Seed* ripens. The reaſon therefore, why the *Uterus* in ſome *Plants*, continues moiſt and ſoft after the *Seed* is ripe; and in ſome, dries up; is, Becauſe in the former, there is a ſmaller, in the latter, a greater Quanty of the *Aer-Veſſels* in proportion to the other *Parts* of the *Uterus*, and ſo a greater quantity of *Aer*. Which as in the *Pith* of moſt *Plants*, ſo here, by degrees excludes the *Sap*, or rendring it more evaporable, comes in the room of it; and ſo the *Uterus* is dryed up: that is, there is no *Fruit* produced, but only a *Seed-Caſe*.

8. §. From the *Size*, *Number*, and *Poſition* of all the *Veſſels* in *Fruits* a reaſon alſo may be given, for the diverſity of their *Taſts*. Some Inſtances have before been given; to which I ſhall add one or two more. So the *Rind* of an *Orange*, is bitter; the *Pulp*, ſower. Becauſe the former is furniſhed with many *Lignous Veſſels*, the *Sulphureous* or *Oyly Tincture* whereof, being copiouſly mixed with the *Acid* of the *Parenchyma*, produce that *Taſt*. Whereas the *Pulp*, which is very ſower, is void of all manner of *Veſſels*. But if the *Sap-Veſſels* are either leſs numerous or leſs *Sulphureous*; they give ſo mild a *Tincture* to the *Parenchyma*, as not to produce a bitter, but a ſweet or ſoft *Taſt*; as in *Apples*, *Grapes*, *Goosberries*, &c. And of a *Goosberry*, it is particularly to be noted, that whereas, in a *Limon*, the *Pulp* only is ſower, as being void of *Veſſels*: here, on the contrary, the *Pulp* only is ſweet, whereinto all the *Veſſels* ſtrike, and the *Rind* ſower.

9. §. The diverſities of the *Skin* it ſelf, have their *Uſe*. And therefore, the more tender and delicate the *Fruit* is; the *Skin*, on the contrary, is thicker and more tough. So *Apples* have a thicker *Skin*, than *Pears*; *Plums*, than *Apples*; and *Grapes* than *Plums*; thoſe having as it were, only a *Coat* of *Kid*, but this of good thick *Buff*. And therefore ſome *Fruits*, although tender, yet either not having ſo rich a *Juyce*, or coming early, and ſo not being expoſed to exceſſive heats, have a very thin *Skin*, as *Mulberries*, *Strawberries*, &c.

CHAP.

CHAP. VII.

Of the USE of the Parts *to the* Seed. *And the TIME, in which the* Uterus *or* Fruit *and* Seed-Case *are formed.*

AND first, for example, in an *Apple*, the Five Inmoſt *Branches*, do beſt ſerve for the *Generation* of the *Seed*; theſe running into the *Attire* of the *Flower*, and ſo carrying off the moſt *Aerial Spirit* from the *Seed*; by which means, it becomes a more compact and denſer *Body*, than the *Fruit*, and ſo more accommodate to the proceſs of *Vegetation*; as hath formerly been ſhewed. *P. 2. Ch. 5. §. 5.*

2. §. The *Elongation* likewiſe of the *Seed-Veſſels*, in the *Fruit* and *Caſe*, ſometimes directly, as in *Plums* and *Nuts*, and ſometimes by ſeveral *Ambages* before they ſhoot into the *Seeds*, as in *Tulip*; ſhewes a deſign for the higheſt refining and maturation of the *Seminal Sap*.

3. §. Chiefly by means of the Inmoſt *Veſſels*, is made that *Chanel* in ſome *Pears*, and eſpecially in *Quinces*. For theſe periſhing with the *Flower*, the circumjacent *Parenchyma* ſhrinks up, leaving the ſaid *Chanel* in the midſt. Deſigned for an inlet to the *Aer*, for the better drying of the *Seeds*; which here ſtand the more in need of it, becauſe encompaſſed with a *Mucilage*.

4. §. For the better drying of the *Seed*, and the disburſing or ſowing of it in due time, the opening of the *Caſe* is, in the ſame manner, alſo contrived: either at the *Top*, as in *Popy*; or on the *Sides*, as in *Tulip*, *Pimpernel*; or at the *Bottom*, as in *Codded Arſmart*. All which openings are effected by the running of the *Aer-Veſſels* along thoſe places: for by drying the *Parenchyma* next adjacent, they cauſe it to chop and cleave aſunder.

5. §. Of the *Seed-Caſe* of *Poppy*, it is particularly to be noted, That as the ſeveral *Windows*, ſerve to let in *Aer*, for the drying of the *Seeds*, after their full Growth: So the *Canopy* over them, ſerves to keep out *Rain*. For here, the *Caſe* not cleaving down the *Side*, as it uſually doth; ſhould the *Rain* get in, it would ſtand in it, as in a *Pot*, and ſo rot the *Seeds*. And as the *Canopy* ſerves to preſerve the *Seeds*; ſo the ſeveral *Partitions* or *Walls*, for their better *Stowage*. For by an eaſie ſurvey of this little piece of Ground, it is plain, that as they ſtand on both *Sides* every *Wall*, there is as much more Ground for them to ſtand upon, as if there were no parting *Walls*, but the *Seeds* ſtuck all round about upon the *Ambit* or *Sides* of the *Caſe*; or upon a great *Bed* or *Placenta* within it, as in *Hyoſcyamus*, *Anagallis*, &c. where there is a leſs numerous *Brood*.

6. §.

6. §. The *Coar* likewiſe, by ſtanding betwixt the moyſt *Parenchyma* and the *Seed*, and being hollow and ſo filled with *Aer*; doth much conduce to the ripening and drying of the *Seed*, and its greater fitneſs both for keeping, and ſowing. So the *Parchment Lining* of the *Seed-Caſe*, as in *Hyoſcyamus*, &c. is anſwerable to a *Coar*.

7. §. The *Parenchyma* ſerveth, amongſt other purpoſes, for the *Genèration* of the *Covers* of the *Seed*; as in ſome inſtances hath been ſhewed. For which intent, ſometimes the *Exterior Parenchyma*, as in a *Limon*; ſometimes the midlemoſt, as in a *Goosberry* or *Cucumer*, is ſubſervient; both of them, in thoſe *Fruits*, being more white and dry, than the reſt, and ſo fiter to make the *Covers* of the *Seed*.

8. §. The *Parenchyma* is alſo of uſe for the warmth of the *Seed*; as in the *Seed-Caſe* of *Garden Radiſh*. Wherein, as it ripens the *Parenchyma* gradually drys, breaks, and ſhrinks up into ſeveral ſoft *Membranes*, in which the *Seeds*, in the Centre of the *Caſe*, lie ſwadled, as in ſo many fine *Calico Clouts*.

9. I SHALL conclude with obſerving the *Time* of the *Generation* of the *Fruit* and *Seed-Caſe*. This hath hitherto been thought to be initiated upon the opening, I ſay not, the forming, but the opening of the *Flower*, or not long before. Notwithſtanding which, what I have formerly ſaid of the *Flower*; I now do the like, of the *Uterus* it ſelf; *ſc.* That in very many *Plants*, 'tis formed, with the *Flower*, the year before it appears and comes to its full *Growth*. As for inſtance, in *Azarum*, *Tab. 71.* not only all the *Parts* of the *Flower*, but the *Uterus* it ſelf, and there in alſo the outer *Cover* of the *Seed* of any one year, are perfectly formed in *Auguſt* or *September* of the year foregoing. The like may be ſeen in *Tulip*, *Mezereon*, *Corin*, and many other *Perennial Plants*.

THE

THE
ANATOMY
OF
SEEDS,

PROSECUTED

With the bare EYE,

And with the

MICROSCOPE.

The Figures presented to the *Royal Society*, *in the Year* 1677.

The FOURTH PART.

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LONDON,

Printed by *W. Rawlins*, 1682.

Mo.Bot.Garden, H h
1902.

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THE

THE ANATOMY OF SEEDS.

PART IV.

CHAP. I.

Of the FIGURES of Seeds.

THE *Figures* of *Seeds*, or rather of their outward *Covers*, are made ſuitable, Partly to their *Collocation* in the *Uterus*, as the *End*. So thoſe of *Mallow*, ſtanding like a Coronet round the *Stalk*, are of a wedged *Figure*; whereby their ſharp Edges do all meet together in one *Centre*. Partly, to the various diſtribution of the *Veſſels* or *Fibers*, as one *Cauſe*: by which the *Meaſures* and *Surface* of *Seeds*, as well as of the *Leaves* of *Plants*, are diverſified. And partly, to the Nature of the *Saline* and other *Principles* regent in a *Plant*, as another principal *Cauſe*. And therefore the more *ſtony*, *brittle*, or full of *Salt* the *Covers* of any *Seeds* are, they are generally more *angular*, and their *Figure*, whether *angular* or not, more conſtantly obſerved. So the *Tartareous Stone* of a *Plum*, is not only more *angular*, but alſo more regular than the Husk of the Kernel of a *Pear* or *Apple*.

2. §. For all Stones are meaſured by ſeveral *Circles*, whoſe *Diametres* hold a certain proportion to the Length of the *Stone*; in the ſame manner as hath been ſhewed in the deſcription of the *Leaf*. So the *Stone* of the *Peaſe-Cod-Plum*, is meaſured by two *Circles*. That of the *Turkey-Plum* with Four. That of the *Aprecok-Plum*, with Two repeated oppoſitely; being perfectly *Rhomboid*. To which, thoſe alſo of the *Wheat-Plum*, *Damaſceen*, and ſome others, allude. And ſome are meaſured be four *Circles*, and one repeated. *P.* 1. *Ch.* 3. *Tab.* 72.

3. §. The *Figures*, not only of the larger sort of *Seeds*, but even of the smalleſt, have much and elegant variety. We will take the pleaſure of comparing theſe which follow.

4. §. And firſt of all, ſome are perfectly *Spherick*, and with an even *Surface*; as that of little *Century*. That of *Spergula* is alſo *Spherick*; but hath a knobed *Surface*, and is encompaſſed with a *Membraneous Rimm*, like the *Horizon* of a Globe. That of little *Celandine* is Circular, but compreſſed like a *Cheeſe*. *Tab.* 73.

5. §. Others are *Nephroideous*, or as it were *Hemiſpherick*. Of which *Figure*, and hereunto approaching, there are a greater number than of any other; as that which agrees with the more frequent *Shape* and *Fold* of the *Lobes* and *Radicle* of the *Seed*, as ſhall be ſeen. Yet with ſome difference, as to their *Shape* and *Surface*. So, that of *Lychnis Sylveſtris* is figur'd juſt like the kidney of a *Cat*; and hath a knobed *Surface*. That of *Poppey* comes near it in *Shape*; but hath a *Surface* exactly like that part of the *Paunch* of a *Sheep*, called the *Hony-Coome*. That of great *Celandine*, is a little more oblong; and ſo, like the Kidney, not of a *Cat*, but of a *Sheep*: chequered with parallel *Rings* and other ſhort *Lines* placed alternately betwixt them. *Tab.* 73. *Tab.* 73.

6. §. Where, by the way, we may ſee, as well by the *Seed*, as by the other *Parts*, of how different kinds, the Great and Little *Celandine*, notwithſtandig their Names, are to be eſteemed.

7. §. The *Seed* alſo of *Ben* or *ſpatling Poppey* is ſomewhat like a *Kidney*: but hath its Circumference raiſed up into a double *Ridg*: to which ſeveral ſmall *Ridges* do in ſome ſort alſo radiate frome one *Centre* *ſc.* the *Baſe* of the *Seed*. *Tab.* 73.

8. §. The *Seed* of *Chickweed*, is partly like a *Kidney*, and partly like a little *Retort*. As alſo that of *Pentaphil. fragiferum*. But the former is rough caſt with ſmall pieces having as it were feet on each ſide, like little *Inſects*. With which, the *Seed* of *Leuchanthemum* (which may be called, the *Giant-Chickweed*) doth much agree. The latter, hath ſeveral *Fibrous Ridges*, reſembling the *Fibres* in the *Auricles* of the *Heart*; or runing from the noſe to the Circumference, ſomewhat like the *Azymuth Lines* on a *Quadrant*. *Tab.* 73.

9. §. Some are *Oval*; as that of the little *Bell*, and rough caſt with *Fibres* almoſt parallel and produced by the Length of the *Seed*. In which latter reſpect, the *Seeds* alſo of *Trachelium* and ſome other like *Plants*, are agreeable. That of *Brooklime*, is alſo *Oval*, but encompaſſed with a thick *Rimm*, narrowing all the way to the *Baſe* of the *Seed*. *Tab.* 73.

10. §. The *Seed* of *Dovesfoot* hath an *oval Cone*, and a flat *Baſe*. Its *Surface* favous, like that of *Poppy*, *Toad-flax*, and ſome other *Seeds*. That of *Sedum minus æſtivum luteum*, is in a manner the *Figure* of the former inverted, being flat, not at the *Baſe*, but on the *Top*. And whereas that riſes with a blunt *Angle*, this hath only a *Ridg*, raiſed above the *Surface* of the *Seed*. *Tab.* 73.

11. §. The *Seeds* of divers ſorts of *Graſs*, are more *Conick*, as particularly of that, which for the likeneſs its *Seed* hath to a *Barly Corn*, may be called *Barley-Graſs*. And I little doubt, but that among the ſeveral ſorts of *Graſs*, there are ſome which anſwer to all the kinds of *Eſculent Grains*, as *Oat-Graſs*, *Rice-Graſs*, *Wheat-Graſs*, *Rye-Graſs*. And accordingly, that they may be more profitably ſown in one Ground, than in another; and uſed with diſtinction, for the higher, or more *Tab.* 73.

wholſome

wholsome feeding of Cattle. A *Rush*, though it seems an imperfect *Plant*, yet besides its *Flower*, hath also a plentiful brood of *Seeds* of a *Conick Figure.*

12. §. Some *Seeds* are *Cylindrick*, as that of St. *Johns-wort*, as also of *Tutsan*, and some other like *Plants*, with some little diversity in the *Shape* or *Surface* of the *Seed.* That of *Vervain*, is in a manner, half a *Cylinder*: the true *Seed* lying in the *Covers*, like a Child, in a Cradle without an head. *Tab.* 73.

13. §. Others are rather *Conico-Cylindrick*, as that of *Jacobæa*; having a Coronet on the top, and several furrows by the Length round about. Answerable to which, is that of *Erygerum*; in *Shape* not unlike to a *Rowling-pin.* *Tab.* 73.

14. §. Some are *Plani-Conick*, as that of *Nettle*, which is shaped somewhat like the end of a *Speer.* That of *Eye-bright* is more *Eliptick*; with several *Ridges* running by the Length; and joyned together with short pieces transversly, as in the looping of *Lace.* That of *Wormwood* not very unlike a little flat *Essence-Glass:* in which, the *Fibres* are produced by the Length, as the *Ridges* are in *Eye-bright.* And so in *Yarrow*, which is also encompassed with a *Membraneous Rimm.* That of *Dandelyon*, is *Plani-Conick* towards the *Base.* And so those of *Lettice*, *Sonchus*, and some others. To which, those also of *Hieraceum*, *Tragopogon*, *Scorzonera*, &c. with respect to their *Surface*, do all allude. *Tab.* 74.

15. §. And some are *Conico-Triangular.* Of which, that of *Sorrel* is *Conick* at both ends; the sides equal; and upon every *Angle*, hath a narrow and sharp *Rimm.* As also that of *Anagallis*; but the *Sides* are *Spheri-conick*, and so the ends are blunt. They are also pounced with many little round *Cavities.* But have no *Rimm* upon the *Angles.* *Tab.* 74.

16. §. The *Seed* of *Nigella* is *Triangular*, and *Conick* only at the *Top.* On every *Angle*, hath a narrow *Rimm*; the three *Sides* equal, and *Spheri-conick*; surrounded with seven or eight *Ridges* by the girth, joyned together in some places with others transversly. That of *Arsmart*, is also *Triangular* and *Conick* at the *Top.* But one of the *Sides* is almost equal to the other two; which stand low. That of *Knot-Grass* hath three *Sides*, one less than another; being as 5, 3, and 2, or thereabout. *Tab.* 74.

17. §. The next (which I take to be the *Seed* of a sort of *Bugloss*) is very oddly *figured.* The *Base*, *oval*; the *Top*, *conick*; the *Back*, swelling and round as an *Egg*; the *Belly* also swelling, but rising up into an obtuse *Angle* highest in the midle, somewhat like a *Breast-piece* of *Armour*: and is encompassed with a *Rimm* sloaped upward. *Tab.* 74.

18. §. That of *Moldavian Bawm*, is *Triangular*, and *Conick* only at the *Base.* The place where it is fastned, shaped like the Beard of a Dart. Two of the *Sides* are *Plani-conick*, the Third *Sphericonick*, and near as big as both the other two. The *Head* flat, with a *Rimm* erected upon each *Side*, so as to make a *Spherical Triangle.* Approaching to this, are those of *Sage*, *Horehound*, *Clary*, &c. *Tab.* 74.

19. §. That also of *Bellis Tanaceti folio*, hath two *Sides Planiconick*, and a third *Sphericonick.* The two first have several *Ridges* running to the *Base.* Which is not perfectly *conick*, but a little dilated into two obtuse *Angles.* The *Head Triangular*, with one *Side* convex, *Tab.* 74.

the

the other Two ſtraight, a little hollowd, and having a ſmall pinacle in the *Center*.

20. §. That of *Stæchas Arabica*, as the former, ſaving, that the *Head* is *oval*, and the *Baſe* ſloaped into a little *Triangle*. That of *Wartwort* or *Sun-Spurge*, hath a very complex *Figure*. The *Belly* conſiſteth of two *Planiconick* Sides, as the former; the Back, *Sphericonick*. The whole *Seed*, in a manner, *Conick-oval*. Yet the *Baſe* and *Head* both flat. In the midle of the former, a Peg by which the *Seed* is faſtned; and of the latter, a poynted *Knob*. The midle of the *Belly-Sides*, hollowed, ſo as to make a flat *Rimm* of equal *Bredth*; and the hollows filled up with *Bladders* like thoſe in all the *Parenchymus Parts* of a *Plant*. *Tab.* 74.

21. §. Laſtly, there are ſome *Seeds* which are ſquare. Whereof ſome are ſtraight, as that of *Fox-glove*; which hath alſo an even *Surface*: And that of *Blattaria*, in which there are ſeveral little hollows in even Rows. And ſo in *Brounwort*. *Tab.* 74.

22. §. And ſome *Convex*, as that of *Chryſanthemum Americ.* 'Tis *Quadrati-conick*, or ſquare and ſharp at the *Baſe*, and big at the *Head*. The *Sides* all plain; and a thin *Rimm* erected upon every *Angle*. As alſo on the four *Sides* of the *Head*, which is flat, with a little *Pinacle* in the midle. *Tab.* 74.

23. §. The *Seed* alſo of *Tanſey*, is a *Conick* and bended ſquare not with the *Angle* forward, as the former, but the *Side*. And in the place of every *Rimm*, hath a round *Ridge*. Somewhat like to this, are thoſe of *Febrifuga*, *Mayweed*, and ſome others. Thus far of the *Figures* of *Seeds*. *Tab.* 74.

CHAP. II.

Of the NUMBER *and* MOTIONS *of* Seeds.

NATURE hath ſecured the *Propagation* of *Plants* ſeveral ways, but chiefly by the *Seed*: for the *Production* of which, the *Root*, *Leaves*, *Flower*, and *Fruit*, do all officiate, as hath been ſhewed. And according as the *Plant*, or the *Seed* it bears, is more liable to be deſtroyed, Proviſion is made for *Propogation*, either by a greater number of *Seeds*, or other ways. So the *Seeds* of *Strawberry*, being gathered, or eaten by *Vermin*, with the *Fruit*; the *Plant* is therefore eaſily propagated by *Trunk-Roots*. So *Poppy*, being an annual *Plant*, is highly prolifick: for inſtance, the *White Poppy*; which commonly bears about four mature *Heads*, in each of which, there are at leaſt ten *Partitions*, on both ſides whereof, the *Seeds* grow; and upon $\frac{1}{4}^{th}$ part of one ſide, about 100 *Seeds*; that is, 800 on one *Partition*: which being multiplied by 10 (the number of *Partitions*) makes 8000; and 8000 again by 4 (the number of *Heads*) makes 32000 *Seeds*, the yearly product of that *Plant*.

2. §.

2. §. So in *Typha major*, the *Seeds* being blow'n off and ſow'n (as the Eggs of many *Fiſhes* ſpawn'd) with great hazard, they are ſtrangely numerous. For as they ſtand altogether upon the *Spike*, they make a *Cylinder* at leaſt ſix Inches long, and near $\frac{5}{8}$ths of an Inch in Diametre, or an Inch and $\frac{1}{4}$ about. Now 9 of theſe *Seeds*, ſet ſide to ſide, as they ſtand on the *Spike*, make but $\frac{1}{8}$th of an Inch; ſo that 72 make a line of an Inch in Length. But becauſe upon the *Spike*, the *Hairs* belonging to the *Seeds* come between them; we will abate 10, and count but 62. To which $\frac{3}{4}$ths of 62, that is (without the Fraction) 46. being added, makes 108 for the Circuit of the *Cylinder*. And the *Cylinder* being ſix Inches long, there are ſix times 62, that is, 372, for a Line the length of the *Cylinder*. Which number being multiplied by 108, produceth 40176 the number of *Seeds* which ſtand upon one *Stalk*; and ſo, upon three *Stalks*, which one *Plant* commonly bears, there are in one year, above a hundred and twenty Thouſand *Seeds*.

3. §. SO SOON as the *Seed* is ripe, Nature taketh ſeveral *Methods* for its being duly ſow'n: not only in the opening of the *Uterus*, as in ſome Inſtances (*a*) hath already been ſeen; but alſo in the make of the *Seed* it ſelf. For *Firſt*, the *Seeds* of many *Plants*, which affect a peculiar *Soil* or *Seat*, as of *Arum*, *Poppy*, &c. are heavy and ſmall enough, without further care, to fall directly down into the Ground: and ſo to grow in the ſame place where themſelves had their *Birth*.

(*a*) *P.* 3. *Ch.* 5. *Tab.* 70, & 71.

4. §. But if they are ſo large and light, as to be expoſed to the wind, they are often furniſhed with one or more *Hooks*; To ſtay them from ſtraying over far from their proper place, till by the fall of *Leavs* or otherwiſe, they are ſafely lodged. So the *Seeds* of *Avens* have one ſingle *Hook*, thoſe of *Agrimony* and *Gooſe-graſs*, many; both the former, loving a *Bank* for warmth, the latter, a *Hedge* for its ſupport. *Tab.* 72.

5. §. On the contrary, many *Seeds* are furniſhed with *Wings* or *Feathers*. Partly, with the help of the Wind to carry them, when they are ripe, from off the *Plant*, as thoſe of *Aſh*, *Maple*, *Orach*, &c. leaſt ſtaying thereon too long, they ſhould either be corrupted, or miſs their ſeaſon. And partly, to enable them to make their flight, more or leſs, abroad: that ſo they may not, by falling together, come up too thick; and that if one ſhould miſs a good *Soyl* or *Bed*, another may hit. So the *Kernels* of *Pine* have wings not unlike to thoſe of ſome *Inſects*; yet very ſhort, in reſpect of the weight of the *Seed*; whereby they flye not in the *Aer*, but like domeſtick *Fowls*, only flutter upon the Ground. But thoſe of *Typha*, *Dandelion* and moſt of the *Pappous* kind, with many more, have very long and numerous *Feathers*, by which they are wafted every way, and to any diſtance neceſſary for the aforeſaid purpoſes. *Tab.* 72.

6. §. Again, there are ſome *Seeds*, which are ſcattered not by flying abroad, but by being either *Spurted*, or *Slung* away. The firſt are thoſe of *Woodſorrel*; which having a running *Root*, Nature ſees it fit to ſow the *Seeds* at ſome diſtance. The doing of which is effected by a white thick and ſturdy *Cover* of a *Tendinous* or *Springy Nature*, in which the *Seed* lies within the *Caſe*. This *Cover*, ſo ſoon as it begins to drye, burſts open on one ſide, in an inſtant, and is violently turned inſide outward, as you would turn the *Gizard* of a *Fowl*; and ſo ſmartly throws off the *Seed*. *Tab.* 72.

7. §.

7. §. The *Seeds* of *Harts-tongue*, and of all that *Tribe*, are *Slung* or *Shot* away. The doing of which is performed by the curious contrivance of the *Seed-Case*; as in *Codded Arſmart*, and ſome other like *Plants*. Only there, the *Spring* moves and curles up inward; but here it moves outward. I ſhall deſcribe it, as well as the *Weather* (which when I obſerved it was cloudy) would permit. Every *Seed-Caſe*, as
Tab. 72. it appears through a good *Glaſs*, ſtands upon a *Pedicle* from ¼ an Inch to an Inch or more in Length; at the bottom about as thick again as a *Horſe-hair*, and a little thicker at the *Top*, on which ſtands the *Caſe*, of a *Silver Colour*; about the bigneſs of a *Cherry-ſtone*, of a *ſpherick Figure*, and girded about with a ſturdy *Tendon* or *Spring*, of the *Colour* of *Gold*: the whole *Machine* looking not much unlike a little *Padlock*. The *Surface* of the *Spring* reſembles a fine *Screw*, or ſome of the *Aer-Veſſels* in the *Wood* of a *Plant*. So ſoon as by the *Innate Aer* of the *Plant*, or otherwiſe, this *Spring* is become ſtark enough, it ſuddenly breaks the *Caſe* into two halfs, like two little *Cups*, and ſo flings the *Seed*.

8. §. Theſe *Caſes* grow in oblique *Furrows* or *Trenches* on the back
Tab. 72. ſide the *Leaf*, from ¼ of an Inch to an Inch in Length, and about $\frac{1}{8}$th of an Inch broad. In one of theſe *Trenches* an Inch long are more than 300 of the *Caſes* above deſcribed; and allowing but 10 *Seeds* to every *Caſe*, above 3000 *Seeds*. Which being multiplied by the number of *Furrows* in one *Leaf*, with allowance for the leſſer *Furrows*; and that ſumm by the number of *Leaves* commonly growing upon one *Root*, comes to above Ten Hundred Thouſand *Seeds*, the annual product of this *Plant*. The *Seed* is of a *Tawny Colour*, through a good *Glaſs* about $\frac{1}{12}$th of an Inch long, flat, and ſomewhat oval. Of theſe, ten Thouſand are not ſo big as a white *Pepper Corn*.

CHAP. III.

Of the ſeveral COVERS of Seeds, *and of the VITELLUM.*

THE next ſtep of *Natures Managery*, relates chiefly to the Growth of the *Seed* when it is ſow'n. For which purpoſe, the outer *Covers* are ſomewhere furniſhed with *Apertures* ſufficient for the reception of *Alimental Moyſter* from the *Ground*; and *Diviſions*, for the *ſhooting forth* of the young *Root* into it. As in the *Seed* of a *Gourd*, at the *Bottom*; in a *Bean*, on the *Side*; and in a *Cheſ-*
Tab. 72. *nut*, at the *Top*: in which places the *Radicle* or young *Root* always lies and puts forth, in the ſaid ſeveral *Seeds*. And the *Seed* of *Palma*
Tab. 72. *Chriſti*; which falls to the Ground not only in the uſual *Covers*, but alſo in the *Seed-Caſe*, for the more plentiful admiſſion of *Aliment*, hath a double *Aperture*. Not much unlike to this, is that found ſometimes

in

in larger parcels of *Euphorbium*; for which *Cauſe*, I ſuſpect it to be the *Gumm* of a *Plant* of the *Tithymal* kind.

2. §. If the *Cover* of the *Seed* be ſtony and very hard, it is alſo diſtinguiſhed into ſeveral *Pieces*; whereby they eaſily cleave aſunder without much reſiſtance to the eruption of the *Root*. So the *Shell* of a *Hazel-nut* eaſily cleavs on the edg; and the cleft begins beſt at the poynt, where the *Root* ſtands and ſhoots forth. The *Shell* of ſome *Walnuts* cleavs into three *Parts*; and the *Stone* of the *Bellerick Myrobalan* into five: that ſo, being very thick and hard, if one piece ſhould not yield, another may not fail to do it. And the *Covers* or *Husks* of ſome ſorts of *Grain*, as of *Millet*, are only folded or laped one over another, the better to give way to their tender *Sprouts*. *Tab.* 75.

3. §. Beſides the *Kernels* of *Plums* and ſome other *Fruits*, there are very many *Seeds*, even of the ſmaller ſort, which have alſo ſtony *Covers*; as of *Carthamum*, *Myagrum monoſpermon*, *Beet*, *Borage*, *Lithoſperme*, *Amaranthus*, *Violet*, &c. Sometimes, for the reception of the harſher and leſs matured *Principles* from the *Seed*, in its *Generation*, as in *Borage*. Commonly, to keep it warmer before and after its ſow'n. For which purpoſe, the outer *Covers* of ſome *Seeds*, are as it were Lined with *Fur*: in that of *Great Maple*, Short; of *Goſſipium*, Long. And if the *Seed* requires a longer ſtay under ground, the hardneſs of the *Cover* ſerves to ſtint the *Aliment*; leſt too much, ſhould either rot it, or cauſe it to germinate, before its proper ſeaſon, or full time for a more *Maſculine* Growth.

4. §. On the contrary, many *Seeds*, as thoſe of *Clary*, *Garden-Creſs*, and others of that *Tribe*, have their upper *Covers* faced with a *Mucilage*: which being eaſily receptive of any *Moyſture* in the Ground, gradually ſwells, till it lies like a *Gelly* round about the *Seed*. Either for a more plentiful ſupply of *Aliment*; or at leaſt, to ſoften the *Covers*, the better to accelerate the Growth of the *Seed*.

5. §. The proceſs of Nature in the ſeveral ſteps of the *Vegetation* of the *Seed*, hath formerly been explained. (*a*)

6. §. THE COVERS of all, or at leaſt the far greater number of *Seeds*, are Three; ſome way or other derived from the *Pith*: as ſhall hereafter be ſeen. And ſometimes, Four: even thoſe of ſton'd *Fruits*, have Three, beſides the *Stone*. In that of *Goſſipium*, there are Two *Coats* under that lined with the *Cotton*. The *Seeds* of *Cucumer*, *Goats-beard*, *Broom*, *Scabious*, *Lettice*, &c. although ſo ſmall, have plainly Three *Coats*. But in ſome of theſe, and many more, there are only Two diſtinctly viſible, except in the State of *Generation*. (*a*) *B.* 1. *Ch.* 1. *Tab.* 75.

7. §. In the Upper *Coat*, the *Seed-Veſſels* are diſſeminated. The Second, is firſt a meer *Pulp*; but afterwards ſhrinks up and ſticks cloſe to the upper. The Third or Inmoſt is more denſe; and if it be thin, for the moſt part, tranſparent; whereby the *Seed* ſeems ſometimes to be naked while it lies therein; as in *Almonds*, *Cucumers*, and the like. For this ſticks not to the midle *Coat*, as that doth to the outer; but commonly, remains entire, after thoſe are ſtripp'd off, being as it were, the *Smock* of the *Seed*. *Tab.* 76.

8. §. In *Meliſſa* and ſome other ſmall *Seeds*, it comes finely off upon ſoaking in warm Water or on the *Tongue*. In *Fenugreek*, 'tis ſoft, and of an *Amber-Colour*; and being moyſtened, looks almoſt like fine *Glew*. But commonly, tis a prety tough *Membrane*, and often with

ſome thickneſs, as in *Plums*, *Borage*, *Scabious*. Yet always extream thin at the *Tip* of the *Radicle*; the more eaſily to break and yield to it, as the *Secundine* to the *Fœtus*, when it firſt ſhoots into the Ground. And ſometimes, as in the *Seeds* of an *Orange*, it hath at one end, the reſemblance of a *Placenta*. But of this, and the two upper *Coats*, I ſhall give a further Deſcription in the laſt *Chapter*.

Tab. 75.

9. §. AS ALL *Seeds* are *ex Ovo*; ſo there are many with thin *Covers*, as of *Orach*, *Spinage*, *Beet*, and the reſt of that *Tribe*, &c. which beſides the *Albumen* or clear *Liquor* out of which they are bred; have alſo, a *Vitellum*, or a *Body* thereunto *Analogus*: being neither part of the *Seed*, nor part of the *Covers*, but diſtinct from them both. With reſpect to the *Bulk* of the *Seed*, very large, as white as *Starch*, and pretty friable, like good *Rice* or *Barley*: of a roundiſh *Figure*, and grooved on the *Girth*, ſo as to have a double *Edge*; Whereby the *Seed*, which is long and ſlender, lies round it, as a *Sack* of *Corn* upon a *Pack-Saddle* or a *Rope* upon a *Pully-wheel*. Upon my firſt notice hereof, it ſeemed to anſwer to a *Placenta*. But upon further conſideration, the *Analogy* doth not hold betwixt them. For the *Placenta* lies without the *Membranes* in which the *Fœtus* is conteined: whereas this body lies within the *Covers* contiguous to the *Seed*, and ſo becomes its firſt and fineſt *Aliment*, as the *Yelk* doth to the *Chick*. For which purpoſe, as in the *Generation* of the *Seed*, it is a pure *Milky Chyle*; So in its *Vegetation*, it is converted into the like again.

Tab. 75.

10. §. The ſame Body for Suſtance, is obſervable in the *Seeds* of *Rhapontick*, *Dock*, *Sorrel*, and the reſt of that kindred, with this difference; That whereas in *Orach*, &c. the *Seed* only lies upon it; here, the main *Body* or *Lobes* of the *Seed* are immerſed therein, the *Radicle* ſtanding naked or above it. So that the ſaid *Lobes*, and therein the *Seminal-Root* are beded herein, as in a *Tub* of *Meal* or a little pot of pure refin'd *Mould*, neceſſary for the firſt *Vegetation* of the *Radicle*.

11. §. BY THESE midle *Steps*, *Nature* proceeds from the *Thiner Covers* of *Seeds*; or thoſe, which after the *Generation* of the *Seed* is finiſhed, ſhrink up; to the *Bulky Kind*, or thoſe which keep their *Bulk* after they are dry. Wherein, not only the *Lobes*, as in *Dock*, but the whole *Seed* is immediately lodged. Different in *Subſtance*, *Shape* and *Bulk*; but always many times biger than the true *Seed* within it: for which it is commonly miſtaken; but is no more the *Seed*, than is the *Stone* of a *Plum*, the *Kernel*.

Tab. 76.

12. §. In the *Barbado Nut*, 'tis *White*, *Soft*, *Conick-oval*, and taking all its *Dimentions*, 8 or 10 times bigger than the *Seed* within it. In *Aſhen Keys*, 'tis of a ſad *Colour*, *hard*, yet ſomewhat *Oyly*, *Oval* and *flat*, and of the ſame *Bigneſs* as in the *Barbado Nut*, with reſpect to the *Seed*. In the *Fruit* commonly called *Nux Vomica Officinarum*, 'tis of the *Colour* and *Hardneſs* of a *Cows-Horne*; and makes almoſt the whole *Body* of the *Fruit*, being about 14 or 15 times the *Bulk* of the *Seed*.

Tab. 77.

In *Gooſgraſs* or *Cliver* 'tis of the like *Horny Subſtance*, but ſhaped ſomewhat like a *Bonet* with the *Rimm* tuckt in. And ſo in a *Coffee-Berry*; but rowled or foulded up into a kind of *Oval Figure*, with a *Notch* or *Rima* through the Length, where the two *Ends* meet. With other diverſities which will beſt be underſtood, when I come preſently to the *Deſcription* of the *Seed* herein contained.

13. §.

13. §. With reſpect to the uſe of this *Cover*, it is obſervable, that where there is a *Stone* or *Shell* over it, as in the *Barbado Nut*, it is *ſoft*; but where there is none, as in *Nux Vomica*, *Aſh*, &c. 'tis hard; and ſo it ſelf inſtead of a *Stone*. As alſo, That it becomes *hard*, only by the proper Nature of its *Parenchyma*, and the exquiſite *ſmallneſs* of the *Bladders* of which it conſiſts. Whereas a *Stone*, is alſo hardened by the *Lees* or *Tartar* of the *Sap* which ſinks into it, and thereby *petrifies* it (*a*) as hath been ſaid. So that whereas a *Stone*, as it lies in the *Ground*, only cleavs in certain Places, but continues hard: This *Cover*, like ſome *Horns*, upon the due acceſſion of *Moiſture*, doth gradually become *ſoft*. Whereby, as while it is *hard*, it performs the Office of a *Stone*, in guarding the *Seed* til the proper *Seaſon* for its *Growth*: So afterwards when it is *ſoft*, it anſwers, as in *Orach* or *Dock*, (*b*) to a *Vitellum*, from whence the *Seed* receiveth its firſt and pureſt *Aliment*.

(a) *P.* 3. *Ch.* 3.

(b) *Ch.* 3. §. 8, 9.

CHAP. IV.

Of the FOETUS or true SEED: and firſt of the RADICLE and LOBES.

HAVING diſcourſed of the *Covers*, I come next to the *Seed* or *Fœtus* it ſelf. Of the *Shape* and *Poſture* whereof, I ſhall give ſome *Examples*, firſt, among thoſe with the thinner ſort of *Covers*; and then, of thoſe with the *Bulky* one: where I ſhall ſpeak only of the *Lobes*, or *Main Body*, and the *Radicle*. Next, I ſhall deſcribe the ſeveral ſorts of *Nodes* or *Buds* of *Seeds*. And laſtly, the ſeveral Parts, of which the *Lobes*, *Radicle*, and *Buds* are compounded.

2. §. Among *Seeds* with the *Thinner Covers*, are thoſe of all ſorts of *Corn* and *Graſs*. Of a different make, from that of moſt other *Seeds*: The *Main Body* being not divided into *Lobes*, but one entire Piece, doubled in the form of a Pair of *Lipps*. And whereas commonly, the whole *Seed* is very *Soft* and *Oyly*; here, only thoſe two minute *Parts*, which become the *Root* and *Stalk*, are ſo: The *Main Body* being of a different Subſtance; when the *Corn* is ripe, *hard* and *friable*; but when it is ſown, eaſily *colliquable* into a kind of *Milk* or *Chyle*, ſo that, in ſome reſpects, it hath a near *Analogy* to a *Vitellum*. For as that is gradually melted into a ſort of *Chyle*, and by the *Branches* of the *Ductus Inteſtinalis* carryed into the *Bowels* of the *Chick*: So is this, into a like *Subſtance*, and by the *Branches* of the *Seminal Root* (formerly deſcrib'd) conveyed to thoſe *Parts*, which become the future Plant. *B.* 1. *Ch.* 1.

3. §. Of Relation to this Kind, the *Seeds* of *Dates*, and of ſome other like *Plants*, may be eſteem'd. For that which is commonly called the *Stone*, ſeems indeed to be the *Main Body* of the *Seed*, doubled or folded up in the ſame manner as in *Corn*. To which that *Part* which becomes the *Plant*, is annexed. But whereas in *Corn*, 'tis placed at *Tab.* 75.

the Bottom of the *Main Body*; here it lies in a ſmall round *Cavity* in the middle of the *Back*. The *Stone*, or *Main Body*, where this Part grows to it, is not ſo hard, as more remote from it: and is therefore probably in ſome part diſſolved, by lying in the *Ground*, as in *Corn*.

4. §. But for the moſt part, the *Main Body* is divided, as hath been ſaid, into two *Lobes*; and thoſe in Subſtance *Homogeneous* to the other *Part* or *Parts*, plainly diſtinguiſhed in moſt *Kernels* and other large *Seeds*; and not difficultly in many leſſer ones, as in that of *Viola Lunaris*, *Scabious*, *Doves-Foot*, &c. if ſlipped out of their *Covers* before they are full ripe. *Tab.* 75.

5. §. In *Hounds-Tongue*, they are of a circular figure, and very large in Proportion to the *Radicle*. In *Cucumer*, oblong, with ſome viſible *Branches* of the *Seminal Root*; and the *Radicle* ſomewhat bigger. But in *Scorzonera*, very long, like the Leggs of a Pair of *Compaſſes*: and the two firſt, or *diſſimular Leavs* of the *Plant* into which they are converted, are of the ſame *Shape*. Of theſe and many more, the *Radicle* is ſhort and pointed; and lies in one ſtraight Line with the *Lobes*. *Tab.* 75.

6. §. In *Viola Lunaria*, they are very large; and the *Branches* of the *Seminal Root*, fairly apparent, ſo as to reſemble a Pair of *Leavs*. The *Radicle* pretty long, equally thick from end to end, and couched down upon the two *Lobes*, each of them having a little *Shoulder* for it to lie upon. In *Woad*, where it hath the like *Poſture* and *Shape*, as alſo in *Chamælina*, *Eruca*, and many others, it is very *Bulky*, being bigger than both the *Lobes* put together. *Tab.* 75. *Tab.* 75.

7. §. Of this Part, I think it may be obſerved, That commonly thoſe *Seeds*, wherein it is very ſmall with reſpect to the *Lobes*, produce a *Perennial* Plant: And ſo, *vice verſa*, where it is very large, an *Annual* one. In the latter, the *Seminal Virtue* being more vigorous, and ſo tending more haſtily to the Buſineſs of *Generation*, followed with the *Death* of the Plant.

8. §. IN THE former *Seeds*, the *Lobes* lie flat one againſt another. But in *Garden-Radiſh*, they are folded up, ſo as to receive the *Radicle* into their *Boſome*: as when a *Chicken* tucks his Head under his Wing. *Tab.* 75.

9. §. In *Holyoak*, the *Lobes* are plated upwards, and re-plated down again. Being moſt agreeably compoſed to the *Shape* of the *Covers*, as thoſe are to their *Poſture* on the Plant. In *Maple*, they are plated one over another, and ſo rouled up. *Tab.* 75.

10. §. In the *Cotton-Seed*, which conſiſteth almoſt wholly of two very broad and thin *Lobes* or *Leaves*, the *Folds* are yet more numerous; all curiouſly reduced to an exact and ſolid *Oval*. *Tab.* 75.

11. §. It happens now and then, that inſtead of two, there are three *Lobes*, as in the *Kernels* of *Plums*, *Apples*, and other *Fruits*, and the ſmaller ſorts of *Seeds*, will ſpring up ſometimes with more than two *diſſimilar Leaves*, originally the *Lobes* of the *Seed*. Theſe are obſerved by ſome, more frequently to produce a double *Flower*, which may be, becauſe the *ſeminal Virtue* in ſuch *Seeds*, is increaſed by a third Part.

12. §. IN

12. §. IN many *Seeds*, the *Radicle* is of one and the ſame *Colour* from end to end. But in others, as in the *Lupine*, it is obſervable, That the upper and greater half, is *White*; the Lower to the *Point*, hath a kind of *Horny Gloſs*, and ſeems to be of a ſomewhat different make. *Tab. 75.* Whereby it comes to paſs, that after the *Radicle* is ſhot forth a little way, only this lower half deſcends and becomes the *Root:* The upper half is produced or raiſed above ground, as a *Pillar* upon which the *Lobes*, or *diſſimilar Leaves* are erected.

13. §. This *Seed*, on the out ſide of each *Lobe*, and near the *Radicle*, hath a very ſmall and round *Node*, like a *Navel*; whereof, in the firſt Book: the whole *Seed* looking not much unlike a *Pidgeons Head*; *Ch. 7.* the *Radicle* reſembling the *Bill*, and the *Navel* the *Eye*.

14. §. IN the *Seed* of *Garden-Orach*, both the *Radicle* and *Lobes* *Tab. 75.* are very long and ſlender, and lie almoſt in a compleat Circle round about the *Vitellum* before deſcrib'd. The *Lobes* of *Rhapontick* are ſhaped like the *Bitt* of a *Spade*; and the *Radicle* ſtands erected above *Ch. 3.* them like the *Handle*.

15. §. OF SEEDS alſo with the *Bulky Cover*, there are many not divided into *Lobes*; being in a manner, all one *Piece*; as all of the *Bulbous-Kind*. In ſome of which, though the inmoſt *Cover* be thin; yet compared either with the other *Covers*, or with the *Seed* it ſelf, it may very well be accounted of the *Bulky- Kind*.

16. §. In *Flag*, it is above twenty times bigger than the *Seed* within it. Conſiſting of *Bladders* all *Radiated* towards the *Seat* of the *Seed*. The *Seed* it ſelf is ſhaped ſomewhat like a *Penknife*. The lower Part *Tab. 76.* which becoms the *Bulb*, as the *Haft*, is thick, and cometh near to a *Cylindrick* Figure, and the end, round. The upper Part which becomes the firſt years *Leaf*, as the *Blade*, is rather flat, double edged, and pointed, and the Point a little bent. The *Fibers* and *Bladders* of which it conſiſts, are all diſpoſed into Parallel Lines running by the length. In *Lily*, where this *Cover* is thinner and more *Tranſparent*, without being cut, but only held up againſt the Light, the *Seed* may be ſeen within it.

17. §. BUT THE greater number of *Seeds* alſo with the *Bulky Cover*, are divided into two *Lobes*; which, for the moſt part, reſemble a pair of little *Leavs*. In the *Purging Nut* of *Angola*, the *Shell* being taken off, the upper *Covers* (dry'd and ſhrunk up) ſeem to be but one. *Tab. 78.* In theſe, the *Spermatick Veſſels* are Branched. Under theſe, lies the Thick and Inmoſt *Cover*; which being cut down the middle, exhibits the true *Seed*: Conſiſting of a couple of fair *Leavs*, Veined, and as white as *Milk*, joyned together with the *Radicle* at their *Baſe*; and let into a Hollow, made in the *Cover*, of an anſwerable ſhape. The like is obſervable in the *Barbado-Nut*, *Ricinus Americanus*, and ſome other *Indian Fruits*; wirh ſome little difference in the Shape of the *Root* and *Leavs*.

18. §. IN the foregoing *Fruits*, the *Bulky Cover* is very ſoft. But in the *Nux Vomica Officinarum*, 'tis near as hard as a *Date-ſtone*. *Tab. 76.* In this, beſides the hollow made for the reception of the *Seed*, or the two *Leavs* and *Root*; the *Sides* are ſeparated or diſtinct almoſt to the *Edge* of the *Cover* round about, eſpecially towards the *Root*: So that it may not unaptly be compared to a little *Pouch* with the *Sides* clapt together.

19. §. IN this and the *Nuts* above mentioned, the *Seeds* are all very large. But in some other *Plants*, they are extream small, so as to be
Tab. 77. hardly visible without a *Glass*; as in *Staphisagria*, *Peony*, &c. In *Staphisagria*, the *Thick* or *Inmost Cover*, is commonly a *Spherical Triangle*, *conick* towards the *Base*. At the poynt of which, there is a little *Cavity*, in which the *Seed*, about as big as a small pins head, is lodged. The *Root* whereof is a little poynted, and the two *Lobes* rounded at the *Top*.

20. §. In *Peony*, the same *Cover* is *Soft*, *White*, and of an *Oval Fi-*
Tab. 77. *gure*; the part used in *Medicine*. Usually thought to be the *Seed* it self. But is near two hundred times biger than the true *Seed*, which is almost invisible. It lies in a little *Cavity* near the bottom of the *Cover*; with a thick and blunt *Root*, and two poynted *Lobes* or *Leavs*.

23. §. IN the *Coffee-Berry*, the *Seed* lies in the *Inner* or *Cartilagi-*
Ch. 3. *nous Cover* (formerly described) where one would not expect to find
Tab. 77. it, *sc.* near the *Top* or *Surface* of the *Back*. The *Lobes* of the *Seed* are veined like two very minute *Leaves*, and joyned to a long *Root* like a *Stalk*. The end of which comes just to the bottom of the *Cover*, ready for its *exit* into the *Ground*.

22. §. In *Goosgrass*, where the *Inner Cover* is also *Cartilaginous* or
Tab. 77. *Horney*, the *Seed* is postured in much a like manner, and looks just like a couple of poynted *Leavs* with a very long *Stalk*.

23. §. THE *Seed* of *Stramonium*, is also incloſed in a *Bulky Co-*
Tab. 77. *ver*. Which being soaked in warm water, and very warily cut about the edges, with a *Rasor*, the *Seed* may be taken out of it entire. Shaped like that of *Orach*, but much longer. For the *Reception* whereof, the *Cover* is formed with a hollow, which runs round about it near the *Edge*; where in the *Seed* lies like a little winding *Snake*.

CHAP. V.

Of the BUDS of Seeds. *And of the PARTS, of which these, the* Radicle, *and* Lobes *are compounded.*

FROM between the two *Lobes*, rises up the *Stalk* of the *Plant*. The original whereof, either to the naked *Eye*, or by a good *Glass*, is always visible in the *Seed*.

2. §. In many *Plants*, *Nature* sees fit only to lay the foundation hereof in a small round *Node*; where upon the *Leavs*, in the *Vegetation* of the *Seed*, are superstructed: as in *Viola Lunaria*, and others.

3. §. But in the greater number of *Seeds*, is formed a true *Bud*, consisting of perfect *Leavs*; different from those, which grow upon the *Stalk*, only in *Bigness*; and so far in *Shape*, as the same *Parts* of an Animal *Fœtus*, in its several ages in the *Womb*. In many *Seeds*, as well small

ſmall as great, and as well of *Herbs* as *Trees*, it is very apparent. But oftentimes lyeth ſo deep between the *Lobes* as to be almoſt undiſcernable, as in *Maple*.

4. §. The *Leaves* of the *Bud*, in different *Plants*, are of a different *Number*; in ſome, Two; in others, Four, Six, and ſometimes more. In the *Bay-Berry*, they are only two; very ſmall, but thick or fat, and finely veined. In the *Seed* of *Carduus Benedictus*, they are alſo Two; almoſt inviſible; broad at the *Bottom*, poynted at the *Top*, thick or fat, yet plated inward, and poſtured a little diſtant one from the other; for the two next to riſe up betwen them. The like may be ſeen in *Carthamum*; and ſo, I ſuppoſe, in all the *Carduus Kind*. *Tab.* 78.

5. §. In ſome *Herbs*, although the *Bud* conſiſteth but of two perfect *Leaves*, yet they are very conſpicuous. Not only in larger *Seeds*, as in the *Phaſeolus* or *French Bean*; but in thoſe which are ſmall, as in the *Seed* of *Hemp*. In this, the two *Leaves* are both plated, and ſo ſet *Edge* to *Edge*, with mutual *Undulations*. Of that Length, as to be extended beyond a third part of the *Lobes*. *Tab.* 78.

6. §. In the *Seed* of *Sena*, the *Bud* conſiſteth of Four *Leaves*; of which, the greater pair is the outer, and guards the leſs. Shaped not much unlike thoſe in the *Seed* of *Carduus*; but are a little more viſible. *Tab.* 78.

7. §. In the *Bud* of an *Almond*, we may eaſily count ſix, or eight *Leaves*, and ſometimes more; the Inermoſt being laid bare by a dexterous *Separation* of the Outer. Theſe are by much the greateſt, doubled Inward, and ſo laped one over another; whereby they emboſome all the reſt, as a *Hen* ſpreads her *Wings* over her *Chickens*. The like is obſervable in many other large *Kernels*, as alſo in the *Garden Bean*, and ſome other *Plants*. With reſpect to which, I have taken leave (*a*) to call this *Part* the *Plume*. *Tab.* 78. (*a*) *B.* 1. *Ch.* 1.

8. §. THE LOBES of the *Seed*, and ſo likewiſe the *Radicle* and *Bud* conſiſt of a *Skin*, *Parenchyma*, and *Branched Veſſels*: all which I have formerly deſcribed. (*b*) I ſhall now add the following *Remarques*. (*b*) *B.* 1. *Ch.* 1.

9. §. And firſt of the *Skin*, which in ſome *Seeds*, as the *French-Bean* may eaſily be ſeparated from the *Parenchyma*: eſpecially if the *Bean* be ſoaked in water for ſome days; for then it will ſlip off, like the *Skin* in any part of ones *Body* where it is bliſtered. 'Tis woven into *Bladders*, as the *Parenchyma*; but into ſmaller ones, and upon the *Lobes* of a *Garden Bean*, all radiated towards the *Center*. With theſe *Bladders*, there are alſo mixed a ſort of *Lignous Fibres*, incomparably ſmall, which give a *Toughneſs* to the *Skin*, and by which the *Bladders* are directed into *Rays*. *Tab.* 79.

10. §. The *Bladders* of the *Parenchyma*, as is ſaid, are much larger than thoſe of the *Skin*, eſpecially in the *Lobes*. In thoſe of a *Garden Bean*, ſomewhat oval, about $\frac{1}{x}$ of an Inch Diametre by their *Bredth*, and directed towards the *Branches* of the *Seminal Root*. In the *Radicle*, they are twenty times ſmaller, than in the *Lobes*: and ſo in the *Plume*. *Tab.* 79.

11. §. Throughout the *Parenchyma* run the *Branched Veſſels*, which in the *Lobes* make the *Seminal Root*; in the *Radicle* and *Plume*, the *Wood* of the *Root* and *Stalk*. In all of them, diſtributed as hath been (*c*) formerly ſhewed. *Tab.* 79. (*c*) *B.* 1. *Ch.* 1.

12. §.

12. §. I ſhall here further note, That the utmoſt diviſions are no where extended to the Circumference of the *Lobes*, but are all inoſculated together at a conſiderable diſtance from it, as in the *Leaves* of ſome *Plants*. *Tab. 79.*

13. §. In the *Lobes* they all meet in one ſolid *Nerve*. But in the *Radicle*, are dilated into a hollow *Trunk*, filled up with a *Pith*; compoſed of *Bladders* ſomewhat bigger than thoſe which make, as it were, the *Barque* of the *Radicle*. In the *Radicle* of a *French Bean*, the *Pith* is very conſpicuous. *Tab. 79.*

14. §. The *Veſſels* are of two kinds, as in the other *Parts* of a *Plant*; for *Sap*, and for *Aer*. Not running collateral, as *Arteries* and *Veins*; but the latter every where ſheathed in the former. From the *Aer-Veſſels* it is, that if a *Bean* be ſteeped in water, and then the *Radicle* cut tranſverſly and preſſed, it will yield *Bubles* as well as *Liquor*. Theſe *Veſſels* are admirably ſmall, yet through a very good *Glaſs* become viſible. *Tab. 79.*

15. §. The *Liquor* conteined in the *Seed*, when full ripe is chiefly *Oyl*; generally, found in a greater proportion here, than in any other part of a *Plant*. Being as the *Pickle*, in which the *Seminal Virtues*, *i. e.* the more *volatile* and *active Principles* of the *Seed*, are immerſed for their *Preſervation*: and to curb them from too great a *Luxuriance* in the *Vegetation* of the *Seed*.

CHAP.

CHAP. VI.

Of the GENERATION of the SEED.

AS I made choice of a *Garden-Bean*, to ſhew the manner of the *Vegetation* of the *Seed*: ſo I ſhall take an *Aprecock*, as very apt and convenient, to obſerve and repreſent the *Method* which *Nature* taketh in its *Generation*.

2. §. In order to this, the firſt thing that is to be done, is to make a fit *Uterus*. Both to keep the *Membranes* of the *Fœtus* warm, and ſucculent, till it be formed: and to preſerve and ſecure the *Fœtus* it ſelf afterwards, till it comes to be born into the *Ground*.

3. §. For this purpoſe, the *Pulp* and *Stone* of the *Fruit* are both neceſſary; but primarily the *Stone*: the *Meat* or *Pulp* being no otherwiſe neceſſary, but becauſe the *Stone* cannot be made without it; the petrifying of that *Parenchyma* which is the *Ground* of the *Stone*, being effected, by the ſinking of the *Tartar* from the *Pulp* thereinto.

4. §. And that, at the firſt, the *Ground* of the *Stone*, is a diſtinct, but ſoft *Parenchyma*; is evident in the cuting of a young *Aprecock*. Of which, alſo a ſlice cut off, with a *Raſor*, and viewed through a good *Glaſs*, ſheweth it to be compoſed of *Bladders*, as the *Pulp* it ſelf. Only, whereas many of thoſe of the *Pulp* are large, now about as big as a white *Pepper-Corn*: theſe are no bigger than a *Muſtard-Seed*. But as the *Parenchyma* hardens into a *Stone*, theſe *Bladders* are all gradually filled up, and diſappear. *Tab.* 82.

5. §. This *Parenchyma* is derived immediately from the *Pith*, as the *Pulp* is from the *Barque*; and makes the far greater part of the *Stone*. 'Tis covered all over within, with a very thin *Lining*; derived, not from the *Pith* but the *Parenchyma* which covers the *Seed-Branch*, upon its firſt entrance within the hollow of the *Stone*. This *Lining* is of a cloſe ſubſtance; yet compoſed of *Bladders*, exquiſitely ſmall and hardly viſible. By which means, it ſoon becomes a very hard and dry *Body*; and is hereby fitted, both to promote the induration of the reſt of the *Stone*; and the ſeaſonable drying, and ſo, the ſhrinking up, of the *Covers* of the *Seed*, to make room for its *Growth*. *Tab.* 80.

6. §. The *Stone* being made hard and dry; it could never be ſo ſufficiently ſoftned by lying under gtound, but that, it would keep the *Seed* a perpetual priſoner, unleſs it were alſo made pretty eaſily to cleave in two. For which purpoſe, the *Skin* of the *Fruit* doth obſervably conduce. For in a *Slice* of a young *Aprecock* cut tranſverſly with a very ſharp knife, it may be ſeen, eſpecially with the help of a *Glaſs*, to be doubled inward from the two *Lips* of the *Fruit*, and ſo to be con- *Tab.* 80.

tinued, not only through the *Pulp*, but alſo through the *Stone* it ſelf, into the hollow of the ſame, where it meets, and is united with the *Lining* thereof. Whereby, as it further helps to the drying and hardning of the *Stone*; ſo alſo renders it cleavable in that part, where it runs through it. And therefore, whereas towards the *Stalk*, it goes no farther than to the *Seed-Branch*, and ſo but half way through the *Stone*: towards the *Top* of the *Fruit*, where the *Radicle* ſtands, and where the *Stone* begins to cleave, it runs quite through it.

7. §. *Nature* having thus provided a convenient *Uterus*, She next taketh care about the *Membranes* of the *Fœtus*. Theſe are *Three* apparently diſtinct, and in many reſpects different one from another.

8. §. The outer *Membrane* is derived from the *Parenchyma* which ſurrounds the *Seed-Branch*; which, upon its entry into the hollow of the *Stone*, is expanded, as it were, into two *Bladders*, one within another; whereof, one becomes the *Lining* of the *Stone*; the other, this outer *Membrane*: as is beſt ſeen by cuting a young *Aprecock*, when it is about half an Inch long, down through the midle, or from the *Seat* of the *Flower* to the *Stalk*, between the two *Lips*. *Tab.* 80.

9. §. This outer *Membrane*, at this age, hath a good full and frim *Body*, about $\frac{1}{12}^{th}$ of an Inch thick, or through an ordinary *Glaſs*, half an Inch, where it is thickeſt, as at the *Sides* and the greater end: the *Poynt* being thinner, for the more eaſy eruption of the *Radicle* into the *Earth*. Compoſed of *Bladders*, through an ordinary *Glaſs*, about as big, as a *Colewort-Seed*. *Tab.* 80.

10. §. Throughout this *Membrane*, the *Veſſels* conteined in the *Seed-Branch* are diſtributed. Beginning a little below the ſmaller end of the *Coat* or *Membrane*, they thence fetch their circuit both ways round about, juſt beneath the *Surface* of the *Membrane*, and at laſt, meet in the midle of the greater end, where they are all inoſculated, ſo as to make a kind of *umbilical Node*. From whence they ſtrike deeper into it, and at laſt, into the midle *Membrane*, in which they preſently become inviſible. By theſe *Veſſels*, the *Sap* is brought and ſpewed into the midle *Membrane*. So that the outer *Membrane* ſeemeth, in ſome reſpects, to be anſwerable to the *Placenta* in *Animals*. *Tab.* 80.

11. §. The midle *Membrane*, is derived from the bottome of the Outer. From whence eſpecially, but alſo round about, the *Bladders* hereof (all angular) are more and more amplified towards the *Centre*; moſt of them being at leaſt two hundred times biger, than thoſe of the Outer *Membrane*: whereby it looks, through a *Glaſs*, not unlike a *Coome* full of *Hony*; or in regard of their great tranſparency, like a company of little *Cryſtal Pans* full of a pure *Lympha*. *Tab.* 80.

12. §. This Midle *Membrane*, is properly ſo called, from the ſtate and condition it hath, upon the *Augmentation* of the *Seed*, at which time, it obteins the nature of an *Involucrum*. But originally, it is every where entire, without any *Hollow*, filling up the *Cavity* of the Outer *Membrane*, like a ſoft and delicate *Pulp*. After a ſhort time, there

there appears in it a ſmall *Ductus* or *Chanel*; which runs from the bottom to the top, like an *Axis*, through the midle of it. At firſt, no wider than to receive the *Hair* of a *Mans Head*; not viſible, except in a ſlice hereof cut tranſverſly, and viewed in a *Glaſs*. Being grown a little wider, it may be ſeen, if the *Membrane* be dexterouſly cut by the length. At which time, it is alſo dilated into two *Oval Cavities*, one at each end: which are as two little *Ciſterns*, whereinto a moſt pure *Lympha* continually owzeth, and is therein reſerved for the nouriſhment of the *Seed*; and through the *Chanel* which runs between the *Ciſterns* is emptied out of one *Ciſtern* into another, according as the *Seed* or the Inmoſt *Membrane* hath need of it; *i. e.* as the *Weather* and other Circumſtances do more or leſs accelerate their *Growth*, and ſo render the *Lympha* uſeful to them. *Tab.* 81.

13. §. A few days after this, the Innermoſt *Membrane* begins to appear; growing, like a ſoft *Node* or *Bud*, out of the upper *Ciſtern*; to the lower end of which it is joyned by a ſhort and tender *Stalk*, from whence it is produced into a *Conick-oval Figure*, anſwerable to that of the *Ciſtern*. *Tab.* 81.

14. §. This *Membrane*, though ſoft and full of *Sap*, yet being compared with the midlemoſt, is a cloſe and compact *Body*, compoſed of *Bladders* above 300 times ſmaller than they are in that. Whereby, as the *Seed* is ſo well guarded, as not to be ſupplyed with any part of the *Lympha*, but the pureſt: ſo neither with any more of this, than will ſuffice, without the danger of making an *Inundation* out of ſo great a *Lake*.

15. §. This *Membrane*, if it be pulled with a moſt ſteady hand, and very gently, upwards, it will draw a ſmall tranſparent *String* after it to the bottom of the Midle *Membrane*: The ſaid *String* though for the greater part, *Parenchymous*, yet being ſtrengthened with the *admixture* of ſome *Lignous Fibres*; no otherwiſe viſible in either of theſe two *Membranes*. So that they ſeem, to be a ſmall portion of thoſe which are inoſculated at the bottome of the *Outer Membrane*, and thence produced through the midlemoſt, underneath the *Chanel*, till at laſt they break forth into the upper *Ciſtern*, where they form this Inner *Membrane*: a piece of cloſe-wrought *Work*, ſuitable to the incomparable fineneſs of all the *Stuff* out of which it is made.

16. §. The ſame *Membrane* is originally entire, as the Midlemoſt: but being grown to about the bigneſs of a *Carvi-Seed*, becomes a little hollow near the *Cone*. And the *Lignous Fibers* aboveſaid, fetching their compaſs from the *Baſe*, ſhoot forth into the *Cone*; and ſo make a very ſmall *Node* therein, for the firſt *Eſſay* towards the *Generation* of the *Seed*. The ſaid *Fibers* being thus ſpun out, to the utmoſt degree of fineneſs for this purpoſe. *Tab.* 81.

17. §. This *Node*, being grown about $\frac{1}{5}$th part as big as a *Cheeſe-Mite*; it begins next to be divided by a little indenture at the *Top*. Which growing by degrees ſtill deeper, the *Node* is hereby at length diſtinguiſhed into two *Lobes* or thick *Leavs*. *Tab.* 81.

18. §.

18. §. So ſoon as theſe are finiſhed, their *Baſis* begins afterwards
Tab. 81. to be contracted, and ſo to be formed into a *Radicle* or that part of the *Seed* which becomes the *Root*. As the *Stalks* of *Fruits* do grow leſſer, while the *Fruits* themſelves are expanded. So that in this eſtate, the *Radicle* is, as it were, the *Stalk* of the *Seed*.

19. §. At this time, the *Seed* being extream ſmall, the *Lobes* are not ſo manageable as to be ſeparated one from the other. Butit is moſt reaſonable to ſuppoſe that ſo ſoon as the *Radicle* is finiſhed, the next ſtep, is the puſhing forth of another *Node*, between the *Lobes*, in order to the making of a *Bud*, and ſo the perfection of the *Seed*.

20. §. This being done or in doing, the *Radicle* or *Stalk* of the *Seed*, contracting ſtill more and more at the bottome, hangs at the Inner *Membrane*, only by an extream ſmall and ſhort *Ligament* or *Navel-String*. Which at laſt, alſo breaks; and ſo the *Seed*, as *Fruits* when they are
Tab. 81. ripe, falls off and lies looſe in the Iner *Membrane*; this gradually ſhrinking up and ſo becoming more hollow, to make room for the further *Growth* of the *Seed*.

Several

Several LECTURES Read before the ROYAL SOCIETY.

By *NEHEMIAH GREW* M.D. Fellow of the *ROYAL SOCIETY*, and of the *COLLEGE* of *PHYSICIANS*.

LONDON,

Printed by *W. Rawlins*, 1682.

Mo.Bot.Gard.n,
1902.

THE

TITLES

Of the following

LECTURES.

I. *OF the Nature, Cauſes, and Power of MIXTURE.* The ſecond Edition.

II. *Of the LUCTATION ariſing upon the* Mixture *of ſeveral* Menſtruum's *with all ſorts of Bodies.* The ſecond Edition.

III. *An Eſſay, Of the various* Proportions, *wherein LIXIVIAL SALTS are found in* Plants.

IV. *Of the ESSENTIAL and MARINE SALTS of* Plants.

V. *Of the COLOURS of* Plants.

VI. *Of the* Diverſities *and* Cauſes *of TASTS; chiefly in* Plants. *With an* Appendix, *Of the ODOURS of* Plants.

VII. *Experiments in Conſort, upon the SOLUTION of SALTS in* Water.

TO THE

Right Honourable WILLIAM

Lord Vi-Count *BROUNCKER*,

PRESIDENT

OF THE

Royal Society.

MY LORD,

ONE *Reaſon why I Dedicate the following* Diſcourſes *to Your* Lordſhip, *is, For that by Your great und undeſerved Reſpects, You have obliged me to do no leſs.*

Another, my Lord, *is, Becauſe I could not but Publickly return Your* Lordſhip *Thanks, for minding the* Royal Society *of ſo good a Way, they are lately reſolved upon, for the Management of a great part of their Buſineſs. Wherein, my* Lord, *I do more than preſume, that I alſo ſpeak the Senſe of the whole* Society; *I think, not any one excepted.*

I may with the ſame Confidence intimate, my Lord, *how happy they account themſelves, in having a* Perſon *ſo fit to preſide their Affairs, as Your* Lordſhip. *The Largeneſs of your Knowledge, the* Exactneſs *of Your Judgment, the Evenneſs of Your Comport; being ſome of thoſe neceſſary Qualifications, which His* Majeſty *had in His Eye (as right well underſtanding what He did) when He fixed His Choice upon Your* Lordſhip.

I know, my Lord, *that there are ſome men, who have*

just so much Understanding, as only to teach them how to be Ambitious: The Flattering of whom, is somewhat like the Tickling of Children, till they fall a Dancing. But I also know, that Your Lordship *unconcerneth Your self as much, in what I even now spake; as* Cæsar *did himself, when his* Souldiers *began to style him* King. *For as he said,* Non Rex, sed Cæsar: *So let Your* Lordship *be but once nam'd, and all that follows, is but a* Tautology *to what You are already known to be. Your being* President *of the* Royal Society, *Your being the* First *that was Chosen, and* Chosen *by so Knowing a* Prince; *becomes so real a* Panegyrick *to Your* Lordship, *as leaveth Verbal ones without any sound.*

Whence, my Lord, *I have a third Reason most naturally emergent, which is, That I dare to submit my self, as to what I have hereafter said, to Your* Lordships *Censure. You being so able and just an* Arbiter *betwixt the same and all those Persons therein concern'd; that You can neither be deceived, nor corrupted, to make a Judgment in any Point, to the Injury of either.*

And truly, my Lord, *were it only from a Principle of self-Interest, yet I could not desire it should be otherwise. For the* World, *if it lives, will certainly grow as much more knowing than it is; as it is now more, than it was heretofore. So that we have as little Reason to despise* Antiquity; *as we can have willingness, that we our selves should be despised by* Posterity.

Yet some difference there is to be made; viz. *betwixt those of all* Ages, *who have been modestly ignorant; and those who have thought, or pretended, that they were Omniscient. Or if knowing and acknowledging that they were Ignorant; have yet not been contented to be so; unless, with as good manners, as sense, they did conjure all Mankind not to offer at the knowing any more than themselves.*

Upon the whole, my Lord, *I desire not You should be a* Patron, *any further than You are a* Judge. *For if this small* Essay *hath deserved the least acceptance, I am sure, that in being one, You will be both.* *I am,*

My Lord,
Your *Lordships* most Faithful
and Obedient Servant,
NEHEMIAH GREW.

A DISCOURSE

Read before the

ROYAL SOCIETY

Decemb. 10. 1674.

Concerning the

NATURE, CAUSES, and *POWER*

OF

MIXTURE.

HAVING the honour to perform the Task of this day; I ſhall endeavour to conform to the *Phyloſophy*, which this *Society* doth profeſs; which is, *Reaſoning grounded upon Experiment, and the Common Notions of Senſe.* The former being, without the latter, too ſubtle and intangible; the latter without the former, too groſs and unmanageable: but both together, bearing a true analogy to our ſelves; who are neither Angels, nor meer Animals, but Men.

The Subject I have choſen to ſpeak of, is *Mixture.* Whereof, that our *Diſcourſe* may be the more *conſiſtent*, and the better *intelligible*; all I have to ſay, ſhall be ranged into this Method; *viz.*

1. Firſt, I ſhall give a brief account of the received *Doctrine* of *Mixture.*

2. Next, lay down ſome *Propoſitions* of the *Principles* whereof all *Mixed* Bodies conſiſt.

3. Then, open the true *Nature* of *Mixture*; or ſay, *What* it is.

4. And then enumerate the *Cauſes* of *Mixture*; or ſay, *How* it is made.

5. Laſtly, I ſhall ſhew the *Power* of *Mixture*; or, *What* it can *do.*

CHAP.

CHAP. I.

Of the received Doctrine of Mixture.

FIRST, As to the received *Doctrine* of *Mixture*; not to trouble you with tedious quotations of what *Aristotle*, *Galen*, *Fernelius*, *Scaliger*, *Sennertus*, *Riverius*, and other Learned men say hereof; we may suppose the whole summed up in that *Definition* which *Aristotle* himself hath given of it, and which the greater number of his Followers, have almost religiously adhered to; *viz.* that 'tis, τῶν μικτῶν ἀλλοιωθέντων ἕνωσις. that 'tis, *Miscibilium alteratorum unio.* Which *Definition*, as it is usually explicated, is both *Unintelligible*, and *Unuseful.*

Lib. 1. *de Generat. & Corrupt.* Cap. ult.

2. §. Two things are *unintelligible*; what they mean by *Alteration*; and what by *Union.* In this *Alteration*, they say, That the very *Forms* of the *Elements* are *altered.* And therefore lay it down for an *Axiom*, *Quod in Mixto, Formæ Elementares tantum sint in potentia*, But let us see the consequence. For if in a *mixed* body, the *Forms* of the *Elements* are but in *potentia*; then the *Elements* themselves are but *in potentia*: for we all say, *Forma dat esse.* And if the *Compounding Elements*, are only *in potentia*; then the *Compounded Body* it self can be only *in potentia*: yet to say it is no more, is most absurd.

3. §. As for the *Union* of *Elements* in a *mixed Body*; they make it such, as brings them at last to assert, the *Penetration* of *Bodies*, and that the *Union* of *mixed Bodies* is nothing else. For they say it is made in such sort, that every particle of the *mixed Body*, partaketh of the *Nature* of the whole. Which *Nature*, ariseth from the contemperated *Qualities* of the four *Elements.* Whence they conclude, That every particle of the *mixed Body*, containeth in it self all the four *Elements.* Which is plainly to assert a *penetration* of *Bodies.* For every *Element* is, at least, one particle; if therefore every particle of the *mixed* Body, containeth four *Elements*; then four particles are but one. I conclude then, That the received *Doctrine* of *Mixture* is *Unintelligible.*

4. §. Whence it follows, That it is also *Barren* and *Unuseful.* For who can make any use of that which he understandeth not? And the experience of so many years, wherein it hath been ventilated by the disputes of men, proveth as much: Scarce any of them, except the Learned *Sennertus*, daring to venture upon Experiment, for fear they should come to understand themselves.

5. §. It is confessed, that many gallant things have been found out by artificial *Mixture.* But no thanks to this *Definition* of it. For as an *Ignorant* Man may make bad *Work*, and a good *Rule* be never the worse; so one that is *Ingenious* may make good *Work*, and a bad *Rule* be never the better. The question is not, what have men done? but what have they done upon this foundation, *Quod Mixitio sit miscibilium alteratorum unio.* Had this ever taught them to do any thing, even so much as to make the *Inke* wherewith they have wrote, all their *Disputes*; I confess, they would have had something to shew for it. But the truth is, their *notions* of *Mixture*, have been so far from doing us any good, that they have done us much harm: being, through their seeming subtlety, but real absurdity, as so many phantastick *Spectrums*, serving only to affright men from coming near them, or the Subject whereof they treat.

6. §.

§. 6. I ſhall therefore endeavour to open the true *Nature* of *Mixture*. And I ſhall build my *Doctrine* upon the *Common Notions* of *Senſe*: which none can *deny*; and every one may *conceive* of. In order to which, I ſhall take leave to lay down ſome *Propoſitions*, of the *Principles* of all *mixed Bodies*.

CHAP. II.

Of the Principles of Bodies.

AND firſt, by *Principles*, I mean *Atomes*, or certain *Sorts* of *Atomes*, or of the *ſimpleſt* of *Bodies*. For otherwiſe they would not be *Principles*; for a *compounded Principle*, in ſtrict ſpeaking, is a *Contradiction*. Even as *Fives*, *Threes*, or *Two's* are not the *Principles* of *Number*, but *Unites*.

2. §. Whence, ſecondly, it follows, that they are alſo *Indiviſible*. Not *Mathematically*; for the *Atomes* of every *Principle* have their *Dimenſions*. But *Phyſically*; and ſo, what is but *one*, cannot be made *two*. If it be asked, Whether a Stick cut with a Knife, be not of one, made two? I ſay, that a Stick, is not *one* Body, but *many millions* of Bodies; that is, of *Atomes*; not any one whereof is *divided* within it ſelf, but only they are *ſeparated* one from another, where the Knife forceth its way. As in the drawing of a mans Finger through a Heap of Corn; there is no *Diviſion* made in any one *Grain*, but only a *ſeparation* of them one from another, all remaining ſtill in themſelves entire. I ſay, therefore, that what is *Phyſically one*, is alſo moſt firm, and *Indiviſible*, that is, *Impenetrable*: for *Penetration* is but the *Separation*, not the *Diviſion* of *Atomes*.

3. §. Hence, thirdly, they are alſo *Immutable*. For that which cannot be *divided*, cannot be *chang'd*. So that of the whole World of *Atomes*, not any one hath ever ſuffer'd, or can ſuffer the leaſt *mutation*. Hereupon is grounded the *Conſtancy* of *Cauſes* and *Effects*. So that, in all *Generations*, it is not leſs certain, that the ſelf ſame *Principle* is ſtill *propagated* from the ſame; than, that *Man* is from *Man*. Wherefore, *compounded Bodies* are *generated*; but *Principles* are not, but only *propagated*; that is, in every *Generation*, they paſs, in themſelves unaltered, from one Body, into another.

4. §. If *Principles*, or *Atomes* are all *Immutable*; it again follows, That they are of *Divers Kinds*. For one and the ſame *Principle*, or *Kind* of *Atomes*, will ſtill make the *Same* Thing, and have the *ſame Effect*: ſo that all *Generations* would then be the *Same*. Wherefore, ſince they are *Immutable*, they muſt be *Divers*.

5. §. This *Diverſity*, for the ſame reaſon, is not ſmall, but very *Numerous*. For as the *World*, taken together, is *Natures Shop*; ſo the *Principles* of Things are her *Tools*, and her *Materials*. Wherefore, as it ſpeaks the *goodneſs* of a *Shop*; ſo the *Perfection* of the *Univerſe*, That it is furniſhed with many *Tools* wherewith, and many *Materials* whereupon to *work*. And conſequently, that *Philoſophy* beareth beſt its own name; which doth not ſtrain all to two or three *Principles*, like two or three

Bells

Bells in a Steeple, making a pitiful *Chime*: but tryeth to riſe up to *Natures* own *Number*, and ſo to *ring* all the *Changes* in the World.

6. §. Yet doth not this vaſt *Diverſity* take away the *Regiment* and *Subordination* of *Principles*. There being a certain leſſer *number* of them, which either by their greater *quantity*, or other ways, have *Rule* and *Dominion*, in their ſeveral *Orders*, over all the reſt. For where-ever the *Subject* is *Multitude*, *Order* is part of its *Perfection*. For *Order* is *Proportion*. And how can *Nature* be imagin'd to hold *Proportion* in all things elſe, and not here? Wherefore, as certainly, as *Order* and *Government* are in all the Parts of the *Rational*; ſo certainly, of the *Material World*. Whence it is, That although the *Species* of *Principles* be very *numerous*; yet the *Principles* called *Galenical*, *Chymical*, or any others, which do any way fall under the notice of Senſe, are notwithſtanding *reduceable* to a *ſmaller number*: *viz.* according to the *number* of *Predominant Principles* in *Nature*; or, rather in this part of the *Univerſe* which is *near and round about us*. To the *Power* and *Empire* whereof, all other *Principles* do ſubmit. Which *Submiſſion*, is not the *quitting* of their own *Nature*; but only their appearance under the external Face or *Habit* of the ſaid *Predominant Principles*.

7. §. As there can be no *Order* of *Principles*, without *Diverſity*; ſo no *Diverſity*, but what is *originally* made by theſe two ways; *ſc.* by *Size* and *Figure*. By *theſe* they may be exceeding different: and all other *Properties* beſides, whereby they differ, muſt be *dependent* upon *theſe Two*.

8. §. Nor therefore, can they be of any other *Figures*, than what are *Regular*. For *Regularity*, *is a Similitude continu'd*. Since therefore all kinds of *Atomes* are *divers* only by their *Size* and *Figure*; if the ſelfe ſame *Size* and *Figure* were not *common* to a certain number of *Atomes*, they could not beſaid to be of any *one kind*: and conſequently, if there were no *Similitude* of *Atomes*, there could be no *Diſtinction* of *Principles*.

9. §. Hence alſo, theſe two *Modes* of *Atomes*, *viz.* their *Size* and *Figure*, are the true, and only *original Qualities* of *Atomes*. That is, an *Atome* is *ſuch* or *ſuch*, becauſe it is of ſuch a certain *Size* and *Figure*.

10. §. Laſtly, As theſe two *Modes*, taken ſeverally, are the *Qualities* of an *Atome*: ſo conſider'd together, they are its *Form*. A *ſubſtantial Form* of a *Body*, being an unintelligible thing. I ſay of a *Body*; for although the *Rational Soul* be a *ſubſtantial Form*, yet is it the *Form* of a *Man*, and not of a *Body*. For the *Form* of a *Body*, we can conceive of no otherwiſe, than as of the *Modification* of a *Body*, or a *Complexion* of all the *Modes* of a *Body*. Which alſo agrees with that *Definition* of a *Form*, which amongſt the *Peripatetick Philoſophers* is well enough accepted, *viz.* *Quod ſit, Ratio ejus Eſſentiæ, quæ cuique Rei competit.* Which *Ratio*, if it be referred to a *Body*, what is it, but the *Modification* of that *Body*? Having thus propoſed a Summary of my *Thoughts* about *Principles*; I ſhall next proceed to ſhew what their *Mixture* is.

CHAP.

CHAP. III.

Of the NATURE *of* Mixture.

AND first of all, from the *Premisses*, we arrive at this *Concluſion*; *ſc.* That the *Formation* and *Transformation* of all Bodies, can be nothing elſe, but the *Mixture* of Bodies. For all *Principles* are *immutable*; as we have above proved: and therefore not *generable*, *formable*, or *transformable*. And the *Forms* of *Principles*, being but their *Modes*, are alſo *immutable*. So that the whole *Buſineſs* of the *Material World*, is nothing elſe, but *Mixture*. *Ch.* 2. §. 3. *Ch.* 2. §. 10.

2. §. Again, as *Nature* worketh every where only by *Mixture*; ſo is this *Mixture* every where but *one thing*, and can be but *one*. For whether it be the *Mixture* of *great* Bodies, or of *ſmall*; of *Compounds*, or of *Atomes*; it is every where *Mixture*, and the *Mixture* of *Bodies*. Wherefore, *Mixture* is either an *intelligible Affection* of *all* Bodies, or of *none*; which later, no man will ſay. As many ways therefore, as we can *ſee*, or *conceive* the *Mixture* of any *groſs* Bodies, which we hold in our hand; ſo many ways, we may, of the *ſubtileſt Mixtures* which *Nature* maketh, or of *Atomes* themſelves; and no other ways. *Ch.* 2. §. 2.

3. §. Now all the ways we can diſtinguiſh *Mixture* by, are, in general, theſe *Two*; either in reſpect of the *Bodies Mixed*, or elſe of the *Modes* of the *Mixture* it ſelf.

4. §. In reſpect of the *Bodies Mixed*, *Mixture* is diſtinguiſhed alſo *two* ways; *viz.* by *Conjugation*, and by *Proportion*.

5. §. By *Conjugation*, I mean, a *Mixture of ſome certain Principles, and not of others*. Which is *threefold*. *Firſt*, As to *Number*: as when one Body may be compounded of *two Principles*, another of *three*, a third of *four*, a fourth of *five*, and ſo on. *Secondly*, As to *Kind*: where, though there be a conjunction of the ſame *Number*, yet not of the ſame *Kind*. *Thirdly*, When they differ from one another both in *Number* and *Kind*. So many ways the *Principles* of Bodies may be conceived to be *Conjugated*; and therefore are: for here, that which *may* be, *is*. The Conſequence is clear. For *firſt*, *Nature* hath various *Materials* wherewith to make theſe *Mixtures*; as we have ſhewed. *Secondly*, By theſe *Mixtures* ſhe *may*, and without the concurrence of any imaginary *Forms*, *muſt* produce all the varieties in the *material World*; as likewiſe hath been ſaid. Wherefore, ſince all imaginable *Mixtures may* be *made*, and that to *ſome purpoſe*; if they ſhould not be *ſo*, *Nature* would be *Imperfect*: becauſe we our ſelves can think, how ſhe might put her *Materials* to further uſe, then *ſo* ſhe would do. To think therefore, that all *Kinds* of *Principles*, or all *Elements* go to make up every *Compounded Body*, as by the *Peripatetick Philoſophy* we are taught; is a conceit, no more to be credited, than one that ſhould tell us, all *Kind* of *Wheels* and other *Ch.* 2. §. 5. *Ch.* 3. §. 1.

parts of a *Watch*, were put into a *Clock*; or that there were no other *Materials* wherewith to build an *Houſe*, then for a *Tent* or a *Ship*. For why ſhould *Nature*, the great *Artificer* by which all *perfect Works* are made, be feigned to cram and ram *all things into one*, which we our ſelves look upon as abſurd?

6. §. *Secondly*, The *Mixture* of *Principles* is diverſifi'd, as by *Conjugation*, ſo alſo by *Proportion*. That is, by the divers *Quantities*, of the ſeveral *Principles* or *Parts mixed* together. As if the *Quantity* of one, were as *five* to *ten*; of a ſecond, as *five* to *fifteen*; of a third, as *five* to *twenty*, &c. Or if that of one, be as *five* to *ſix*; of a ſecond, as *ſix* to *ſeven*; of a third, as *ſeven* to *eight*. By which, and by other *Proportions*, *Mixture* may be varied innumerable ways.

7. §. *Again*, As *Mixture* is varied with reſpect to the *Bodies Mixed*; ſo likewiſe in reſpect of the *Mixture* it ſelf, which I call the *Location* of *Principles*, or the *Modes* of their *Conjunction*. Which may be various, as well as their *Conjugation* and *Proportion*. Yet are they all reduceable unto *two* general *Modes*: all *Bodies*, and therefore all *Principles*, being *mixed* either by *Mediation*, or by *Contact*. *Ch.* 2. §. 2.

8. §. Now all *Contact*, whether of *Compounds*, or of *Atomes*, can be no other way, than ſuch as is anſwerable to their *Figures*. Whereof, therefore, we can conceive but *three* general ways, *viz.*

Firſt, By *Contract* in a *Point*, or ſome *ſmaller part*: as when *two Atomes* meet, which are *globular* or otherwiſe *gibboſe*. *Secondly*, By *Contact* in a *Plain*: as in the conjunction of the *ſides* of *Triangular* or *Quadrangular Atomes*, or otherwiſe *flat*. *Thirdly*, By *Contact* in a *Concave*: as when one *Atome* is admitted into the *Concave* or *hole* of another; as a Spigot is into a Foſſet. The *firſt* may be called, *Appoſition*; the *ſecond*, *Application*; the *third*, *Reception* or *Intruſion*.

9. §. In the *two laſt* ways, *Atomes* may be joyned by *Mediation*; but beſt of all the *laſt*. As when the *two extreams* of one *Atome* are received into the *Concaves* or the *holes* of two others.

10. §. And theſe are all the *general* ways, whereby we can conceive Bodies to be *Mixed* together; *ſc.* by their various *Conjugation*, *Proportion* and *Location*. So that the *Compoſition* of *Atomes*, in *Bodies*; is like that of *Letters*, in *Words*. What a Thunderclap would ſuch a *Word* be, wherein all the four and twenty *Letters* were pack'd up? One therefore is compounded of more, another of fewer: this of ſome, and that of others: and both the *Conjugation*, *Proportion*, and *Location* of *Letters* is varied in every *Word*: whereby, we have many thouſands of *differing Words*, without any *alteration* at all, in the *Letters themſelves*; and might have ten times as many more. In like manner, therefore, or in the ſelf ſame analogous way, as the *Letters* of the *Alphabet*, are the *Principles* of *Words*; ſo *Principles*, are the *Alphabet* of *Things*.

11. §. What we have ſaid of *Principles*; and of *Mixture* as conſequent thereupon; may be a *foundation* for an *intelligible* account, of the *Nature* and *Cauſe* of moſt of the Intrinſick *Properties*, and *Qualities* of *Bodies*: as of *Gravity*, *Levity*, *Fixity*, *Fluidity*, *Angularity*, *Roundneſs*, *Heat*, *Cold*, *Blackneſs*, *Whiteneſs*, *Sowerneſs*, *Sweetneſs*, *Fragrancy*, *Fetidneſs*, and very many more. I ſay an *intelligible* account; *ſc.* ſuch as is grounded upon the *Notions* of *Senſe*, and made out *Mechanically*. But the exemplification hereof, being too large a field for

for this, or any one *Lecture*, I ſhall, before I come to the *Cauſes* of *Mixture*, only deduce from the *Premiſes*, theſe following *Corollaries*.

12. §. *Firſt*, That there is no *alteration* of *Principles* or of *Elements*, in the moſt *perfect Mixture* of Bodies. It *cannot* be; for *Principles* are *Immutable*, as we have ſaid. And if it could be, yet it *needeth not* to be: for they are alſo *many*, and *compoundable infinite* ways; as hath been ſhewed. So that we have no need to perplex our ſelves with any of thoſe difficulties, that ariſe from the *Doctrine* of the *Alteration* of *Elements*. The ground of which conceit, is that, of three being but four *Elements*, and all in every particle of the *mixed Body*. And ſo men being puzeled, how from thence to make out the infinite *variety* of Bodies, they feigned them to be alterable, and *altered*, upon every *perfect Mixture*. Not conſidering, that if their four *Elements* be *alterable*; as few as they are, no fewer then *three* of them may be ſpared: for *one Element*, if *alterable*, may be made *any*. *Ch.* 2. §. 3. *Ch.* 2. §. 5. *Ch.* 3. §. 10.

13. §. Hence, *Secondly*, may be ſolved that great *Diſpute*, Whether ſuch as we call *Lixivial Salts*, are *made* by the *fire*? For *firſt*, No *Principle* is made by the *fire*: all *Principles* being *unalterable*; and therefore *unmakable*. *Secondly*, We muſt therefore diſtinguiſh betwixt the *Principle*, and its various *Mixture* with other *Principles*; from whence it may receive different *Shapes* and *Names*. Wherefore, a *Lixivial Salt*, *qua Lixivial*, is certainly *made* by the *fire*. But *quatenus Salt*, it is not: that *Principle* being *extractable* out of *moſt* Bodies; and by *divers* other *ways*, then by the *fire*. For whether you *Calcine* a body, or elſe *Ferment* it, (after the manner ſhewed by the *curious Improver* of *Chimical* Knowledg, *Dr. Daniel Cox*) or *putrifie* it under ground, or *drown* it in the Sea; it ſtill yieldeth *ſome kind* of *Salt*. All which *Salts* are *made*, not by *making* the *Saline Principle*; but only by its being differently *Mixed*, by thoſe ſeveral ways of the *Solution* of Bodies) with other *Principles*: from which its different *Mixture*, it receives the *various Denominations*, of *Marine*, *Nitrous*, *Volatile*, or *Lixivial*. *Ch.* 2. §. 3.

14. §. Hence, *Thirdly*, the moſt *perfect Mixture* of Bodies, can go no higher than *Contact*. For all *Principles* are *unalterable*; and all *Matter* is *impenetrable*; as hath been ſaid. In the moſt *viſible* and *laxe Mixture*, there is *Contact*; and in the moſt *ſubtile* and *perfect*, as in *Generation* it ſelf, there is *nothing more*. *Ch.* 2. §. 3. *Ch.* 3. §. 2.

15. §. Hence, *Fourthly*, we eaſily underſtand, how divers of the ſame *Principles*, belonging both to *Vegetables* and many *other* Bodies, are alſo *actually* exiſtent in the Body of *Man*. Becauſe even in *Generation* or *Tranſmutation*, the *Principles* which are tranſlated from one Body to another, as from a *Vegetable* to an *Animal*, are not in the leaſt *alter'd* in themſelves; but only their *Mixture*, that is, their *Conjugation*, *Proportion* and *Location*, is *varied*.

16. §. Hence alſo the difference of *Mixture*, ariſing from the difference of *Contact*, is intelligible; *ſc.* as to thoſe *three degrees*, *Congregation*, *Union*, and *Concentration*.

Congregation, and *Inconſiſtent Mixture*, is when the ſeveral *Atomes* touch but in a *Point*, or *ſmaller part*. In *which* manner, I have divers arguments, inducing me to believe the *Atomes* of all *Fluid Bodies*, *qua Fluid*, do touch; and in *no other*. *Ch.* 3. §. 8.

Ch. 3. §. 8. *Union*, is when they touch in a *Plain*. As in the *Cryſtals* and *Shootings* of all *Salts*, and *other* like Bodies. For if we purſue their divided and ſubdivided parts, with our eye, as far as we can; they ſtill *terminate*, on every ſide, in *Plains*. Wherefore, 'tis intelligible, That their very *Atomes* do alſo *terminate*, and therefore *touch*, in *Plain*.

Ch. 3. §. 8. *Concentration*, is when two, or more *Atomes* touch by *Reception* and *Intruſion* of one into another: which is the *cloſeſt*, and *firmeſt Mixture* of all; as in any *fixed unodorable*, or *untaſtable* Body: the *Atomes* of ſuch Bodies, being not able to make any *Smell* or *Taſte*, unleſs they were firſt *diſſolved*; that is to ſay, *unpin'd* one from another.

17. §. Hence, *Sixthly*, we underſtand, how in ſome caſes, there ſeemeth to be a *Penetration* of *Bodies*; and in what *ſenſe* it may be admitted: *viz.* if we will mean no more by *Penetration*, but *Intruſion*. For the *Intruſion* of one *Atome* into the *Concave* or *hole* of another, is a *kind* of *Penetration*; whereby they take up leſs room in the *mixed* Body, then they would do by any other way of *Contact*. As a naked knife and its ſheath, take up almoſt double room, to what they do, when the knife is ſheathed. Whence we may aſſign the *reaſon*, Why many *Liquors* being *mixed*; take up leſs room or ſpace, then they did *apart*; as the *Ingenious* Mr. *Hook* hath made it to appear by *Experiment*, that they do. I ſay the plain *reaſon* hereof, or at leaſt one reaſon, is the *Intruſion* of many of their *Atomes* into one another. Which yet is not a *Penetration* of Bodies ſtrictly ſo called.

Ch. 3. §. 1. *Ch.* 3. §. 14. 18. §. *Seventhly*, If all that *Nature maketh*, be but *Mixture*; and all this *Mixture* be but *Contact* 'tis then evident, That *Natural* and *Artificial* Mixture, are the *ſame*. And all thoſe *ſeeming ſubtilties* whereby *Philoſophers* have gone about to *diſtinguiſh* them; have been but ſo many *Scarcrows* to affright *Men* from the *Imitation* of *Nature*.

Ch. 3. §. 1. 19. §. *Eighthly*, Hence it follows, That *Art* it ſelf may go far in doing what *Nature* doth. And who can ſay, how far? For we have nothing to *Make*; but only to *mix* thoſe *Materials*, which are already *made* to our hands. Even *Nature* her ſelf, as hath been ſaid, *Maketh* nothing *new*; but only *mixeth* all things. So far, therefore, as we can govern *Mixture*, we may do what *Nature* doth.

Ch. 3. §. 18. 20. §. Which that we may ſtill the better underſtand; let us before, and in the next place, ſee the *Cauſes* of *Mixture*. For ſince *Natural* and *Artificial Mixture* are the *ſame*; the *immediate Cauſes* of both, are and muſt be the *ſame*.

CHAP.

CHAP. IV.

Of the CAUSES of Mixture.

NOW all the *Causes* of *Mixture* we can conceive of, must, I think, be reduced to these *six* in *general*; *viz. Congruity*, *Weight*, *Compression*, *Solution*, *Digestion*, and *Agitation*.

1. §. *Congruity*, or aptitude and *respondence* betwixt the *Sizes* and *Figures* of *Parts* to be *mixed*: whereby Bodies may be truly called the *Instrumental Causes* of their own *Mixture*. As when a *Plain* answers to a *Plain*, a *Square* to a *Square*, a *Convex* to a *Concave*, or a *Less* to a *Greater* or an *Equal*, &c. according to which *Respondencies* in the *parts* of Bodies, they are more or less easily *mingleable*.

2. §. *Weight*, by means whereof all *Fluid* Bodies, upon supposition of the *Congruity* of their parts, must unavoidably *mingle*.

3. §. *Compression*; which either by the *Air*, or any other Body, added to *Weight*, must, in some degree, further *Mixture*. Because, that *Weight* it self, is but *Pression*. For further Proof of all the said *Causes*, I made this *Experiment*; Let *Oyle* of *Aniseeds*, and *Oyl* of *Vitriol* be put apart into the *Receiver* of an *Air-Pump*. And, having *exhausted* it of the *Air*, let the *two* said *Oyls* be then affused one upon the other. Whereupon, *First*, It is visible, that they here *mix* and *coagulate* together; that is, their parts are *wedged* and *intruded* one into another, without the *usual compression* of the *Air*; for that is *exhausted*, and therefore only by the *Congruity* of their receiving and intruding parts; and by their *Weight*; by *which* alone they are so *compressed*, as to make that *Intrusion*. *Secondly*, It is also evident, That although they do *Coagulate*; yet not altogether so much, as when poured together in the same manner, and quantity, in the *open Air*. Wherefore, *Compression*, whether made by the *Air*, or any thing else, as it doth further the *Dissolution* of some Bodies, so the *Mixture* of others, and the greater the *Compression*, the more.

4. §. *Solution*; For all Bodies *mix* best, in *Forma fluida*. And that for two reasons. *First*, Because the *parts* of a Body are not then in a *state* of *Union*, but of *Separation*; and therefore, in a more capable *state*, for their *Mixture* and *Union* with the *parts* of *another* Body. *Secondly*, because then they are also in a *state* of *Motion*, more or less; and therefore, in a continual tendency towards *Mixture*; all *Mixture* being made by *Motion*. Wherefore all *Generations*, and most *perfect Mixtures* in *Nature*, are made by *Fluids*; whether *Animal*, *Vegetable*, or *Mineral*. Which is also agreeable to the *Doctrine* of the *Honourable* Mr. *Boyle*, in his *Excellent Treatise* of the *Nature* and *Vertues* of *Gems*. And it is well known, That Bodies are ordinarily *petrified*, or *Stones made*, out of *Water*. That is, out of *petrifying parts* dissolved *per minima* in *Water*, as both their *Menstruum* and their *Vehicle*. Wherefore, if we will talk of *making Gold*; it must not be by the Philosophers *Stone*, but by the Philosophers *Liquor*.

5. §. *Di-*

5. §. *Digestion.* For which there is the same reason, as for *Mixture*, by *Solution*. For, *First*, All heat doth *attenuate*, that is, still further *separate* the *parts* of a Body; and so render them more *mingleable* with the *parts* of *another*. And therefore, *Secondly*, Doth also add more *Motion* to them, in order to their *Mixture*.

6. §. *Agitation.* Which I am induced to believe a great and effectual means of *Mixture*, upon divers Considerations. As, *First*, That the *making* of *Blood* in the *Bodies* of *Animals*, and the *mixing* of the *Chyle* therewith, is very much promoted by the same means; *sc.* by the *Agitation* of the parts of the *Blood* and *Chyle*, in their continual *Circulation*. *Again*, from the *making* of *Butter* out of *Milk*, by the same means: whereby alone is made a *separation* of the oleous parts from the *Whey*, and Conjunction of the *Oleous* together. *Moreover*, From the great *Effects* of *Digestion*; well known to all that are conversant in *Chymical Preparations*. Which *Digestion* it self, is but a *kind* of *insensible agitation* of the *parts* of *digested* Bodies. 'Tis *also* a known *Experiment*, That the readiest way to dissolve *Sugar* in *Wine* or other *Liquor*; is to give the *Vessel* a *hasty turn*, together with a *smart knock*, against any *hard* and *steady* Body: whereby all the parts of the *Sugar* and *Liquor*, are put into a vehement *Agitation*, and so the *Sugar* immediately dissolved, and *mixed* with the *Liquor*. And I remember, that having (with intent, to make Mr. *Matthews's Pill*) put some *Oyl* of *Turpentine* and *Salt* of *Tartar* together in a Bottle, and sent it up hither out of the *Country*; I found, that the continual *Agitation* upon the *Road*, for three or four days, had done more towards their *Mixture*; than a far greater time of *Digestion* alone had done before. And it is certain, That a vehement *Agitation*, especially, if continu'd, or joyned with *Digestion*; will accelerate the *Mixture* of some Bodies, ten times more, than any bare *Digestion* alone; as may be proved by many *Experiments*. I will instance in this one. Let some *Oyl* of *Turpentine* and good *Spirit* of *Nitre* be stop'd up together in a Bottle, and the Bottle held to the Fire, till the *Liquors* be a little heated, and begin to bubble. Then having removed it, and the Bubbles by degrees increasing more and more; the two *Liquors* will of themselves, at last fall into so impetuous an *Ebullition*, as to make a kind of *Explosion*; sending forth a *smoak* for the space of almost *two yards* high. Whereupon, the *parts* of both the *Liquors*, being violently *agitated*, they are, in a *great portion*, *incorporated* into a *thick Balsam* in a *moment*: and that without any *intense* heat, as may be felt by the Bottle. And thus much for the *Causes* of *Mixture*.

CHAP.

CHAP. V.

Of the POWER *and* USE *of Mixture.*

HAVING enumerated the *general Cauſes*, we ſhall, laſtly, enquire into the *Power* and *Uſe* of *Mixture*; or, into what it can *Do* and *Teach*. And I ſhall Inſtance in *ſix* particulars. *Firſt*, to Render all Bodies *Sociable*, whatſoever they be. *Secondly*, To *Make Artificial* Bodies in Imitation of thoſe of *Natures* own production. *Thirdly*, to *make* or *imitate* the *ſenſible Qualities* of Bodies; as *Smells*, and *Taſts*. *Fourthly*, To *make*, or *imitate* their *Faculties*. *Fifthly*, It is a *Key*, to diſcover the *Nature* of *Bodies*. *Sixthly*, To diſcover their *Uſe*, and the *Manner* of their *Medicinal Operation*.

INSTANCE I.

FIRST, To render all Bodies *Sociable* or *Mingleable*: as *Water* with *Oyl*, *Salt* with *Spirit*, and the like. For *Natural* and *Artificial Mixture*, are the ſame; as we have before proved. If therefore *Nature* can do it, as we ſee in the *Generation* of Bodies ſhe doth, 'tis likewiſe in the *Power* of *Art* to do it. *Ch.* 3. §. 18.

2. §. And for the doing of it, two *general Rules* reſult from the *Premiſſes*, *ſc.* The *Application* of *Cauſes*, and the *Choice* of *Materials*. As for the *Cauſes*, they are ſuch as I have now inſtanc'd in. And for the *Application* of them, I ſhall give theſe *two Rules*. *Ch.* 4.

3. §. *Firſt*, That we tread in *Natures* ſteps as near as we can; not only in the *Application* of ſuch a *Cauſe*, as may be moſt proper for ſuch a *Mixture*; but alſo in allowing it *ſufficient time* for its *effect*. For ſo we ſee *Nature* her ſelf, for her more *perfect Mixtures*, uſually doth. She maketh not a *Flower*, or an *Apple*, a *Horſe*, or a *Man*, in a *moment*; but all things *by degrees*; and for her more *perfect and elaborate Mixtures*, for the moſt part, ſhe requireth *more time*. Becauſe all ſuch *Mixtures* are made and carri'd on *per minima*; and therefore require a greater time for the compleating of them.

4. §. A *ſecond Rule* is, Not only to make a due *Application* of the *Cauſes*; but ſometimes to *Accumulate* them. By which means, we may not only, *imitate Nature*, but in ſome caſes go beyond her. For as by adding a *Graft* or *Bud* to the *Stock*, we may produce *Fruit ſooner*, and ſometimes *better*, than *Nature* by the *Stock* alone would do: So here, by *accumulating* the *Cauſes* of *Mixture*, that is, by joyning *two*, *three*, or *more* together; or by *applying more* in ſome Caſes, where *Nature* applyeth *fewer*; we may be able to make, if not a more *perfect*, yet a far more *ſpeedy Mixture*, than *Nature* doth. As by joyning *Compreſſion*, *Heat*, and violent *Agitation*, and ſo continuing them all together, by ſome means contrived for the purpoſe, for the ſpace of a *Week*,

Week, or *Month*, or *longer*, without ceſſation. Which may probably produce, not only *ſtrange*, but *uſeful Effects*, in the *Solution* of ſome, and the *Mixture* of other Bodies. And may ſerve to *mix* ſuch Bodies, as through the *ſmall number* of their *congruous* parts, are hardly *mingleable* any other way. *Agitation* being, as carrying the *Key* to and fro, till it hit the *Lock*; or within the *Lock*, till it hit the *Wards*.

5. §. *Secondly*, For the *Choice* of *materials*, if they are not *immediately*, that is, of themſelves, *mingleable*; we are then to turn one *Species* of *Mixture* into a *Rule*; which is, To *mix* them by *mediation* of ſome *third*, whether more *ſimple* or *compounded* Body, which may be congruous *in part* to them *both*: as *Sulphurous Salts* are to *Water* and *Oyl*; and are for that reaſon *mingleable* with *either* of them. Or, By any *two* congruous Bodies, which are alſo, *in part*, congruous to *two others*: and other like ways. Whereby the *parts* of Bodies, though never ſo *heterogeneous*, may yet be all *bound* and *lock'd* up together. Even as *twenty Keys* may be *united*, only by *uniting* the *two Rings* whereon they hang. *Ch.* 3. §. 9.

6. §. The Conſideration of theſe things, have put me upon making ſeveral *Experiments*, for the *mingling* of *heterogeneous* Bodies. I ſhall give two Examples of Tryal; the one upon *Fluid*, the other upon *conſiſtent* Bodies.

7. §. For the *firſt*, I took *Oyl* of *Aniſeeds*, and pouring it upon another Body; I ſo order'd it, that it was thereby turned into a perfect *milk-white Balſam*, or *Butyr*. By which means the ſaid *Oyl* became *mingleable* with any *Winy*, or *Watery Liquor*; *eaſily*, and *inſtantaneouſly diſſolving* therein, in the form of a *Milk*. And *note*, That this is done, without the *leaſt alteration* of the *Smell*, *Taſt*, *Nature*, or *Operation* of the ſaid *Oyl*. By ſomewhat the like means, not only *Oyl* of *Aniſeeds*, but any other *ſtillatitious Oyl*, may be transformed into a *milk-white Butyr*; and in like manner be *mingled* with *Water* or any other *Liquor*. Which is of *various uſe* in *Medicine*; and what I find oftentimes very convenient and advantageous to be done.

8. §. Again, not only *Fluid* but *conſiſtent* Bodies, which of themſelves will *mix* only with *Oyl*; by due *mixture* with other Bodies, may be render'd *eaſily* diſſoluble in *Water*; as may *Roſin*, and all *reſinous* and *friable Gums*. As alſo *Wax*: and this without changing much of their *Color*, *Taſt*, or *Smell*. Whereof likewiſe, whatſoever others may do, the *Phyſician* may make a manifold *Uſe*.

INSTANCE II.

BY *Mixture* alſo, we may be *taught* to *Imitate* the *Productions* of *Nature*. As to which, from what we have before ſaid of *Mixture*, we may conclude; That there is no *Generation* of Bodies *unorganical*, but what is in the *Power* of *Mixture* to *imitate*. As of *Animals*, to Imitate *Blood*, *Fat*, *Chyle*, *Spittle*, *Flegm*, *Bile*, &c. Of *Vegetables*, to Imitate a *Milk*, *Mucilage*, *Roſin*, *Gum*, or *Salt*. Of *Minerals*, to Imitate *Vitriol*, *Allom*, and other *Salts*; as alſo *Metals*, and the like.

2. §. I do not ſay, I can do all this: yet if, upon good *Premiſſes*, we can conclude this poſſible to be done; it is one ſtep to the doing of it. But I will alſo give an *Inſtance* of ſomewhat that may be *done* in every *kind*. And,

3. §.

3. §. *First*, For the *Imitation* of an *Animal Body*, I will instance in *Fat*. Which may be *made* thus; Take *Oyl Olive*, and pour it upon high *Spirit* of *Nitre*. Then *digeſt* them for ſome days. By degrees, the *Oyl* becomes of the *colour* of *Marrow*; and at laſt, is *congealed*, or hardned into a *white Fat* or *Butter*, which *diſſolveth* only by the *fire*, as that of *Animals*. In converting *Oyl* thus into *Fat*, it is to be *noted*, That it *hardens* moſt upon the *exhalation* of ſome of the more *Sulphureous* parts of the *Spirit* of *Nitre*. Which I effected, well enough for my purpoſe, by unſtopping the glaſs after ſome time of *digeſtion*; and ſo ſuffering the *Oyl* to *diſſolve* and *thicken* divers times by ſucceſſive *heat* and *cold*. Hence, The true *Congealing Principle*, is a *Spirit of Nitre ſeparated from its Sulphur*. For the better doing whereof, the *Aer* is a moſt commodious *Menſtruum* to the ſaid *Spirit* of *Nitre*. Whence alſo, if we could procure ſuch a *Spirit* of *Nitre*, we might *congeal Water* in the midſt of *Summer*. We might alſo *refrigerate Rooms* herewith *Artificially*. And might *Imitate* all *froſty Meteors*. For the *making* of *Fat*, is but the *Durable Congelation* of *Oyl*: which may be done without *froſt*, as I have ſhewed how.

Hence alſo it appears, That *Animal Fat* it ſelf, is but the *Curdling* of the *Oyly* parts of the *Blood*; either by ſome of its own *Saline* parts; or by the *Nitrous* parts of the *Aer* mingled therewith.

Hence likewiſe it is, That ſome *Animals*, as *Conies*, and *Fieldfares*, grow *fatter* in *froſty* weather: the *oily* parts of the *blood*, being then more than ordinarily *coagulated* with a greater abundance of *nitrous* parts received from the *Aer* into their *bodies*.

For the ſame reaſon it is, That the *Fat* of *Land-Animals* is *hard*; whereas that of *Fiſhes* is *very ſoft*, and runs all to *Oyl*, *ſc.* Becauſe the *Water*, wherein they live, and which they have inſtead of *breath*, hath but very few *nitrous* parts in it, in compariſon of what the *Aer* hath.

4. §. *Secondly*, For the *Imitation* of a *Vegetable Body*, I will give three *Inſtances*; In *Roſin*, *Gum*, and a *Lixivial Salt*. The *firſt* may be made thus; Take good *Oyl* of *Vitriol*, and drop it upon *Oyl* of *Aniſeſeeds*; and they will forthwith *incorporate* together; and by degrees, will *harden* into a *perfect Roſin*; with the *general* and *defining Properties* of a *truly Natural Reſinous Gum*. Being not at all *diſſoluble* in *Water*; or at leaſt, not any more, then any natural *Roſin* or *Gum*: yet very *eaſily* by *fire*: as alſo higly *inflamable*: and exceeding *friable*. Although this *Artificial Roſin*, be the reſult of *two Liquors*, both which very ſtrongly affect the *Senſe*: yet being well *waſhed* from the *unincorporated parts*, (which is to be done with ſome care) it hath ſcarce any *Taſt* or *Smell*.

The *Concentration* of theſe *two Liquors*, is likewiſe ſo *univerſal*; that the *Roſin* is not made by *Precipitation*, but almoſt a *total Combination* of the ſaid *Liquors*; and that with ſcarce ſo much, as any *viſible* fumes.

5. §. *Again*, Having taken a certain *Powder* and a *Saline Liquor*, and mixed them together in a bottle, and ſo *digeſted* them for ſome time; the *Powder* was at laſt tranſmuted to a perfect *Oily Gum*; which will alſo *diſſolve* either in *Oyl* or in *Water*; in the ſelf ſame manner, as *Galbanum*, *Ammoniac*, and the like will do.

6. §. And *Laſtly*, A *Lixivial Salt* may be *imitated* thus; Take *Nitre*, *Oyl* of *Vitriol*, and high *Spirit* of *Wine*, of each a like quantity. Of theſe *three* Bodies, not any *two* being *put together*, that is to ſay

neither the *Nitre* with the *Oyl*, nor the *Oyl* with the *Spirit*, nor the *Nitre* with the *Spirit*, will make the leaſt *Ebullition*: yet all *three mingled together*, make a very *conſpicuous one*. The *Spirit* of *Wine* being as the *Sulphur*; and ſo that, and the *Nitre* together, ſtanding, as it were, in the ſtead of an *Alkalizate*, that is, a *Sulphurious Salt*, againſt the *Oyl* of *Vitriol*. Divers other *Experiments* may be ſhew'n of the like Nature.

7. §. In the laſt place, for the *Imitation* of a *Mineral Body*, I will inſtance in *two*, *ſc. Nitre* and *Marine Salt*; if I may have leave to reckon them amongſt *Mineral Bodies*. As for *Nitre*, by mixing of *four Liquors* together, and then ſetting them to *ſhoot*; I have obtained *Chryſtals* of *true* and *perfect Salt*; which have had much of a *nitrous taſt*; and would be *melted* with a *gentle Heat*, as *Nitre* is; and even as eaſily as *Butyr* it ſelf: I mean not, by the addition of any ſort of *Liquor*, or any other Body, to *diſſolve* it; but only by the *fire*.

8. §. And as for a *Sea-Salt*, that I might *Imitate Nature* for the *making* thereof, I conſider'd, That the ſaid *Salt* is nothing elſe but that of *Animals* and *Vegetables*, freed from its true *Spirit* and *Sulphur*, and ſome *Saline particles*, *ſpecifically Animal* or *Vegetable*, together with them. For both *Animal* and *Vegetable* Bodies being continually carried by all *Rivers* into the Sea; and many likewiſe by *Shipwrack*, and divers *other* ways *immerſed* therein: they are at laſt *corrupted*, that is, their *Compounding* parts are *opened* and *reſolved*. Yet the *Reſolution* being in the *Water*, is not made *precipitately*, as it is in the *Air*; but by degrees, and very *gently*; whence the *Sulphurious* and other *Volatile* parts, in their *Avolation*, make not ſo much *haſte*, as to carry the more *fixed Saline* parts along with them; but leaveth them behind in the *Water*, which *imbibeth* them as their proper *Menſtruum*.

And the *Imitation* of *Nature* herein, may be performed thus; Put as much of a *Lixivial Salt* as you pleaſe, into a wide-mouth'd Bottle, and with fair *Water* make a ſtrong *Solution* of it; ſo as ſome part thereof may remain *unreſolved* at the bottom of the Bottle. Let the Bottle ſtand thus for the ſpace of about half or three quarters of a year, all the time unſtopped. In which time, many of the *Sulphurious* and *other Volatile* parts gradually flying away; the top of the *unreſolved Salt* will be *incruſtate*, or as it were *froſted* over, with many ſmall and hard *Concretions*, which, in their nature, are become a true *Sea-Salt*. Whereof there is a double Proof; *Firſt*, In that moſt of the ſaid *Concretions* are of a *Cubical*, or very like *Figure*. Eſpecially on their *upper parts*; becauſe having a *fixed Body* for their *Baſis*, their *under* parts, therefore, contiguous thereto, are leſs *regular*. Whereas the parts of the *Salt* in the Sea, being environed on all ſides with a *Fluid*; their *Figure* is on all ſides *regular*. *Secondly*, In that a ſtrong *Acid Spirit* or *Oyl* being poured upon a *full body'd Solution* hereof; yet it maketh herewith no *Ebullition*, which is alſo the *property* of *Sea-Salt*. And thus much for the more *General Imitation* of *Bodies*.

IN-

INSTANCE. III, & IV.

FROM the aforesaid *Premisses*, and by the aforesaid *Means*, there is no doubt to be made, but that also the other *sensible Qualities* of Bodies may be *Imitated*, as their *Odors*, and *Tasts*. And that not only the *general* ones, as *Fragrant*, or *Astringent*: but also those which are *specifical* and *proper* to such a *species* of Bodies.

2. §. Thus for *Example*, by *mixing Spirit* of *Nitre* or *Vitriol* with *rectified Oyl* of *Turpentine*, and some other *Vegetable Oyls*, severally, and in a due *Proportion* and *Time*, I have *Imitated* the *Smells* of *divers Vegetables*; as of *Tansy*, of *Lignum Rhodium*, and *others*. And I conclude it feasable, To *Imitate* the *Tast* or *Smell* of *Musk*, or *Ambergreece*, or *any other* body in the world.

3. §. Hence also we may be *Taught*, How to *Imitate* the *Faculties*, as well as other *Qualities* of Bodies. The reason is, because even *these* have no dependance upon any *substantial Form*: but are the meer result of *Mixture*; effected by the same *Causes*, whether in *Nature* or *Art*; as I think I have made to appear in the foregoing *Idea*. And as in the *Premisses* of this *Discourse* hath been shew'd. *Id.* §. 55. *Ch.*2. §.10. *Ch.*3. §.10.

INSTANCE V.

FROM whence, *again*, it is likewise a *Key* to *Discover* the *Nature* of Bodies. For how far soever we can attain to *Mingle*, or to *Make* them, we may also know *what they are*.

2. §. For Bodies are *mingleable*, either *of themselves*, or by some *Third*. As to those which *mingle of themselves*, we may certainly conclude, That there is a *congruity* betwixt them, in some respect or other. So upon various Tryals I find, That *Essential Oyls* do more easily *imbibe* an *Acid*, then an *Alkaly*. Whence it is evident, That there is some *Congruity* and *Similitude* betwixt *Essentian Oyls*, and an *Acid*, which there is not betwixt the said *Oyls* and an *Alkaly*.

3. §. As to those that mingle only by some *third*; we may also certainly conclude, That though the *two extreams* are *unlike*; yet that they have both of them some *congruity* with that *third*, by which they are *united*.

4. §. *Moreover*, We may make a *Judgment* from the *manner* or *Degree* of *Mixture*. Thus the *Acid Spirit* of *Nitre*, as is said, will *coagulate Oyl-Olive*, and render it *consistent*. Whence it might be thought, That any other strong *Acid* will do the like; and that therefore, there is no great difference in the *Nature* of the said *Acid Liquors*. But the contrary hereunto, is proved by *Experiment*. For having *digested* the same *Oyl* in the same *manner*, and for a much *longer* time, with strong *Oyl* of *Sulphur*; although it thence acquired some change of *Colour*, yet not any *Consistence*.

5. §. *Again*, Because the said *Spirit* of *Nitre coagulates Oyl-Olive*; it might be expected, it should have the same effect upon *Oyl* of *Aniseeds*; or, at least, that if other *Acids* will *Coagulate Oyl* of *Aniseeds*, that this should do it *best*. But *Experiment* proveth the contrary. For of all I have tryed, *Oyl* of *Vitriol* is the only *Acid* that doth it *instantaneously*. *Oyl* of *Sulphur*, if very strong, will do it; but not so *soon*,

nor so *much Aqua fortis*, and *Spirit* of *Salt*, for the present, *do not* at all *touch* it. And *Spirit* of *Nitre* it self will not *coagulate* it, under *eight* or *ten* hours at least.

INSTANCE VI.

LASTLY, and *consequently*, It is a *Key* To *Discover* the *Medicinal Use* and *Operation* of Bodies. Thus, for *Example*, by the *Imitation* of *Rosins* and *Resinous Gums*, we certainly know what all of them *are*, and *when*, and *wherefore* to be *used*. For what are *Mastick*, *Frankincense*, *Olibanum*, *Benzoin*, and *other like Rosins*, or *Resinous Gums*, for their *principle* and *predominant* parts, that is, *quà Rosins*; but Bodies resulting from *Natural*, in like manner, as I have shewed, they may be made to result, from *Artificial Mixture*? That is to say, the *Oleous*, and *Acid* parts of *Vegetables*, being both *affused* and *mingled* together, *per minima*, in some one sort of *Vessels* in a *Plant*, they thus *incorporate* into one *consistent* and *friable* Body, which we call *Rosin*.

2. §. Now from hence it is, That the said *Rosins*, and *Resinous Gums*; as also *Amber* and *Sulphur* for the same Reasons; are of so great and effectual *Use* against most *thin* and *salt Rheums*; *&c.* as they are *Acidoleous* Bodies. For by their *Acid* parts, which in all these Bodies are exceeding *copious*, they *mortifie* and *refract* those *Salt* ones, which feed the *Rheum*. And by their *oleous* parts, the same *Salt* ones are also *Imbibed*. Whence, they are all, in some degree, *incorporated* together; that is, The *Rheum* is *thickned*: which is the desired *effect*.

3. §. Whereas, on the contrary, if the *Cough* proceed not from a *thin*, and specially a *Salt Rheum*, but from a *Viscous Flegm*; the use of *many other* Bodies which are also more *oleous*, and abound not so much with an *Acid* as *these* do, especially *some* of them, is more proper: such as *these*, in this Case, proving sometimes not only *ineffectual*, but *prejudicial*. Since the very *Cause* of the said *Viscousness* of *Phlegm*, is chiefly some great *Acidity* in the *Blood*, or in some other *part*, as may be proved by divers Arguments.

4. §. Many more *Instances* might be hereunto subjoyned: and may hereafter be offered to the acceptance of such, who are inquisitive into *matters* of this *Nature*. If I shall not herein anticipate, or reiterate the *Thoughts* and *Observations*, of those two *Accurate* and *Learned Persons* Dr. *Willis*, and Dr. *Walter Needham*, as to what the one hath already *published*, and both have put us in *Expectation* of. But the *Instances* already given, are sufficient to evidence what I have said. And, I hope, this present *Discourse* to prove, in some measure, thus much; That *Experiment*, and the *Common Notions* of *Sense* are *prolifick*; and that nothing is *Barren*, but Phansie and *Imagination*.

An

An Appendix to the precedent discourse of Mixture.

HAVING, in the first Edition of the foregoing Discourse, made mention of the preparation of *Essential Oyls*, so as to become easily mingleable with any *unoyly Liquor*. I shall here acquaint the Reader, That this may be done, by digesting any of the said *Oyls* with about an equal quantity of the *Yelk* of an *Egg*, with a very soft heat, like that of the *Meridian Sun* in *Summer*, continued for the space of three Weeks or a Month; and in the mean time, to be now and then stirred a little together. The *Yelk* will by degrees, imbibe the *Oyl*, and at length be incorporated with it, and become a *Balsam*, as *white* as *Milk*, easily dissoluble in any *watery* or *winy Liquor*. *Ch.* 5. *Inst.* 1. §. 8.

2. §. I confess, that it will be very difficult to prepare any good quantity for use, this way. But this being a sufficient proof of the possibility of such a *Mixture*; I considered, whether the application of some other forementioned *Cause* of *Mixture*, might not supply the defect of this: and hereupon, have made several successful tryals; not only for the mixing of the said *Oyls*, but likewise of all sorts of *Rosins* and *Gums* with any *winy* or *watery Liquor*, in great quantities, in a short time, and without much trouble. But for the mixing of some of them, the *Yelk* of an *Egg* alone will not serve, without the intervening of some other sociable Body, according to one of the *Rules* given in the foregoing *Discourse*. *Ch.* 5. *Inst.* 1. §. 6.

3. §. In the same *Discourse*, upon certain premises, I have laid down this following conclusion. *Ch.* 5. §. 5.

—— By accumulating the *Causes* of *Mixture*, that is, by joyning "two or three or more together; or by applying more in some cases, "where *Nature* applyeth fewer; we may be able to make, if not a more "perfect, yet a far more speedy *Mixture*, than *Nature* doth. As by joyning COMPRESSION, *Heat*, and *violent Agitation*, and so continuing them altogether, by some means contrived for the purpose, for "the space of a Week or Month, or longer without *Cessation*. Which "may probably produce, not only strange, but useful effects, in the "SOLUTION of some, and the *Mixture* of other *Bodies*.

4. §. For the proof whereof, and that I had throughly weighed what I have said, Mr. *Pappin* hath since given us an ingenious Instance, in his new *Digester*. Which is, a *Balneum Mariæ clausum*: all *Infusions* and *Digestions* made with *Double Vessels*, having hitherto been made with the outer *Vessel*, open. So that whereas by the old way of *Digestion*, their is no other *Power* made use of but that of *Heat*: in this way, that also of *Compression* is joyned therewith.

EXPERI-

EXPERIMENTS IN CONSORT OF THE LUCTATION

Arising from the Affusion of several

MENSTRUUMS

Upon all sorts of

BODIES,

Exhibited to the *Royal Society*, *April* 13. and *June* 1. 1676.

Ch.5.Inst.5

THE *intent of the following* Experiments *is twofold. The one, to be as a* Demonstration *of the Truth of one, amongst other* Propositions, *laid down in the precedent Discourse of* Mixture, *&c.* That it would be a Key to let us easily into the knowledge of the Nature of Bodies.

The other, and that consequently, To be as a Specimen of a Natural History of the Materia Medica: *that is to say, a multifarious Scrutiny into the intrinsick Properties of all those Materials, which have been, or may be used in* Medicine: *for the performance whereof, the following* Method *is exibited as one, amongst others, necessary to be insisted upon. For what Dominion a* Prince *hath over the* Moral, *that a* Physician *hath, as one of God Almighty's* Vice-Roys, *over the* Corporeal *World. Whom therefore nothing can more import, than a particular knowledge of the* Genius *of all his* Subjects, *those several* Tribes *of* Matter, *supposed to be under his Command.*

There

There are some known Obſervations *of this nature: but there is no Author, I think, who hath given us a* Syſteme of Experiments upon the Subject: *The performance whereof is here intended.*

The Experiments *may ſeem too numerous to be of one* make. *But no leſs a number would have anſwered the deſign of an* Univerſal Survey; *which, though leſs pleaſing, proves the more inſtructive in the end: not being like angling with a ſingle Hook; but like caſting a Net againſt a ſhole: with aſſurance of drawing up ſomething. Beſides the advantage of* comparing many together; *which being thus joyned, do oftentimes, like* Figures, *ſignifie ten times more, then ſtanding alone, they would have done.*

How far the Corollaries *all along ſubjoyned have made this good, is left to the* Reader *to judge. And alſo, to add to them, ſo many more, as he pleaſes: for I make my own Thoughts no mans* Meaſure.

CHAP. I.

What is generally to be obſerved upon the Affuſion *of the* Menſtruum; *and what, particularly of* Vegetable Bodies.

THE Bodies whereupon I made tryal, were of all kinds, *Animal*, *Vegetable*, and *Mineral*. Amongſt *Vegetables*, ſuch as theſe, *ſcil. Date-ſtones*, *Ginger*, *Colocynthis*, *Pyrethrum*, *Hawthorn-ſtones*, *Staphiſagria*, *Euphorbium*, the *Arenulæ* in Pears, *Semen Milii Solis*, *Tartar*, *Spirit* of *Scurvygraſs*, *Spirit* of *Wine*, &c.

2. §. Amongſt *Minerals*, ſeveral ſorts of *Earths*, *Stones*, *Ores*, *Metals*, *Sulphurs*, and *Salts*.

3. §. Amongſt *Animals*; ſuch as theſe, *ſcil. Hairs*, *Hoofs*, *Horns*, *Shells*, and *ſhelly Inſects*, *Bones*, *Fleſh*, and the ſeveral *Viſcera*, *Silk*, *Blood*, *Whites* and *Yelks* of *Eggs*, *Sperma Ceti*, *Civet*, *Musk*, *Caſtor*, *Gall*, *Urine*, *Dungs*, *animal Salts* and *Stones*.

4. §. The *Liquors* which I poured hereupon ſeverally, were theſe, *ſc. Spirit of Salt Armoniac*, *Spirit* of *Harts-Horn*, *Spirit* of *Nitre*, *Aqua fortis*, *Oyl* of *Salt*, *Oyl* of *Sulphur*, and *Oyl* of *Vitriol*; commonly ſo called.

5. §. In the *Mixture* of theſe Bodies, two things, in general, are all along to be obſerved, *viz. Firſt*, which they are, that make *any*, or *no Luctation*. For, as ſome which ſeem to promiſe it, make none: So, many, contrary to expectation, make a conſiderable one.

6. §. *Next*, the *manner* wherein the *Luctation* is made; being with much variety in theſe *five* ſenſible *Effects*. 1. *Bullition*; when the Bodies mixed produce only a certain quantity of froth or bubbles. 2. *Elevation*; when, like Paſte in baking, or Barm in the working of Beer, they ſwell and huff up. 3. *Crepitation*; when, they make a kind

kind of hiſſing and ſometimes a crackling noiſe. 4. *Effervescence*; then only and properly ſo called, when they produce ſome degree of heat. 5. *Exhalation*; when not only fumes, but viſible ſteams are produced.

7. §. Of all theſe, ſometime one only happens, ſometimes two or more are concomitant. Sometimes the *Luctation* begins preſently upon mixture, and ſometimes not till after ſome intermiſſion. In ſome bodies, it continues a great while; in others, is almoſt inſtantaneous: Examples of all which I ſhall now produce; beginning with *Vegetables*, as affording the leaſt variety.

8. §. *And firſt, if we take Spirit or Oyl of Salt, Oyl of Vitriol, Spirit of Nitre, or Aqua fortis, and pour them ſeverally upon the ſeveral parts of Vegetables, as Roots, Woods, Stones, &c. we ſhall find, that they are, generally far leſs apt to make a Luctation, than either Animal, or ſubterraneal Bodies.* Whence, as from one argument, it ſeemeth evident, That in moſt *Vegetables*, and in moſt of their parts, the predominant *Salt* is an *Acid*. But that, on the contrary, the predominant *Salt* in moſt *Minerals*, and parts of *Animals*, is an *Alkaly*: in the former, uſually a *fixed*; in the latter, a *volatile Alkaly*.

9. §. *Again, although the Luctation which moſt Vegetables, and moſt of their parts make with Acids, be but ſmall, yet ſome they make; eſpecially with ſome Acids, as with Spirit of Nitre and Aqua fortis.* Whence it ſeemeth plain, That there is an *Alkaline Salt* exiſtent in many *Vegetables*, even in their *natural eſtate*; and that it is not made *Alkaline*, but only *Lixivial*, by the *fire*. Or, there is ſome quantity of a *Salt*, call it what we will, in the ſaid Bodies, which is ſo far different from an *Acid*, as to make a *Luctation* therewith. But to give particular inſtances of the ſeveral *proportions*, or *manner* of *Mixture*, wherein it appears to be in ſeveral *Plants*.

10. §. *And firſt, of all vegetable Bodies, Date-ſtones are amongſt the leaſt apt to make a Luctation with Acids, if they may be ſaid to make any at all.* Hence they are not ſo potent *Nephriticks*, as many other Stones, which make a more ſenſible *Luctation*.

11. §. *Ginger makes a ſmall Bullition* with *Aqua fortis*, *only obſervable by a Glaſs.* Hence the *pungency* of Ginger lyeth in a *ſulphureous* and *volatile Salt*, which yet is very little *Alkalizate*.

12. §. *Scurvygraſs-ſeeds make a very ſmall Bullition with Aqua fortis, like that of Ginger. So doth alſo the Seed of Purſlane.* Hence, although there is much more of a certain kind of *volatile Salt* in Ginger or Scurvygraſs, than in *Purſlane*; yet there is little more of an *Alkaly* in any one, than in an other.

13. §. *The Pulp of Colocynthis, Fruit-Stones, the ſtony Covers of the Seeds of Elder, of white Bryony, of Violets, and others, with Aqua fortis make a Bullition juſt perceivable without a Glaſs.* Hence it appears, That the great *Cathartick* power of *Colocynthis* lieth not ſo much in an *Alkaly*, as an *Acid*; as making a much leſs *Bullition*, than ſome other *vegetable Bodies*, which are leſs *Cathartick*. For which reaſon likewiſe it is, That the beſt Correctors, or Refractors of the force of *Colocynthis*, are ſome kinds of *Alkalies*, as particularly that of *Urine*, as *Riverius* hath ſomewhere obſerved.

14. §. *The Root of Pyrethrum, with Aqua fortis, makes a Bullition and huff, in a ſhort time.* Hence, the Cauſe of a *durable Heat*, upon the Tongue, is an *Alkalizate Sulphur*. For the Heat of Ginger, though

greater;

greater; yet abideth *nothing near ſo long* as that of *Pyrethrum*; which, as is ſaid, maketh alſo a more ſenſible *Bullition* with *Acids*.

15. §. *Kermes-berries, commonly, but ignorantly, ſo called, with the ſaid Liquor, huff up to an equal height, but in a ſomewhat longer time.* Hence they are gently *aſtringent*; *ſcil.* as their *Alkaly* binds in with ſome preternatural *Acid* in the ſtomach.

16. §. *Hawthorn-ſtones, with Aqua fortis, huff up equally with the former Body; but the Bullition is not ſo viſible. The like is alſo obſervable of Medlar-ſtones.* Hence, as they contain a middle quantity of an *Alkaly*, they are not inſignificantly uſed againſt the *Stone*.

17. §. *Seeds of Staphiſagria, with Aqua fortis, make a Bullition ſtill more viſible. But it quickly ends.* This confirms what was ſaid before, *ſc.* That the cauſe of a *durable Heat* is an *Alkaline Sulphur*; theſe Seeds producing a *durable Heat*, as doth the Root of *Pyrethrum*.

18. §. *The Seeds alſo of red Roſes, Borage, and Comfrey do all with Aqua fortis make a conſiderable Bullition and huff; and that very quickly.* So that amongſt all Shells and Stones, thoſe generally make the greateſt *Bullition*, which are the hardeſt and the brittleſt, and ſo the fulleſt of *Salt*.

19. §. *Euphorbium makes a Bullition yet more conſiderable, with much froth, and very quickly.* From which Experiment, compared with two of the former, it appears, That *Euphorbium* is not an *Acid*, but an *Alkaline Gum*. As alſo, that the cauſe of its ſo very *durable Heat*, is an *alkaline Sulphur*, as of *Pyrethrum* and *Staphiſagria* hath been ſaid. It ſeems alſo hence evident, that the power of all great *Sternutatories* lyeth not in their *Acid*, but their *Alkalies*.

20. §. *The Arenulæ or little ſtones in Pears, cluſter'd round about the Coar, with Aqua fortis, preſently huff up, and make a great Bullition and Effervеſcence, much greater than do any of the Bodies above-named.* Whence, although, ſo far as I know, they have never yet been uſed in *Medicine*; yet it is probable, that they are a more potent and effectual *Nephritick*, than any of the Bodies aforſaid, ſome of which are uſually preſcribed. It is hence alſo manifeſt, That, according to what I have elſewere ſaid, for the ſweetning of the Fruit and Seed, the *Tartareous* and *Alkaline* parts of the *Sap*, are *precipitated* into their Stones, ſtony parts, and Shells. *Anat. of Plants, B. 1. Ch. 6.*

21. §. *The laſt Inſtance ſhall be in the ſhells of the Seeds of Milium Solis; which not only with Aqua fortis, but ſome other Acids, make a greater and quicker Bullition and Effervеſcence, than any other vegetable Body, upon which I have yet made tryal, in its natural eſtate.* Hence, as well as from divers of the laſt fore-going Inſtances, we have a clear confirmation of what I have, towards the beginning of this Diſcourſe, aſſerted; *ſc.* That there is ſome kind of *Alkaline Salt* in *Plants*, even in their *natural eſtate*. As alſo, that they are as ſignificantly uſed againſt the Stone, *quatenus alkalizate*, as *Millipedes*, *Egg-ſhells*, or any other *teſtaceous Bodies* of the ſame ſtrength. To theſe I ſhall ſubjoyn one or two Examples of Vegetable Bodies which are more or leſs altered from their *natural eſtate*.

22. §. *Neither Cryſtals of Tartar, nor Tartar it ſelf (although they have ſome ſtore of alkaline mixed with their acid parts) make any Effervеſcence with Acids, but only with Alkalites, as Spirit of Harts-Horn, &c.* Hence the *calculous ſediment* or *Arenulæ* in *Urine*, may not ſo properly be called

the *Tartareous part* of the *Urine*; the events following the mixture hereof with the aforesaid *Salts*, being quite contrary; as will be seen in the *Last Chapter*.

23. §. *Spirit of Scurvy-grass maketh no Luctation with any Acid.* Hence (as from a former Experiment was above-noted) it seems, That there may be a kind of *volatile Salt*, which is neither *acid*, nor *alkaline*; such as this of *Scurvygrass* and other like *Plants* seems to be: yet contrary to an *acid*; as experience shews in their efficacy against the *acid Scurvy*.

24. §. *Rectified Spirit of Wine, both with Spirit of* Nitre, *and with Oil of Vitriol, severally, maketh a little Luctation.* Which argues, that there is contained, even in this Spirit, some portion of a *volatile Alkaly*.

25. §. *Spirit of Wine, and double Aqua fortis, as the strongest is called, make an effervescence so vehement, as plainly to boil.*

26. §. *Besides the vehemency hereof, there is another surprizing circumstance. For whereas all other Liquors which make an Effervescence together, will do it in any proportion assigned, although but one drop to a thousand: these two,* &c. *rectified Spirit of Wine and Aqua fortis, require a certain proportion the one to the other. For if, suppose, into six drops of Spirit of Wine you put but two or three of Aqua fortis, they stir no more than if you put in so much Water: but drop in about seven or eight drops of Aqua fortis, and they presently boil up with very great vehemency.* Hence we may conceive the reason of the sudden access of an *acute Disease*, and of its *Crisis*. These not beginning *gradually with the Cause*; but then, when the *Cause* is arrived unto such an ἀκμὴ, or such a certain *Proportion*, as is cecessary to bring Nature to the contest. And these may serve for Examples upon *Vegetables*.

CHAP. II.

What may be observed of MINERALS.

HAVING given several Instances of tryal upon *Vegetables*; I next proceed to *Minerals*, which, for some orders sake, I shall distribute into five or six sorts, *viz. Earths, Stones Ores* and *Metals, Sulphurs*, and *Salts*.

2. §. *First for Earths. Oyl of Vitriol upon Fullers Earth, doth not stir it, or cause the least Bullition. Nor upon yellow Oker. Nor upon the Oker which falls from green Vitriol. The same Oyl of Vitriol and Spirit of Harts-Horn poured severally upon Bolus Armena of two kinds, and upon one kind of Terra sigillata, stir none of them.* Hence *Bolus*'s are the *Beds*, or as it were, the *Materia prima*, both of opacous *Stones*, and *Metals*; into which the said *Bolus*'s are transmuted, by being *concentred* with divers kinds of *Salts* and *Sulphurs*, which successively flow in upon them.

3. §.

3. §. *Aqua fortis, and Oyl of Vitriol being poured ſeverally upon another ſealed Earth, which was vended by the name of Terra Lemnia; they both made a very conſiderable Effervеſcence herewith.* Whence it appears, That there is no ſmall difference in the nature, and therefore the operation of *Bolus Armena* and *Terra Lemnia.* As alſo, betwixt the ſealed Earths themſelves, one making a great *Effervеſcence*, another none at all. Whereto thoſe that uſe them, are to have regard.

4. §. *Next for Stones. And firſt, Iriſh Slat, with Spirit of Hartshorn, maketh a ſmall, yet viſible Bullition: and it preſently ceaſeth.* So that it ſeems to be nothing elſe but a *Vitriolick Bole.* As is alſo argued from its taſte, which is plainly acid, and ſomewhat rough. Whence alſo it is with good reaſon given upon any inward Bruiſes. Becauſe by coagulating the Blood, it prohibits its too copious afflux into the affected part. Yet being but gently aſtringent, and ſo the Coagulations it makes, not great; they are likewiſe well enough carried off from the ſame part in the Circulation; by both which means an Inflammation may be either prevented, or the better over-ruled.

5. §. *Lapis Hæmatites maketh no Effervеſcence at all either with Alkalies or Acids.*

6. §. *Powder of the green part of a Magnet with Oyl of Vitriol maketh ſome few bubbles, yet not viſible without a Glaſs. But the powder of the black part of a Magnet, which is the ſaid ſtone fully perfect, ſtirreth not with any acid. Neither doth the calcined Magnet.* Hence there is ſome conſiderable difference betwixt *Iron* and the *Magnet.*

7. §. *Lapis Lazuli, with Oil of Vitriol, and eſpecially with Spirit of Nitre, maketh a conſpicuous Bullition.* Hence its *Cathartick* virtue lyeth in an *Alkaly.* For which reaſon it is alſo appropriate, in like manner as *Steel*, to the cure of *Hypochondriacal Affections*; originated from ſome kind of fermenting Acid.

8. *Oſteocolla, with Spirit of Nitre maketh yet a greater Effervеſcence.* How it comes to be ſo great a knitter of broken Bones, as it is reputed, is obſcure. It ſeemeth, that upon its ſolution by a *Nitrous Acid* in the body; it is *precipitated* upon the broken part, and ſo becomes a kind of *Cement* thereto.

9. §. *Lapis Tuthiæ, with Spirit of Nitre, maketh an Effervеſcence much alike. And with Oyl of Vitriol very conſiderably. But Lapis Calaminaris with Oyl of Vitriol grows ſtark; as the powder of Alabaſter doth with water. With Spirit of Nitre it maketh a little Bullition, and quickly. But with Aqua fortis, a great one; beyond any of the Stones above named.* Hence both *Tutty* and *Calamy* are *Ophthalmicks* from their *Alkaly.* Which is alſo confirmed, from the efficacy of ſome *Alkalies* of the like uſe. Hence alſo *Calamy* ſeemeth to partake ſomewhat of the nature of *Silver*: as by tryal made upon that alſo, will hereafter better appear.

10. §. *Chalk and Oil of Sulphur or Vitriol make as ſtrong an Effervеſcence as any of the reſt.* Whence it is ſometimes well uſed againſt a Cardialgia.

11. §. *Whiting makes as great an Effervеſcence as Chalk.* So that it ſeems the ſaline parts are not waſhed away with the water, wherein the Chalk, for the making of Whiting, is diſſolved.

12. §. *Talk will not ſtir in the leaſt either with Spirit of Nitre, or Oyl of Vitriol. But the Lead-Spar maketh a conſiderable Effervеſcence with both of them ſeverally.* Hence, however this be alſo called *Engliſh Talk*, yet there is no ſmall difference betwixt this, and true *Talk*.

13. §. *To theſe Stones may be added petrified bodies. As petrified wood; which (that upon which I made tryal) no acid ſtirreth in the leaſt. Petrified ſhells; upon four or five ſeveral ſorts whereof, Oyl of Vitriol being poured, produceth a great Effervеſcence. The Root or rougher part of the Stone called* Gloſſopetra, *with Spirit of Nitre, makes a conſpicuous Bullition.* Aſteria, *the Stone ſo called, and found in ſome places in* England, *with Oyl of Vitriol, maketh an Effervеſcence at the ſame degree. So doth the Belemnites, or Thunder-Stone, both the larger and the leſſer kinds.* So that none of theſe are *acid*, or *vitriolick*, but *alkalizate* Stones.

14. §. *Coraline, with Oyl of Vitriol, makes a conſpicuous Bullition, yet mild and gentle; that is, with very little, if any heat, and without any viſible Fumes. And red and white Coral do the like.* Hence they are all of a very gentle operation, and fit for Children, as the caſe requires.

15. §. *Magiſtery of Coral (prepared the ordinary way) ſtirreth not in the leaſt, either with Alkalies or Acids.* Whence it is evident, That its active Principles are in its preparation deſtroyed and waſhed away: that is to ſay, It is an elaborate Medicine good for nothing. And thus far of Stones.

16. §. *I next come to Metals and Ores. And firſt for Lead; upon which Spirit of Salt Spirit of Nitre, or Aqua fortis being dropped, it ſtirreth not in the leaſt with any of them: but with Oyl of Sulphur, and eſpecially with Oyl of Vitriol it maketh a ſlow Bullition and froth.* Hence it ſeemeth to be *the moſt alkalizate Metal.* Which is alſo confirmed by a foregoing Experiment upon the *Lead-Spar*, which maketh a conſiderable Effervеſcence with any ſort of *acid*. And which likewiſe, being calcined, yieldeth a good quantity of *Lixivial Salt.*

17. §. *Lead-Ore ſtirreth not at all with Aqua fortis or Oil of Vitriol. But Spirit of Salt makes it bubble, and Spirit of Nitre makes it boil.* Hence there is a conſiderable difference betwixt the perfect Metal and the Ore.

18. §. *Burnt Lead and red Lead, make a very ſmall Bullition with Oyl of Vitriol, with Spirit of Nitre a far greater.*

19. §. *Mercury, with Oyl of Vitriol, will not ſtir, nor with Oyl of Sulphur. But with Spirit of Nitre preſently boyls up.* Hence *Mercury* is a *ſubacid Metal*; *Spirit* of *Nitre* being a *ſubalkaline Acid.*

20. §. *The filings of Iron or Steel, with Oyl of Vitriol, make a fair Bullition, like that of Minium. But Spirit of Nitre makes them boil with much celerity.* Hence Iron is likewiſe a *ſubacid Metal.*

21. §. *Steel prepared with Sulphur maketh a far leſs Effervеſcence with the ſame Spirit of Nitre, than do the filings.* Hence there is a great difference in their ſtrength. So that ten grains of the filings unprepared, will go as far as fifteen grains or more of thoſe which are prepared, as above-ſaid. Yet in ſome caſes the weaker and milder may be the better.

22. §. *There is one Circumſtance in the mixture of Steel and Aqua fortis, which is ſurprizing; and that is this, That ſtrong Aqua fortis, dropped upon Steel, will not, of it ſelf, make the leaſt Bullition: but if*

hereto

hereto you only add a drop or two of Water, they preſently boil up with very great vehemency. The Cauſe is obſcure; yet it is well known, that *Water* it ſelf will diſſolve *Iron*: ſo that it appeas, as well by this, as by ſome other Experiments, that even in common Water, as mild as it is, there is ſome kind of corroſive Principle.

23. §. *Antimony with Spirit of Nitre, and Aqua fortis ſeverally, maketh an Efferveſcence; ſomewhat lower than Iron. With Oil of Vitriol the Bullition is ſo ſmall, as difficulty to be perceived with a Glaſs.* Hence it ſeemeth to be of a very compounded nature; if I may ſo call it, a ſubacid-alkaline Metal.

24. §. *Antimonium Diaphoreticum, with Spirit of Nitre and Oil of Vitriol ſeverally, makes a conſiderable Efferveſcence.* Wherefore it is not an uſeleſs *Preparation*; as from the *Calcination* and *Ablution* uſed therein, ſome have thought.

25. §. *Bezoardicum Minerale, (that upon which I made tryal) ſtirreth not at all either with Alkalies or Acids.* To which, let thoſe who make uſe of it, have regard.

26. §. *Tin, with Spirit of Nitre, makes ſo hot and vehement an Efferveſcence, that it turns preſently, as it were, into a Coal. It makes alſo a fair Bullition with Oyl of Vitriol. And a gentle one with Spirit of Salt.* Wherefore, it hath ſomething of the nature both of *Iron, Lead*, and *Copper*.

27. §. *The like remarkable circumſtance is ſeen in the mixture of Aqua fortis with Tin, as with Iron. For Tin and ſtrong Aqua fortis of themſelves will not ſtir; but add a few drops of water to them, and they boyl up with the greateſt vehemency.*

28. §. *Copper, with Spirit of Salt, and Oyl of Vitriol ſeverally, ſtirs not at all. Spirit of Nitre, and Aqua fortis, both boil it up vehemently. Neither Spirit of Harts-horn, nor Spirit of Salt Armoniac maketh any Bullition therewith. But both of them, by a gentle ſolution, that is, gently ſeparating its Sulphur from its Salts, turn it blue.* Hence *Copper* hath a greater proportion of *acid* than *any* of the forementioned *Metals*.

29. §. *Silver, neither with Spirit of Salt, nor Oyl of Vitriol makes any Bullition. With Spirit of Nitre it makes one, but tis ſoon over: and then continues to diſſolve ſlowly into white Coagulations. It alſo maketh with Spirit of Harts-horn, or of Salt Armoniac, a full and deep blue.* Hence there is a greater proportion of *acid* in *Silver*, than in *Lead, Mercury, Iron, Antimony, Tin*, or *Copper*.

30. §. *Litharge of Silver maketh the greateſt Efferveſcence with Oyl of Vitriol. Yet ſome with Spirit of Nitre. And with Spirit of Salt Armoniac maketh ſome little huff or elevation. And being mixed with Spirit of Nitre and Spirit of Salt Armoniac both together, produceth a faint blue.* Hence, although the far greater part of this *Litharge* be but *Lead*; yet, it ſeems, it hath ſome ſmall mixture of *Silver*. But that of *Gold* ſeemeth, for contrary reaſons, not to have any *Gold*.

31. §. *Gold maketh no Efferveſcence with any ſingle Salt I know of. But it is commonly diſſolved with Aqua Regis, which is known to be an alkaline Liquor.* Whence it ſeemeth, That as *Lead* is the *moſt alkalizate*, ſo *Gold* the *moſt acid* of *Metals*.

32. §. Theſe things conſidered, and other obſervations added hereunto, may poſſibly give ſome directions, not only for the ordering and uſing, but even for the making, imitating and tranſmuting of *Metals*. Thus far of *Metals*.

33. §. *I will next give one or two Inſtances of tryal upon Sulphurs. And firſt Sulphur vive, with Aqua fortis, maketh an apparent Bullition, but it is ſome time, before it begins. But the factitious or common Brimſtone, maketh ſcarce any, if any at all.* So that there is no ſmall difference betwixt them.

34. §. *White and yellow Arſenick make no Bullition either with Alkalies or Acids.* Wherefore the ſtrength of its operation on the Body, lies more in a *Sulphur* than a *Salt*; or in a *Salt* drowned in its *Sulphure*.

35. §. *The aſhes either of Pit-Coal, or Sea-Coal, make no Effervеſcence with Alkalies or Acids.* Whence the ſaline Principle is altogether volatile, and ſublimed away by the fire.

36. *Laſtly for Salts. And firſt of all, Borax maketh no Effervеſcence nor any Fumes with Oyl of Vitriol or Spirit of Nitre.*

37. §. *Oyl of Vitriol and Nitre make fumes or ſteams, though no Effervеſcence.*

38. §. *Green Vitriol, with Spirit of Harts-Horn, is ſcarcely moved. White Vitriol, with the ſame Spirit, maketh a conſpicuous huff. And Roman Vitriol a vehement Effervеſcence.* Whence the *former* is the *leaſt acid*, and the *latter the moſt of all*. Which alſo confirms what I ſaid before of the like natures of the ſeveral *Metals* to which they belong.

39. §. *Salt of Vitriol, though a fixed Salt, and made by Calcination, yet maketh no Effervеſcence with the ſtrongeſt acid; but only with Alkalies; as may be ſeen upon their mixture, but much better heard by holding the mixture to ones ear.* Hence, there are *fixed Acids*. Which further confirms what I have above aſſerted concerning the nature of *Gold*, *ſc.* That the *predominant Salt* thereof is a *fixed Acid*.

40. §. *Sal Martis, with Spirit of Harts-horn, maketh a conſiderable huff.* Hence it is much more *acid* than *green Vitriol*; and is therefore a cooler body.

41. §. *Alum and Spirit of Harts-horn make a plain Effervеſcence.*

42. §. *Saccharum Saturni, with Oyl of Vitriol, ſtirs not at all. With Spirit of Salt, huffs a little. With Spirit of Nitre much more.* Hence the *acid* of the *Vinegar*, and not the *Alkaly* of the *Lead*, is the predominant Principle.

43. §. *Common Salt ſtirs neither with Spirit of Salt, nor with Spirit of Nitre; nor with Aqua fortis. But with Oyl of Vitriol it maketh a great Effervеſcence with noiſe and ſteams.* Hence, even common Salt, though it be not reckoned amongſt *alkaline Salts*, yet is far nearer in nature to *that*, than to an *acid*. Hence alſo the *Spirit* of *Salt* is a *ſubalkaline Acid*, and of a very different nature from *Oyl* of *Sulphur* or *Vitriol*.

44. §. *Salt Armoniac, with Spirit of Nitre, ſtirreth not. But with Oyl of Vitriol it maketh a great Effervеſcence.* Hence *Spirit of Nitre* is a *ſubalkalizate Spirit*.

45. §. *Oyl of Vitriol and Spirit of Nitre, though both acids, yet make a great ſmoak; greater than that which the Spirit maketh of it ſelf.* Which confirms the laſt precedent *Corollary*.

46. §.

46. §. *Oyl of Vitriol and Spirit of Salt, though both acids, yet make a ſtrong Effervеſence, with noiſe and fumes.* Which further confirms, what was noted before, *ſc.* that Spirit of Salt is a *ſubalkaline Acid.*

47. §. *Spirit of Salt Armoniac, with Oyl of Vitriol, makes an Effervеſcence ſo extraordinary quick, and as it were inſtantaneous, that nothing ſeemeth quicker.* Whence it is probable, That if *Gun-powder* were made of *Salt Armoniac*, inſtead of *Nitre*, or with *both* mixed together; it would be *far ſtronger*, than any kind now in uſe. And thus far for *Minerals.*

48. §. I have only one *Corollary* to add, from the whole; which is, That whoever doth undertake the *Natural Hiſtory* of a *Country*, (ſuch as that the Learned Dr. *Plot* hath exceedingly well done of *Oxfordſhire*) the foregoing *Method*, ſeemeth ſo eaſie, cheap, and indeceitful, for the finding out and well diſtinguiſhing the natures of all kinds of *Metalls*, *Ores*, *Salts*, *Earths*, *Stones*, or other *ſubterraneal Bodies*; as cannot, I think, be ſupply'd, but by others of greater difficulty and expence.

CHAP. III.

What may be obſerved of the PARTS of Animals.

NOW proceed to the ſeveral *Parts* of *Animals*; as *Hairs*, *Hoofs*, *Horns*, *Shells* and *ſhelly Inſects*, *Bones*, *Fleſh and the ſeveral Viſcera*, *Silk*, *Blood*, *Eggs*, *Musk*, *Caſtor*, *Gall*, *Urine*, *Dungs*, *Salts and Stones.*

2. §. *And firſt of all, the Hair of a mans head, with Oyl of Vitriol, maketh no Bullition at all. Nor yet with Spirit of Nitre.* So that although it contains a good deal of *volatile Salt*; yet it ſeemeth either not to be *alkaline*, or elſe is *centred* in ſo great a quantity of *Oyl*, that the *acid menſtruum* cannot reach it.

3. §. *Hares Fur, with ſpirit of Nitre, maketh, although a ſhort, yet very plain Bullition and huff.* Hence the *Hair*, and therefore the *Blood*, of ſome *Animals*, is fuller of *Salt*, at leaſt of an *Alkaline Salt*, than that of ſome others. And perhaps the *Hair* of ſome men, as of *Black's*, may be ſo full of *Salt*, as to make a Bullition like *Hares Fur.*

4. §. *The ſhavings of Nails ſtir not at all, either with Oyl of Vitriol, or Spirit of Nitre: only with the latter they turn yellow. But Elks Claws, with Spirit of Nitre, make a ſmall and ſlow Bullition.*

5. §. *Horſes Hoof, with Oyl of Vitriol, ſtirs not of many hours. But with Spirit of Nitre, allowing it ſome time, makes a very plain Bullition, and huffs up very high.*

6. §. *Cows Horn, neither with Oyl of Vitriol, nor with Spirit of Nitre, maketh any Bullition, only turneth to a yellow colour.*

7. §. *Rams Horn ſtirs not with Oyl of Vitriol; but with Spirit of Nitre, makes a ſmall and ſlow Bullition.*

8. §.

8. §. *Harts-Horn makes a conſiderable Bullition and huff, even with Oyl of Vitriol, which the reſt of the Bodies aboveſaid, will not do. But with Spirit of Nitre, it makes yet a greater.* From the foregoing Experiments, and almoſt all that follow, what is before aſſerted of the *Salts* of *Vegetables* and *Minerals*, is here alſo evident concerning that of *Animals*, *ſcil.* That it is not *made*, but only *ſeparated* by the fire. It likewiſe hence appears, That the *proportion* of *Salt* in the forementioned *parts* is very different; and that therefore ſome of them are never, and none of them but with good diſcretion, to be ſubſtituted one for another in Medicine. As alſo, that there is a different proportion of *Salt* in the ſeveral *Animals* themſelves, to which the ſaid *Parts* belong.

9. §. *Next for ſhells; as thoſe of Lobſters, Eggs, Snails and Oiſters: all which make an Efferveſcence, both with Oyl of Vitriol, and Spirit of Ire. But with Spirit of Nitre the greateſt. Lobſter-ſhells make a conſiderable Bullition and huff, but no noiſe nor ſteams. Egg-ſhells make a Bullition and huff, with ſome noiſe, but no ſteams. Snail-ſhells make an Efferveſcence with noiſe and ſteams. Oyſter-ſhells make one with the grateſt noiſe and thickeſt ſteams.* Hence we may judge, in what caſe to adminiſter *one* more appoſitely than *another*. As alſo *in what proportion*, according to their different ſtrength. Some may be better for *Children*, as being milder. Or for a Body whoſe very ſharp *Blood* or other *Humors*, are more eaſily kindled into *Ferments*. Or elſe may be ſafeſt, to avoid a ſudden *precipitation* of the *Humors*; or for ſome other cauſe.

10. §. *Oyſter-ſhells, and the reſt above-ſaid, make a quicker Efferveſcence, not only with Spirit of Nitre, but even with Spirit of Salt, than they do with Oyl of Sulphur, or Oyl of Vitriol.* So that *theſe bodies*, as well as *Metals*, have their proper *Menſtruums* whereby they are be diſſolved.

11. §.. *Egg-ſhells calcined, make with Oyl of Sulphur, or Oyl of Vitriol, or Spirit of Nitre, a greater Efferveſcence, than when uncalcined. As alſo with ſteams, which uncalcined, they produce not. The like is ſeen in calcined Oyſter-ſhells. And the longer the Calcination is continued, the quicker and ſtronger will be the Efferveſcence. This I tryed at ſeveral terms, from a quarter of an hour, to five hours. So that after ſo long a Calcination, they make an Efferveſcence almoſt inſtantaneous.* The reaſon hereof is, Becauſe the ſeveral *Principles* whereof the *Shells* conſiſt, being relaxed, and the *Sulphur* for the greateſt part, driven away by the fire; the remaining *Salt* lies now more open and naked to the attaque of the *Menſtruum*, ſo ſoon as ever they are mixed together. From hence it is plain, That *Egg-ſhells*, and the others above-ſaid, being *burnt*, are far *ſtronger* Medicines, than when *unburnt*. It is hereby likewiſe evident, That a great portion of their *Salt*, is not a *volatile*, but a *fixed Alkaly*. To theſe may be ſubjoyned all kinds of ſhelly *Inſects*. I will inſtance in three or four.

12. §. *And firſt Bees, with Oyl of Vitriol, ſtir not in the leaſt. With Spirit of Nitre they make an exceeding ſmall Bullition, without any elevation.*

13. §. *Cochinele* (the *Neſt* of an *Inſect*) *makes ſome Bullition with Oyl of Vitriol, but very ſmall: for the bubbles are not to be ſeen without a Glaſs. But with Spirit of Nitre the Bullition is more viſible, and joyned with ſome elevation.*

14. §.

14. §. *Cantharides make no viſible Bullition with Oyl of Vitriol. But with Spirit of Nitre they do, and huff up rather more than Cochinele. Yet is this done very ſlowly, and comparatively with many other bodies, is not much.* Hence it is not the *quantity*, but the *quality* of their *volatile Salt*, which makes them ſo ſtrong an *Epiſpaſtick*. For moſt of thoſe Bodies above, and hereafter named, make a greater *Bullition*, and yet are neither *Cauſtick* nor *Epiſpaſtick* in the leaſt. It is hence alſo evident, as hath been before ſuggeſted, That there are divers kinds of *Volatile Salts*, eminently different; ſome being highly *alkaline*, others very *little*, and ſome ſcarce any thing ſo: ſuch as thoſe of *Scurvy-graſs*, *Anemone*, *Crowfoot*, and many the like *Plants*; to whoſe *Salts*, this of *Cantharides* ſeemeth to be very near of kin.

15. §. *Millepedes make a Bullition and huff, much greater and quicker, than any of the Inſects above-named: and that both with Spirit of Nitre, and Oyl of Vitriol it ſelf. Yet is this Inſect of a very temperate nature.* Whereby is further demonſtrated, That the being *ſimply alkaline*, is not enough to make a body to be *Cauſtick*.

16. §. *Again, although Millepedes make a Bullition, greater than any of the Inſects above named: yet is it much leſs, than that of Oyſter, Snail, or even Egg-ſhells; and of divers other bodies above, and hereafter mentioned.* Hence, being given to the ſame intent, as any of thoſe bodies; it is the mildeſt and gentleſt in its operation of them all.

17. §. *Millepedes likewiſe calcined, makes a ſtronger Effervеſcence, than when uncalcined, as do the Oyſter-ſhells, &c.* So that it appears, That *all Teſtaceous Salts*, are at leaſt in part, *fixed Salts*.

18. §. *I next proceed to Bones. And firſt Whale-bone maketh no Bullition at all with any acid. A Cartilage, with Spirit of Nitre, makes ſome very ſmall bubbles, not to be ſeen without a Glaſs.*

19. §. *The Bone in the Throat of a Carp, makes a little and ſlow Bullition with Spirit of Nitre. The Spina of a Fiſh (that which I uſed was of a Cod-fiſh) maketh a Bullition one degree higher.*

20. §. *All ſorts of Teeth, as Dogs, Boars, the Sea-horſe, Elephant, make the like. As alſo the Bone of an Oxes heart.* So that all theſe are very gentle in their operation, and fit for *Children*.

21. §. *Sheeps and Calves Bones both of them make a Bullition yet a little higher, eſpecially with Spirit of Nitre. Cocks Bones ſomewhat higher than the former. Cranium humanum a little higher than all the reſt.*

22. §. *Bones likewiſe, being calcined, make a Bullition with Acids. And ſo doth alſo calcined Harts-Horn. But in neither of them, is the Bullition advanced by Calcination, any thing comparable to what it is in ſhells.* Whence it appears, That the *Salt* of *Horns* and *Bones*, is much more *volatile*, than that of *Shells*.

23. §. *Next for Fleſh and the ſeveral Viſcera. And firſt, dryed and powdered Mutton, with Oil of Vitriol, ſtirs not at all. But with Spirit of Nitre makes a ſmall Bullition and huff. Sheeps Heart doth the like ſomewhat more apparently. Vipers fleſh produceth a froth, but huffs not, Powdered Earthsworms make a great froth, and huff a little. Powdered Tripe makes only a little Bullition. Lamb-ſtones do the like. Kidney, Spleen, and Liver, with ſome elevation. Lungs, with bubbles very large; becauſe extraordinary ſlowly. Dryed Brain makes alſo a little*

and ſlow Bullition. Hence there is a greater proportion of *Sulphur* or *Oyl*, and leſs of *an Alkaly in all theſe parts*, than there is in *Bones*, *Shells*, and divers other *parts* hereafter mentioned. And in ſome of them, as in the *Brain*, that *Alkaline Salt* which there is, may rather be lodged in ſome *ſanguineous* parts mixed with them, than in their own proper ſubſtance.

24. §. I proceed to inſtance in all ſorts of Animal *Contents*. *And firſt, raw Silk, with Spirit of Nitre, makes a very ſmall Bullition, but the elevation is conſiderable.*

25. §. *The grumous part of the Blood dryed, with Oyl of Vitriol, ſtirs but little. But with Spirit of Nitre it huffs up conſiderably.*

26. §. *Serum of Blood dryed, with the ſame Spirit makes a plain elevation, with a little Bullition. Herewith may be reckoned the White of an Egg, which is nothing but a pure Cryſtalline Serum ſeparated from the common ſtock. This being dryed, with Spirit of Nitre, huffs up rather more than even the grumous part of the Blood, the Bubbles are much larger, break oftner, and the elevation ſooner made.* Whence it ſeemeth, that there is a greater quantity of a *volatile Alkaly* in proportion to the *Sulphur*, requiſite to the *Generation*, than to the *Nutrition* of an *Animal*.

27. §. *The Yelk of an Egg is ſcarce moved with Spirit of Nitre, producing only a very few Bubbles.* The *Salt* being either little *alkalizate*, or elſe *immerſed* in ſo great a quantity of *Oyl*, that the *Menſtruum* cannot reach it. *For the ſame reaſon Sperma Ceti ſtirs not with any Acid. Neither doth Civet.*

28. §. *Ruſſian Caſtor, with Oyl of Vitriol, ſtirs not. But with Spirit of Nitre makes a conſiderable huff and froth. Yet it requires time.* Wherefore it ſeemeth, That *Caſtor* by virtue of its *alkaline Sulphur*, becomes ſo good a *Corrector* of the *acid-alkaline Sulphur* of *Opium*: ſo I take leave to call it, having ſome reaſons to believe it ſuch.

29. §. *Musk, with Oyl of Vitriol, ſtirs not. But with Spirit of Nitre it makes a conſiderable and quick Bullition, with large bubbles, which often break and riſe again.* Whence there is a very eminent difference betwixt *Musk* and *Civet*. Hence alſo, *Musk* is Cordial, not only from its *Sulphur*, but its *Alkaly*; by both directly oppoſite to preternatural *Acidities*.

30. §. *Dryed Gall with Spirit of Nitre, for ſome time, is ſtill: but at length it makes a conſiderable Bullition and froth.* The reaſon why it is ſo long before it begins, is becauſe the *Salt*, (as was obſerved of ſome other *Parts*) is locked up in ſo great a quantity of *Oyl*. The abundance whereof is manifeſt, not only from *Deſtillation*, but alſo from hence, In that the dryed *Powder*, in lying by, incorporateth all together into one body, as *Mirrh*, and ſome other ſofter and oily *Gums* are uſed to do.

31. §. *Extract of Urine, with Spirit of Nitre, makes a Bullition with ſome Effervеſcence, which continues for a conſiderable time; and at laſt it huffs up with great bubbles. The Bullition begins preſently: the Salt being copious, and the Oyl but little.*

32. §. *The ſame Extract of Urine makes a conſiderable Bullition and froth, not only with Spirit of Nitre, but even with Oyl of Vitriol.* Hence the *Salt* of *Urine* is more *alkaline* than that in moſt of the afore-ſaid *Contents*.

Contents. From this and ſome of the following *Experiments*, it alſo appears, That the *Salt* which concurs to the generation of *Gravel* or of a *Stone* in the *Kidneys* or *Bladder*, is of a very different nature from the *Salt* of *Urine*.

33. §. *Next for Dungs. And firſt, dryed Goats-dung makes with Spirit of Nitre, a ſmall Bullition, but no elevation. That of Mice the like. And that of Cows. So that of all I have tryed, theſe three ſtir the leaſt.*

34. §. *Gooſe-dung, with Spirit of Nitre, makes a very ſmall Bullition and ſome elevation. But it requires time. Oyl of Vitriol ſtirs it not.*

35. §. *Album Græcum, with Spirit of Nitre, beſides innumerable ſmall bubbles, riſes up with ſome great ones, exactly reſembling the huffing up of Yeſt or Barm. Alſo with Oyl of Vitriol it maketh ſome little froth, but ſlowly.* So that it ſhould ſeem, that the *Bones* are a little *opened* by ſome *acid Menſtruum* in the Dogs ſtomach (as the body of *Steel* is in its preparation with *Sulphur*) whereby it becomes a good mild *Topick* in *Quinzies*.

36. §. *Hens dung, with Spirit of Nitre, makes a very great bullition and huff: greater and quicker, than any of the reſt above-named.*

37. §. *But of all I have tryed, Pigeons dung, with the ſame Spirit, maketh the greateſt and the quickeſt Effervеſcence and huff; and that not without ſteams. Yet neither the ſame Dung, nor that of Hens, is moved in the leaſt with Oyl of Vitriol.* The Cauſe of ſo great an *Effervеſcence* in theſe, more than in the reſt, is that *white part* which is here mixed in a great quantity with the *Dung*. Which *white part*, deſcendeth not from the *Stomach*, but is an *Excrement* ſeparated from the *Blood* (as the *Urine* in other *Animals*) by a peculiar *Organ*, which evacuates it into the *Inteſtinum rectum*; whence, together with the *Stercus* it is excluded. Hence it is evident, That in the ſaid *white part* of *Hens*, and eſpecially *Pigeons dung*, is contained a great quantity of a *volatile Alkaly*.

38. §. *I proceed to Salts. And firſt Salt of Blood and Urine both make a more durable Effervеſcence with Acids, than doth Salt of Wormwood, or Salt of Fern.* Hence the former are more *alkaline*, than the latter.

39. §. *Again, though divers other Animal Salts will not ſtir with Spirit of Salt, or with Oyl of Sulphur or Vitriol; yet the Salt of Blood will make an Effervеſcence with all kinds of Acids.* Whence it is further argued to be highly *alkaline*, and very proper for the *correction*, of all ſorts of *preternatural Acids* in the body. There is little doubt, but that *Spirit* of *Harts-horn* will do the like.

40. §. *The Gravel which is precipitated out of Urine; with Oyl of Vitriol makes no bullition in the leaſt. Nor with ſtrong Spirit of Salt. But with Spirit of Nitre, it makes a very great one, with Effervеſcence and ſteams.* From hence it appears, That there is much difference to be made in the uſe of *acid Diureticks*, *Nephriticks*, &c.

41. §. And that I may not altogether omit to mention, what may be ſo much for the good of mankind, I do here declare, That for preventing (I ſay not, the breaking, but preventing) the generation of the *Stone*, either in the *Kidneys*, or in the *Bladder*, there are not bet-

ter *Medicines* in the world, than ſome certain *Preparations* of *Nitre*, duly adminiſtred. Whoever ſhall think that any kind of *acid*, as *Oyl of Sulphur*, *Oyl of Vitriol*, *Spirit of Salt*, or the like, will have the ſame effects, will find themſelves much deceived in their practice.

42. §. *I conclude with Stones. And firſt, Spirit of Nitre droped upon a Stone of the Kidneys or Bladder, produceth the very ſame effect, as upon the Gravel in Urine. That is to ſay, it makes it boil and huff up, until at length it is perfectly diſſolved into a ſoft Pulp; which neither Oyl of Sulphur, nor Oyl of Vitriol, nor Spirit of Salt will do; nor give the leaſt touch towards its diſſolution.* This confirms what I ſaid before of the uſe of *Nitre* and *Nitrous Spirits*, if duly prepared and adminiſtred, above any other *Acids*, againſt the breeding of the *Stone*.

43. §. *Pearls, with any Acid, make the like Effervеſcence, as do Oyſter-ſhells. But Magiſtery of Pearls, as uſually prepared, ſtirs not at all, with any Alkaly or Acid.* So that as to the effect frequently intended by it, it is very inſignificant; as of that of *Corals* hath been ſaid.

44. §. *Crabs Eyes, with any Acid, make an Effervеſcence, almoſt as quick as that of Oyſter-ſhells.*

45. *Crabs Eyes likewiſe calcined, make a ſtronger Effervеſnence, than when uncalcined.* So that *theſe*, as well as *Shells*, contain a *fixed Alkaly*.

46. §. *The Stones in Whitings heads make a ſtrong Effervеſcence like that of Oyſter-ſhells.*

47. §. *Stone of humane Gall, ſtirs not with Oyl of Vitriol. But with Spirit of Nitre maketh a little bullition juſt upon mixing, and after a conſiderable time, a little froth. Much leſs than what was obſerved before of the Gall it ſelf.* So that it ſeemeth to be generated of the *Gall coagulated* by ſome *Acid*, which hath already *refracted* the *Alkaly* wherewith the *Gall* abounds. This confirms the uſe of thoſe *Medicines* in the *Jaundies*, or any other bordering *Diſeaſe*, which deſtroys thoſe *Acidities* by which the *Gall* is *curdled* or *coagulated*, and ſo rendred more difficulty ſeparable into the *Guts*.

48. §. Since the firſt publiſhing of theſe Obſervations, Mr. *William Matthews* an *Apothecary* in *Ledbury*, ſent me part, as I take it, of a *Stomach-ſtone*, as big as a *Wallnut* of the largeſt Size, voided by a woman about 82 years of age, ſometime after an *Autumn Fever*. It conſiſteth of the ſame *Striæ*, as the *Bezoar Stone*; and maketh ſome *Bullition* with *Spirit* of *Nitre*.

49. §. *Bezoar, neither the Weſtern nor the Eaſtern, doth ſtir at all with Oyl of Vitriol.*

50. §. *Weſtern Bezoar, with Spirit of Nitre, makes a very little thin froth, and that's all; and that it doth very ſlowly. But Oriental Bezoar, with Spirit of Nitre, after ſome time, maketh a very great Effervеſcence, froth, elevation, noiſe, and ſteams (as if you poured Oyl of Vitriol upon Salt of Tartar) till it be wholly diſſolved by the affuſed Spirit, and turned into almoſt a blood-red.* Hence it may ſeem to be no mean *Remedy* againſt ſuch *fretting* and *venenate acids*, as oftentimes in *Fevers*, and other *Diſtempers*, lye about the *Stomach*, and are thence frequently tranſlated to the *Heart*, *Brain*, *Nerves*, and other *parts*. The difference likewiſe betwixt the *Weſtern* and the *Eaſtern Bezoar*, is ſo great, that in any caſe of danger, and where the *Bezoar* is relyed upon, it is an unpardon-

able

able fault, for the *Apothecary*, or any *Perſon*, to *ſubſtitute* the one for the other: unleſs he will take *ten times* as much, or *ten times* as little of the one, as he would have done of the other: if that will ſerve turn.

51. §. The *Stones* already mentioned, (except the great *Stomach-ſtone*) are ordinarily generated in the bodies of *Animals*. I have one Inſtance more of ſome other *Stones* which are extraordinary. In the City of *Hereford* lives a Maid, who often voids theſe *Stones*, and in the ſpace of ſome years laſt paſt, hath voided ſeveral pounds, of ſeveral *Colours* and *Sizes*, not only *per vias urinarias*, but alſo by vomit, and by ſtool. The firſt mention made to me of them, was by Mr. *Diggs*, a worthy Gentleman of that City, as a thing that was there much wondred at. And ſome of them, upon my deſire, were ſent me by Mr. *Wellington*, an Apothecary in the ſame place. *I have tryed what ſeveral acid Menſtruums will work upon them; and find, That with Oyl of Vitriol, and eſpeially with Spirit of Nitre the great ones make a very quick and conſpicuous Effervеſcence. But the ſmall ones, neither the white, nor the grey, make any Bullition in the leaſt:* for in truth, they are no other but little *Pebbles* and *Grit-ſtones*.

52. §. This being conſiderd, and the various *colours* and *mixture* of any one of the great *Stones*, being well obſerved; it ſeemeth plain, That although ſhe be ſomewhat old (above thirty years) yet may ſhe have a kind of μαλαξία, or *diſeaſed Appetite* to *Stones*, *Bones*, *Wood-aſhes*, *Tobacco-Pipes*, *Chalk*, and ſuch like things; which ſometimes ſwallowing in little *lumps*, ſometimes groſly, or finely ground betwixt her teeth; they are in her *Stomach* and *Bowels*, more or fewer of them, *cemented* together, either with a *pituitous*, *bilious*, or ſome other more or leſs *glutinous ſubſtance*. And that by virtue alſo of the ſaid *Cement*, or any of the ſaid, or other like *alkalizate Bodies*, the greater *Stones*, which conſiſt of thoſe partly, do make an *Effervеſcence* with *acid Liquors*. Thus far of *Inſtances* upon the *parts* of *Animals*. I ſhall cloſe with ſome *Corollaries* deduced from the whole.

53. §. And firſt, ſince we find, that amongſt all the *Menſtuums* we have made uſe of, *Spirit* of *Nitre*, or any very *Nitrous Spirit*, is the moſt *univerſal diſſolver* of all kinds of *Animal Bodies*; the *beſt diſſolver* of many others both *Vegetable* and *Mineral*, and the *only diſſolver* of ſome: Hence it is probable, That the great *ſtomachick Menſtruum*, which either *diſſolves*, or *opens* almoſt all *Bodies* which come into the *Stomach*, is a kind of *Nitrous Spirit*.

54. §. Again, *Spirit* of *Nitre* being a *ſubalkaline Acid*, and working more evidently upon *Animal bodies*, than other *ſimpler Acids* do, which yet are as *ſtrong*; It hence follows, That moſt of the *Salts* of *Animals* are *ſubacid Alkalies*. How far this *concluſion* may further inſtruct us, I ſhall have occaſion to ſhew in another *Diſcourſe*.

55. §. Laſtly, there being ſo many, ſay twenty or thirty *degrees*, from the *ſloweſt* to the moſt *vehement*, in the *Bullition* of *mixed Bodies*; it ſeemeth, That *Fermentation* it ſelf, as to the *formal notion* of it, is nothing

nothing elſe: or that from the common *Luctation* of *mixed Bodies* whereof we have now been ſpeaking, it differs not *in ſpecie*, but only in the manner of its *cauſation*, and in *degree:* the *Aer*, or ſome certain *Menſtruum* lodged therein, being of no greater *ſtrength*, than to produce a *Bullition* or *Luctation* of that *low* and *ſoft degree*, which we call *Fermentation*.

56. §. I have thus endeavoured to prove, by various *Inſtances*, how inſtructive this moſt eaſie, plain and ſimple *Method* in the *Mixture* of *Bodies*, may become to us: and that meerly by obſerving the *Luctations* which thence ariſe betwixt them. How much more then, if a diligent remarque be made of all thoſe various *Colours*, *Smells*, *Taſtes*, *Conſiſtencies*, and other *Mutations* thereupon emergent?

AN

AN ESSAY OF THE Various Proportions Wherein the LIXIVIAL SALT Is found in PLANTS.

Read before the *Royal Society*, *March*, 1676.

CHAP. I.

Of the QUANTITIES afforded by ſeveral Plants *calcined in groſs.*

IT is the part of a *Phyſician*, knowingly and artificially to uſe and govern *Nature*. And therefore by every likely *Method*, to inſpect the *State* and *Properties* of all ſorts of *Bodies*. One *Method*, is that I have taken in the foregoing *Experiments*; *ſc.* by mixing them with ſeveral *Meſtruums* or *Liquors*: whereby we may be aſſiſted to judge, both of the *Kinds* and the *Proportions* of *Principles* in any *Body*; and of the manner of their *Mixture* in the ſame.

Another is by *Calcining* them; or, as it were, by *mixing* them with the *Fire*, a potent and almoſt univerſal *Menſtruum*. I ſhall here only ſet down ſome *Tryals* for an *Eſſay*, upon *Plants*; chiefly noting, The different *Proportions* of their *Lixivial Salts*. Of theſe *Tryals*, ſome were

were made upon the whole *Plant*, or ſome *Portion* of it wherein ſeveral *Parts* are mixed together: And others, upon ſome one *Part* of a *Plant* diſtinct from the reſt. All of them anſwering to ſuch *Queries*, as may ſeem proper to be propoſed.

Query 1. As firſt, *Whether Trees or Herbs and Buſhes, quantity for quantity* & cæteris paribus, *yeild the moſt Lixivial Salt?*

For this I took *Aſh-Barque* and *Roſemary* of each ℔j. The latter yielded 5 *Scruples*; the former but 32 *Grains*; which is three times leſs. I took alſo the ſame quantity of the *Barque* of *Black-Thorn*, and of *Agrimony*. The latter yielded 5 *Scruples* and 6 *Grains*; the former, not above 1 *Scruple* and 5 *Grains*; which is four times leſs.

Although the *Barque* of a *Tree* be compounded of *Pithy* and *Lignous Parts*; yet to anſwer the *Query* exactly, the *Wood* of theſe *Trees* ſhould be taken with the *Barque*, that there may be ſome portion of every *Part* of the *Tree*, as well as of the *Herb*.

But thus far the *Experiment* is *concluſive*, That the ſame quantity of *Lixivial Salt*, doth not always follow the ſame *Generical Taſt*. For the *Barque* of *Aſh* and *Roſemary*, are both equally *Bitter*; and the *Barque* of *Black-Thorn* and *Agrimony* are both *Aſtringent* and *Bitter*.

Quer. 2. *Whether any Plant growing in a Garden or the Field, doth not yield a leſſer quantity of Lixivial Salt, than another of the ſame kindred growing on the Sea-Coaſt; and with what difference?*

For this, I took *Garden* and *Sea-Scurvygraſs*, of each ℔j. The former yields 2 *Drachms* and 1 *Scruple*; the latter, being well waſhed, 9 *Drachms*, which is more than 4 times as much. The like may be tryed upon others.

Quer. 3. *Whether the ſame Specifick Plant affords more Lixivial Salt, being only dryed, and then calcin'd, or after it hath firſt been diſtilled, it is then dryed and calcin'd?*

For this, was taken ℔j of *Mint* only dryed and then calcin'd; and another firſt diſtilled. The former yielded $\frac{1}{3}$ an Ounce and $\frac{1}{2}$ a Drachm of *Salt*; the latter, 5 Drachms and a Scruple; which is almoſt $\frac{1}{5}^{th}$ more. This alſo ſhould be tryed on other *Plants*.

Quer. 4. *How far the proportion follows the different Taſts of Plants?* The firſt Experiment, relates to the ſame *Taſt* in ſeveral *Plants*; this, to ſeveral Taſts. And ſo,

Of *Majorane*, which is *Aromatick*, ℔j affords but one Scruple of *Lixivial Salt*; which is but the 384th part of the whole pound.

Of *Oak-Barque* which is *Aſtringent*, ℔j yields $\frac{1}{2}$ a Drachm of *Salt*; or the 256th part of the whole.

Of *Liquiriſh*, which is ſweet, ℔j yields about the ſame quantity. But *Aniſe Seeds* ℔j yields 2 Scruples or a 192^{d} part.

Of *Sorrel*, which is ſower, ℔j yields one Drachm, or the 128th part.

Of *Garden Scurvygraſs*, which is *Hot*, ℔j yields 2 Drachms and $\frac{1}{2}$ a Scruple; or the 59th part.

Of *Mint*, which is *Hot* and *Bitter*, ℔j yields 5 Drachms and a Scruple, or the 24th part.

Of *Sea Scurvygraſs*, which is *Salt*, ℔j yields 9 Drachms and a Scruple or 28 Scruples; which is near $\frac{1}{13}^{th}$ part of the whole. A greater proportion of *Salt*, than in any other *Plant* upon which I have hitherto made Tryal: Or even in *Tartar* it ſelf. Yet is it not a *Marine*, but true *Lixivial Salt*: as is evident, both from its *Taſte*; and in that it maketh

maketh an *Effervescence* with *Spirit* of *Salt*; which *Sea-Salt* will not do.

For the Experiment to be fully adequate to the *Query*; the *Tryals* shouldbe made,either all on *Trees*, or all on *Herbs*; all on *Roots*,or all on *Stalks*, &c. Yet thus much is evident, That *Sorrel* yields Thrice as much as *Majorane*; *Sea-Scurvygrass*, Eight and Twenty times as much: *Mint*, Five times as much as *Sorrel*; and Sixteentimes as much *Majorane*, &c.

Quer. 5. *How far the Proportion follows the Faculties of Plants?* And so, it appears, that

Majorane,a *Cephalick*, hath a greater *Proportion* of *Volatile Parts*, than any of the *Plants* above mentioned, and so far, is more agreeable to the *Animal Spirits*, and *Genus Nervosum*.

Agrimony, (*a*) an *Aperient*, yields above Five times as much *Lixivial Salt*, as *Majorane*. Yet much less than many other opening *Plants* which are stronger. (*a*) *Quer.* 1.

Mugwort (℔j) yields two Drachms and two Scruples; or above half as much more as *Agrimony*. So that this *Plant*, though it hath no considerable *Taste*, and in that respect promiseth but little; yet yielding a good quantity of *Lixivial Salt*, seems no contemptible *Medicine* to subdue those *Acidities* which either by causing *Obstructions*, or immoderate *Fermentations*, frequently disorder the *Female Sex*.

Mint, yieldeth still a greater quantity; and is therefore, partly for the same cause so excellent a *Stomachick*: And *Rosemary*,(*b*)which is appropriated both to the *Head* and *Stomach*, yieldeth a midle quantity of *Salt*; more than the chief *Cephalicks*, and less than the chief *Stomachicks*. (*b*) *Quer.* 1.

Common Mallow (℔j) yields 5 Drachms and 2 Scruples. *i. e.* the 23d part of the whole. So that this *Plant*, though of a very mild *Taste*, yet yields more *Salt* than *Mint* it self a *Bitter Plant*. Whereby it no longer seems strange, that a *Plant* of so soft a *Taste*, should be very *Diuretick*, and so evidently affect the *Reins*.

Rhubarb (2 Ounces) yieldeth scarce any fixed *Salt*, so far as can be judged by the *Taste* of the *Ashes*, not more than a Grain or two. So that its *Salt* is, in a manner, wholly volatile; and thereby apter to operate upon the *Bilious* parts of the *Blood*; which contein a far greater proportion of *Volatile Salt*, than do the *Serous*.

Of the *Caput Mortuum* or meer *Earth*, it is observable, that it was near ½ an Ounce or $\frac{1}{4}^{th}$ part of the whole; Which is almost Six times as much as the *Caput Mortuum* of *Common Dock*: and much more than that of any other *Root* I have yet calcin'd. Whereby it seemeth probable that *Rhubarb* looseth much of its *Volatile Part*, and therefore of its *Virtue*, before it comes to our *Shops*.

Sena (℔j) yields 4 Scuples and ½ of *Salt*; or the 85th part.

Jalap (℔j) yields but one Drachm and 15 Grains, or 102^{d} part.

Colocynthis (℔j of the *Pulp*) yields an Ounce and half of *Caput Mortuum*, which is almost all *Salt*. Yet allow half an Ounce of the *Salt*, and *Earth* to be wasted in filtring &c. theremaining Ounce is no less than $\frac{1}{16}^{th}$ part of the whole. Which is more than in any of the above named *Plants*, except the *Sea-Scurvygrass*.

CHAP. II.

Of the QUANTITIES afforded by the Parts *of ſeveral* Plants *diſtinctly calcin'd.*

I SHALL next ſet down ſome *Tryals*, upon one *Part* of a *Plant*, as well *Organick*, as *Content*, ſeparated from the reſt; in anſwer to theſe ſuppoſed *Queries.*

Quer. 1. *What Proportion doth the Lixivial Salt of the Pith or Pithy Part of a Plant, bear to that of the Fibrous, or of the Woody Part? Or whether is there a Fixed Salt always found in either of them?* A ſufficient *Anſwer* to which, muſt be built upon many *Tryals.* At preſent I ſhall mention only Two; one upon *Starch*, anſwerable to the *Pithy Parts*; the other upon *Flax*, conſiſting almoſt wholly of the *Nervous* or *Towy Fibres:* of the *Volatile parts* whereof, chiefly, I have given ſome account in the foregoing *Idea.* §. 50, 51, 52.

Of *Starch*, ℔j yieldeth about ℔¼ not of *Aſhes*, but of *Black Coal.* For though it be expoſed in a *Calcining Furnace* to a vehement *fire*, for 5 or 6 hours, which is longer then will ſerve to calcine moſt Bodies: yet would it not in the leaſt part, be reduced to *Aſhes*; but to the laſt continued (though the fierceneſs of the *Fire* conſumed part of it) as *black*, as when it was firſt burnt. So ſtrangely was the remaining part of the *Sulphur* fixed to the *Earth*; that in flying away, it did volatilize and carry that away with it. In this *Coal* or *Cinder*, there is not the leaſt of a *Lixivial* or other *Taſte.* And although, upon *Tryal* I find, That the *Pith* of many *Plants*, as of a *Cabbage Stalk*, will yield ſome quantity of *Lixivial Salt*; yet it is probably, that generally, it yields leſs than the *Wood.*

Of *Flax*, ℔j yields not above 50 Grains of *Caput Mortuum* or *white Aſhes*, which are *Salt.* According to vulgar conceit, it would ſeem to be a very dry Body: yet of 153 parts, 152 are *volatile*, and being diſtilled would have been collected into *Liquor.* Hence alſo appears the great and unexpected *Variety* in the *Proportion* of the *Earthy Parts*, as well as the other *Principles* of *Bodies.* Or elſe, that there are divers kinds of *Earths*, even in *Plants*, of which, as well as of *Salts* &c. ſome are *volatile.* For of ℔j of this *Plant*, there remaineth fixed but 50 Grains: whereas of ℔j of *Rhubarb*, there will remain near 1920 Grains, *i. e.* 88 times as much as the former.

Quer. 2. *In what proportion is the Lixivial Salt found in the Gumms of Plants? and whether is it yielded, more or leſs, by all?* For anſwer to which, I cauſed the Eleven following, of each two Ounces, to be calcin'd, and ſo obſerved,

That *Common Roſin*, yields but one Grain and ½ of *Caput Mortuum.* So that ℔j will yield but 12 Grains. In this *Caput Mort.* there is not the leaſt particle of *Salt*, it being altogether inſipid.

Maſtick yields gr. 12 of *Cap. Mort.* But not the leaſt part of *Salt.* Of this *Roſin*, it is obſervable; That being ſet, in a *Crucible*, within the

the fire, before it comes to have thick fumes, it boyls up with a very great foame or froath; and is the only *Gum* or *Rosin* (of the Eleven) that hath this property. So that I suspect, there is a great quantity of some kind of *volatile Spirit*, which then flies away; and so, in breaking through the *Oyly parts*, huffs them up to so great a froath.

Olibanum yields half a Drachm of *Caput Mortuum*. But it is to be noted, That the weight is encreased by certain little *Spar-Stones*, which in the burning of several parcels, I always found mixed with this *Gumm*. These being picked clean out, the *Cap. Mort.* weigheth not much more than that of *Mastick*. And is in like manner insipid, when the said *Stones* are picked out.

From hence it appears, how proper these *Gums* are for the *Concoction* of *Salt Rheums*; according to what I have formerly suggested from another Experiment. *Discourse of Mixture* Cap. Ult.

It may also be noted, that *Rosin* and *Mastick*, seem to be more purely *Acidoleous Gums*; not only from their consistence which is uniform; and their *Smell*, which is less strong and more pleasant: but also from the *Acid Liquor* they yield by *Distillation*; and in that the young *Leavs* of *Fir*, and especially of *Pine*, are sower; and tis probable that those of *Mastick* are so likewise. Whereby these, and other like *Gums* are more especially fitted for the abovesaid purpose. But *Olibanum* seems, besides its *Acidity*, to contein some *Volatile Alkaly*, and so to be an *Acid-Alkaline Gum*. For as it hath a stronger *Smell* than the former, so a hotter *Taste*; both the ordinary effects of an *Alkaline Sulphur*. And being infused in several *Menstruums*, appears to constist of two Bodies, one of them more *Resinous* than the other. Of which, it is probable, that the one is made by the *Acid parts* as the other by the *Alkaline*. Whereby it is very well adapted in some *Cases*, as in a *Pleuresie*, for removing the *Coagulations* of the *Blood*, or its disposition thereunto.

Asa fœtida yileds no less than half its weight or an Ounce of *Caput Mort.* that is 8 times as much as that of the other *Gumms*, and 48 times as much as that of some of them. Yet doth it not contein one grain of *Salt*, so far as can be judged by its *Tast*. Yet the *Strength* and *Loathsomness* of the *Smell* and *Tast* of the *Gumm* do argue it to be highly impregnated with some kind of *Volatile Alkaly* proper to arrest those offensive *Vapours* (to use the vulgar word) which flying, either by the *Blood* or *Nerves*, from part to part, do often prove so troublesome.

Gum Arabick yields one Scruple of *Cap. Mort.* whereof, by the *Taste*, about $\frac{1}{3}^{d}$ part is *Salt*.

Euphorbium yields one *Drachm* of *Caput Mort.* of which, by the strength of the *Taste*, two Scruples seem to be *Salt*. Which confirms a former conjecture (*a*) of its being an *Alkaline Gumm*. (*a*) Of the *Luctation of Bodies*, Ch. I.

Myrrh also yields a Drachm of *Cap. Mort.* and at least two Scruples of *Salt*. Of the Eleven, these two *Gums* have the greatest quantity of a fixed *Alkaly*.

Opium yields half a Drachm of *Cap. Mort.* whereof the one half is *Salt*.

Aloe yields a Drachm of *Cap. Mort.* conteining about one Scruple of *Salt*.

Scammony yields Two Scruples of *Cap. Mort.* of which, about half a Scruple is *Salt.*

Gutta Gamba yields but half a Scruple of *Cap. Mort.* of which four or five Grains are *Salt.*

So that conſidering the *Doſe* of any *Cathartick Gumm*, the quantity of the Fixed *Alkaly*, is extream ſmall with reſpect to the *Volatile parts:* In which, therefore, its *Crthartick Power* doth chiefly reſide.

Yet none of the *Cathartick Gumms* are without ſome portion, more or leſs, of a Fixed *Alkaly*; though ſome of the reſt are. Which ſeemeth to prove, That the Fixed it ſelf, hath ſome Intereſt in the buſineſs of *Purgation*: as by being a *Clog* to the *Volatile*, and ſo preventing its being deleterious; or ſome other way. But the manner of their *Operation* will better be underſtood, when the *Volatile Parts* have likewiſe been examined.

It may alſo be of good import, to know, what different quantities of *Salt*, are afforded by the *Tartars* of all ſorts of *Wines* Whereby, partly, as well as by the quantity of the *Tartar*, we may be enabled the better to judge of the *Nature* of *Wines.*

A

DISCOURSE

Concerning the

ESSENTIAL and MARINE

Salts of Plants.

Read before the *Royal Society*, *December* 21. 1676.

CHAP. I.

In which is ſhewed the way of making both an ESSENTIAL and a MARINE Salt, *out of the LIXIVIAL* Salt *of a* Plant.

SOMETIME ſince, I took the boldneſs to preſent my thoughts to this Honourable and Learned Body in a *Diſcourſe* concerning *Mixture*. Wherein I have endeavoured to lay ſuch a *Foundation*, as might hereafter reduce the *Doctrine* hereof to *Experience* and *Practiſe*; and to demonſtrate, the *Power* and *Uſe* of *Artificial Mixture*. And in further proof of what is therein aſſerted, I have ſince made a continuation of *Experiments* upon the ſame Subject, in Two *Methods*. One in the *Mixture* of ſeveral *Menſtruums*, both *Acid* and *Alkaline*, with all Sorts of *Bodies*. The Other, by calcining them, or, as it were, *mixing* them with the *Fire*.

2. §. I ſhall now proceed to a Third, which is, the *mixing* them with the *Aer* or expoſing them to it; another of Natures grand *Menſtruums*; which goes ſometimes further than the *Fire* it ſelf, in the diſ-

ſolution

solution of Bodies. This I have formerly mentioned for the Imitation of *Nature*, in producing a *Marine* or *Muriatick Salt* out of the *Lixivial Salt* of a *Plant*. But some Learned Persons then present, seeming to doubt of the Experiment; I thought it requisite to prosecute the same a little further; that so, if possible, it might become clear and unquestionable. And because that *Method* was imperfect, and required half a year, or a longer time: I bethought my self of an other way; which proved far better, and more expedite. And which, withall, afforded me, not only a true *Marine Salt*, out of the *Lixivial Salt* of a *Plant*; but also another kind of *Salt*, different from them both: which may not be improperly called, an *Essential Salt* or *Nitre* of *Plants*. The History or manner of the production of them both, is as follows.

Discourse of Mixture Ch. 5. Inst. 2.

3. §. *December* 15. 1675, I took about half a pound of a strong *Solution* of the *Lixivial Salt* of *Firne*: and pouring it into an *Earthen Pan*, well glazed, broad and shallow, exposed it therein to the open *Aer*, in a Chamber Window, to evaporate of it self.

Tab. 83.

4. §. This *Solution* or *Lee*, although it was very clear before, and having stood corked up in a bottle many days, had no sedement: yet standing now in the open *Aer*, within the space of 4 or 5 days, it began to let fall a very *white Sedement*, like fine *Chalk*; which encreased daily for 8 or 10 days; amounting at last to about half a Drachm of white, light and meer *Earth*, altogether insipid, and when it was well washed, stirring not upon the *Affusion* of *Acids*.

5. §. Within the space of a day or two after this *white Sedement* began to fall to the bottom; there was also gatherd on the top, a kind of soft *Scum* or *Cremor*, wherewith the *Solution* was covered all over.

6. §. Within 8 or 9 days after the first exposing of the *Liquor*, or 2 or 3 days after the gathering of the *Cremor*; that *Salt*, which I take leave to call, an *Essential Salt* of *Plants*, began to appear; shooting into several little *Crystals*. These *Crystals*, as they grew bigger, began to sink, and at last fell down to the bottom of the *Pan*.

Tab. 83.

7. §. Upon their first generation or shooting, the said *Cremor* presently breaks, leaving a bare space round about each *Crystal*; and upon the bounds of every space is indented; the space growing bigger and bigger together with the *Crystal* in the Centre. And so, by that time the *Crystals* are grown to a considerable number and bigness, the *Cremor* vanishes away, the several *Circles* or bare places breaking at last one into another all over the *Surface* of the *Lee*. After which, it never comes again.

8. §. From whence it seemeth, That the several *Circles* or bare *Spaces* about the *Crystals*, are made for the more free admission of the *Aer*, requisite to their *Generation*. For as there is no *Crystal* begins to be formed before there is a breach made in the *Cremor*: so that breach is enlarged together with the *Crystal*. So that as the falling of the *Sedement* and the gathering of the *Cremor*, sheweth that the *Aer*, as a *Menstruum* separates some part from the *Lee*: so the breaking of the *Cremor* afterwards, that as a *Vehicle*, it brings something to it: both in order to the *Generation* of the *Crystals*. *Nature* taking a *Method* for the *Generation* of simpler Bodies, as well as of those which are *Compounded* and *Organical*.

9. §.

9. §. The *Figure* of these *Crystals* is angular and oblong, most of them about the fifth, sixth or seventh of an Inch; but none of them very regular. Yet we are not hence to conclude, but that with the help of some Circumstances which might be wanting in the shooting of these; some portion of regular ones may be obteined from this, as well as other *Lixivial Salts* hereafter mentioned.

10. §. They are somewhat transparent, and of a dark *Ambar Color*, or like that of brown *Sugar-Candy*. Of a quite different *Taste* from that of the *Solution* or *Lee* out of which they are bred; being not at all *Lixivial*, but very weak and mild; not *Salt*, but *Bitter* in a good degree.

11. §. It is also observable, that *Alkaline* and *Acid Salts* being both poured severally upon these *Crystals*, they stir not, nor are any way affected with either of them. So that these *Crystals* are no sort of *Tartar*, or *Tartareous Salt*. As is plain, from the manner of their *Generation*; *Tartar* being still bred in close *Vessels*; these never, but by exposing the *Liquor* to the *Aer*. As also from their *Taste*, being not sower, in the least, but bitter. And in that *Tartar* will make a *Bullition* with *Alkaline Salts*, which these will not do. Upon which accounts it appears, that they are a *Salt* different in Nature from all other *Salts* hitherto known, or a new *Species* added to the *Inventory* of *Nature*.

12. §. These *Crystals* within the space of about a fortnight after their first *Generation*, did also cease to shoot any more, but only increased a little in their *Bulk*. After which time, I dayly expected to see the production also of a true *Marine Salt*. And about two months after the said *Essential Crystals* had done shooting, and not before, this also began to shoot, in many small *Crystals*, and at the top of the *Solution*, as the other did, still falling to the bottom as they grew biger.

13. §. The *Size* of most of them was near that of the *Flakes* or *Grains* of *Bay-Salt*. The *Colour* of some of them *white*, of others *transparent*; and of others *white* in the *Centre*, with transparent *Edges*; as is also usual in the *Crystals* of *Common Salt*.

14. §. The *Figure* of most is a perfect *square*, and of very many coming near to a *Cube*; which is also the *Figure* of *Common Salt*, and seldome an exact *Cube*. An exact *Cube*, being the constant property of no *Marine Salt*, that I know of, except that of the *Dead Sea*. Divers of them were also raised as it were by several steps from a deep Centre to the Top: as is often seen in the common shooting of *Common Salt*; and not in any other. Their *Taste* is neither *Lixivial*, as that of the *Solution* out of which they shoot; nor bitterish, as that of the *Essential Crystals*; nor soweriſh, as that of *Tartar*; but the perfect *Taste* of *Common Salt*. *Tab.* 83.

15. §. It is also to be noted, That if *Oyl* of *Vitriol*, and some other strong *Acids*, be poured upon this artificial *Sea-Salt*, they make an *Effervescence* together: but if *Spirit* of *Salt* or *Spirit* of *Nitre* either be poured on it, though it be never so strong it stirreth it not. In both which, and all the formentioned respects, it answers to the *Properties* of a *Marine* or *Common Salt*, which no other *Salt* doth. I conclude it therefore to be a true *Marine Salt* produced by *Art* in the imitation of *Nature*.

CHAP.

CHAP. II.

Wherein is shewed, That the said ESSENTIAL *and* MARINE Salts *of* Plants *are both of different Sorts.*

HAVING made the Experiment, that both an *Essential* and *Marine Salt* may be produced out of the *Lixival Salt* of a *Plant.* I thought it probable, that neither the one nor the other, was always the same, but that as they had their general properties which made them to be of two general kinds; so they might have some special property, for the distinguishing of each kind into several Sorts. And withall, that in a warmer season, than before taken, the *Tryal* hereof might be finished in a shorter time.

2. §. For the making of which, I conceived it requisite to remove an Opinion which seemed to lye in my way; *&c.* That there is little or no difference between the several *Lixivial Salts* of *Plants*, as some Learned men have thought. But either there is a difference, or not: if not, it should be proved: and if there be, it should then be justly stated, what that difference is. For the doing of which, I chose this *Method.* I took an equal quantity of the whitest and purest *Salts* of divers *Plants*, all made by an equal degree of *Calcination*; and dissolved them all severally in an equal quantity of water. And pouring likewise an equal quantity, as about 10 or 12 drops of each into a spoon, I tasted them severally. Whereby it was very evident, that they were not all of one *Tast*, but of very different ones, both as to strength and kind: and therefore different in Nature also. The *Salts* I made tryal of were those of *Sorrel*, *Anise*, *Wormwood*, *Mallow*, *Ash*, *Tartar* and others: and upon half a Drachm of each I poured ℥ij ß of water. The *Solutions* are here present to be tasted. By which the differences will easily be observed, and particularly that the *Salt* of *Wormwood* or *Scurvygrass*, is almost as strong again as the *Salt* of *Anise*, or *Sorrel*: and that the *Salt* of *Ash* is above twice as strong, and that of *Tartar* above thrice as strong, as that of *Sorrel*, and almost thrice as strong as that of *Wormwood* or *Scurvygrass*. So that he who shall give half a Scruple, suppose of *Salt* of *Tartar*; instead of half a Scruple of *Salt* of *Wormwood*, or other like *Salt*; he may as well give a Scruple of *Rosin* of *Jalap*, for a Scruple of the powder, or almost three Drachms of *Rhubarb*, or other like *Purge*, instead of one. And the like is to be said of other *Lixivial Salts* in their degrees.

3. §. Having observed thus much, I proceeded to repeat the former Experiment, with some of the aforesaid, and some other *Vegetable Salts*, the best calcin'd, and the purest, that could be made for this purpose, being these Six *Salts*, *&c.* of *Rosemary*, *Garden Scurvygrass*, *Black*

Black Thorn, *Common Wormwood*, *Aſh*, and *Tartar*. All which diſſolved ſeverally in fair water, I expoſed in a Chamber window, and not in Winter, as before, but in the heat of Summer, *ſc.* on the 19 of *July*, to evaporate of themſelves.

4. §. The Effect was, That the third day after their being expoſed, the *Eſſential Cryſtals* began to ſhoot in three of the *Solutions*, *ſc.* in that of *Roſemary*, of *Garden Scurvygraſs*, and of *Black Thorn*. On the fouth day, in that of *Wormwood*. On the fifth day, in that of *Aſh*. In that of *Tartar*, not at all.

5. §. Theſe *Eſſential Cryſtals* began, in all, to ſhoot at the top, and then to fall to the bottome; as in the Experiment before. But as there was very little of the *white Sedement* before mentioned, that preceded; So no *Scum* or *Cremor* at all. Which although a more perfect *Calcination*, it ſeems, did here almoſt prevent; yet did not in the leaſt deſtroy the aforeſaid *Eſſential Salt*, but rather make way for its more ſpeedy and copious *Production*: exhibiting likewiſe a diſtinct *Species* in ſeveral of the *Solutions*.

6. §. For firſt, the *Cryſtals* of *Roſemary* (the largeſt of them) were about the bigneſs of a *Rice-Corn*. In *Figure* almoſt like a *Tip-Cat*, which Boys play with, ſplit down the midle. Each *Tip* being cut into 5 ſides all ending in a poynt: the midle part divided into 7, all drawn by parallel *Lines*; the topmoſt with the lowermoſt but one, on each ſide, beeing three exact *Squares*. *Tab.* 83.

7. §. The *Cryſtals* of *Black Thorn* are moſt of them poynted with juſt ſix ſides of Equal *Meaſure*: very like to the ſhooting of true *Cryſtal* it ſelf. From the topmoſt of which ſix Sides, a *Line* being drawn out, runs parallel to a broad *Baſe*, whereon each *Cryſtal* ſtands. So that they are in ſome ſort of a *Rhomboid Figure*. *Tab.* 83.

8. §. The *Cryſtals* of *Scurvygraſs* have alſo a very elegant and regular *Figure*, which is in a manner compounded of the two former now deſcribed. But they are nothing near ſo bigg, the largeſt of them, being no biger than a *Grain* of that which we call *Pearl Barley*.

9. §. The *Cryſtals* of *Wormwood* have alſo very many of them a regular *Figure*; but quite different from that of the *Cryſtals* before mentioned; each *Cryſtal* being a little *Cylinder*, ſaving that it is conſtantly ſomewhat ſmaller at one end, than the other: as it were one half of a *Rowling-pin*. And not evenly *Circular*, but cut out by Six *Sides* of equal *Meaſure*: almoſt as in the *Cryſtal* of *Nitre*. So that contrary to what is ſeen in the forementioned *Cryſtals*, the ends of theſe of *Wormwood* are not poynted, but *flat*; and cut at *Right Angles* with the *Sides*. *Tab.* 83.

10. §. The *Cryſtals* of *Aſh*, though by their properties they appear likewiſe to be *Eſſential*; yet are nothing near ſo regularly figur'd, as all the forementioned.

11. §. The *Colour* alſo of the ſaid *Cryſtals* is ſomewhat different: Thoſe of *Aſh* being of a *brown* tranſparency, almoſt like thoſe of *Firne*. Thoſe of *Wormwood* being alſo *browniſh*, but *paler*. Thoſe of *Roſemary* and *Scurvygraſs* having ſome little *Tincture*, yet very *clear*. But thoſe of *Black Thorn* without the leaſt *Tincture*, and as *clear* as *Cryſtal* it ſelf.

12. §. None of these *Essential Crystals* have any hot fiery *Taste*, but are very *mild*, and sensibly *Bitter*; especially, about the *Root* of the *Tongue*: as is also observable of some *Plants* hereafter mentioned, in speaking of the different *Tastes* of *Plants*.

13. §. *Oyl* of *Vitriol* droped upon these *Crystals* doth not affect them in the least: yet droped into the several *Solutions* out of which the *Crystals* are produced, immediately causeth a great *Effervescence*.

14. §. Of the *Solutions* above named, that, of *Salt* of *Tartar* was the 6th. Whereof it is remarquable, That having waited several Months together, I could not observe the least *Essential Salt* to be therein produced in all that time. Whether there be any other *Vegetable Salts*, besides this of *Tartar*, which will not yield the *Essential* above described, I have not yet experimented.

15. §. In the mean time, from the *Premises* it is very probable, that most of them afford more or fewer of the said *Crystals*. In regard they are *Plants* of a very different kind, which I made tryal upon: as *Garden Scurvygrass*, very *Hot*; *Rosemary*, very *Aromatick*. *Wormwood* very *Bitter*; *Black Thorne*, *Astringent* and *Sower*. And it is also plain, That the said *Essential Salts* contained in the *Lixivial*, are not altogether one and the same, but of divers Sorts.

16. §. ABOUT 7 or 8 days after the *Essential Crystals* were produced; the *Marine Salt* did also begin to shoot; first in *Rosemary*; quickly after, in *Scurvygrass*; Next, in *Black Thorn* and *Wormwood*, *&c.* after the space of a week or 10 days more. And in all of them with some difference of *Size* and *Figure*.

17. §. The plainest of all, was that produced out of the *Salt* of *Black Thorn*, consisting for the most part of very small *Crystals*, not above the 15th of an Inch square, as also *thin*, shaped like a *Duch Tile* used for *Chimnies*. Many others were very *thick*, and near to a *Cube*. Most of which were a little hollowed in the midle, like a grinding *Marble* or *Salt-Celler*; and the hollow bounded by 4 plain and equal *Sides*, all descending a little towards the *Centre*; and measured by two cross *Lines*, which staid upon the four *Angles* of the *Square*, and so cut one the other at *Right Angles*. Both which *Properties* are likewise usually seen in the *Crystals* of *Common Salt*.

Tab. 83.

18. §. In *Wormwood*, many of these *Crystals*, besides the plain ones, were figur'd crosways like a *Dagger-Hilt*. Which was sometimes naked, and sometimes incloſed in a square and almost *Cubical Box*. Many others were figur'd into *Sprigs* made up of four chief *Branches* standing croswise, and those *subbranched*; and all the *Branches* made up of little square *Crystals*, clustered together in that *Figure*. The *sprigy Figure* of these *Crystals* is not accidental, but hath constantly come after they hadbeen three times dissolved, and the *Solution* exposed to evaporate.

Tab. 83.

19. §. The *Marine Salt* of *Rosemary* hath also some variety. For besides the plain ones above described, there are some thick *Squares*, which have also a square hollow descending by five, six, or seven narrow steps, towards the *Centre*; being in *Figure*, saving these *Steps*, somewhat like the *Hoper* in a *Mill*.

Tab. 83.

20. §. Upon a second *Solution* of the same *Salt*, there shoots another sort of square; which is not plain on the edges, as the above-named, but scalloped or florid all round about, not unlike the *Leaves* of some *Plants*.

21. §.

21. §. The *Cryſtals* of *Marine Salt* of *Scruvygraſs* are ſomewhat like to thoſe of *Roſemary* now deſcribed.

22. §. As for the *Lixivial Salts* of *Aſh* and *Tartar*, though in a Month or Five Weeks Space, they yield ſome *Cryſtals* of very clear *Salt*: yet of *Marine Salt* neither of them yieldeth the leaſt particle. So that of theſe Six *Lixivial Salts*, *ſc.* of *Roſemary*, *Scurvygraſs*, *Black Thorn*, *Wormwood*, *Aſh* and *Tartar*, all, but that of *Tartar*, yielded an *Eſſential Salt*. And all, but thoſe of *Aſh* and *Tartar*, yielded a *Marine*, ſuch as is above deſcribed. All which *Salts* both *Eſſential* and *Marine*, together with their *Models*, made of *white Alabaſtre*, I have here ready to be ſeen.

23. §. Of thoſe that yield theſe *Salts*, or either of them, it is further to be noted, That there is a conſiderable difference in the *Proportion* or *Quantities* which they yield. The *Roſemary* yields ſtore both of *Eſſential* and *Marine*, but more *Eſſential*. *Wormwood* and *Scurvygraſs* more *Marine*. *Black Thorn* leſs of Either. The *Aſh* no *Marine*, and the *Tartar* neither the *Eſſential* nor *Marine*, as hath been ſaid.

24. §. From what hath been ſaid, I deduce only at preſent theſe Three *Corallaie*. *Firſt*, That a *Lixivial Salt*, is not only a compounded Body *ſc.* of *Salt*, *Sulphur*, *Aer* and *Earth*; but even a *Compounded Salt*, containing both a *Vegetable Nitre*, and a true *Sea Salt*.

25. §. *Secondly*, That the *Expoſing* of *Bodies*, in the manner above ſhewed, may juſtly be accounted one *Part* of *Chymiſtry* hitherto *Deficient*, and much farther to be improved for the *Diſcovery* of the *Nature* of *Bodies*. For as *Nature* chiefly compoundeth *Bodies* by *Digeſting* them, and ſo either ſhutting out or keeping in the *Aer*: So ſhe *Diſſolveth* them by *Expoſing*, and ſo neither ſhutting in the *Aer*, nor keeping it out, but leaving it free to come and go; and thereby to bring, and carry off whatſoever is neceſſary for the *Separation* or *Solution* of *Bodies*. For the *Sea* it ſelf (to confine the ſimilitude to our preſent caſe) is but as a *Great Pan*, wherein all kinds of bodies being long expoſed, are throughly reſolved, ultimately yielding from the reſt of their *viſible Principles*, that which we call *Sea Salt*.

26. §. *Laſtly*, if by *Expoſing* and *Diſſolving* we can make one *Satl*; then by *Compounding* and *Digeſting* we may make another, yea any other *Salt*; either a *Fixed* of a *Volatile*, or a *Volatile* of a *Fixed*. That is to ſay, a *Volatile Salt* may be ſo ſeparated from other *Bodies*, as to become *Fixed*; or a *Fixed Salt* may be ſo *mixed* with other *Bodies* as to become *Volatile*. For that any *Salt* ſhould of it ſelf become *Fixed* or *Volatile*, is a *Fixion* not grounded upon *Experiment*.

27. §. As for the *Virtue* of the *Eſſential Salts* above deſcribed, I believe they will be found upon tryal, not contemptible in ſome Caſes. For which amongſt other reaſons, I have been the more punctual

in relating the manner of their *Generation*; that others alſo may have the opportunity of making proof hereof.

28. §. When I made the *Experiments* for this and the foregoing *Diſcourſe*, not having ſo good conveniency at home for making the *Salts* I uſed: I procured them all (except that of *Firne*, which I made my ſelf) to be purpoſely prepared by Mr. *John Blackſtone* a *London Apothecary*, who aſſured me of his great care herein; and particularly, that he added no *Nitre* to whiten any of the *Salts* with, as is commonly done for that of *Tartar*.

I do declare, That all the *Lixivial Salts* mentioned in this and the foregoing *Diſcourſe* except that of *Firne*, were faithfully prepared by me

John Blackſtone.

A DISCOURSE OF THE COLOURS OF PLANTS.

Read before the *Royal Society*, *May* 3. 1677.

CHAP. I.

Of the COLOURS *of* Plants *in their Natural Eſtate.*

HAVING formerly made ſome *Obſervations* of the *Colours* of *Plants*; I ſhall now crave leave to add ſome more to them of the like *Nature*. None of which, nor any of the *Concluſions* thence deduced, will, if duly conſidered, appear contrary to the *Hypotheſis* and *Experiments* of Mr. *Boyle*, Mr. *Des Cartes*, Mr. *Hook*, Mr. *Newton*, or any other, concerning *Colours*. As not having reſpect to the *Colours* of all *Bodies* in general. Nor to the *Body* of *Colour*, which is *Light*; Nor to the formal notion of *Colours* (*ad extra*) as the *Rays* of *Light* are moved or mixed: But to thoſe *Materials*, which are principally neceſſary to their *Production* in *Plants*. Concerning which, the preſent *Diſcourſe* ſhall be reduced to theſe Three general *Heads*, *ſcil.*

Idea, §. 27. and *Anat.* of *R. P.* 2. §. 65, &c.

2. §.

2. §. *First*, Of those several *Colours*, which appear in *Plants* in their *Natural Estate.*

3. §. *Secondly*, As they appear upon the *Infusion* of *Plants* into several Sorts of *Liquors.*

4. §. *Thirdly*, As upon the *Mixture* of those *Infusions*, or of any one of them with some other *Liquor*, or other *Body.*

5. §. As they appear in the *Plants* themselves, it may be observed in the first place, That there is a far less variety in the *Colours* of *Roots*, than of the other *Parts:* the *Parenchyma* being, within the *Skin*, usually *White*, sometimes *Yellow*, rarely *Red.* The *Cause* hereof being, for that they are kept, by the *Earth*, from a free and open *Aer*; which concurreth with the *Juyces* of the several *Parts*, to the *Production* of their several *Colours.* And therefore the upper parts of *Roots*, when they happen to stand naked above the Ground, are often deyed with several *Colours:* so the tops of *Sorrel Roots* will turn *Red*, those of *Mullen*, *Turneps* and *Radishes*, will turn *purple*, and many others *green.* Whereas those parts of the same *Roots* which lie more under Ground, are commonly *White.*

6. §. As *Roots* are most commonly *White*; so the *Leaves*, *Green.* Which *Colour* is so proper to them, that many *Leaves*, as those of *Sage*, the young *Sprouts* of St. *Johns-wort*, and others, which are *Redish* when in the *Bud*; upon their full *Growth*, acquire a perfect *Green.*

7. §. The *Cause* of this *Colour*, is the *action* of the *Aer*, both from within, and from without the *Plant*, upon the *Juyces* thereof, whereby it strikes them into that *Colour.*

8. §. By the *Aer* from without, I mean that which surrounds the *Body* of the *Plant:* which is the Cause of its *Greeness*, not meerly as it is contiguous to it, but as it penetrates through the *Pores* of the *Skin*, thereinto; and so mixing with the *Juyces* thereof, plainly deys or strikes them into a *Green.*

9. §. By the *Aer* from within, I mean, that which entring, together with the *Aliment*, at the *Root*, thence ascends by the *Aer-Vessels*, into the *Trunk* and *Leaves*, and is there transfused into all the several *Juyces*, thereby likewise concurring to their *Verdure.* Whence it is, that the *Parts* of *Plants* which lie under *Water*, are *Green*, as well as those which stand above it; because, though the ambient *Aer*, conteined in the *Water* be but little, yet the want of it is compensated, by that which ascends from the *Root.*

10. §. And therefore it is observable, that the *Stalks* of *Marsh-Mallow*, and some other *Plants*, being cut transversly, though the *Parenchyma* in the *Barque* be *white*, yet the *Sap-Vessels* which lie within that *Parenchyma*, are as *Green* as the *Skin* it self; *scil.* because they stand close to the *Aer-Vessels.* The *Parenchyma*, I say, which is intercepted from the *Aer*, without, by the *Skin*; and from the *Aer* within, by the *Sap Vessels*, is *white:* but the *Skin*, which is expos'd to the *Aer* without, and the *Sap-Vessels* which are next neighbours to that within, are both equally *Green.* So likewise if a *Carrot* be plucked up, and suffered to lie sometime in the open *Aer*; that part which standeth in and near the *Centre*, amongst the *Aer-Vessels*, will become *Green* as well as the *Skin*, all the other *Parts* continuing of a *Redish Yellow*, as before. The *Aer* therefore, both from without, and from within the *Plant*, together with the *Juyces* of the *Plant*, are all the concurrent *Causes* of its *Verdure.*

11. §.

11. §. BUT how doth the *Aer* concur to the *Greeneſs* of *Plants?* I anſwer; Not as it is meerly either *cold* or *dry*, or *moiſt*, nor yet *quatenus Aer*; but as it is a mixed, and particularly, a *Saline Body*: that is, as there is a conſiderable quantity of *Saline Parts* mixed with thoſe which are properly *Aereal*. It being plain from manifold Experience; That the ſeveral kinds of *Salts*, are the grand *Agents* in the *Variation* of *Colours*. So that, to ſpeak ſtrictly, although *Sulphur* be indeed the *Female*, or *Materia ſubſtrata*, of all *Colours*; yet *Salt* is the *Male* or *Prime Agent*, by which the *Sulphur* is determined to the *Production* of one *Colour*, and not of another.

12. §. If then it be the *Aer* mixed with the *Juyces* of a *Plant*, and the *Salt* of the *Aer*, that makes it *Green*; It may further be asked, what kind of *Salt*? But this is more hard to judge of. Yet it ſeemeth, that it is not an *Acid*, but a *Subalkaline Salt*; or at leaſt ſome *Salt* which is different from a ſimple *Acid*, and hath an *Affinity* with *Alkalies*.

13. §. One reaſon why I ſo judge, is, Becauſe that although all *Plants* yield an *Alkaly*, or other *Salt* different from an *Acid*, and ſome in good quantity; yet in moſt *Plants*, the *Prædominant Principle* is an *Acid*. So that the *Supply* of an *Acid Principle* from the *Aer*, for the *Production* of a *Green Colour*, as it would be ſuperfluous; So alſo ineffectual: a different *Principle* being requiſite to the ſtriking of this, together with the *Sulphur*, into a *Green Colour*.

14. §. I ſuppoſe therefore, That not only *Green*, but all the *Colours* of *Plants*, are a kind of *Precipitate*, reſulting from the concurrence of the *Saline Parts* of the *Aer*, with the *Saline* and *Sulphurious Parts* of the *Plant*; and that the *Subalkaline*, or other like *Saline Part* of the *Aer*, is concurrent with the *Acid* and *Sulphurious Parts* of *Plants*, for the *Production* of their *Verdure*; that is, as they ſtrike altogether into a *Green Precipitate*. Which alſo ſeemeth to be confirmed by divers *Experiments* hereafter mentioned.

15. §. THE *Colours* of *Flowers* are various; differing therein not only from the *Leaf*, but one from another. Yet all ſeem to depend upon the general *Cauſes* aforeſaid. And therefore the *Colours* of *Flowers*, as well as of *Leaves*, to reſult not ſolely from the *Contents* of the *Plant*, but from the concurrence likewiſe of the *ambient Aer*. Hence it is, that as they gradually open, and are expoſed to the *Aer*, they ſtill either acquire, or change their *Colour*: no *Flower* having its proper *Colour* in the *Bud*, (though it be then perfectly formed) but only when it is expanded. So the *Purple Flower* of *Stock-July Flowers*, while they are in the *Bud*, are *white*, or *pale*. So *Butchelors Buttons*, *Blew Bottle*, *Poppy*, *Red Daiſies*, and many others, though of divers *Colours* when blown, yet are all *white* in the *Bud*. And many *Flowers* do thus change their *Colours* thrice ſucceſſively; as the youngeſt *Buds* of *Ladys-Lookinglaſs*, *Bugloſs* and the like, are all white, the larger *Buds* are *purple* or *murrey*, and the open *Flowers*, *blew*: according as they come ſtill neerer, and are longer expoſed, to the *Aer*.

16. §. But if the *Colour* of the *Flower* dependeth on the *ambient Aer*; it may be asked: How it comes to paſs then, that this *Colour* is various, and not one, and that one, a *Green*? that is to ſay that all *Flowers* are not *Green*, as well as the *Leaves*? In anſwer to this Three things are to be premiſed.

17. §.

17. §. *First*, What was said before, is to be remembred, that here the *Aer* is not a solitary, but concurrent *Cause*. So that besides the *Efficacy* of this, we are to consider that of the several parts of the *Plant*, by which the *Contents* both *Aereal* and *Liquid* are supplied to the *Flower*.

18. §. *Secondly*, That in the *Lymphæducts* of a *Plant*, *Sulphur* is the *predominant Principle*, and much more abounding than in any other *part* of a *Plant*, as also hath been formerly shewed.

19. §. *Thirdly*, That it appears, according to what we have observed in the *Anatomy* of the *Flower*, That the quantity of *Lymphæducts* with respect to the *Aer-Vessels* is greater in the *Flower* than in the *Leaf*.

20. §. It seemeth therefore, that the *Aer-Vessels*, and therefore the *Aer*, being *predominant* in the *Leaf*; *Green*, is therein also the *predominant Colour*. I say *predominant*, because there are other *Colours* lye vailed under the *Green*, even in the *Leafe*, as will hereafter appear more manifest.

21. §. On the contrary, the *Lymphæducts*, and therefore the *Sulphur*, being more, and the *Aer-Vessels* and therefore the *Aer*, less, in the *Flower* than in the *Leaf*; the *ambient Aer* alone is not able to controle the *Sulphur* so far, but that it generally carrys the greatest port in the *Production* of the *Colour*. Yet in different degrees; For if the proportion betwixt the *Lymphæducts* and the *Aer-Vessels* be more equal, the *Flower* is either *White* or else *Yellow*, which latter *Colour* is the next of kin to a *Green*. If the *Sulphur* be somewhat *predominant*, the *Flower* will shew it self *Red* at first; but the *ambient Aer* hath so much power upon it, as gradually to turn the *Red* into a *Blew*. But if the *Sulphur* be much *predominant*, then the *Acid* of the *ambient Aer* will heighten it to a fixed *Red*.

22. §. Hence it is, that *Yellows* and *Greens* are less alterable, upon the drying of *Plants* than other *Colours*; *sc.* Because the *Aer* being *predominant* in their *Production*, they are the less lyable to suffer from it afterwards. Whereas *Reds* and *Purples*, in the *Production* whereof *Sulphur* is *predominant*, are very changeable. So the *Red* Flowers of *Lysimachia*, upon drying, turn *Purple*, and the young *purple Flowers* of *gloss* turn *Blew*. So likewise the *Purple* of *Bilberries*, and the *Crimson* of baked *Damascens*, both turn *Blew*. For being gathered, and so wanting a continued supply of fresh *Sulphur*, to bear up the *Colour* against the force of the *Aer*; it strikes it down at last from *Red* to *Purple* or *Blew*. I conclude therefore, that one *Principal Cause* of the *Variety* of *Colours* in the *Flower*, is the over proportion of the *Lymphducts* to the *Aer-Vessels*, and therefore the dominion of the *Sulphur* over the *Aer*, therein.

23. §. If it be objected, that the *Aer* doth not deepen, but highten the *Colour* of the *Blood*: I answer, *First*, That I am not now speaking of *Animal*, but of *Vegetable Bodies*; the same *Aer* which hightens the *Colour* of *Blood* one way, may deepen that of a *Flower*, another: nay and may highten that of some *Flowers* too, some other way.

24. §. And therefore, *Secondly*, it is to be considered, That as there is not one only, but divers *Saline Principles* in the *Aer*; so are there also in the several *Parts* of one *Plant*; as in the *Root*, of one sort; in the *Leavs*, of another; in the *Flower*, of another; and so in the other *Parts*. For since the *Figuration* of the *Parts* of a *Plant* dependeth chiefly

chiefly upon the *Saline Principles*: and that the *Flower* hath a different *Figure* from that of the *Leaf*: it follows, that there is some *Saline Principle* in the one, which is not in the other, especially, all in such *Flowers*, whose *Figures* are cut out by a greater *Variety* and *Complication* of *Lines*. The *Leavs* therefore, though variously shaped, yet agreeing so far in one common *Figure*, as usualy to be *flat*; it therefore seemeth plain, that there is a *Saline Principle* in them all, so far *one*, as to be the chief *Cause* of that common *Figure*: and in concurrence with the *ambient Aer*, to be likewise the chief *Cause* of one common *Colour*, *&c.* a *Green*.

25. §. Whereas the *Figure* of the *Flowers*, and therefore their *Saline Principle*, being more various, and commonly distinct from that of the *Leaf*; it will easily concur with as a great *Variety* of *Salts* in the *Aer*, whether *Acid*, *Alkaline*, *Nitrous*, *Urinous*, *Armoniacal*, or any other therein existent, to the *Precipitation* of the *Sulphur* into the like *Variety* of *Colours*. Thus far of the *Colours* of *Plants* as they appear in their *Natural Estate*.

CHAP. II.

Of the COLOURS of Plants *by* Infusion.

THE next general *Inquiry*, proposed to be made, was this, After what manner the *Colours* of *Plants* shew themselves, upon their *infusion* into *Liquors*. The *Liquors* I made use of for this purpose, were three, *&c.* *Oyl* of *Olives*, *Water*, and *Spirit* of *Wine*. The *Water* I used was from the *Thames*, because I could not procure any clear *Rain Water*, and had not leasure at present to distill any. But next to this, that yields as little *Salt*, as any.

2. §. As for *Oyl*, it is known, that most *Plants* either by *Coction* or long *Infusion*, will give it their *Green Colour*. I have likewise tryed some *Yellows*, and find they will do indifferently well; as *Saffron*, which, by *Infusion* in *Oyl*, gives it a light golden *Tincture*.

3. §. Divers *Aromatick Plants*, as *Mint*, *Majorane*, &c. being dryed and infused in *Oyl* give it a double *Tincture*, both *green* and *yellow*; one drop of the *Oyl* shewing *green*; but a good quantity of it held up against a candle looketh *rediſh* or of a deep *yellow*.

4. §. But there is no *Vegetable* yet known which gives a true *Red* to *Oyl*, except *Alkanet Root*: with which, some colouring either common or other *Oyl*, vend it under the name of the *Red Oyl* of *Scorpions*.

5. §. These things confirm what we have said concerning the *Causes* of *Colours* in the *Leavs* and *Flowers* of *Plants*, upon this twofold Consideration. *First*, that *Oyl* is the most proper *Menstruum* of *Sulphur*. *Secondly*, that *Oyls* have a greater congruity with *Acids* than with *Alkalies*; as I have formerly shewed. *Discourse of Mixture* Ch. 5. Inst. 2. §. 3. & Inst. 5.

6. §. I ſay therefore, that in *Blews*, *Purples* and eſpecially *Reds*, the *predominant Principles* being *Sulphur* and *Acid*, the *Oyl* either abſtracts the *Sulphur* of it ſelf, or at leaſt, unlocks it from the *Acid Parts*; whereby both of them are beſtowed ſeperately to their like parts in the *Oyl*; upon which their diſunion the *Colour* vaniſhes: that depending, not upon either of them alone, which of themſelves are *Colourleſs*, but upon both united together.

7. §. On the contrary, a *Green Colour* not depending on a *predominant Acid*, but an *Alkaly*, or ſome *Saline Principle* different from an *Acid*; this will not ſo eaſiely be imbibed ſeparately, into the *Pores* of the *Oyl*, but only by mediation of their *Sulphur*. So that being both imbibed without any diſunion, they ſtill retein the ſame *green Colour* they had before in the *Plant*.

8. §. Hence alſo it is, that *red Roſes* being dryed and infuſed ſome time in *Oyl* of *Aniſe Seeds*, a more potent *Menſtruum* than *Common Oyl*; they wholly loſe their own *Colour*, and turn *white*; the *Oyl* remaining *Limpid*, as at the firſt. That is the *Sulphur* or that part of it on which cheifly the *Red* depended, is abſorbed ſeparately by the *Oyl*, and ſo the *Colour* vaniſhes.

9. §. A SECOND *Menſtruum* I made uſe of, was *Water*. And *Firſt*, *Alkanet Root*, which immediately tinctures *Oyl* with a deeper *Red*, will not colour *Water* in the leaſt.

10. §. Next it is obſervable, That *Water* will take all the *Colours* of *Plants* in *Infuſion* except a *Green*. So that as no *Plant* will by *Infuſion* give a perfect *Blew* to *Oyl*; ſo their is none, that I know of, which, by *Infuſion* will give a perfect *Green* to *Water*.

11. §. But although the *Green Leavs* will not give their *viſible Colour*, by *Infuſion* in *Water*; yet they will give moſt other *Colours*, as well as the *Flowers* themſelves. So the *Green Leavs* of *Cinquefoyl*, give a *Tincture* no higher than to reſemble *Rheniſh Wine*; thoſe of *Hyſſop*, *Canary*; of *Strawberrey*, *Malaga*; of *Mint*, *Muſcadine*; of *Wood-Sorrel*, *Water* and ſome drops of *Claret*; of *Blood-wort*, *Water* and a daſh of *Claret*; and thoſe of *Bawm* make a *Tincture* near as *red* as ordinary *Claret* alone. All *Aromatick* hot *Plants*, give a *yellow-red Tincture*, or *colorem ex luteo rubrum*. All *Plants* with a *yellow Flower* give either a pale *citrine* or *yellowiſh Tincture*; and the like. Yet all give not their *Tincture* in the ſame ſpace of time; ſome requiring a fortnight, others a week, others five, three or two days, and ſome but one, or half a day. From hence it appears, that the *Colours* of moſt *Flowers* are begun in the *Leavs*; only *Green* being therein the *predominant Colour*, as a *veil* ſpred over them, conceils all the reſt. But paſſing on into the *Flower*, where the *Aer-Veſſels*, as is aforeſaid, are under the dominion of the *Lymphæducts* they ſhew themſelves diſtinctly.

12. §. A THIRD and the laſt *Menſtruum* I made uſe of, was *Spirit* of *Wine*. And here it is to be remarqued; That as *Oyl* rarely takes a *Red*, there being but one known *Inſtance* of it; nor *Water*, a *Green*: So neither *Spirit* of *Wine*, a *Blew*. I have tryed with ſeveral *blew Flowers*, as of *Lark-heel*, *Violet*, *Mallows*, *Burrage*, and others, whereof it will not take the leaſt *Tincture*.

13. §. Again though no *Blew Flowers*, that I know of, will give a *Blew Tincture* to *Spirit* of *Wine*: yet having been for ſome days infuſed

in

in the said *Spirit*, and the *Spirit* still remaining in a manner *Limpid*, and void of the least *Ray* of *Blew*; if you drop into it a little *Spirit* of *Sulphur*, it is somewhat surprizing to see, that it immediately strikes it into a full *Red*, as if it had been *Blew* before: and so, if you drop *Spirit* of *Sal Armoniac* or other *Alkaly* upon it, it presently strikes it *Green*. Which further confirms what have been before said of the *Causes* of *Vegetable Colours*.

14. §. It is also observable, That the *Green Leaves* of *Bawm*, which give a *Muscadine Red*, with some *Rays* of *Claret*, to *Water*, gives a pure and perfect *Green* to *Spirit* of *Wine*: and is the only *Plant* of all that I have yet tryed, which doth the like.

15. §. It is likewise to be noted, That both *Yellow* and *Red Flowers* give a stronger and fuller *Tincture* to *Water*, than to *Spirit* of *Wine*; as in the *Tinctures* of *Cowslip*, *Poppys*, *Clove-July-Flowers* and *Roses*, made both in *Water* and *Spirit* of *Wine*, and compared together, is easily seen. So that for *Tinctures* made with *Flowers*, whether for *Medicines*, or other purposes, *Water*, with respect to the *Colour*, is the better *Menstruum*. I say for *Tinctures* made with *Flowers*; for there are some other *Parts*, especially *Gumms*, as *Gamboja*, *Myrrh* and *Aloes*, which give their *Tinctures* full and clear, only to *Spirit* of *Wine*. Some of which are used by *Leather-Gilders*, and others, for the washing over of *Silver*, so as to give it the *Colour* of *Gold*. Thus far of the *Colours* of *Plants* as they appear upon *Infusion*.

CHAP. III.

Of the COLOURS of Plants *produced by their* Mixture *with other Bodies.*

THE last general Enquiry proposed to be made, was this, After what manner they would exhibite themselves upon the *Mixture* of those *Infusions*, or of any one of them with some other *Liquor*.

2. §. A strong *Infusion*, or the *Juyce* of the *Leavs* of *Rose-Tree*, *Raspis*, *Strawberry*, *Cynquefoyle*, *Goosberry*, *Primrose*, *Jerusalem Cowslip*, *Bearseare*, *Bearsfoot*, *Peony*, *Bistort*, *Lawrel*, *Goats-beard*, droped upon *Steel*, make a *Purple Tincture*. But that of *Vine Leaves* scarce maketh any *Tincture* at all. So that there is something else besides *Sowerness* concurring to the *Purple* upon *Steel*.

3. §. *Saccharum Saturni* droped on a *Tincture* of *Red Roses*, turneth it to a *faint pale Green*.

4. §. *Salt* of *Tartar* droped upon the same *Tincture*, turneth it to a *deeper Green*.

5. §. *Spirit* of *Harts Horn* droped upon a *Tincture* of the *Flower* of *Lark-heel* and *Borage* turn them to a *verdegreese Green.*

6. §. *Spirit* of *Harts Horn* droped on most *green Leavs* doth not change them at all. The like Effects have *Aq. Calcis*, and *Spirit* of *S. Armoniac.*

7. §. Theſe *Experiments* ſeem to confirm, That it is ſome *Alkaline* or other like *Salt* in the *Aer*, which is *predominant* in the production of *Green* in the *Leavs* of *Plants.*

8. §. *Salt* of *Tartar* droped on the *white Flowers* of *Daiſy*, changeth them into a *light Green.* Which as it further confirms the aforeſaid *Poſition*; ſo likewiſe argues, That *Whiteneſs* in *Flowers*, is not always from the defect of *Tincture*: but that there may be *White*, as well as *Yellow*, *Green*, *Red* or *Blew Tinctures.*

9. §. *Spirit* of *Sulphur* droped on the *green Leavs* of *Adonis Flower*, *Everlaſting Peaſe*, and *Holy Oak*, turns them all *Yellow.*

10. §. *Spirit* of *Sulphur* on a *Tincture* of *Saffron* changeth it not.

11. §. *Spirit* of *Sulphur* on the *Yellow Flower* of *Crowfoot* alters them not. Neither are they changed by the *Affuſion* of *Alkalies.*

12. §. So that it ſeemeth, that in all *Yellows*, the *Sulphureous Acid* and *Alkaline Parts* are all more equal.

13. §. *Spirit* of *Sulphur* on a *Tincture* of *Violets* turns it from *Blew* to a true *Lacke*, or midle *Crimſon.*

14. §. *Spirit* of *Sulphur* upon a *Tincture* of *Clove-July-Flowers* makes a bright blood *Red.* Into the like *Colour*, it hightens a *Tincture* of *Red Roſes.*

15. §. So that as *Alkalys*, or other *Analogous Salts*, are *predominant* in *Greens*, ſo *Acids* in *Reds*, eſpecially in the brighter *Reds*, in the *Leavs* and *Flowers* of *Plants.* Hence it is, that *Spirit* of *Nitre* droped upon the *Blew Flower* of *Ladies Looking-Glaſs*, *Larkspur*, *Borage*, turns them all *Red*, *ſc.* into the *Red* of *Common Lychnis.* But (which is particularly to be noted) being droped on the ſaid *Red Flowers* of *Lychnis*, alters them little or nothing: becauſe, that very *Colour* is therein produced by a copious admixture of the like *Principle.*

16. §. The Summ therefore of what hath now been ſaid, of the *Cauſes* of *Vegetable Colours*, is this: That while their *Sulphur* and *Saline Principles*, only ſwim together, and are not as yet united into one *Precipitate*, no *Colour* reſults from them, but the *Contents* are rather *Limpid*; as uſually in the *Root*, and many other *Parenchymous Parts.*

17. §. When they are united, and the *Alkaline* are *predominant*, they produce a *Green.*

18. §. When the *Sulphur* and the *Alkaline* are more equal, they produce a *Tauny.*

19. §. When the *Sulphur*, *Acid* and *Alkaline*, there a *Yellow.*

20. §. When the *Sulphur predominant*, and the *Acid* and *Alkaline* equal, there a *Blew.*

21. §. When the *Sulphur* and *Acid* are *predominant* to the *Alkaline*, then a *Purple.*

22. §. When the *Sulphur predominant* to the *Alkaline* and the *Acid* to them both, a *Scarlet.*

23. §.

23. §. *Lastly*, When the *Acid predominant* to the *Alkaline*, and the *Sulphur* to them both, a *Blood-Red:* which is the higheſt and moſt *Sulphurious Colour* in Nature.

24. §. From the *Premiſes*, divers Rules do alſo reſult for the making of *Tinctures*, either for *Medicines*, or for any other purpoſes.

25. §. I ſhall only add one or two Notes. As firſt, that of all *Colours*, *Yellows* are the moſt fixed and unfading. As for inſtance, if you drop either a *Solution* of *Tartar*, or of *Spirit* of *Sulphur* upon a *Tincture* of the *Yellow Flowers* of *Crowfoot*, of *Adonis*, or of *Saffron*, neither of them will alter their *Colour*. Which ſhewes the ſtrength of moſt *Yellows*, to reſiſt all manner of impreſſions from the *Aer*.

26. §. Again, that the uſe of *Salts*, is not only to highten or deepen *Colours*, but alſo to fix and make them permanent. As for Inſtance, The *Tincture* of *Clove-July-Flowers*, made either with *Water* or *Spirit* of *Wine* being expoſed to the *Aer*, will often turn into a *Blackiſh Purple*. But the addition of a few drops of *Spirit* of *Sulphur*, doth not only highten the *Colour*, but renders it ſtable and permanent.

27. §. Likewiſe, of *Salts* themſelves there is choice to be made. For there are ſome, which although they fix the *Colour*, yet, will a little *give*, as we ſay, and not hold throughly dry; as moſt *Lixivial Salts*, and *Stillatious Acids*. But there are ſome *Salts*, which will not *give* in the leaſt, as *Alum*, that in *Lime-Water* and ſome others; which latter, is ſo far from being moyſtened, that it is rather petrified by the *Aer*. For which reaſon I take it to be one of the beſt *Liquors* for a ſtable and permanent *Green*, and ſome other *Colours*.

28. §. Amongſt all *Water-Colours*, the rareſt, and moſt difficult to make clear bright and permanent, is a *Blew*. There are many *Flowers* of an excellent *Blew*, as thoſe of *Bugloſs*, *Lark-heel* and others; but they eaſily fade. And there are very few *Flowers* that will ſtrike into a *Blew* by any *Liquor*; being almoſt all changeable into *Green*, *Purple* or *Red*. Yet ſome few there are, in which this *Colour* may be produced. As for inſtance, the *Flower* of *Lathyrus* or *Parſeverlaſting*; which upon the affuſion of *Spirit* of *Harts-Horn* is changed from a *Peach*, to as pure a *Blew*, as the beſt *Ultramarine*: that which hitherto is, I think, wanting in *Water Colours*. *Spirit* of *Harts Horn* was the *Liquor* I uſed; but I queſtion not, but that other *Alkalies*, and particularly *Lime-Water*, will have the like Effect, and ſo render it the more ſtable.

29. §. From what hath been ſaid, we may likewiſe be confirmed in the uſe of the already known *Rules*, and directed unto others yet unknown, in order to the variation of the *Colours* of *Flowers* in their Growth. The effecting of this, by putting the *Colour* deſired in the *Flower*, into the *Body* or *Root* of the *Plant*, is vainly talked of by ſome: being ſuch a piece of cunning, as for the obteining a painted face, to eat good ſtore of *white* and *Red Lead*.

30. §. The beſt known *Rules* are theſe Two; Firſt, that the *Seed* be uſed above any other part, if the variation of the *Colour* be intended. One reaſon whereof is, becauſe that part being but very ſmall, the *Tinctures* of the *Soyl* will have the greater over proportion to thoſe of the *Seed*. Beſides, the tender and *Virgin Seed*, being committed to the Soyl, will more eaſily take any peculiar *Tincture* from it, then an other

other *Part*, which is not ſo ſuſceptive, and hath been tinctur'd already. All the ſtrange varieties in *Carnations*, *Tulips*, and other *Flowers* are made this way.

31. §. The other *Rule* is, To change the *Soyl*, or frequently to tranſplant from one *Bed* to another. By which means, the *Plant*, is as it were, *ſuperimpregnated* with ſeveral *Tinctures*, which are prolifick of ſeveral *Colours*; which way is taken for *Roots* and *Slips*.

32. §. The conſideration whereof, and of the foregoing *Experiments*, may direct us not only in changing the *Bed*, but alſo in compounding the *Soyl*, as by mixing ſuch and ſuch *Salts*, or *Bodies* impregnated with ſuch *Salts*, I ſay by mixing theſe Bodies in ſuch a proportion, with the *Soyl*, as although they have no *Colour* in themſelves, yet may be effectual to produce a great variety of *Colours* in the *Plants* they nouriſh; ſupplying the *Plants* with ſuch *Tinctures*, as ſhall concur with the *Aer*, to ſtrike or precipitate their *Sulphur* into ſo many ſeveral *Colours*, after the manner above explicated: and ſo to bring even Natures Art of *Painting*, in a great part, into our own power.

A DISCOURSE OF THE DIVERSITIES and CAUSES OF TASTS CHIEFLY IN PLANTS.

Read before the *Royal Society*, *March* 25. 1675.

CHAP. I.

Of the ſeveral Sorts of SIMPLE and COMPOUNDED Taſts; and the DEGREES of both.

I HAVE formerly publiſhed ſome Notes, concerning *Taſts*. Since then, I have made other *Obſervations* upon the ſame Subject: and theſe have produced further *Thoughts*. I will ſumm up all in giveing an account, Firſt, of the *Diverſities*; and then, of the *Cauſes* of *Taſts*, chiefly in *Plants*. *Idea*, §. 29. & *Anat.* of *R. P.* 2. §. 68, &c.

2. §. The *Diverſities* of *Taſts* are ſo many, and ſo conſiderable; that it ſeemeth ſtrange, to ſee the matter treated of both by *Philoſophers* and *Phyſicians*, with ſo much ſcantneſs and defect. For the *Subject* is not barren, but yieldeth much and pleaſant *Variety*. And doth alſo appear to be of great import unto *Medicine*. Beſides, it is prepoſterous to diſcourſe of the *Cauſes* of *Taſts*, before we have taken an account of their *Diverſities*; Whereof therefore I ſhall in the firſt place, exhibit the following *Scheme*.

3. §.

3. §. TASTS may be distinguished by these Three general ways. First, with respect to the *Sensation* it self. Secondly, with respect to its *Duration* and *Terms*. Thirdly, with respect to its *Subject*.

4. §. The *Sensation* it self is differenced two ways, by its *Species*, and by its *Degrees*. With respect to the *Species*, *Tasts* are *Simple*, or *Compounded*. By *Simple Tasts*, I mean not such, as are never found in conjunction with other *Tasts:* but the *Simple* or *Single Modes* of *Tast*, although they are mixed with divers others in the same *Body*. As for example, the *Taste* of a *Peppin*, is *Acidulcis*; of *Rhubarb*, *Amaraſtringens*; and therefore *Compounded* in both. Yet in the *Peppin*, the *Acid* is one *Simple Taste*, and the *Sweet* another; and so in *Rhubarb*, the *Bitter* is one *Simple Taste*, and the *Astringent* is another.

5. §. Two faults have here been committed; the defective *Enumeration* of *Simple Tasts*; and reckoning them indistinctly among some others which are *Compounded*.

6. §. SIMPLE *Tasts*, (of which, properly so called, there are commonly reckoned but Six or Seven Sorts,) are, at least Sixteen. *Fist*, *Bitter*, as in *Wormwood:* to which, the contrary is *Sweet*, as in *Sugar*. *Thirdly*, *Sower*, as in *Vinegar:* to which, the contrary is *Salt*. *Fifthly*, *Hot*, as in *Cloves:* whereto, the contrary is *Cold*. For we may as properly say, a *Cold Taste*, as a *Hot Taste:* there being some *Bodies*, which do manifestly impress the *Sense* of *Cold* upon the *Tongue*, though not by *Touch*. So doth *Sal Prunellæ*, although the *Liquor* wherein it is dissolved, be first warmed.

7. §. *Seventhly*, *Aromatick*. For it doth not more properly agree to an *Odour*, than a *Taste*, to be *Aromatick*. And that an *Aromatick Taste*, is distinct from an *Hot*, is clear; In that, there are many *Bodies* of a *Hot Taste*, some meanly and others vehemently *Hot*; which yet are not in the least *Aromatick:* as amongst others, is apparent in *Euphorbium*. So that although an *Aromatick Taste* be often conjoyned with *Heat*; yet it is not that *Heat* it self, but another distinct *Sense*.

8. §. *Eighthly*, *Nauseous* or *Malignant*, contrary to the former. Such as is perceived, together with the *Astringent* and *Bitter*, in *Rhubarb*; or with the *Bitter*, and *Sweet*, in *Aloes*. It may be called *Malignant*, because distastful although mixed in a low degree with other *Tasts:* whereas other *Tasts* will render one another grateful.

9. §. Again, *Tasts* may properly be said, to be *Soft* or *Hard*. A *Soft Taste*, is either *Vapid*, as in *Watery Bodies*, *Whites* of *Eggs*, *Starch*, *Fine Boles*, &c. Or *Unctuous*, as in *Oyls*, *Fat*, &c.

10. §. A *Hard Taste* is Fourfold, *sc. Penetrant*, *Stupifacient*, *Astringent*, *Pungent*. Contrary to a *Vapid*, are *Penetrant* and *Stupifacient*.

11. § *Penetrant*, is a kind of *Taste*, which worketh it self into the *Tongue* (as some *Insects* into the *Skin*) without any *Pungency*; as in the *Root* and *Leavs* of *Wild Cucumer*.

12. §. *Stupifacient*, as in the *Root* of *Black Hellebore*. Which being chew'd, and for sometime reteined upon the *Tongue*; after a few minutes, it seemeth to be benum'd and affected with a kind of *Paralytick Stupor*; or as when it hath been a little burnt with eating or supping of any thing too hot.

13. §. Contrary to an *Unctuous Taste*, are *Astringent*, and *Pungent*; as in *Galls*, and *Spirit* of *Sal Aromanick*.

14. §.

14. §. Again, *Tasts* are either *Continual*, as most commonly: or *Intermittent*; as that of *Dracontium*, especially in the *Root*. For after it seems to be lost and extinguished; it will then again (chiefly upon the *Collision* of the *Tongue* and *Goomes*) be plainly heightened and reviv'd.

15. §. *Lastly*, *Tasts* are either *Still*, as usually; or may be called *Tremulous*, as the *Heat* produced by *Pyrethrum*. *Distinct* from that of *Cloves*, *Ginger*, and many other *Hot Bodies*, in that there the *Heat* is *still*; but here in *Pyrethrum*, 'tis joyned with a kind of *Vibration*: as when a *Flame* is brandished with a *Lamp-Furnace*. Thus far of the Sorts of *Simple Tasts*.

16. §. COMPOUNDED *Tasts* are very numerous; being made by the various *Conjunction* of *Simple Tasts*, as *Words* are of *Letters*. Sometimes of two, as in *Saccharum Saturni*, of *Astringent* and *Sweet*. Sometimes three, as in *Aloes*, *Malignant*, *Bitter* and *Sweet*; in *Rhubarb*, *Malignant*, *Astringent* and *Bitter*. Sometimes four, as in *Agarick*, *Malignant*, *Astringent*, *Bitter* and *Sweet*. And in some *Bodies*, five or six *Species* may be joyned together.

17. §. For the more accurate *Observation* whereof, there are these easie *Rules*. That not too many be tasted at one time: least the *Tongue* being surcharged, become less critical. That the *Mouth* be washed with warm water betwixt every tasting. And that those things be first tasted which produce a less durable *Taste*; that so one may be throughly extinguished, before another be try'd.

18. §. Of the numerous *Conjunctions* of *Tasts*, which may thus be observed, there are only Six to which the penury of *Language* hath allowed (if I may call them) *Proper Names*, sc. *Acerbus*, *Austerus*, *Acris*, *Muriaticus*, *Lixivus & Nitrosus*. Most of which are commonly taken in to make up the number of *Simple Tasts*. But very improperly; being all of them *Compounded* and *Decompounded Tasts*: to which *Class* they ought therefore to be refer'd. For

19. §. *Austere*, is *Astringent* and *Bitter*; as in the green and soft *Stones* of *Grapes*.

20. §. *Acerb*, properly so called, is *Astringent* and *Acid*; as in the *Juyce* of unripe *Grapes*.

21. §. *Acris*, is also *Compounded*. For first, simply *Hot*, it is not: because there are many *Hot Bodies*, which are not *Acria*; as the *Roots* of *Zedoary*, *Yarrow*, *Contrayerva*. Nor Secondly, is it simply *Pungent*, because there are also *Bodies*, which are *Non-acria pungentia*; of which kind is the *Root* of *Arum*. Wherefore *Acritude*, is *Pungency* joyned with *Heat*.

22. §. *Muriatick*, is *Saltness* joyned with some *Pungency*, as in common *Salt*.

23. §. *Lixivial*, is *Saltness* joyned with *Pungency* and *Heat*.

24. §. *Nitrous*, is *Saltness* joyned with *Pungency* and *Cold*.

25. §. Besides these Six, or perhaps one or two more, there are, as is said, a great number of *Conjuctions*, for which we have no *Proper Names*. For admit that there were but *Ten Species* of *Simple Tasts*, sc. these *Ten*; *Amarus*, *Dulcis*, *Acidus*, *Salsus*, *Calidus*, *Frigidus*, *Aromaticus*, *Malignus*, *Astringens*, *Pungens*. And of these *Ten*, but *Two*, or at most, but *Three* to be compounded together in any one *Body*. If only *Two*, they produce 45 *Compounded Tasts*. For the *First*, may

be compounded with all the 9 following; the *Second*, with all the 8 following; and ſo, the reſt: which together make 45. But if the ſame *Ten* be compounded by *Threes* together; they produce no leſs than 120 *Variations:* as by the *Table* made of them all doth plainly appear.

26. §. Some few of the *Conjunctions* therein ſet down, may not be found actually exiſtent in *Nature*. The abatement of which, will be much more than compenſated two ways. *Firſt*, by the other *Six Species* of *Simple Taſts*, which are alſo ſometimes compounded. And by other more complex *Conjunctions*, as of many *Quadruples*, and perhaps ſome *Quintuple* or *Sextuple* ones. Thus far of the *Simple Species*, and *Conjunctions* of *Taſts*.

27. §. THE DEGREES of *Taſts* are alſo numerous; and each *Species*, in every *Conjunction*, capable of *Variation* herein. For the more accurate obſerving whereof, it will be beſt, To take thoſe *Bodies*, whoſe *Taſts* are, as near as may be, the ſame in *Specie:* and that thoſe be firſt taſted, which are leſs ſtrong; whereby the true *Degree* will be more preciſely taken.

28. §. The *Taſts* of *Bodies* will thus appear to be varied, in moſt *Species* unto *Five Degrees*; and in ſome of them, unto *Ten*. So the *Root* of *Turmerick*, is bitter in the *Firſt Degree*; of *Gentian*, in the *Tenth*. The *Root* of *Carduus Benedictus*, is *Hot* in the *Firſt Degree*; the *Green Pods* or *Seed-Caſes* of *Clematis peregrina*, in the *Tenth*. So that, allowing ſome to vary under *Five*; yet by a moderate eſtimate, we may reckon every *Species*, one with another, to be varied by at leaſt *Five Degrees*. Which being added to the ſeveral *Species* of *Taſts*, in all the *Treble Conjunctions* of the aforeſaid *Table*, come to 1800 ſenſible and defineable *Variations* of *Taſte*. And theſe are the *Diverſities* of *Taſte*, with reſpect to the *Senſation* it ſelf.

CHAP. II.

Of the DURATION and ſeveral TERMES of Taſts.

THE next general way of dinguiſhing *Taſts*, is by their *Duration*, and their *Terms*, or their *Motion* of *Intenſion* and *Remiſſion* from one *Degree* to another. For there are many *Taſts*, which have their *Motions* analogous to thoſe of *Diſeaſes*; and by thoſe may be diſtinguiſhed in the ſame manner. For as of *Diſeaſes*, ſo of *Taſts*, there are Four *Times*, as *Phyſicians* call them, or *Terms* of *Motion*; ſc. *Principium*, *Augmentum*, *Status*, & *Declinatio*.

2. §. For the diſtinct obſerving of which, thoſe *Bodies* which are hard, and ſo their taſtable parts leſs eaſily extractable by the *Tongue*, ſhould be reduced to a fine *Powder*: otherwiſe, the true meaſure of the *Princi-*

Principium will be lost. And for the precise measuring of all the *Four Termes*, it should be done by a *Minute-Watch* or a *Minute-Glass*. For so it will appear, that the *Variations* of each, are divers and remarquable.

3. §. To instance first in those of the *Principium*. Which I call, That space of time, betwixt the first *Contact* of the *Body* to be tasted, and the first manifest *Perception* of the *Taste*. For Example, those *Bodies* which are *Acid*, or *Bitter*, as *Vinegar* or *Wormwood*, are presently perceiv'd, *quatenus Acid* or *Bitter*, upon the first *Contact*; or have *Principium brevissimum*. Those *Bodies* which are *Acria*, have their *Principium* somewhat longer. So the *Seed-Cases* of *Clematis peregrina*, although they have a vehement *Acritude*, even in the Tenth *Degree*; yet is not that *Acritude* so soon tasted, as the *Bitterness* of *Roses*, which is but in the second. But the *Principium* of *Hot Tasts*, is generally longer than that of any other. So the *Bitterness* of the *Root* of *Black-Helebore*, which exceedeth not the second *Degree*, is yet presently tasted: but the *Heat* proceeding from the same *Root*, and which ascendeth to the third *Degree*, is not perceived at all, till after two full *Minutes*. And so the *Bitterness* of *Enula*, which exceedeth not the 4th *Degree*, yet is sooner tasted than its *Heat*, which ascendeth to the 8th.

4. §. Next, in those of the *Augment*. Which I call, That space, betwixt the first *Perception* of the *Taste*, till it be come to the heighth. So the *Heat* of *Galangale*, is not only presently perceived, but ariseth to the heighth within half a *Minute*. But the *Heat* of the *Root* of *Enula*, comes not to the heighth till after a whole *Minute*. And the *Heat* of *Black-Hellebore*, not till after four full *Minutes* from the first *Contact*.

5. §. The *Status*, or space wherein the *Taste* continues in its heighth, is also divers. So the *Heat* of the *Seed-Case* of *Helleboraster*, comes to its heighth, and begins to decline within half a *Minute*; that of the *Root* of *Garden-Scurvygrass*, not till after a *Minute*; and that of the *Root* of *Asarum*, not till after two full *Minutes*.

6 §. And *Lastly*, the *Declination*, or the space betwixt the first *Remission* of the *Taste*, and its total *Extinction*. For instance, The *Leavs* of *Millefolium*, are *Bitter* in the 4th *Degree*, and *Hot* only in the 1st. yet the *Heat* continues for sometime, and the *Bitter* presently vanishes. *Calamus Aromaticus*, is *Bitter* in the 4th *Degree*, *Hot* in the 1st, and *Aromatick* in the 3d: yet the *Bitter* quickly vanishes, the *Heat* continues two *Minutes*, and the *Aromatick* seven or eight. The *Heat* of the *Root* of *Contrayerra*, is extended, almost to two *Minutes*; the *Pungency* of *Jalap*, almost to six; the *Heat* of *Garden Scurvygrass*, to seven or eight. And even the *Bitterest* of *Wild Cucumer*, to near a quarter of an hour. But the *Heat* of *Euphorbium* dureth much longer, as also that of *Black Hellebore*. *&c.* above half an hour.

7. §. So that the *Augmentum*, is seldom extended beyond Four or Six *Minutes*, from the first *Contact*: but the *Declination*, sometimes to Thirty, Fourty, or more. Thus far of the *Terms* of *Tast*, or the manner of their *Intension* and *Remission*.

CHAP. III.

Of the SUBJECT or SEAT of Taſts.

THE *Third* and *Laſt* way of diſtinguiſhing *Taſts*, is by their *Subject*, or the *Part* or *Parts* where they are either wholly or chiefly perceived. And ſo, *Taſts* are either *Fixed*, or *Movable*.

2. §. A *Fixed Taſt*, is that which keepeth within the compaſs of ſome one *Part*, all the time of its *Duration*; as upon the *Tip*, or the *Root* of the *Tongue*, or other *Part*.

3. §. A *Movable Taſte*, is either *Diffuſive* or *Tranſitive*.

4. §. A *Diffuſive Taſte*, I call that, which by degrees ſpreads abroad into divers *Parts*, and yet in the mean time, adheres to that *Part* in which it is firſt perceived. So the *Bitterneſs* in the dryed *Roots* of *Black Hellebore*, is firſt felt on the *Tip* of the *Tongue*; from whence it ſpreads it ſelf to the midle of the ſame. And the *Bitterneſs* of the *Leavs* of *Wild Cucumer*, ſpreads from the *Tip*, to the *Root* of the *Tongue*.

5. §. A *Tranſitive Taſte*, is that, which after ſometime, wholly quitting the *Part* wherein it is firſt perceived, is thence transfered into ſome other *Part*: as the *Bitterneſs* of *Gentian*, imediately from the *Tip*, to the midle of the *Tongue*. And moſt of the *Diffuſive*, are alſo *Tranſitive*.

6. §. The ſeveral *Parts* which theſe ways become, and with ſome latitude may be called, the *Seats* of *Taſts*, are, the *Lips*, *Tongue*, *Palate*, *Throat* and *Gulet*.

7. §. Upon the *Lips*, the *Root* of white *Hellebore*, as alſo of *Pyrethrum*, being chewed, make a ſenſible *Impreſſion*; which continues (like the flame of a *Coal* betwixt in and out) for 9 or 10 *Minutes*. But the *Heat* in other *Parts* much longer.

8. §. Upon the *Tongue*, *Taſts* are perceived in Three places, as hath been intimated. On the *Tip* or *Cone* of the *Tongue*; as moſt commonly. On or near the *Baſis* of the *Tongue*; where the *Taſte* of the *Leavs* of *Wild Cucumer* chiefly fixeth it ſelf. Or on the *Vertex* or midle of the *Tongue*; in which place it is obſervable, that the *Taſt* of *Gentian*, *Colocynthis*, and divers other *Bodies*, is then conſiderably ſtrong, when not at all perceived at the *Tip* of the *Tongue* or in any other *Part*.

9. §. Upon the *Palate* or *Roofe* of the *Mouth*, the *Root*, as I take it, of *Deadly Nightſhade* maketh its chief *Impreſſion*; and there continues about four *Minutes* in ſome degree.

10. §. The *Throat*, or the *Uvula*, *Larinx* and other adjacent *Parts* are oftentimes the *Seat* of *Taſte*. For there are many *Bodies*, which although they have ſcarce any *Taſte* upon the *Tongue*, or any other of the aforeſaid *Parts*, yet make a ſtrong *Impreſſion* on the *Throat*: as the *Leavs* of little *Daiſy*, little *Celandine*, and of *Pimpinel*; as alſo the *Roots* of *Jalap*, *Mercury*, *Aſparagus* and others. Which being chewed makelittle or no *Impreſſion* on the *Tongue*, but their *Juyce* being ſwallowed,

lowed, causeth a kind of pricking in the *Throat*; as when one is provoked by a sharp *Rheum*.

11. §. And that this *Taste* or *Sense*, is truly distinct from either the *Heat*, *Pungency*, or *Acritude* upon the *Tongue*, it is hence further manifest; In that *Pyrethrum*, which is very *Hot*, and *Cortex Winteranus* which is very *Pungent* upon the *Tongue*; yet their *Juyce* being swallowed, causeth no *Heat*, *Pungency* or *Exasperation* in the *Throat*.

12. §. *Lastly*, if we will take the word (*Tast*) in a larger sense, the *Oesophagus* it self may be said to be sometimes the *Subject* thereof; as of the *Heat* produced by the *Root* of *Common Wormwood*. For of this *Heat* it is remarquable, that being first perceived on the *Tip* of the *Tongue*, it thence maketh its *transit* to the *Root* of the *Tongue*, and so into the *Throat*, and by degrees descends into the very *Gulet*; where it seemeth to warm the *Stomach*; and so continues, in some degree, almost ¼ of an hour. And the *Transition* and *Descent* of this *Heat* is made, although none of the *Juyce* be swallowed. And in this maner *Tasts* are distinguished with respect to their *Subject*.

13. §. So that the general *Diversities* of *Tasts* are these. With respect to their *Species*, they are *Simplices vel Compositi*; To their *Degree*, *Remissi vel Intensi*; To their *Duration*, *Breves vel Diuturni*; To the *Terms* of their *Motion*, *Celeres vel Tardi*; and lastly, To their *Subject*, *Fixi*, *Diffusivi & Transitivi*.

14. §. I HAVE thus endeavourd to draw up a *Scheme* or *Inventory* of the several sorts of *Tasts*. In which, some may think, that I have over done: and that as *Galen* hath been censured for being too curious in the *Distinctions* of *Pulses*; so have I been, in these of *Tasts*. Not to enquire now, how far the *Differences* of the *Pulse* may be extended, or be fit to be taken notice of; I shall only say, That we have not so much reason to censure him, if he hath given us some few which are coincident; as we have to thank him, for observing so many which are really distinct.

15. §. By the *Scheme* of *Tasts* here represented, we may be able, so to enumerate the *Modes* of any *Tast*, as to make a *Scientifick Definition* of it. Which is pleasant *Instruction* to any inquisitive mind; these things being all matter of sense and demonstration; wherein lyeth, though not always the most plausible, yet the most satisfying *Philosophy*; and where men, after they are grown weary with turning round, are oftentimes contented to rest.

16. §. But the usefulness of this *Schem* will further appear, in two respects; *sc.* In conducting us to a cleerer and more particular *Explication* of the *Causes* of *Tasts*: and the *Investigation* of the *Virtues* of those *Bodies* in which they reside. Whereof in the following *Chapters*.

CHAP.

CHAP. IV.

Of the CAUSES *of* Tasts.

TO speak of the *Causes* of *Tasts*, before we have well enumerated and distinguished them; is to provide *Furniture* for a *House*, before the *Roomes* have been counted and measured out. But the *Varieties* of *Tasts* having been first laid down; it will induce us to believe, and investigate as great a variety in their *Causes*.

2. §. Now the *Causes* of *Tasts*, particularly of the *Tasts* of *Plants*, whereof we chiefly speak, are, in general, these Four or Five, *&c.* The *Bed* out of which they grow; The *Aer* in which they stand; The *Parts* of which they consist; The several *Fermentations* under which their *Juyces* pass; And the *Organs* by which their *Tastable Parts* are perceiv'd: as will appear upon *Instance*.

3. §. But the immediate *Causes*, besides the *Organs* of *Taste*, are the *Principles* of *Plants*. As many of which, as come under the notice of *Sense*, we have already supposed to be these Seven, *Alkaline*, *Acid*, *Aer*, *Water*, *Oyl*, *Spirit* and *Earth*. The *Particles* both of *Alkaline* and *Acid Salts*, are all *angular* and *poynted*. Those of *Aer*, properly and strictly so called, are *Elastick* or *Springy*; and therefore also *Crooked*; as I have likewise formerly conjectured. And I find the Learned *Borelli*, in a Book of his since then published, to be of the same Opinion. Those of all *Fluid Bodies*, *quà Fluid*, and therefore of *Water*, *Oyl* and *Spirit*, I conceive to be *Globular*, but *hollow*, and with holes in their Sides. Those of *Water*, to be larger *Globes*, with more *holes*; those of *Oyl*, to be lesser, with fewer *holes*; and those of *Spirit* the least. Lastly, that the particles of *Earth* are also *Round*; yet angular; and nearer to a *solid*.

4. §. These *Principles* affect the *Organs* of *Sense*, according to the variety of their *Figures*, and of their *Mixture*. So those which are sharp or poynted; and those which are *springy*; are fitted to produce any stronger *Taste*: and those which are round, are apt, of their own *Nature*, to produce a *weaker* or *softer* one. And so by the diversities of their *Mixture*; not only with respect to their *Proportion*, but also the very *Mode* of their *Conjunction*. Hence it is, that many *Bodies* which abound with *Salt*, as *Ambar* with an *Acid*, and the *Bones* of *Land-Animals* with an *Alkaline*, have notwithstanding but a weak *Tast*; the *Saline Parts* being in the former drowned in the *Oyl*, and in the latter also buried in the *Earth*.

5. §. The same is further confirmed by an *Experiment* mentioned in a former *Discourse*; *&c.* the *Transmutation* of *Oyl* of *Anise-Seeds*, with the help of *Oyl* of *Vitriol*, into a *Rosin*. For both those *Liquors*, though so strongly tasted, apart; yet the *Rosin* made of them, being well washed, hath a very mild *Taste*, and without any smatch of that

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in

in either of the *Liquors.* Whence it follows, that the very *Mode* of *Mixture* is sufficient, not only for the variation of the *Degrees* in any one *Species* of *Tast*; but also for the destroying of one *Species*, and the introducing of another.

6. §. THESE things being premised, I conceive, That as an *Unctuous Tast* dependeth upon *Oyl*; so a *Vapid* either on *Water*, or *Earth*: or upon such an intimate *Mixture* of other *Principles*, as renders them indissoluble by the *Saliva*, and so, in a manner, untastable.

7. §. That a *Pungent*, is made either by an *Alkaly* or an *Acid* sharpned or whetted; that is, cleared from the soyl of other *Principles*; as in the *Spirit* of *Sal Aromoniac* or of *Sulphur*. And so in those *Plants* which have a *Pungent Tast*; whose *Juyces* or *Tinctures*, although they consist of divers *Principles*, yet all so loosely mixed, that being dissolved by the *Saliva*, the *Saline* are hereupon left naked. Wherefore *biting Plants*, *quà biting*, are *Nitrous Plants*. So that the *Juyce* of such *Plants*, is a kind of *Spirit* of *Nitre*, made by the several *Parts* of the *Plant*. Hence *Arum* grows best under an Hedg; where the Ground, not being exposed to the *Sun*, but the *Aer* only, like those *Rooms* in *Houses*, which are covered, is impregnated with a greater quantity of *Nitrous Salt*. And those *Roots* which are *Biting*, have but few or but small *Aer-Vessels*; whereby fewer parts of the *nitroaereal Sap* are carryed off into the *Trunk*. For the same *Cause*, it is no wonder, that many *Aquaticks* are *Biting*; *Water* being, though it self cold, yet the *Menstruum* by which all *Salts* are imbibed most easily, and in laxer state of *Commixture* with other *Principles*.

8. §. *Penetrant* (something slower than *Pungent*) is made by any *Salt* that is also soiled or guarded with *Earth*. *Sower*, by an *Acid* only soyled with *Earth*. *Salt*, by an *Acid* guarded by an *Alkaly*, and soyled with *Earth*. *Cold*, by an *Acid* drowned in *Water*, and soyled with *Earth*.

9. §. In all these, the *Salts* are *predominant*; In *Heat* the *Oyl* or *Sulphur*. The particles whereof being *Spherick* and *bored* with *holes*; those of *Salt* stick in them, as the *Spokes* do in the *Hub* of a *Wheel*, or as the *Quills* in the *Skin* of a *Porcupine*. Whereby, as in *Common Fire* the *Sparks* of *Sulphur* being agitated and whirled about by the *Aer*; with the help of the *Salts*, which stick in them, tear in pieces all kinds of *Bodies*: so here, being agitated by the *Circulation* of the *Blood*, they make a kind of hurry or combustion; and so, according to the degree and strength of their *Motion*, tear in pieces fewer or more of the *Fibers* of the *Tongue*; and in a greater quantity, would raise a *Blister* upon it; the common *Effect* of *Fire*, or any strong *Epispastick*. So that a *Hot Tast*, is produced by *Sulphur* toothed or armed with *Salts*. Wherefore all *Stillatitious Oyls* are *Hot*; being strongly impregnated or armed with the *Essential Salts* of the *Plants* from whence they are distilled. And as those *Plants* which are very *Parenchymous*, from the predominancy of their *Volatile Acid*, are *biting*: So those which are *Lignous*, that is, have a good quantity of *Lympheducts*, from the dominou of their *Sulphur* are commonly *Hot*. For the same reason it is, that many both *Biting* and *Hot Plants*, as the *Roots* of *Dragon*, *Garden-Radish*, *Onion*, *Iris*, *Rape-Crowfoot*, &c. being corked up in a bottle with *Water*, and set in a Cellar or other cool place; they do all of them turn *Sower* in a few days: The same *Fermentation*, at once

fullying

ſullying the *Salts* of the one, and diſarming the *Sulphurs* of the other. But ſome, wherein the *Sulphureous* parts are more copious, will hardly ever become *Sower*. Hence alſo, ſome *Plants*, whoſe *Roots* are neither *Hot*, nor of any ſtrong *Taſte*, as thoſe of *Wild Anemone*; yet their *Leaves* and *Flowers* are plainly *Cauſtick*: So that it ſeems, that as their *Juyces* riſe up into the *Trunk* or *Stalk*, and are therein further fermented, the *Sulphureus Parts* thereof, are at the ſame time relaxed from the other *Principles*, and acuated with an *Aereal Salt*.

10. §. A *Stupifacient Taſt* (as the *Impreſſion* which ſome *Hot Plants* make upon the *Tongue* may be called) is in ſome ſort, analogous to the mortifying of any part of the Body by the application of a *Cauſtick*. For as there the mortification ſucceeds the burning pain, ſo here, the *Stupifaction*, neither comes before, nor with the *Heat*, but follows it.

11. §. *Sweetneſs* is produced, ſometimes by an *Alkaly*; ſmoothed either by a *Sulphur*, as in *Lime-Water*; or by both a *Spirit* and a *Sulphur*, as in the *Stillatitious Oyls* of *Animals*. But moſt commonly, by a ſmoothed *Acid*; as in *Malt*, *Sugar*, *Hony*. Hence a *Sweet Taſte*, is generally founded in a Sower; So Sower *Apples*, by mellowing, and harſh *Pears*, by baking become ſweet; the *Spirit* and *Sulphur* being hereby at once ſeparated from the other *Principles* and brought to a nearer union with the *Acid*. So the Sower *Leaves* of *Wood-Sorrel*, being dry'd, become ſweet: and thoſe of a ſower *Codlin*, while they hang on the *Tree*, and even of a *Crab-Tree*, are neither *Aſtringent*, nor ſower, but ſenſibly ſweet. And ſo commonly, wherever the ſaid *Principles* are a little exalted by a ſoft *Fermentation*; as in the *Juyce* of the *Stalk* of *Maze* or *Indian Wheat*, which is a ſweet as *Sugar*; and in the *green Stalks* of all ſorts of *Corn* and *Graſs*, in ſeveral degrees. So likewiſe *Tulips* and ſome other *Roots*, being taken up, in open weather, ſometime before they *ſprout*; if taſted, are as ſweet as *Liquiriſh* or *Sugar*; and at no other time: not only *Fruits*, but many *Roots*, *Seeds*, and other *Parts*, upon their firſt or early *Germination*, acquiring a curious *Mellowneſs*, wherein, all their *Principles* are reſolved, and their moſt *Spirituous Parts* exalted and ſpread over the *Acid*. Wherefore alſo moſt *Roots*, which are not meerly long, but grow deep in the ground, have at leaſt ſome of their *Juyces* of a ſweet *Taſt*; as *Liquiriſh*, *Eryngo*, *Hounds-Tongue*, *Garden-Parſnep*, *Black Henbeane*, *Deadly Nightſhade*, *&c.* Even the *Juyce* of *Horſe Radiſh*, which bleeds at the *Lympheducts*, is of a ſweet *Taſte*. And of the ſame kindred thoſe which grow the deepeſt, are the ſweeteſt; as a *Parſnep* is ſweeter than a *Carroot*, eſpecially if you taſt the bleeding *Sap*; and the *Root* of *Common Tall Trefoyl* taſteth ſomewhat like *Liquiriſh*, but is not near ſo ſweet. For all deep *Roots*, are fed with a leſs *Nitrous Aliment:* and being remoter from the *Aer*, their *Juyces* paſs under much more ſoft and moderate *Fermentations*.

12. §. *Bitterneſs* is produced by a *Sulphur* well impregnated, either with an *Alkaline*, or an *Acid Salt*, but alſo ſhackled with *Earth*. And therefore the *Bittereſt Plants*, commonly yield the greateſt quantity of *Lixivial Salt*. So alſo many *Stillatitious Oyls* digeſted with any ſtrong *Acid*, will acquire a *Bitter Taſte*. Wherefore this *Taſte* is often founded either in a *Hot Taſte*, or a *Sweet*. Hence it is, that the *Leaves* of all ſweet *Roots* are *Bitter*. And that the *Fig-Tree*, which bears a ſweet *Fruit*, bleeds a *Bitter Milk*. So likewiſe thoſe *Plants*, which bear a

Bitter

Bitter Stalk, have not *Bitter*, but *Hot Roots*, as in *Yarrow*, *Primrose*, *Wormwood*, *Rue*, *Carduus benedictus* &c. is manifest. So the *Coats* of the *Seeds* of *Viola Lunaria* are of a *hot* and *biting Tast*; but the *Seeds* themselves, in which the *Salts*, though copious, yet are also immersed in a greater quantity of *Oyl*, are *Bitter*. And that the *Earthy Parts* do also contribute something more to this, than to most of the forementioned *Tasts*, is argued from its being more *Fixed*; that is, the *Body* in which it resides, is either more *Fixed*, or else flyeth not away in that same state of conjunction, by which it maketh a *Bitter Taste*. For whereas *Hot*, *Biting*, and divers other *Plants* lose the strength of their *Taste*, by drying; most of those which are *Bitter*, do hereby increase it. And although the *Extract* of *Dandelion* and some other *Roots*, which are very *Bitter*, hath scarce any *Tast*; yet generally, they are *Bitter Plants*, which are best for the making of *Extracts*. And the distilled waters of *Plants* which are *Hot* and *Bitter*, notwithstanding that they always tast high of the *Heat*, yet rarely and very faintly of the *Bitter*.

13. §. *Astringency*, is made, partly, by the further increase and more intimate union of the *Earth*. And therefore this is seated still in a more *Fixed Composition*, than a *Bitter*. And partly, by the diminution of the *Sulphur*. And therefore the *Acid Parts* ingredient to it, either by *Fermentation* or otherwise, are easily exposed. *Astringency* being the *Womb* or *Bud* of a *Sower*. For all or most *Astringent Roots* bear a sower *Leaf*, or a sower *Fruit*; as those of all *Docks* and *Sorrels*, *Black-Thorn*, *Dog-Rose*, and others. Wherefore also, *Astringency* is often found in conjuction with *Bitter*, *Sweet*, or *Sower*; but scarce ever with *Pungent*, or *Hot*.

14. §. An *Aromatick Tast*, seems to be produced, chiefly, by a *spirituous*, *acid*, and *volatile Sulphur*; as in *Ambar-grise*, *Cardamon-Seeds*, many *Stillatitious Oyls* &c. A *Nauseous*, by a *Sulphur* less *Spirituos* and *Volatile*, and more *Alkaline*; as in the *Root* of *Dog-stones*, *Sheep-scabious*, the young and green *Leaves* of *Coriander*, or the *Seeds* of *Cumine*. The *Spirit*, as it enters the *Nerves*, carrying the *Alkaline Sulphur* along with it; as when a City is betrayed by one of its Inhabitants to an Enemy.

25. §. An *Intermittent Taste*, as in *Arum*, seems to have its dependance upon a simple and very pure *Nitre*, which by its subtilty enters into the very *Concaves* of the *Nervous Fibers* of the *Tongue*: and so being lodged there, is little affected or stirred, by the *Motion* of the *Blood*; but only when the *Tongue* it self is moved, at which time it causeth a kind of pricking *Taste*.

16. §. A *Tremulous Taste*, as in *Pyrethrum*, dependeth probably, upon an *Aereal Sulphur*; which being agitated by the *Blood* in its *Circulation*, the *springy Motion* or *Vibration* of the *Aereal Parts* produce that *Taste*.

17. §. A *Tast* is *Lingual*, *Guttural*, &c. according to the grosness or fineness or other difference of the *Membranes* into which the *tastable parts* are admitted. For *Tasts* are made not meerly by the outward *Contact*, but the *Ingress* of the *tastable parts*. Now the outer *Skin* of the *Tongue*, which is commonly observed to pill off in boyling, like the *Cuticula* in other *Parts*, hath either no sense, or much less than that which lies under it; and is therefore, but a *Seive* or *Strainer* to the *tastable parts*. So that being of different fineness in the several parts of the

Tongue; it hereby comes to paſs, that according as the *taſtable parts* of any *Plant* are more or leſs penetrant, ſubtle, or diſſoluble, they are admitted into one part of the *Tongue*, and not another. And in the *Throat*, the outer *Skin* it ſelf, ſeems to be the immediate *Senſory*; and ſo, to be evidently affected with the *Juyces* of ſome *Plants*, from which the *Tongue* receiveth little or no ſenſible *Impreſſion*.

18. §. When the *Taſt* is *Permanent* and *Fixed* in ſome one *Part*; it is a ſign, either that the *Guſtable Parts* are leſs diſſoluble; or more ſubtle, ſo as to enter the *Concaves* of the *Fibers*; and that there is an admixture of an *Aereal Salt*, or a like *Sulphur*; ſome of the parts whereof, being crooked, hang like *Hooks* on the *Fibers* of the *Tongue*. For the reception of ſuch a *Taſt*, is not to be looked upon as a wound made with a *Lancet*, and ſo the *Lancet* taken away; but with the *Lancet* ſticking in the wound; until in time, 'tis carryed off by the *Circulation* of the *Blood*; which like the *Stream* of a *River* in a *Flood*, carries all before it, but thoſe things laſt, which ſtick in the *Mud*.

19. §. But when the *Taſt*, though *Permanent*, yet is *Diffuſive* or *Tranſitive*; it ſeems probable, that as there is a leſs admixture of *Aer*; ſo a greater ſubtlety of the *Taſtable Parts*, whereby they are conveyed, through the *Nervous Fibers*, from one *Part* to another.

CHAP. V.

Of the Judgment which may be made of the VIRTUES of Plants, *from their* Taſts.

AS by duly obſerving the *Taſts* of *Plants*, we may be directed to underſtand their *Cauſes*. So alſo the *Uſe* and *Virtues* of thoſe *Plants* or *Parts* of *Plants* in which they reſide. For the proof whereof, an *Inſtance* might be fetched from every particular difference of *Taſt* before ſet down. But it may be enough, to give theſe which follow.

2. §. And firſt, we may make no ill gueſs *ex Analogia*, or where we find the ſame *Taſt*, that there the ſame *Virtue* in ſome kind, and in ſome degree, may reſide. So *Jalap*, *Mercury*, and *Daiſy*, have all of them that exaſperating *Taſt* in the *Throat* before deſcribed; and they are all three more or leſs *Cathartick*. Wherefore, we may believe, that other *Plants* which make the like *Impreſſion* on the *Throat*, and there are many others which do, that they are in ſome degree alike *Cathartick*. Thoſe *Plants* which are reckoned amongſt the chiefeſt *Cephalicks*, cauſe rather a durable, than a vehement *Heat* upon the *Tongue*, as *Pyrethrum*, *Euphorbium*, *Black-Hellebore*, &c. It ſeemeth therefore reaſonable to rank with theſe, any other *Plant*, though not uſed, which produceth the like durable *Heat*. The young *Roots* of *Yarrow*, or *Millefolium*, have

have the same *Taste*, as the *Root* of *Contrayerva*: and may therefore be used for the same purpose, with a probability of the like success; if not a better, because they may be gotten fresher. But by drying the *Root*, the *Tast* and *Virtue*, which lie in its exhalible parts, are much lost. The *Seeds* of the lesser *Cardamom*, and of *Zedoary Root*, if sound, have both a smatch of the *Tast* of *Camphire*. They may therefore all, so far, reach the same Case.

3. §. Again, as we may make no ill conjecture from the sameness of *Taste* in *Plants* of several *Tribes*; so from the diversity of *Taste*, in those of the same. So the *Flowers* of all the *Docks* are evidently *Astringent*, and not *Sower*; except those of the *Rha-pontick*, which are extream sower, even in the 5th degree. Which is no mean *Signature* of some more than ordinary *Virtue* in it, besides what it hath in common with the rest of the *Tribe*. The *Flowers* of *Pancy* have a kind of fulsome *Tast*, plainly different from that of *Violets*: and in some *Hypochondriacal Cases* may be more useful.

4. §. It likewise importeth much, to observe the difference of *Taste* in the several *Parts* of the same *Plant*. So the *Barque* of *Sassafras* is three times as strong, as the *Wood*: and the like may be observed in any other commonly known *Tree*. If therefore we could obtein the *Barques* of *Santalum*, *Lignum Rhodium*, *Lignum Aloes*, &c. they would doubtless, most of them, be of much greater use. And as the *Taste* is sometimes stronger; so, much more grateful, in one *Part* than in another: as in the *Flowers* or *Yellow Attire* in the *Heads* of *Carduus Benedictus*; which being infused in *Spirit* of *Wine*, or other convenient *Liquor*, make a pleasant *Cordial*. Nature having laped up the *Virtue* in the *Leavs*, as in a brown *Paper*; but in the *Flowers*, as in *Leaf-Gold*.

5. §. As also, how far the *Taste* of any *Plant* may alter, either in preserving, or preparing it. So the *Root* of *Arum*, when taken fresh out of the ground, is notably *Pungent*: but being throughly dryed, and especially kept for some time, hath no more *Taste*, and therefore in all likelyhood, no more *Virtue*, than a *Lump* of *Starch*. The like we are to judge of all other *Plants*, whose *Virtue* lieth in their exhalible *Parts*. The *Stillatitious Oyls* of many *Plants*, are stronger than the *Leavs* or other *Parts* from whence they are drawn: but some there are, which are weaker; as is that of *Euphorbium*, in which the *Heat* is neither pertinaceous, as in the *Gum* it self, nor so great.

6. §. We may make, moreover, a jugdment from the *Nature* of the *Tast*. So those *Roots* which are *Bitter*, and not *Hot*, as of *Cichory*, and the rest of the *Intybous* kind, may be accounted *Nitro-Sulphureous*; and so, to be *Abstersive* without any *Heating Quality*. The *Marum Austriacum*, which is extream *Pungent*, as well as *Aromatick*, may be looked upon as the best *Cephalick* of that *Tribe*. Because we find, that *Jalap* hath a special property of imitating the *Glandulous Parts* of the *Mouth*, and *Throat*; we may gather, That it is a better *Purge* to all the other *Glandulous Parts*, than most other *Cathartick*s. Which is also one reason of its operation, for the most part, with at least a tendency to vomit; the *Stomach* it self being *Glandulous* as well as the *Throat*, and thereby answerably affected with it. A strong *Infusion* of *white Sarzaparilla* in *Water*, botled up, and kept in a *Cellar* for the space of two months, becomes extream sower; far beyond any thing observed in the *Tasts* of the *Juyces* and *Infusions* of divers other

Plants kept as long and in the ſame manner. Which ſhews, how well Nature hath adapted a *Plant* of ſo mild a *Taſte*, either by ſimilitude of parts, for the carrying off of any *preternatural Acid*; or by contrariety, for the curbing of an exorbitant *Salt*. The *Barque* of the *Root* of common *Wormwood*, which impreſſeth a pertinaceous and diffuſive *Taſte*, which deſcendeth from the *Tongue* into the *Gulet*, as is before deſcribed; may be juſtly ranked with the moſt excellent *Stomachicks*; and upon tryal, I find it one of the beſt: beſides, that it is neither unpleaſant, nor affecteth the *Head*, as the *Leavs*. Yet the *Gardener*, and every Body throws it away, as good for nothing.

7. §. I ſhall conclude with one note, which is this; That the *Specifick Virtue* of *Medicines*, which ſome *Phyſicians* poſitively deny, and moſt diſpute; from ſome of the forementioned *Differences* of *Taſte*, as well as for other reaſons, may ſeem, at leaſt, to be probable. For why ſhould not a *Medicine* make an *Impreſſion* upon one *Part*, and not upon another, within the *Body*, as well as we find it doth within the *Mouth*? eſpecially, ſince the *Parts* of the *Mouth*, are of a leſs different *Nature*, than ſome of the *Viſcera*.

An Appendix.

Of the ODOURS *of* Plants.

THE *Senſes* of *Taſting* and *Smelling* being ſo nearly ally'd; many things already explained concerning the *Diverſities* and *Cauſes* of *Taſts* in *Plants*, may eaſily be transferr'd to thoſe of their *Odours*. I ſhall now therefore only remarque ſome particulars, not commonly taken notice of hitherto, and leave them as a *Specimen* to be Improved by other Hands.

§. 2. The *Root* of *Rape-Crowfoot* being cut, and held to the *Noſe*, when it is newly taken out of the *Ground*, ſmelleth almoſt like *Spirit* of *Sal Armoniac*, or freſh *Scurvygraſs Juyce*. And hath the property of making the *Eyes* to water, as *Onions* do. *Horſe-Radiſh Root* is not ſo *Pungent* to the *Noſe*, but gets pretty much into the *Eyes*. But that of *Dragon*, doth neither affect the *Eyes*, nor the *Noſe*.

3. §. The *Succulent Roots* of *Dogſtones*, and moſt of that *Tribe*, have a ranck *Smell*. And that of *Crown Imperial*, being rub'd a little, ſmells as like a *Fox*, as one *Fox* ſmelleth like another.

4. §. The *Root* of *Patience* digeſted with *Water*, in a warm *Room*, for the ſpace of three weeks, ſmels like *Spirit* of *Harts Horn*, or other *Urinous Spirit*. Of *Red Dock*, almoſt like *Aqua fortis* or *Spirit* of *Nitre*. That of *Dragon* bottled up with *Water*, and ſet in a *Cellar*, about a Month, ſtinks like the *pus* of the moſt *Fetid Ulcer*. At the end of five Months, more abominably, than either to be endured or expreſſed.

5. §. The *Leavs* of *Mountain Calamint*, ſmell like *Peny Royal*. Thoſe of *Ulmaria*, like *Walnut Pills*. Of *Yellow Lamium*, like a *Balſame*. Of *Sena*, a good quantity being held to the *Noſe*, of a rank

Smell

Smell betwixt that of *Sweat* and *Urine*. Of *Coriander*, when green and young, ſtink ſo baſely, that they can hardly be endur'd. Sometimes the *Leavs* have a ſtronger *Smell*, than the *Flower*, as in *Borage*, and ſometimes the *Stalk*, a ſtronger than the *Leavs*, as in *Ulmaria*.

6. §. *Rue Leavs* corked up in a bottle and ſet in a *Cellar* for about ten weeks, ſmell like *Spirit* of *Harts Horn*, or of *Urine*. The green *Leaves* of *Roſes* infuſed in water, have a mild, but pleaſant *Smell*. Neither is that of *Savine* unpleaſant, upon the like *Infuſion*.

7. §. *Scurvygraſs Juyce* kept about ¾ of a year in bottles, with the green *Sedement*, in a warm *Room*, ſtinks like Humane *Excrements*. And *Scurvygraſs Wine*, made only of the *Juyce*, ſmells like ſome *Iſſues*.

8. §. The *Flowers* of *Yarrow*, ſmell not much unlike to thoſe of *Southernwood*. And the *Flowers* of *Crowfoot* almoſt like thoſe of *Scurvygraſs*. Some *Flowers* are of a weaker *Smell* in the *Bud*, as thoſe of *Mallow*. But many have a ſtronger, than when they are blown open; as thoſe of *Lavender*, *Roſemary*, &c.

9. §. The *Buds* of *Vervaine Mallow*, while they are young, and the *Flowers* unſeen, have a very pleaſant *Smell*, like that of *Geranium Moſchatum*: but when afterwards they are opened they have an unpleaſant *Smell*. Common *Mallow Flowers* dryed and bottled up for ſome time, acquire, though not a ſtrong, yet very noyſom *Smell*.

10. §. The *Purple Pouch* of *Dragon* which covers the *Seed*, being broken, ſmells juſt like a *Lobſter*. But permitted to lie in a warm *Room* for ſome days, ſmells exactly like *Carrion*; and ſcents the *Room* with the ſame *Smell*.

11. §. Some *Seeds* as thoſe of *Cumine*, *Daucus*, being powdered and laped up only in *Papers*, do notwithſtanding retein their *Smell*. But many others, as of *Sweet Fenil*, in a ſhort time, loſe it. Some *Seeds*, when they firſt begin to ſprout, become *Odorous*, which were not ſo before; as the *Garden Bean*.

Tabula

Tabula, quâ perſpicuè videre eſt, quot Triplicati Sapores, ex ſolummodo decem Simplicibus numerantur.

AMARUS	Am.du.ac.						
	am.du.ſa.	am.ac.ſa.					
	am.du.ca.	am.ac.ca.	am.ſa.ca.				
	am.du.fr.	am.ac.fr.	am.ſa.fr.	am.ca.fr.			
	am.du.ar.	am.ac.ar.	am.ſa.ar.	am.ca.ar.	am.fr.ar.		
	am.du.ma.	am.ac.ma.	am.ſa.ma.	am.ca.ma.	am.fr.ma.	am.ar.ma.	
	am.du.aſ.	am.ac.aſ.	am.ſa.aſ.	am.ca.aſ.	am.fr.aſ.	am.ar.aſ.	am.ma.aſ
	am.du.pu.	am.ac.pu.	am.ſa.pu.	am.ca.pu.	am.fr.pu.	am.ar.pu.	am.ma.pu.
							(am.aſ.pu.
DULCIS	Du.ac.ſa.						
	du.ac.ca.	du.ſa.ca.					
	du.ac.fr.	du.ſa.fr.	du.ca.fr.				
	du.ac.ar.	du.ſa.ar.	du.ca.ar.	du.fr.ar.			
	du.ac.ma.	du.ſa.ma.	du.ca.ma.	du.fr.ma.	du.ar.ma.		
	du.ac.aſ.	du.ſa.aſ.	du.ca.aſ.	du.fr.aſ.	du.ar.aſ.	du.ma.ſa.	
	du.ac.pu.	du.ſa.pu.	du.ca.pu.	du.fr.pu.	du.ar.pu.	du.ma.pu.	du.aſ.pu.
ACIDUS	Aci.ſal.cal.						
	aci.ſal.fri.	aci.cal.fri.					
	aci.ſal.aro.	aci.cal. ar.	aci.fri.ar.				
	aci.ſal.mal.	aci.cal.ma.	aci.fri.mal.	aci.ar.mal.			
	aci.ſal.aſt.	aci.cal.aſt.	aci.fri.aſt.	aci.ar.aſt.	ac.ma.aſt.		
	ac.ſal.pu.	aci.ca pun.	aci.fr.pun.	aci.ar.pun.	ac.ma.pu.	ac.aſt.pu.	
SALSUS	Sal.cal.fri.						
	ſal.cal.aro.	ſal. fri. aro.					
	ſal.cal.mal.	ſal.fri.mal.	ſal.aro.mal.				
	ſal.cal. aſt.	ſal. fri. aſt.	ſal.aro.aſt.	ſal.ma.aſt			
	ſal.cal.pun.	ſal.fri.pun.	ſal.aro.pun.	ſal.ma.pu.	ſal.aſt.pun.		
CALIDUS	Cal.fri.aro.						
	cal.fri.mal.	cal.aro.mal.					
	cal.fri. aſt.	cal.aro.aſt.	cal.mal.aſt.				
	cal.fri.pun.	cal.aro.pun.	cal.mal.pun.	cal.aſt.pun.			
FRIGIDUS	Fri.aro.mal.						
	frig.aro.aſt.	fri.mal. aſt.					
	fri.aro.pun.	fri.mal.pun.	fri.aſt.pun.				
AROMATICUS	Aro.mal.aſt.						
	aro.mal.pun.	aro. aſt. pun.					
MALIGNUS							
ASTRINGENS							
PUNGENS							

Tabula,

Tabula, quæ Genericas omnes Saporum differentias comprehedit.

SAPORES, ratione

Subjecti, sunt

Senſationis ipſius, diſtinguuntur per

Species. Sunt enim alii

Simplices, qui ſunt

- Amarus
- Dulcis
- Acidus
- Salſus
- Calidus
- Frigidus
- Aromaticus
- Malignus
- Æqualis
- Tremulus
- Mollis: Vapidus, Unctuoſus
- Durus: Penetrans, Stupifaciens, Aſtringens (Continuus, Intermittens), Pungens

Compoſiti, qui ſunt

Nomina-ti; ſcil.

- Acerbus
- Auſterus
- Acris
- Muriaticus
- Lixivus
- Nitroſus

Iñominati quamplurimi, ut Amaro-dulcis, &c.

Gradus. Ita enim ſunt Remiſſi vel Intenſi a gradu 3° ad 1um. 4° ad 10um.

Durationis, ſunt: Breves, Diuturni

Motûs, ſunt: Celeres, Tardi in Principio, Augmento, Statu, Declinatione. Eſt autem Sapor in

- Principio: Quartarius, Binarius, Trinarius, Minutarius, Minuto-quartarius, &c., Bi-minutarius, Bino-quartarius, &c., Triminutarius
- Augmento: Quartarius, &c., Bi-minutarius
- Statu: Quartarius, &c., Quadrinarius.
- Declinatione: Quartarius, &c., Quadrino-quartarius, &c., Quinarius, Senarius, &c., Vicenarius., Viceno-quinarius, Tricenarius, Triceno-quinarius, Quadragenarius.

Fixi: Labiales, Linguales qui ad Linguæ Apicem, Verticem, Radicem; Palatales, percipiuntur Gutturales, Oeſophagei.

Mobiles: Diffuſivi., Tranſitivi.

EXPERIMENTS IN CONSORT UPON THE Solution of Salts IN WATER.

Read before the *Royal Society*, *January*, 18. 167$\frac{6}{7}$.

CHAP. I.

In which is ſhewed, the Compleat or Utmoſt Impregnation *of WATER with ſeveral kinds of* Salt, *both together, and apart.*

IN diſcourſe upon a *Lecture* formerly read, concerning the *Lixivial Salts* of *Plants*; It was mentioned, as a thing aſſerted by ſome *Philoſophers*, That *Water* having been fully impregnated with one kind of *Salt*, ſo as to bear no more of that kind; it would yet bear, or diſſolve ſome portion of another; and ſo of a third. And it was referred to Me by this Honourable Chair, to examine and produce the *Experiment*. The doing whereof brought into my mind divers other *Experiments* hereunto relating.

2. §. As next, With what difference of quantity this *Superimprægnation* would be made, upon the *Solution* of different *Salts*?

3. §. *Thirdly*, Whether the *Solution* of a ſmaller quantity of ſeveral *Salts*, doth conſiſt with the *non-increaſe* of the bulk of the *Water*? Becauſe this alſo is affirmed by ſome.

4. §.

4. §. *Fourthly*, What quantity of the ſeveral kinds of *Salt*, may be diſſolved ſeverally, in the ſame quantity of *Water*?

5. §. *Fifthly*, Whether by diſſolving a *Salt* in *Water*, there be any *Space* gained, or not? That is, whether the *Bulk* of the *Water* be greater, before the *Salt* lying in it be fully diſſolved, than it is afterwards? Or if a *Cubick Inch* of *Salt* be diſſolved in nine *Cubick Inches* of *Water*; Whether the *Water* will then fill a *Veſſel* of ten *Cubick Inches content*?

6. §. *Sixthly*, Whether the *Space* be equally gained, by an equal encreaſe of the ſame *Salt*?

7. §. *Seventhly*, Whether upon the *Solution* of ſeveral kinds of *Salts*, be gained ſo many ſeveral quantities of *Space*? That is, if the *Solution* of common *Salt* gains, ſuppoſe, an *Inch*, whether the *Solution* of *Salt Armoniack* gains as much, or more, or leſs? and ſo for other *Salts*.

8. §. *Eighthly*, What that juſt ſpace may be, which any *Salt* gaineth with reſpect to its own *Bulk*, or that of the *Water*?

9. §. And firſt, for the *Superimpregnation* of *Water*; I put into a bottle ℥ij of fair *Water*; adding thereto, firſt half an Ounce of *Nitre*; and afterwards more, as the *Water* would diſſolve it; and (that I might be ſure the *Impregnation* was full) ſome portion above what the *Water* would bear. Then having ſeparated this remaining portion; I put to this *Solution* of *Nitre*, two Drachms of *Sal Armoniac*; which wholly and eaſily diſſolved in the ſaid *Solution*; though it would not bear a grain more of *Nitre*. I then added a third Drachm of *Sal Armoniac*, after that a fourth, and a fifth; all which, within the ſpace of half an hour, were perfectly diſſolved in the ſaid *Solution*, without any precipitation of the *Nitre*.

10. §. In the making of this Experiment, two things, to render it infallacious, are to be noted. That the ſaid *Salts* were not diſſolved by the help of *Fire*, but only by a ſtrong and continued *Agitation*. And that this was done upon a warm day: which I mention, becauſe that even the changes of the weather will ſomewhat alter the *Solubility* of the *Salts*.

11. §. Having made the Experiment upon two *Salts*, I proceeded to repeat it upon three. And firſt I diſſolved as much common *Salt* in ℥ij of *Water*, as that quantity would bear. Then having ſeparated the ſubſiding portion; I put to the *Solution*, no leſs than five Drachms of *Nitre*, which by a continued *Agitation*, was wholly diſſolved therein, neither the *Nitre* nor the common *Salt* being in the leaſt precipitated. Then adding a Scruple more, it would not diſſolve, but ſubſided. This ſecond ſuſiding portion, I again ſeparated; and then put to this *Superimpregnation*, near ℥j of *Sal Armoniac*, which was alſo diſſolved as the former. And if as many more *Salts* had been added, tis probable that the ſame *Water* would have born ſome quantity of them all.

12. §. From this Experiment, it is a Concluſion demonſtrated, That not only the viſible *Cryſtals*, but the very *Atomes* of every *Salt*, at leaſt thoſe *Particles* which are ultimately diſſolved in *Water*, have a different *Figure* one from another. Becauſe that if they were all of one *Figure*; there would be no *Superimpregnation*, but the *Pores* of the ſame *Water*, would imbibe as much of one *Salt*, as anſwers to the total of two more *Salts* imbibed: that is to ſay, it would as well imbibe two Ounces of common *Salt*, as one Ounce of common *Salt* and

another of *Nitre:* which yet is contrary to the Experiment. And it is the ſame thing, whether we ſuppoſe the *Pores* of *Water* to be alſo different, or not. Becauſe, that if the *Figure* of all the ſaid *Atomes* be the ſame; then their reſpect to the *Pores* of the *Water* muſt be the ſame, how different ſo ever thoſe *Pores* be: which is alſo contrary to the Experiment. Beſides it is a great preſumption, to ſay, that the *Pores*, and therefore the *Atomes* of *Water* have different *Figures*; and yet not thoſe of *Salts*.

13. §. From the ſame Experiment we may go upon good ground in *Compounded Infuſions*; whether of *Purgative*, or other *Materials*. As not doubting, but that the ſame *Menſtruum* may be highly impregnated with ſeveral *Ingredients* at once, whoſe operative parts may be therein copiouſly diſſolved, without hindring either an *Extraction*, or cauſing a *Precipitation* one of an other.

14. §. The *Second* Enquiry is, With what difference this *Superimpregnation* of *Water* is made? which I find conſiderable. For a *Solution* of above five Drachms of *Nitre* may be *ſuperimpregnated* with no leſs quantity of *Sal Armoniac*. And a *Solution* of five Drachms of common *Salt*, may be *ſuperimpregnated* with as much *Nitre*. Yet neither a ſtrong *Solution* (as of five Drachms) of common *Salt*, will bear above two Scruples of *Sal Armoniac:* nor will a ſtrong *Solution* (as of five Drachms) of *Sal Armoniac*, bear above a Drachm of common *Salt:* for if above the ſaid quantities of either of them be mixed together: they are both copiouſly and forthwith precipitated to the bottome of the *Glaſs*.

15. §. Whence, notwithſtanding the former Experiment, yet are we admoniſhed, not to infuſe all manner of *Ingredients* in any proportion. Becauſe though ſome do not, yet others will precipitate one another.

16. §. The *Third* Enquiry was this, Whether the *Solution* of a ſmaller quantity of ſeveral *Salts*, doth conſiſt with the *non-increaſe* of the *Bulk* of the *Water*? For this I took a *Bolthead* with a ſlender *Neck*, conteining about a pint and a quarter of *Water*; and diſſolved therein about ℥jſß of *Nitre*. And marking the place to which the *Water* aſcended in the *Neck* of the *Bolthead*: I then diſſolved in the ſame *Water* about a Drachm of *Sal Gemmæ:* which little quantity, raiſed the *Water* above half an Inch higher then it was before. The like I obſerved in the addition of *Nitre* to a *Solution* of *Sal Armoniac*. So that to ſuppoſe the variation of the *Salt* doth prevent the increaſe of the *Bulk* of the *Water*, is a manifeſt Error.

17. §. From the ſame Experiment it alſo appears, That the aſcent of the *Water* upon a *Superimpregnation*, is the ſame, by whatſoever *Salt* the firſt *Impregnation* be made. For inſtance, Let a *Solution* of *Nitre* aſcend in the *Neck* of the *Bolthead*, ſuppoſe, to 10 Inches, then add ½ an Ounce more of *Nitre*, ſo as to raiſe the *Water*, ſuppoſe, 12 Inches or more, or leſs, according to the *Bore* of the *Neck*. In like manner, let a *Solution* of *Sal Armoniac* reach to ten Inches: then add again half an Ounce of *Nitre*; and it will reach juſt 12 Inches, or more or leſs, as before.

18. §. The *Fourth* Enquiry is, What quantity of the ſeveral kinds of *Salt*, may be diſſolved ſeverally in the ſame quantity of *Water:* that is to ſay, by agitation alone, without the help of fire, as I noted before.

before. And upon tryal it appears, First, that two Ounces of *Water* will dissolve three Ounces of *Loaf-Sugar* and no more, except the *Water* be heated.

19. §. The same quantity of *Water* that is, two Ounces will dissolve above two Ounces of *Salt* of *Tartar*. I say above, for how much more, want of a greater quantity of *Salt* which I could confide in, made me that I could not finish the Experiment.

20. §. The same quantity, *&c.* two Ounces of *Water*, dissolveth an Ounce and a Drachm of *Green Vitriol*.

21. §. The like quantity dissolveth six Drachms and a Scruple or above ¾ of an Ounce of common *Salt*.

22. §. Of *Nitre*, Five Drachms two Scruples and an half.

23. §. Of *Sal Armoniac*, five Drachms and two Scruples.

24. §. Of *Alum*, not above two Drachms and a Scruple.

25. §. And of *Borax*, not above a Drachm and half a Scruple.

26. §. Of these note, That although Common *Salt* be very dissoluble, and will presently catch the moysture of the *Aer:* yet a much greater quantity not only of *Salt* of *Tartar*, but even of *Loaf Sugar*, and of *Green Vitriol* it self, may be dissolved in *Water* than of Common *Salt*.

27. §. Again, as the great *Solubility* of some, so the less *Solubility* of other *Salts* is also observable, as of *Alum*, and *Borax*. For the same quantity of *Water* will dissolve near four times as much of *Green Vitriol*, as it will of *Alum*. And of *Sugar* more than ten times as much. Of *Green Vitriol* near eight times as much as of *Borax*; and of *Sugar*, twenty times as much.

28. §. From this Experiment we are likewise cautioned, not only in the *Infusion* of several *Ingredients* together, but of any one singly; that such a proportion thereof to the *Menstruum*, be not exceeded. For all that is over and above what the *Menstruum* will bear, is either not extracted, or will be precipitated. As is evident not only in the *Dissolution* of the *Salts* above named, but in the *Infusion* of *Plants* themselves: as, for instance; of *Senna*; two Drachms whereof will impregnate four Ounces of *Water* as strongly, as if twice the quantity were infused; because the *Water* will bear no more of the *Purgative Parts* of that *Body*.

29. §. There is only one *Salt* more remaineth to be spoken of under this Experiment; and that is, the *Crystals* of *Tartar*. Whereof, it is somewhat strange to observe, that it will scarce at all dissolve in *Water:* not more, than even divers *Resinous Gums*, as *Mastick*, *Tolu*, *Tacchamahacca*, and some others will do. For if two Drachms, suppose of these *Crystals*, of *Tartar* (commonly sold for *Cremor Tartari*) be put to one Ounce of *Water*, scarce five Grains thereof will, by *Agitation*, be therein dissolved.

CHAP. II.

In which is shewed, that by the Solution *of* Salts *in* Water, *some certain space, more or less, is gained. That the space is different according to the Nature of the* Salt. *And what the just space is, which is gained.*

THE *Fifth* Enquiry is, Whether by dissolving of a *Salt* in *Water*, there be any space gained, or not. That is, whether the *Bulk* of the *Water* be greater before the *Salt* lying in it be fully dissolved, than afterwards. For tryal whereof, I took a *Bolt-head* with a slender *Neck*, holding somewhat more than a pint; and filling it up to a certain place in the *Neck*; I then put in an Ounce or two of *Salt*. And observing the hight of the *Water*, both before it was dissolved, and afterwards; It plainly appeared, that there was some, and that a considerable space, gained by the *Dissolution*; the *Water* thereby sinking several Inches below the place, where it stood after the *Salt* was first put into it.

2. §. From this Experiment it is plain, that there are *Vacuities* in *Water*. That is to say, that all the parts of *Water* are not contiguous, but that either betwixt, or in the *Atomes* of the *Water* themselves, there are certain *Pores*, either absolutely void, or at least filled up with another more subtile body which is easily excluded by the particles of *Salt*: by possessing the room of which the above said space is gained.

3. §. The *Sixth* Enquiry is, Whether the space be equally gained, by an equal encrease of the same *Salt*.

4. §. For this I made two tryals; the first was this. Two half Ounces of *Salt Armoniac*, being successively dissolved in the same *Water*; both of them raised up the *Water* in the *Neck* of the *Bolt-head*, equally; the first 3 Inches $\frac{7}{8}$, and so the second.

5. §. The other was this. Four half Ounces of *Nitre*, being successively dissolved in the same *Water*, they all of them raised up the *Water* in the *Neck* of the *Bolt-head*, equally; the first a little above two Inches, and the 2^{d}, 3^{d}, and 4th, just as much.

6. §. The *Seventh* Enquiry is, Whether upon the *Dissolution* of several kinds of *Salts*, be gained so many several quantities of space. For this I made tryal upon Eleven several *Salts*, *sc.* *Salt* of *Tartar*, *Common Salt*, *Sal Gemmeus*, *Roman Vitriol*, *Nitre*, *White Vitriol*, *Green Vitriol*, *Alum*, *Borax*, *Loaf-Sugar*, and *Sal Armoniac*; of all which, I dissolved an equal quantity *sc.* two Ounces, in an equal quantity of *Water*, severally; that is, taking fresh *Water* for every *Solution*. The success was, That the *Sal Armoniac* raised the *Water* 15 Inches. The *Loaf-Sugar*, 13 Inches and $\frac{3}{8}$ths. The *Borax*, a Foot. The *Alum* 11 Inches, and $\frac{5}{8}$ths. *Green Vitriol*, 9 Inches and $\frac{5}{8}$ths. *White Vitriol*, 9 Inches and $\frac{1}{8}$th. *Nitre*, 8 Inches, and $\frac{3}{5}$ths. *Roman Vitriol*, 7 Inches and

and $\frac{5}{8}$ths. *Sal Gemmæ*, 6 Inches, and $\frac{5}{8}$ths. *Common Salt*, 6 Inches and $\frac{3}{8}$ths. *Salt* of *Tartar*, not above 4 Inches and $\frac{1}{8}$th. All which differences are plain, and moſt of them very remarquable: Two Ounces of *Sal Armoniac* raiſing the *Water* near four times as high, as the ſame quantity of *Salt* of *Tartar*.

7. §. From this and the fourth Experiment, compared, it alſo appears, That the ſeveral ſpaces gained by the ſeveral *Salts*, though ſometimes they do, yet do not always anſwer to the *Solubility* of the ſaid *Salts*. As to give ſome Inſtances; *Loaf-Sugar* is the moſt diſſoluble of any other *Salt*; yet it gaineth leſs ſpace than all the reſt, ſave only *Sal Armoniac*. So *Green Vitriol* is more diſſoluble then either *Nitre* or *Common Salt*; yet gaineth leſs ſpace than either, eſpecially than the latter. And *Sal Armoniac*, which is more diſſoluble than *Alum* or *Borax*, yet gaineth leſs ſpace than either of them. The *Cauſe* whereof is not eaſily aſſigned.

8. §. Note alſo, that by the ſame Experiment, as well as by the *Taſte* and other Circumſtances, it is plain, That *Sal Gemmæ* is nothing elſe but *Common Salt*, coagulated or *Cryſtalliz'd* under *Ground*.

9. §. Again, as the Fifth Experiment ſheweth, That there are *Vacuities* in *Water*: ſo doth this Laſt, that thoſe *Vacuities*, are of differing kinds. Becauſe, otherwiſe, it ſhould ſeem, That the *Bulk* of the *Water* would increaſe, more or leſs, according to the *Solubilitie* of every *Salt*, and not be alternately differenced as it is; Some *Salts*, more diſſoluble, increaſing the *Bulk* of the *Water* leſs, and others leſs diſſoluble, increaſing it more. I ſay, that this difference dependeth not only upon the different *Figures* of the *Atomes* of *Salt*; becauſe then every *Salt* which is more diſſoluble, would (quantity for quantity) take up leſs room in the *Water*: which is contrary to the Experiment.

10. §. From the ſame Experiment, howſoever *paradoxical* it may ſeem, yet is it alſo manifeſt, That although *Water* be a *Fluid*, yet the *Particles* thereof are *hard* and *conſiſtent*, and unalterable in their *Figure*. Otherwiſe it is plain, That all manner of *Salts* would be diſſolved in the ſame manner, and take up the ſame room in the *Water*. For let the *Figures* of the *Salts* be never ſo various, yet if the *Particles* of *Water* were themſelves *Fluid* or *Inconſiſtent* and *Alterable*, they would always ſo conforme to thoſe *Figures*, as to fill up all *Vacuities*; and ſo upon the *Solution* of ſeveral *Salts*, if of equal quantity, the *Water* would ſtill retein an equal *Bulk*. As ſuppoſe an Ounce of *Iron* were drawn into *Wyer*, another beaten into *Plates*, a third made into *Hooks*, a fourth into *Needles*, a fifth into *Nails*; every one of theſe five Ounces, being put ſeverally into *Water* will encreaſe its *Bulk* equally. I conclude therefore, That the *Atomes* of *Water* are hard and unalterable.

11. §. The *Eighth* Enquiry was this, What that juſt ſpace might be, which any *Salt* gaineth upon *Diſſolution*, with reſpect to its own *Bulk*, or the *Bulk* of the *Water*? For the making of this Experiment, *Water* will not ſerve, nor yet *Spirit* of *Wine*; becauſe they both of them diſſolve more or leſs of thoſe *Salts* which are put into them; whereby the obſervation of the true *Bulk* of the *Salt*, and conſequently of the juſt ſpace it gaineth by *Diſſolution* is loſt. I took therefore *Oyl* of *Turpentine*, and pouring it into a *Bolt-head*, marked the place of its aſcent in the *Neck*. Then pouring likewiſe into it two Ounces of

Common

Common Salt, I marked the second ascent of the *Oyl*; and found it to be 10 Inches and 6 eighths. Repeating the Experiment in like manner with two Ounces of *Nitre*, I found the ascent of the *Oyl* to be 11 Inches and $\frac{1}{8}$th. Repeating it again with two Ounces of *Alum*, the ascent of the *Oyl* was 13 Inches and $\frac{2}{8}$ths. And making it once more with *Sal Armoniac*, the *Oyl* ascended to 15 Inches: the said several ascents of the *Oyl* being the true spaces which the Four aboveſaid *Salts* take. From which, the space which the same *Salts* take up upon *Dissolution*, being deducted; the remainder is the space gained by that *Dissolution*. And so it appears, first, that *Sal Armoniac* gaineth nothing; being the only *Salt* of all I have tryed, which causeth the equal ascent both of the *Water* and the *Oyl sc.* just 15 Inches in both. *Alum* causeth the ascent of the *Oyl* to 13 $\frac{2}{8}$ths, of the *Water*, to 11 Inches and $\frac{5}{8}$ths: So that it gains about 1 Inch and $\frac{1}{2}$ out of 13. *Nitre* causeth the ascent of the *Oyl*, to 11 Inches and $\frac{1}{8}$th; of the *Water*, to 8 Inches and $\frac{3}{8}$ths. So that *Nitre* by *Dissolution* gets almost the space of 3 Inches in 11. *Common Salt* causeth the ascent of the *Oyl*, to 10 Inches and $\frac{6}{8}$ths; of the *Water*, 6 Inches and $\frac{3}{8}$ths. So that *Common Salt* gains by *Dissolution* 4 Inches in 10, which is very considerable.

12. §. By this way the *Specifick Gravity* of all kinds of *Salts* may be easily taken, and the difference betwixt them is somewhat surprizing. For it appears by the Ascent of the *Oyl*, that *Nitre*, quantity for quantity, is about a 22th part lighter than *Common Salt*. *Alum* about a 6th part lighter. And *Salt Armoniac*, almost a 4th part lighter than *Common Salt*. The like estimate may be made of the *Gravity* of all other *Salts*.

13. §. By the same Experiment it also appears, That according to the *Specifick Gravity* of *Salts* they are many times at least more or less *Volatile*; as in the four last *Salts* is plain. For *Common Salt* which of all the four is the most fixed, is also the heavyest. *Nitre* which is somewhat less fixed is somewhat lighter. But *Alum* which is still less fixed is much lighter. And *Sal Armoniac* which is wholly *Volatile*, is the lightest of all the *Salts* above mentioned.

CHAP.

CHAP. III.

Wherein, from the Experiments in the foregoing Chapter, *is ſhewed, the* Cauſe *of the* Motion *of the Mercury in the BAROMETER.*

FOR the doing of this, it will firſt be acknowledg'd, That not only ſeveral ſorts of *Sulphur*, but alſo of *Volatile Salts*, are continually ſublimed from moſt *Bodies* into the *Aer*. So *Lightning*, from the celerity of the accenſion, appears to be made of a *Meteor*, which is *Nitro-Sulphureous*. *Snow* dependeth upon a *Mixture* of *Nitrous*, and other *Salts*; as is evident, from the regularly and differently *Figur'd Parts*, which compoſe the whole Body of a *Snowy Cloud*, before it cluſters into *Flakes*. And one reaſon, why *Rain* is the beſt *Water* for any *Soyl*, is becauſe it is impregnated with divers *Volatile* and *Fruitful Salts*. And ſo from other *Meteors*.

2. §. And next, that theſe *Salts*, are not always in the ſame *Quantity*, *Proportion*, and *State*, in the *Aer*: but that ſometimes they are more copious; at others, leſs: ſometimes, one more copious, than an other: ſometimes, more plentifully diſſolved; at others, more ſparingly: and that, either as they are more or leſs pure and diſſoluble; or according to the quantity of the *Vaporous Parts* in the *Aer*, in which they are incorporated or diſſolved.

3. §. Thus much being granted, from the *Experiments* in the foregoing *Chapter* compared together, we may reſolve our ſelves about ſome *Phænomena* in the *Barometre*. Which ſeems to vary, not ſo much with the meer *Weight* of the *Aer*, which hitherto hath been ſuppoſed: as by the different preſſure it makes, in being *crowded* more at one time, than at another. That is, according as certain *Nitrous*, or other *Saline Bodies*, take up leſs *Space* in the *Aer*, when diſſolved in the *Watery Parts* therein, than while they are undiſſolved.

4 §. And therefore it is eſpecially to be obſerved, That as the *Mercury* commonly riſeth in the *Cylinder* for ſome days, but always for ſome time, before the change of the *Weather*, whether for *Snow* or *Rain*: So, that then it preſently falleth again, even before the *Snow* or *Rain* falls. Whereas, if the *Weight* of the *Aer*, were the only, or the chief *Cauſe* of the aſcent of the *Mercury*; than as it riſeth all the while the *Weather* is gathering, ſo it would keep its ſtanding or heighth, until the *Weather* breaks and falleth down: which yet it never doth, but always falls before it; ſometimes no leſs than a whole day. The *Cauſe* whereof is, in that all the while the *Mercury* riſeth in the *Cylinder*, the *Aer* is *crowded* with more and more *Saline Parts*, which by the

the *Winds*, or otherwiſe, are carryed into it; and ſo cauſeth it to preſs upon the *Mercury* in the *Box:* but after that in ſome time the *Salts* are diſſolved or incorporated in the *Aqueous Parts* of the *Aer*, as in *Rain* or *Snow*; ſo ſoon as that is done, there is ſome *Space* gaind; and ſo, before any *Weather* falleth, the *Aer* is leſs crowded, and preſſeth leſs upon the *Mercury* in the *Box*, which gives way to its deſcent in the *Cylinder*.

5. §. From hence alſo it is, that the *Mercury* riſeth higher with *Cold Winds*, than it doth with thoſe which are *Warme*. Both becauſe that in *cold Winds* there is the greateſt quantity of *Nitre:* and that the *coldeſt Winds*, are uſually the dryeſt. So that the *Nitre* wanting *Moyſture* fully to diſſolve it; it takes up ſo much the greater ſpace, and ſo cauſeth a greater preſſure in the *Aer*, as hath been ſaid.

6. §. *Laſtly*, For the ſame reaſon it comes to paſs, that the *Mercury* firſt riſeth higher, and then falleth lower before *Snow*, than it doth before *Rain*. Becauſe that for the production of *Snow*, the *Aer* is crowded with a greater quantity of *Nitre*, or ſome other like *Salts*; which before they are diſſolved, take up ſo much the more ſpace; and afterwards ſo much the leſs, even before the *Snow* falls: as hath been proved.

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THE EXPLICATION OF THE TABLES,

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F. 5. a, *the Corn covered*; c, *naked and a little magnified.*

F. 6. a, b, *the two Lobes*; e, *the Radicle*; c, *the Radicle and Bud*; d, *the Hollow in which the Bud lies.*

F. 7. a, *the Seed covered*; c, *naked*; e, *open.*

F. 8. a, *one Lobe*; --b, *the Bud*; b, *magnified.*

F. 9. *the Slice a little magnified.*

F. 10. *The Radicle* d, *cut tranſverſly* c.

F. 11. *The Plume or Bud* a, *cut tranſverſly* c.

F. 12. *Cut by the Length.*

F. 13. *A Lobe cut tranſverſly.*

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F. 15. a, *the convex ſide of one Lobe, ſhewing the Seminal Root without cuting*; c, *the flat ſide.*

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F. 3. *the Cane ſplit down.*

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F. 5. *A Branch of five years growth. From the Circumference, to the utmoſt black Ring, goes the Barque.*

F. 6. a, *a piece of the Stalk*; b, *magnified.*

F. 7. a, *a piece of Oak-wood cut tranſverſly*; b, *the ſame magnified. The white Lines are the leſſer and greater Inſertions. The Pricks, are the Wood. The little and great Holes two ſorts of Aer-Veſſels.*

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F. 2. *the midle part.*

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TAB. IX. *More Roots cut tranſverſly.*

TAB. X. F. 1. *A Slice of the Root cut tranſverſly; but a little too big for the life.*

F. 2. AA, *One half of a like Slice.*

b b, *The Skin.*

A A D D, *The Barque or all that part of the Root analogous to it.*

G D, *The Lympheducts on the inner edge of the Barque.*

G G, *The Wood.*

G T, *The Aer-Veſſels therein.*

T T, *The Pith.*

TAB. XI. F. 1. *The Neck of the*

the Root cut transversly.

F. 2. *One half of the same split down.*

F. 3. *Magnified.*

AB, *The Skin.*

A E, *The Barque.*

E E, *The Lympheducts.*

The black Columns under them, are the Wood.

The Holes in the Columns are the Aer-Vessels.

The white Columns E L, *are Insertions betwixt the Barque and the Pith.*

L e, *The Pith.*

e e, *The angular Bladders of the Pith.*

TAB. XII. A, *one half of* F. 1. *magnified.*

A b, *The Skin.*

A G, *The Barque, or all that part of the Root which answers to it.*

In which the round black spots, are the Muciducts.

D G, *The common Lympheducts.*

D T, *The Pithy Part of the Root.*

T T, *More Lympheducts.*

In both which, the black Holes are the Aer-Vessels.

TAB. XIII. A, *One half of* F. 1. *magnified.*

A C, *The Skin.*

A G, *The Barque, or that part of the Root which answers to it.*

D D, *The Milk-Vessels placed in Rings.*

E E, *The Parenchymous Rings betwixt them.*

G T, *The Bladders streaming in Rays, by the mixture of the Lympheducts with the Lacteals.*

G G, *To the Centre, the Wood.*

In which the Holes are the Aer-Vessels.

TAB. XIIII. A b., *The kkin, which should have been thicker.*

A F, *The Barque.*

G b, *The Bladders in the outer part of the Barque, oblong and postured circularly.*

S S *The Bladders in the inner part, standing in Arches.*

F F, *A Ring of Sap-Vessels.*

d d, *Parenchymous Insertions.*

d L d, *The Wood.*

In which, the Holes edged with white Rings are the Aer-Vessels.

TAB. XV. A A, *The Skin.*

A B, *The Barque.*

B L, *The Sap-Vessels in the form of a Glory.*

B E, *The Wood.*

In which, the Holes are the Aer-Vessels.

G E, *A Ring of more Sap-Vessels.*

E E, *The Pith.*

TAB. XVI. A b, *The Skin.*

A C, *The Barque.*

In which the round Holes B, *are Balsame-Vessels.*

B. C. *Parcels of Lympheducts.*

In which there aremore Balsame-Vessels.

C D, *Parenchymous Insertions.*

D E, *Parcels of Wood,*

In which the Holes are the Aer-Vessels.

TAB. XVII. A, *the Skin.*

A B, *The Barque.*

L S, *A parcel of Sap-Vessels.*

L l, *A Parcel of Wood.*

In which the Holes great and small are Aer-Vessels.

B B, *Parenbcymous Insertions betwixt the parcels of Wood.*

D D, *Others within them.*

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TAB. XVIII. *Hereof see the Description in the Third Book*, Chap. 1.

TAB. XIX. F. 1. *A Branch of Corin Tree.*

A, *sheweth the surface of the* B. *Barque.*

B, *Of the wood.*

F. 2. *Stalk of Sonchus split down.*

F. 3. *Branch of Vine split down. In both, the several Storys or Chambers of the Pith.*

F. 4. *Branch of Walnut.* A. *an older.* B, *a younger: in both, the Pith parted into transvers Membrans.*

TAB. XX. F. 1. *Sheweth the Surface of a Walking Cane.*

And the Clusters of Aer-Vessels, surrounded with Rings of Succiferous.

F. 2. *The surface of the Skin of Borage Stalk.*

F. 3. *The Turpentine Vessels running through the length of the Barque; one of them cut down the middle, the other entire.*

F. 4. *The Milk-Vessels shewed in the same manner.*

TAB. XXI. *Sheweth the Woody and Aer-Vessels by the length of the Branch, part of the Barque, and wood, being taken away.*

TAB. XXII. AB, *The Skin.*

AC, *the Barque.*

Q, *the Parenchymous part.*

HI, *Parcels of Muciducts in a Ring.*

DC, *Common Lympheducts.*

CDEF, *the Wood of 3 years growth.*

KLMN, *The second years growth.*

O ϱ, *the great Insertions.*

P ϱ, *the smaller.*

XX, *Lignous parcels.*

Within which the Holes are the Aer-Vessels.

EFG, *the Pith.*

TAB. XXIII. AB, *the Skin.*

AC, *the Barque.*

Q, *the simple Parenchyma.*

HI, *a Ring of special Vessels.*

P, *common Sap-Vessels.*

CDEF, *the Wood of 3 years growth.*

KLMN, *one years growth.*

X, *great Insertions.*

PO, *lesser between them.*

The black parcels are the wood.

In which the Holes are the Aer-Vessels.

EFG, *the Pith.*

TAB. XXIV. AB, *the Skin.*

ABCD, *the Bark.*

NN, *the Parenchyma.*

HI, *a Ring of special Sap-Vessels.*

DMC, *Parcels of Lympheducts.*

CDEF, *the Wood.*

EFLK, *one years growth.*

KPQL, *the larger Aer-vessels in the several parcels of Wood.*

ϱ ϱ, *the lesser Aer-vessels.*

MT, *the insertions.*

EFG, *the Pith.*

TAB. XXV. AB, *the Skin.*

ABCD, *the Barque.*

HI, *Special Sap Vessels in arched parcels.*

OO, *the common Sap-vessels which begin to turn into Wood.*

CDEF, *the Wood.*

KLMN. *one years growth.*

The Holes are the Aer-vessels in the wood.

ϱ ϱ, *the true wood.*

Oz, Oy, *the Insertions.*

EF, *other Sap-vessels.*

EFG, *The Pith.*

TAB. XXVI. AB, *the skin.*

ABCD, *the Barque.*

QQ, *the Parenchyma.*

HI, *Special Sap-vessels in arched parcels.*

DC, *a Ring of common Lympheducts.*

DCFE, *the Wood.*

KLMN, *one years growth.*

The Holes are the Aer-Vessels.

OO, *the greater Insertions.*

PO, *the smaller.*

EF, *other Sap-vessels.*

EFG, *the Pith.*

TAB. XXVII. AB, *the Skin.*

ABCD, *the Barque.*

WV, *the Parenchyma.*

HI, *round parcels of Sap-Vessels,*

DC, *the common Sap-Vessels.*

DCEF, *the Wood of 5 years growth.*

QRFE, *one years growth.*
XX, *the true wood.*
The Holes both great and ſmall are the Aer-Veſſels.
SS. *The great Inſertions.*
TS, *the ſmaller.*
EFG, *the Pith.*
TAB. XXVIII. AB, *the Skin.*
ABCD, *the Barque.*
HTI, *ſpecial Sap-Veſſels in round Parcels.*
DSC, *common Sap-Veſſels.*
DCEF, *the Wood of five ysars growth.*
ee, *the true wood.*
KL &c. *the great Aer-Veſſels.*
DC, *the ſmaller.*
SS, *the Inſertions.*
EFS, *the Pith,*
TAB. XXIX. ABCD, *the Barque.*
AB, *a Ring of Sap-Veſſels in round parcels next the Skin.*
HI, *the Parenchyma.*
Another Ring of round parcels.
DOC, *Common Lympheducts.*
DCEF, *the wood.*
MNEF, *one years growth.*
SS, *the true wood.*
KL, *the great Aer-Veſſels.*
PQ, *the leſſer.*
OO, *the Inſertions.*
EFG, *The Pith.*
e, *the Bladders of the Pith.*
TAB. XXX. AB, *the Skin.*
ABCD, *the Barque.*
RR, *the Parenchyma.*
HRI, *two Rings of ſpecial Sap-Veſſels.*
DC, *Common Lympheducts.*
DCEF, *the wood of four years growth.*
dd, *the true wood.*
Qd, *part of it whiter, by the mixture of ſpecial Sap-Veſſels repreſented by the tranſvers Lines.*
MN, *the great Aer-Veſſels.*
ce, *parcels of leſſer ones.*
EF, *a Ring of other Sap-Veſſels.*
EFG, *the Pith.*
TAB. XXXI. ABCD, *the Barque.*
mm, *the Parenchyma.*
HmI, *Milk Veſſels in arched parcels.*
DKC, *Lympheducts.*
DCEF, *the wood of one years growth.*
ST, *probably milk Veſſels heretofore.*
The Holes in the Aer-Veſſels.
KK, *the Inſertions.*
EvF, *other Milk-Veſſels.*
EFG, *the Pith.*
TAB. XXXII. ABCD, *the Barque.*
MN, *The Parenchyma.*
DLC, *the Lympheducts.*
HI, *The Veſſels which carry the Turpentine.*
DCFE, *the Wood.*
LL, *the Inſertions.*
EFG, *the Pith.*
The greater Holes both in the Wood and Pith, are more Turpentine Veſſels.
TAB. XXXIII. ABCD, *the Barque.*
XY. *The Parenchyma.*
KXYL. *Special Veſſels in round parcels.*
HI, *others in a Ring.*
DC, *Common Lympheducts.*
DCEF, *the wood.*
SZT, *probably one ſort of Sap-Veſſels heretofore in the Barque.*
QMQN, *ſmall Aer-Veſſels.*
MN, *great Aer-Veſſels.*
RQ, *the ſmall Inſertions.*
QQ, *the great ones.*
EFG, *the Pith.*
TAB. XXXIV. ABaa, *the hairy Skin.*
ABCD, *the Barque.*
HwI, *the Parenchyma.*
DMC, *the common Lympheducts.*
KL, *the Milk Veſſels.* v, *one Veſſel.*
HI, *Another ſort of Lympheducts, arched over the Milk Veſſels.*
XX, *ſeems to be a third ſort of Lympheducts.*
DCFE, *the Wood.*

The Explication of the Tables.

MM, *the Inſertions.*
XX, *the true Wood.*
The Holes therein are the Aer-Veſſels.
EF, *a Ring of Lympheducts.*
EFG, *the Pith.*
TAB. XXXV. ABCD, *the Barque.*
AMB, *the Parenchyma.*
HMI, *Balſam Veſſels.*
KL, *another ſort of Sap-Veſſels in parcels.*
KLDC, *Lympheducts.*
DCEF, *The Wood.*
In which the Holes are the Aer-Veſſels.
MM, *the Inſertions.*
EF, *more Balſame-Veſſels.*
EFG, *the Pith.*
TAB. XXXVI. aa, *part of a Vine-Branch cut tranſverſly, and alſo ſplit half way down the midle.*
BB, *The ſame magnified. Shewing the Poſition of the Bladders in the Barque and Pith in perpendicular Rows; in the Inſertions, in Horizontal Rows.*
And the Veſſels or Parcels of Wood not raced as in many other Trees..
TAB. XXXVII. *Sheweth the bracing of the Veſſels. And how the ſeveral Parcels of Veſſels or Wood are interwoven with the Inſertions.*
TAB. XXXVIII. ABCD, *the Barque.*
HI, *The Parenchyma.*
ee, *A ſort of Sap-Veſſels.*
aa, *Another ſort.*
cc, *Milk Veſſels.*
DCEF, *the Wood.*
VV, *the Aer-Veſſels.*
tt, *More Lympheducts.*
ſſ, *More Milk-Veſſels.*
at, *The Inſertions.*
EFG, *The Pith, compoſed of angular Bladders, the Bladders of Threds, and the Threds of ſingle Fibers.*
g, *One of the ſingle Fibers.*
TAB. XXXIX. *Sheweth the Structure of the Lympheducts or of the Lignous Fibers both in the Barque, and the Wood.*
F. 1. a, & F. 2, *A ſingle Veſſel in the Barque of Flax, compoſed of a great number of other Lignous Fibers; with which alſo the Parenchymous are intermixd. Not viſible, except very highly magnified.*
F. 3. *A parcel of the ſame Veſſels in Wood.*
F. 4, & F. 5. *ſhew the manner of the Aſcent of the Sap, both in the Lympheducts, and in the Lactiferous and other larger Veſſels.*
TAB. XL. *The Fibers which hang down from the Barque are the Lympheducts; one of which is compoſed of a great many other ſmaller Fibers.*
The large Tubes are the Milk-Veſſels compoſed of Bladders.
The Fibers which hang down from the wood, are ſome of them the old Lympheducts turn'd to wood.
And ſome, Aer-Veſſels unroav'd.
The thin Plate between the two wedges of wood, is one of the Inſertions, compoſed of Bladders, and thoſe Bladders of Threds.
The remainder, is part of the Pith, compoſed of Thredy or Fibrous Bladders.

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TAB. XLI. b, *a Dock-Leaf covered with the Veil.*
d, *the Leaf naked.*
ac, *the Veil ſpred open.*
In Clary, the Bud is embraced by the Curled Leavs.
In Sumach, the Bud lies within the Stalk, as an Egg or Kernel within a Shell.
TAB. XLII. F. 1. *ſheweth how the Pipes are incloſed one within another.*
F. 2. a, *the Leaf foulded up.* b, *opened.*
F. 3. ab, *the Bud.* b, *a little magniſied*

magnified.

F. 4. a b, *the Leaf rowled up, inward.* c, *a little magnified and cut transversly, to shew the Rowl.*

F. 5. a, *the Leaf rowled up.* b, *magnified and cut transversly.*

F. 6. a, *the Leaf rowled backward.* b, *magnified and cut transversly.*

TAB. XLIII. F. 1. *sheweth the Tenter-Hooks, by which the Leaf climbs.*

F. 2. *sheweth the Globulets, turned to a white powder.*

The Leaf of Jerusalem Cowslip. sheweth the Way of the Insect under the Skin.

TAB. XLIV. & XLV. *sheweth the Measures of Leavs by the Circumference.*

TAB. XLVI & XLVII. *sheweth the proportion between the chief Fibers; and also the Angles they usually make together.*

TAB. XLVIII. F. 1, 2, & 3. *shew the Apertures in several Leavs.*

F. 4. *sheweth the same. And likewise, the peculiar composure of the Bladders and Fibers of the Leaf.*

TAB. XLIX. *sheweth the difference in the Bladders, and in the Position of the Lignous Fibers in the Stalks of Leavs.*

TAB. L. *sheweth the Pulp of a Borage-Leaf and many others composed of Bladders; the sides of which Bladders, are made of other smaller ones.*

And the distribution of the Lignous Fibers (and of the Aer-Vessels sheathed within them) not like that of Veins in Animals, but of the Nervs, &c. See the description of the Leaf.

TAB. LI. F. 1. *The appearance of the Aer-Vessels like Cobwebs to the naked Eye, upon breaking the Leaf.*

F. 2. *A small peice cut off of the Leaf.*

F. 3. *The same magnified in which the same Vessels look like spiral wyers stretched out.*

F. 4. *The same as they stand entire within the Wood.*

TAB. LII. *Represenleth the Aer-Vessels of Scabious, as in* Tab. LI.

TAB. LIII. *Sheweth the manner of the Generation of the Leaf; chiefly, by the help of several Salts, wherewith the Sap is impregnated.*

F. 5. (1) *The Foundation of the work.*

F. 6. (1 & 2) *strengthned.*

F. 7. (1 & 3); *in which* (3) *is set with the square end to end: and with the poynt-side of one, to that of another.*

F. 8. *The same, directing the Position of the Lignous Fibers at very Acute Angles.*

F. 9. *At less Acute Angles.*

F. 10. *The greater Fibers at Acute, and the smaller at Right Angles.*

F. 11. *The greater at Right Angles with the help of* (1) (2) *or* (3).

F. 12. (3) *directing the Fiber in the Edge of the Leaf into a greater Circle.*

F. 13. *Into a less, and with divers Diameters.*

F. 14. (4) *derecting the Parenchymous Fibers in making the Bladders.*

F. 15. *In winding from one Bladder to another.*

F. 17. *Or about the Lignous Fibers.*

F. 16. *In making the Aer-Vessels.*

TAB. LIV. *sheweth how Nature manages the Folds of Flowers according to their Shape.*

TAB. LV. F. 1. *sheweth the Edges of the Leaf fastned by their Indented Hairs.*

F. 2. *The Balsamick Knobs in the place of Hairs.*

F. 3. *The number* 5 *running* 3 *times into its self in* 13.

F. 4. *And five times in* 21.

F. 5. &c. *The Seminiform Attire in Clematis Austriaca. With one of the*

the Thecæ magnified; of which, there are about 30 or 40 in one Flower.

F. 8, &c. *The same in Blattaria, with one of the Thecæ magnified; of which are there about 5 in one Flower.*

TAB. LVI. *The same in yellow Henbane.*

With one of the Thecæ magnified; of which there are about 5 in one Flower.

And the Column on the top of the Seed-Case.

TAB. LVII. *The same in St. Johns wort, entire, together with the Seed-Case or Uterus.*

TAB. LVIII. *The Varieties of the Spermatick Particles in the Seminiform Attire.*

TAB. LIX. *The Florid Attire of Golden Rod;*

In which, the several suits consist but of two pieces. And of which Attire, the Flower doth almost wholly consist.

TAB. LX. F. 1, &c. *The same Attire in French Marigold or Flos Africanus, with one suit magnified. Of which, there are about 12, in one Flower; and every suit consisting of 3 Pieces.*

F. 5. *One of another Flower, consisting also of 3 Pieces.*

TAB. LXI. *One suit of the same Attire in Marigold, and Knapweed, each of them consistingof three Pieces.*

F. 5. a, *The Attire of one Piece, proper to each Leaf in a Marigold Flower, besides that in the bosome of the Flower.*

F. 8. a b, *the Seed-Case or Uterus at the bottom of every suit.*

TAB. LXII. *The Attire (of 3 Pieces) proper to each Leaf in the Flower of Cichory.*

TAB. LXIII. *Sheweth the Flower of Mezereon perfectly formed in all its Parts, in the year before it appears. But differs in Shape, as a Fœtus doth when newly formed.*

TAB. LXIV. *sheweth the same in the Flower of Asarum.*

TAB. LXV. *sheweth the position of the 20 chief Branches in an Apple.*

Their Production from the Stalk to the Seeds and Flower.

And a part of the Parenchyma magnified, &c. that which is pricked out from the Coar to the Skin; shewing the oblong Figure of the Bladders, and the Divisions in every Bladder.

TAB. LXVI. F. 1, &c. *sheweth the Bladders in the Rind of a Limon conteining the Oyl.*

The Bags and Bladders of the Pulp, conteining the sower Juyce.

And the Position of the Vessels belongeth to the Fruit, Seed, and Flower.

F. 5. *shews the same Vessels, and treble Parenchyma in a Cucumer.*

TAB. LXVII. *Representeth the Parts of a Pear.*

The position and production of the Vessels.

The Chanel from the top of the Pear to the botome of the Coar.

The Tartareous Knots.

And the Bladders radiated to them.

TAB. LXVIII. *See the Descriptions of Fruits; and the last Chapter of the Generation of the Seed.*

TAB. LXIX. F. 5. *Sheweth the Parts of a Goosberry.*

The darker part is the sower Rind. Consisting of two sorts of Bladders, of which some very small, and others very great.

The white pieces on the circumference of the Berry, are the Lignous Fibers.

The two opposite white and radiated Bodys are the Midle Parenchyma.

And the oblong Baggs round about the several Seeds or Seed-Cases, are the sweet Pulp.

TAB. LXX. *Sheweth the Seed-Case of Radish opened, and the Seeds hanging on two Ropes.*

That of Poppey both entire, and

ſplit down the midle.

A ſlice of the Cod of Garden-Bean, while very young; and therein the Bladders and Threds of the Spongy Parenchyma.

And the gradual ripening and opening of that of yellow Henbane.

TAB. LXXI. *Sheweth the Seed Caſe of Tulip entire, cut tranſverſly, and ſplit downe.*

A ſlice of Thorn-Apple, or of the Seed-Caſe of Stramonium, while young.

That of Pimpinel naturally divided into two Hemiſphers; with the Button, on which the Seeds grow, erected in the middle.

The manner of the ejaculation of the Seed, in Coded Arſmart.

And the Coats of the Seed of Azarum formed the year before it ripens.

TAB. LXXII. *Sheweth the meaſures of Plum-ſtones.*

The Apertures, and Diviſions, of the covers of the Seed.

The Seed and Seed-Caſe of Harts Tongue, opened with a Spring.

And other contrivances both for the Motion, and Arreſt of other Seeds.

TAB. LXXIII & LXXIV. *See the Deſcriptions.*

In Tab. 74. *the corners and edges of that of Fox-glove ſhould have been rounder.*

The Figures are all done pretty near a Scale.

TAB. LXXV. *The Belly and Back of a Dateſtone, and the ſmall ſprouting Node taken out of the Hole in the back cut open.*

The Shapes and Foulds of divers Seeds.

The Vitellum of Orach, and Rhapontick.

In great blew-Lupine, d, *the Navle;* b, *the deſcending part of the Radicle.*

TAB. LXXVI. *Flag.* 1, *the Seed.* 2, *ſplit open.* 3, *the true Seed which lies in the hollow made in the Cover* (2) 4, *one half of* (2) *magnifyd.* 5, *the Seed* (3) *magnifyd.*

Purging Angola Nut. 1, *with the ſhell on.*

2. *taken off.* 3, *the ſoft Cover ſplit down.* 4, *the Seed which lies in it; the Lobes hereof anſwerable to two Leaves, and Radicle to the Stalk.*

And ſo in the reſt.

TAB. LXXVII. *Coffee Berry ſtone.* 1, *The belly of the Stone.* 2, *the Black.* 3, *pared a little.* 4, *the Kernel taken out of it.* 5, *the ſame magnifyd.*

Gooſgraſs. 1, *the entire Seed.* 2, *the back of the hard Cover.* 3, *the belly.* 4, *cut in two.* 5, *the ſame magnifyd.* 6, *the true Seed taken out of it.*

Staphiſagria. 1, *the entire Seed.* 2, *the hard Cover.* 3, *Split in two.* 4, *the true Seed taken out of it.* 5, *The ſame magnifyd.*

Peony, 1, *the Seed commonly ſo call'd.* 2, *one half of it ſplit down.* 3, *the other half.* 4. *the true ſeed taken out of it.* 5, *the ſame magnifyd.*

Stramonium. 1, *the Seed entire.* 2, *the iner thick cover.* 3, *the ſame ſplit in two.* 4, *the true ſeed taken out of it.* 5. *half the thick Cover* (3) *magnifyd.* 6, *the Seed* (4) *magnifyd.*

TAB. LXXVIII. *Some examples of the Buds of Seeds before they are ſown.*

Sena. 1, *the naked Seed.* 2, *the Lobes divided to ſhew the Bud.* 3, *one Lobe with the Bud magnifyd.*

Carduus Benedictus, 1, *the entire Seed.* 2, *with the outer Covers off.* 3, *naked.* 4, *divided.* 5, *that half with the Bud, magnifyd.*

Hemp. 1, *the naked Seed divided.* 2, 3, *the ſame magnifyd.*

Almond. 1. *one half of the Kernel.* 2, *the Radicle and Bud at the bottom of it.* 3, *the ſame broken off.* 4, *magnifyd.* 5, *opened.*

TAB. LXXIX. F. 1. ab, *Part of the outer Coat.*

cd,

The Explication of the Tables.

c d, *Part of the Inner Coat.*

c d e, *one Lobe cover'd with the Skin.*

f g, *the other, with the skin and part of the Parenchyma pared off.*

f f, *the Skin.*

h h. *the Parenchyma.*

i i. *the Seminal Root.*

k k, *the Radicle.*

k l, *where it is cut off from the Lobes.*

M, *the Plume or Bud.*

N, *The Cavitys in which it is lodg'd.*

F. 2. *Sheweth the Barque, Vessels and Pith of the Radicle.*

TAB. LXXX. F. 1. *A Slice of a young Apricock, cut transversly, near the lower end; shewing the duplicature of the Skin half way through the Stone.*

F. 2. *A Slice, cut near the upper end; shewing the duplicature of the Skin quite throw the Stone*

F. 3. *A well-grown Apricock cut by the length.*

F. 4, 5, *The Membranes of a Filbert full rise.*

F. 6, *The Membranes of a young Apricock, with part of the Seed-branch.*

F. 7. *the two Membranes cut by the length.*

TAB. LXXXI. F. 1, *The outer and midle Coats or Membranes; with the Chanel, oval at both ends, now formed in the latter.*

f. 2, *Part of the same, with the upper Oval grown larger, and the inmost Cover now also formed therein.*

f. 3. *the same with the inmost cover grown larger.*

f. 4. *the Inmost Cover more magnified, and the hollow in the smaller end, laid open, to shew the Seed it self, newly begun in a round Node.*

f. 5. *the same; in which the Node begins to be divided into two Lobes.*

f. 6,7, 8, *the gradual forming of the Lobes.*

f. 9, *next the forming of the Radicle.*

f. 10, 11, *Its gradual contraction at the point, into a short and slender Navle string.*

Which in the further growth of the Seed, breaks and disappears.

TAB. LXXXII. a a, *the Pulp, or open Parenchyma.*

b b, *the close Parenchyma or ground of the Stone.*

c c, *the Flower-Branch running through the body of the Stone.*

d d, *the Seed-Branch striking into the hollow of the Stone, and so running round the outer Membrane* e e.

f f, *the middle Membrane.*

g g, *the Chanel.*

h, *the inner Membrane, in which lies the Seed.*

TAB. LXXXIII. f. 1. *the manner of the generation of the Essential Salts of Plants.*

f. 2, *a Crystal of the Essential Salt of Rosemary, a little magnifyd.*

f. 3, a b, *two of Wormwood,* a, *upon the second Solution;* b *upon the first.*

f. 4, *one of* G. *Scurvygrass;* a, *one side;* b *the other.*

f. 5. *a Crystal of the Marine Salt of Rosemary.*

f. b, *of Garden Scurvy-grass;* a *the upper side;* b. *the nether.*

f. 7, *of Wormwood.*

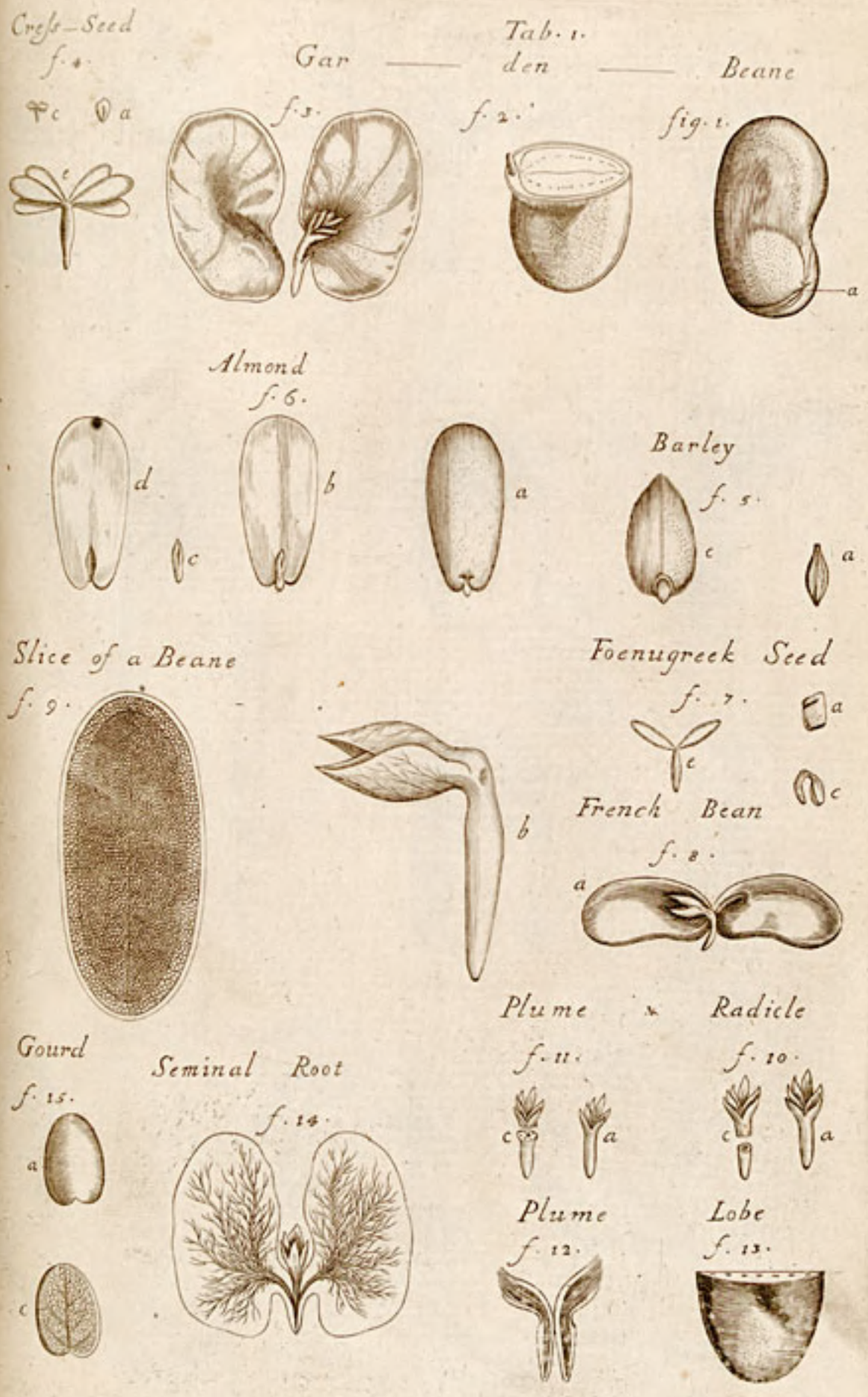
f. 8. *of Black Thorne.*

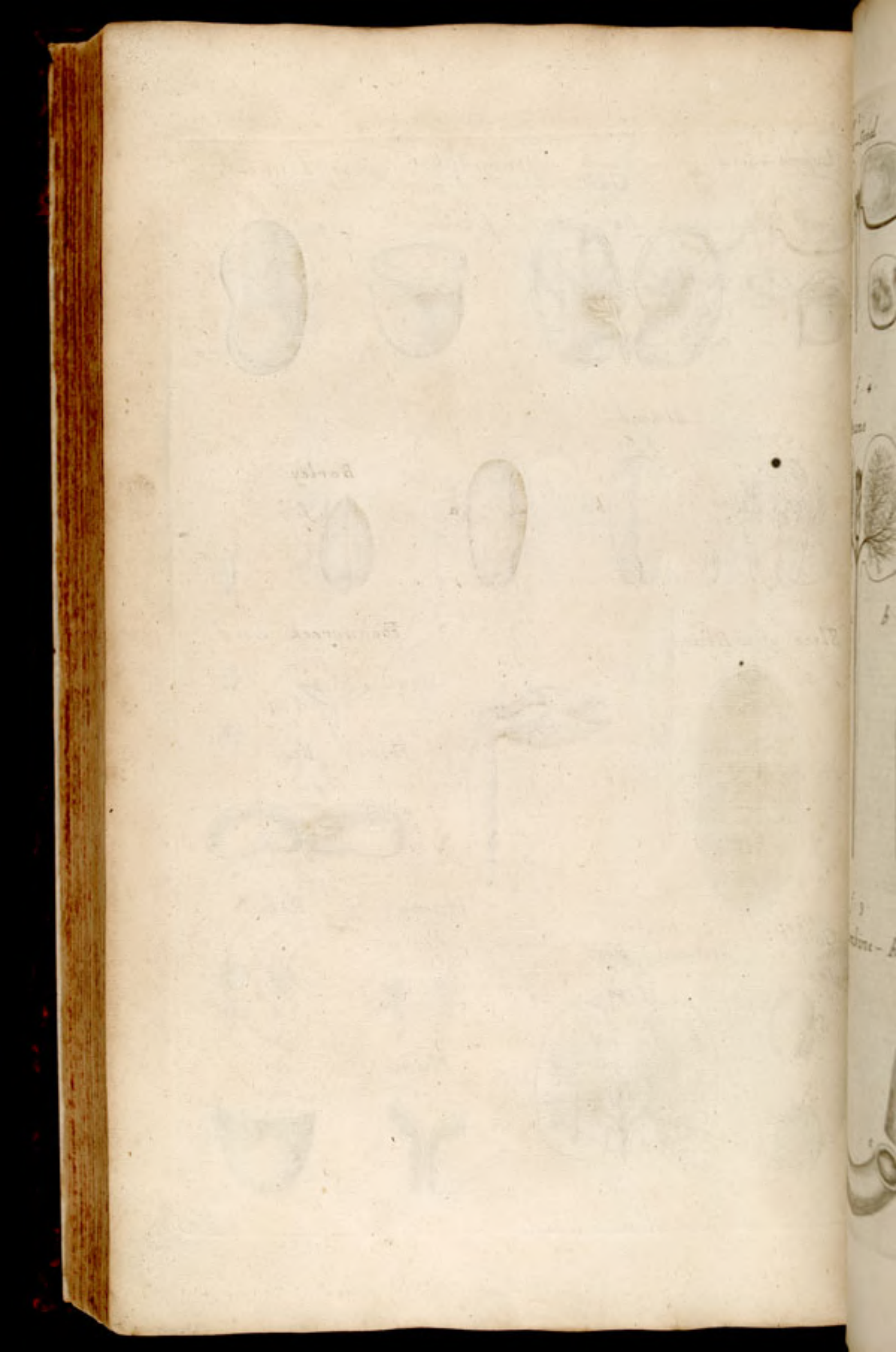
f. 9. *another of the same.*

f. 10, *of Firne.*

f. 11, *another of Wormwood.*

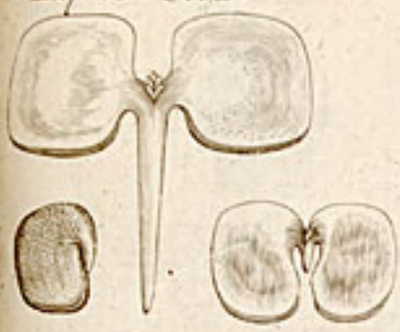
FINIS.


Cress-Seed
f. 4.
c
a
e
Tab. 1.
Gar — den — Beane
f. 3.
f. 2.
fig. 1.
a
Almond
f. 6.
d
c
b
a
Barley
f. 5.
c
a
Slice of a Beane
f. 9.
b
Foenugreek Seed
f. 7.
a
c
c
French Bean
f. 8.
a
Plume & Radicle
f. 11.
f. 10.
c
a
c
a
Gourd
f. 15.
a
c
Seminal Root
f. 14.
Plume
f. 12.
Lobe
f. 13.



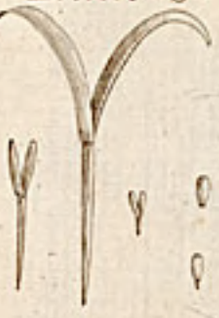
Tab. 2.

fig. 1.
Lupine – Seed.

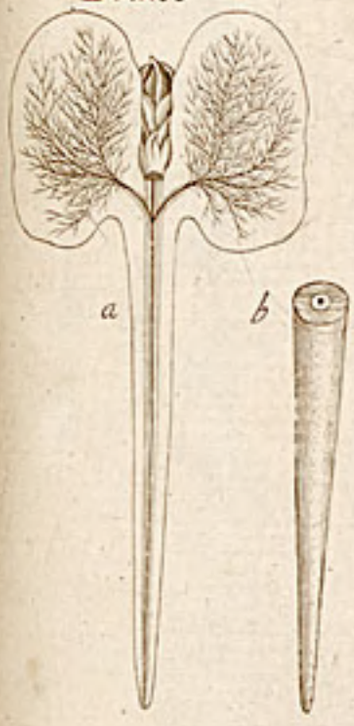


f. 2. Cucumer – S.

f. 3. Lettice – S.



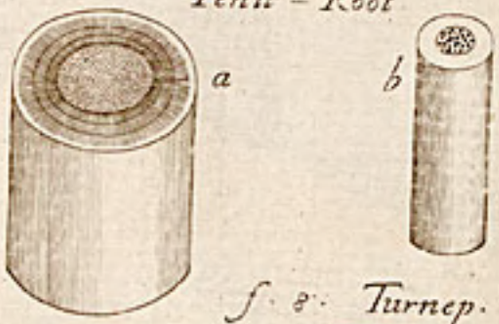
f. 4.
Beane



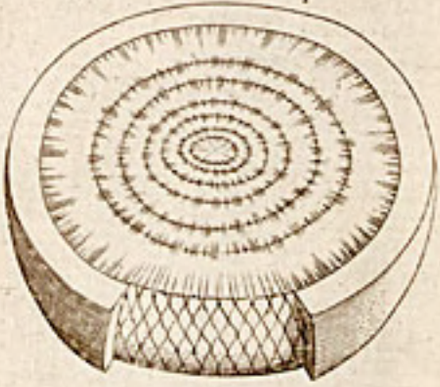
f. 5.
Vine – Root

f. 6.
Plume – Root

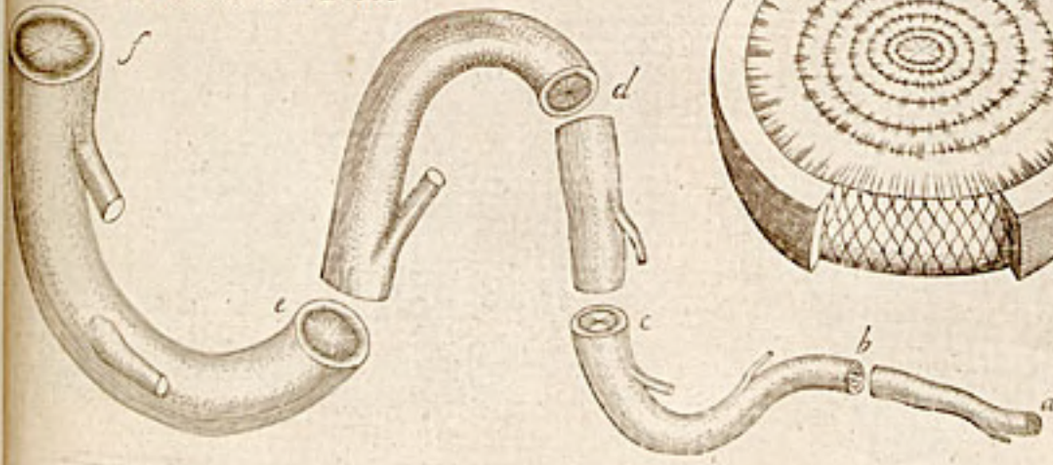
f. 7.
Fenil – Root

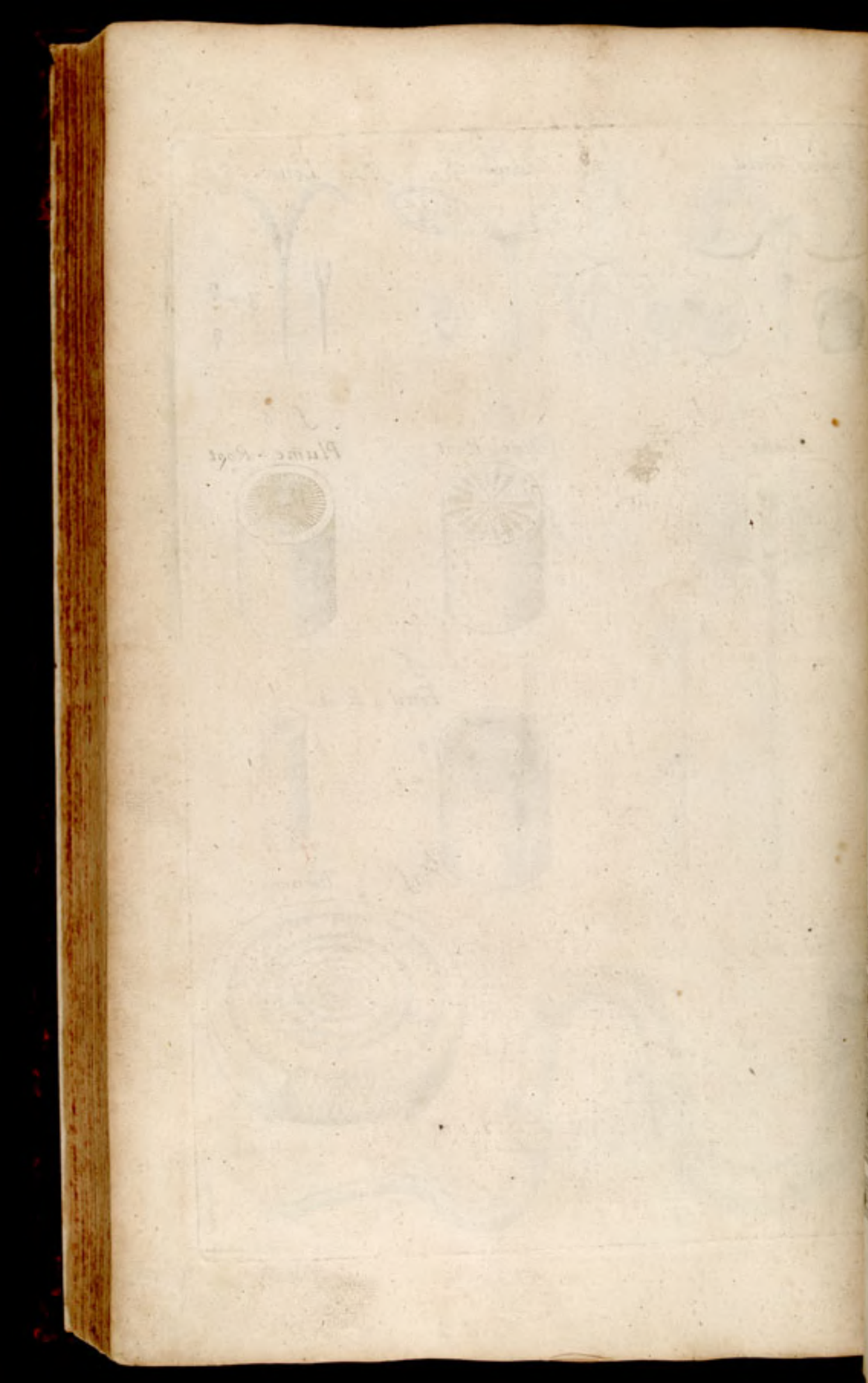


f. 8. Turnep.

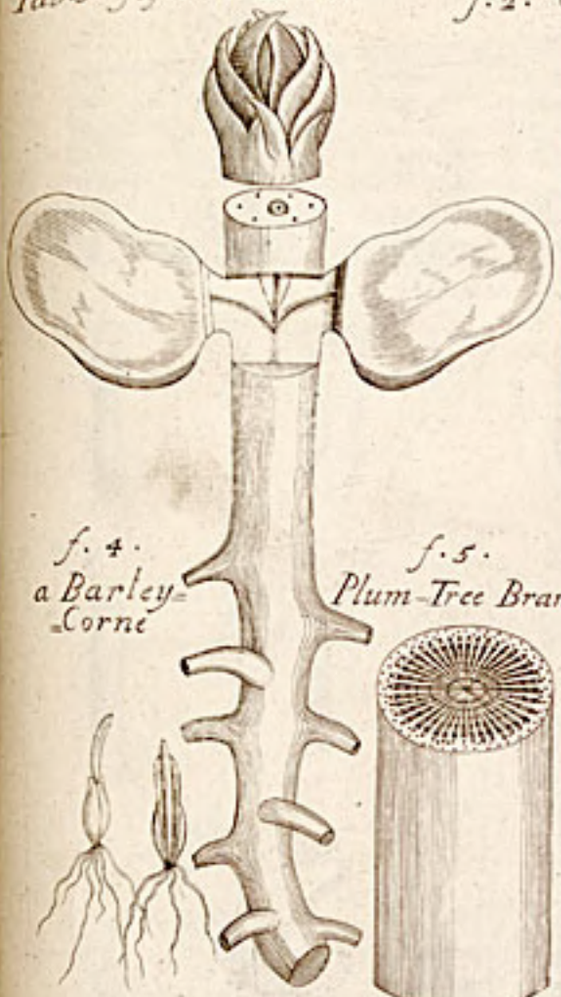


f. 9.
Columbine – Root





Tab 3. fig. 1. a Beane



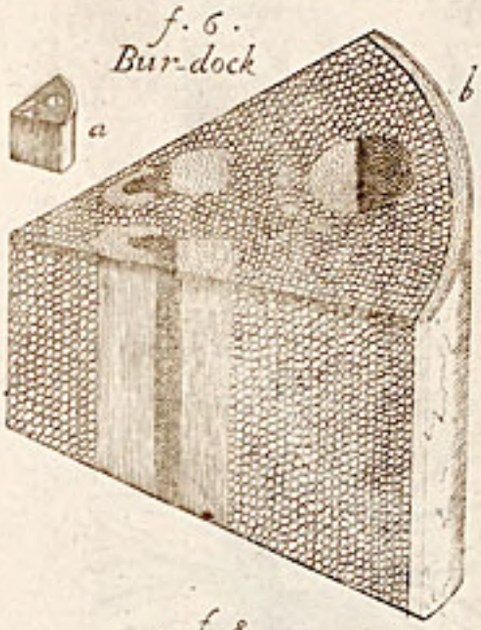
f. 2. Oak-Wood.

f. 3. Peice of Cane

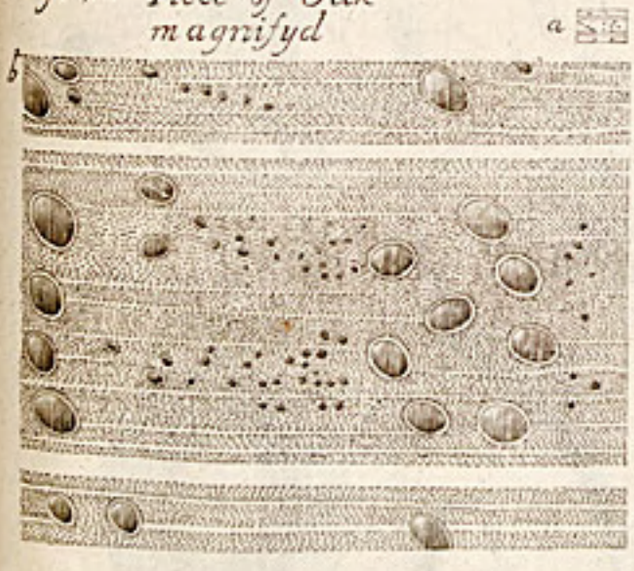
f. 4.
a Barley-Corne

f. 5.
Plum-Tree Branch

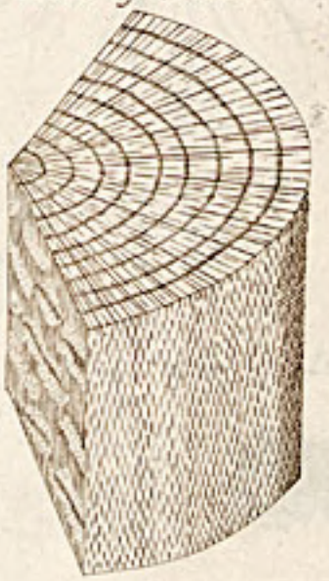
f. 6.
Bur-dock

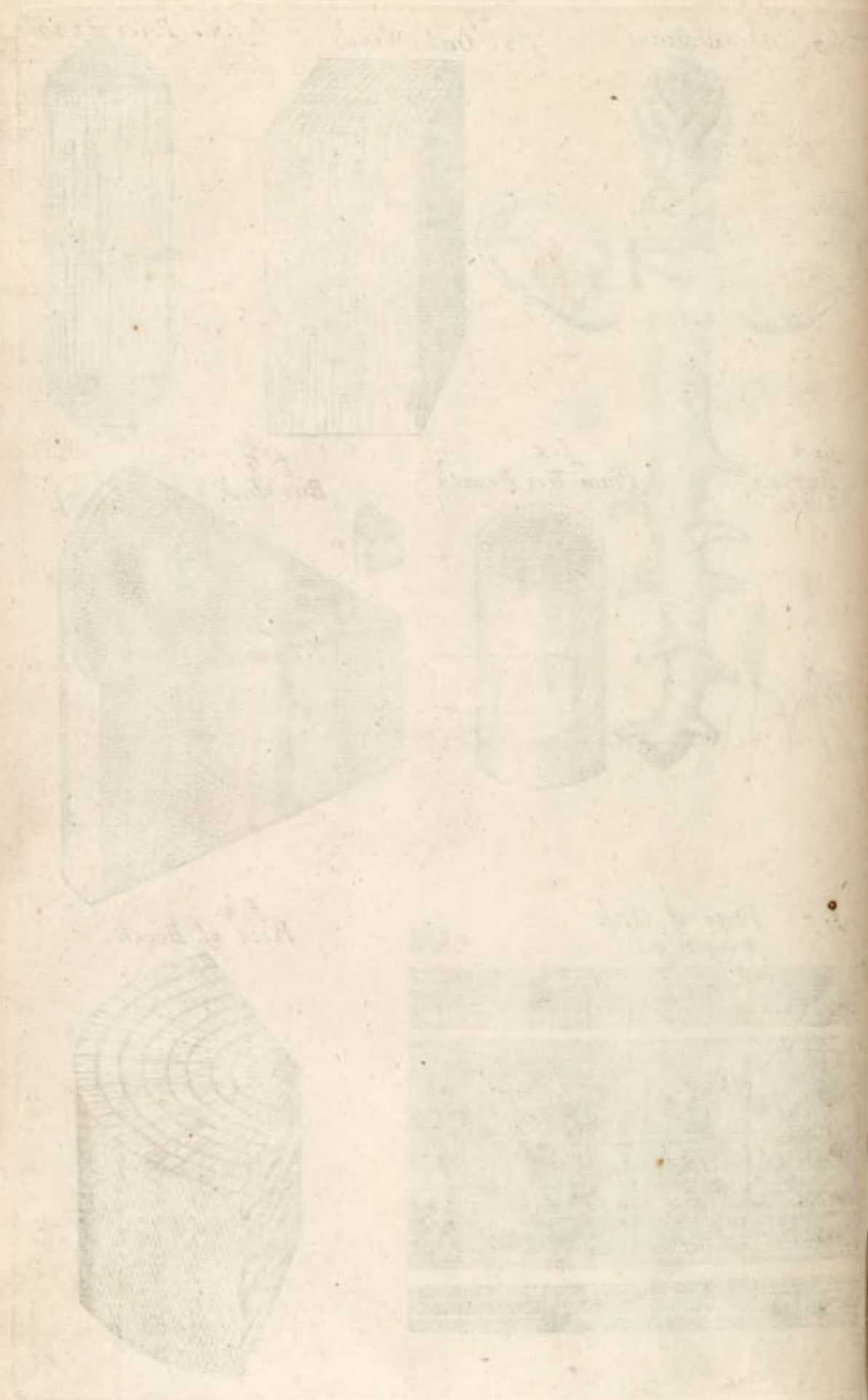


f. 7. Piece of Oak magnifyd



f. 8
Piece of Beech





Tab. IV. Piece of Beech Wood

fig. 1.

Stalkes of ye Leafes of

Asarum f. 2.

Cichory f. 3.

Cabbage f. 4

Colts foot f. 5

Endive f. 6

Ivy f. 7

Dock f. 8

Mint f. 9

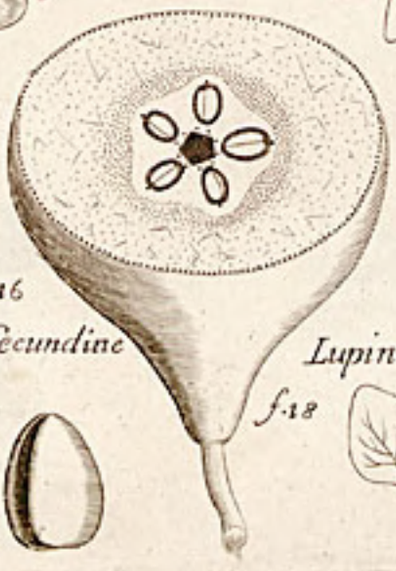
Borage f. 10

Mullein f. 11

Lily f. 12

a

Peare f. 14



Peruvian Starwort f. 13

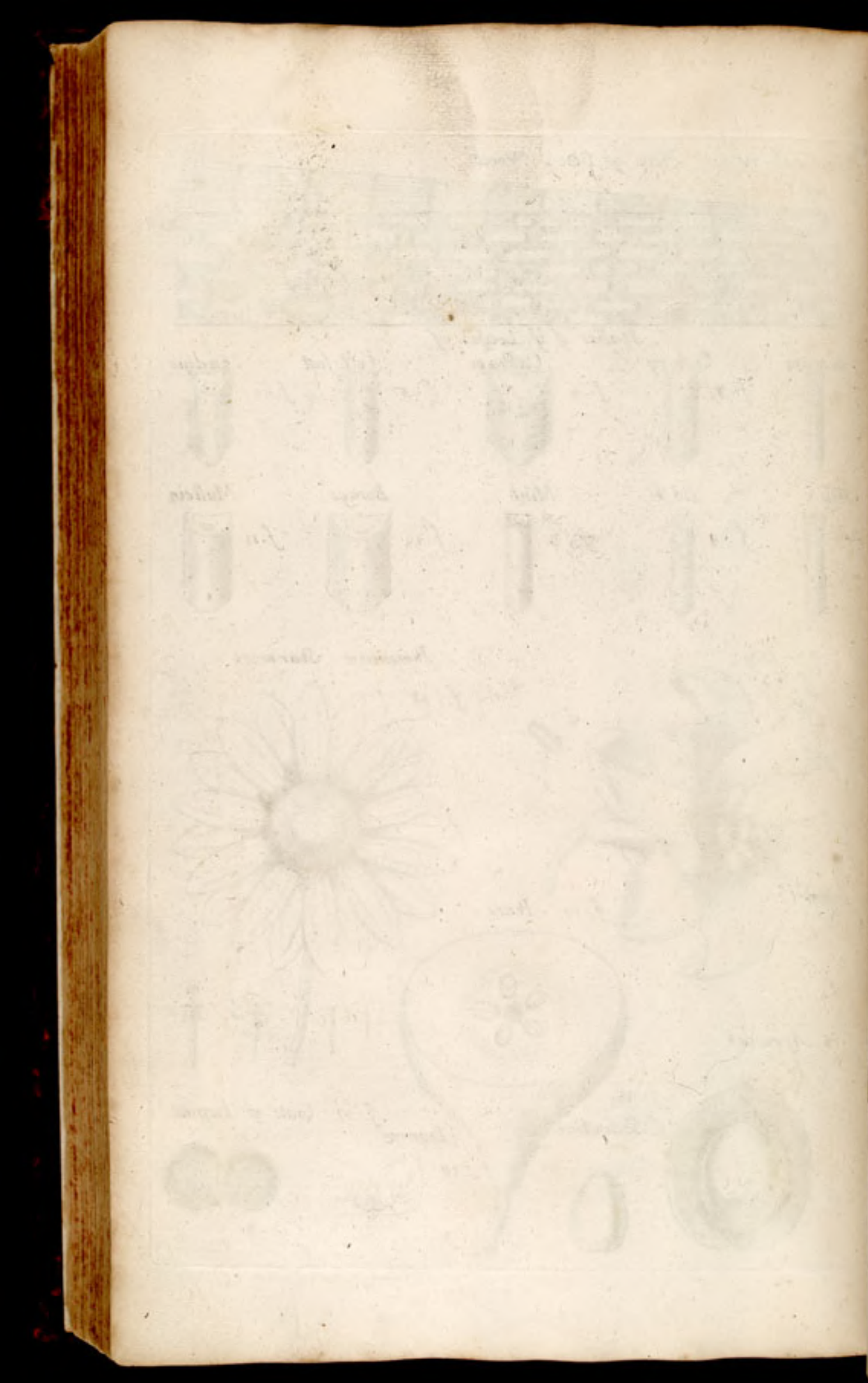
d c b a

f. 15 Aprecock

f. 16 ye Secundine

Lupine f. 18

f. 17 Coats of lupine



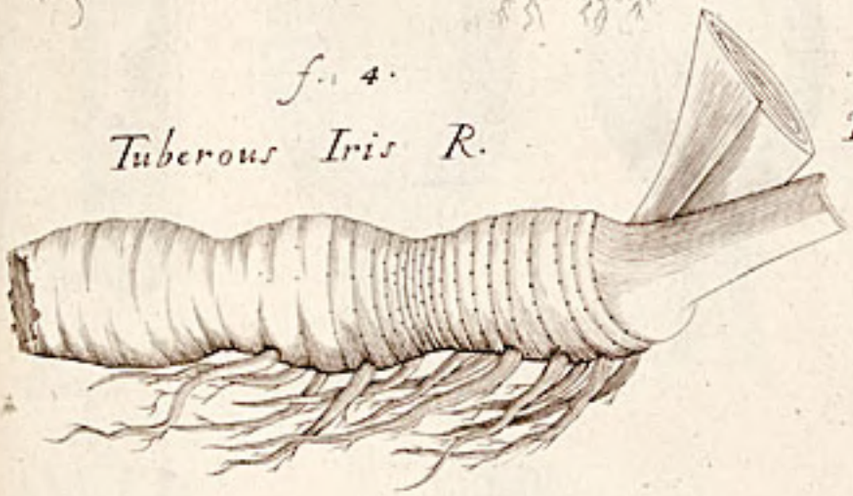
Tab: 5.

fig. 1.
Primrose Root

f. 2.
Wood-sorrel R.

f. 3.
Deuils-bitt R.

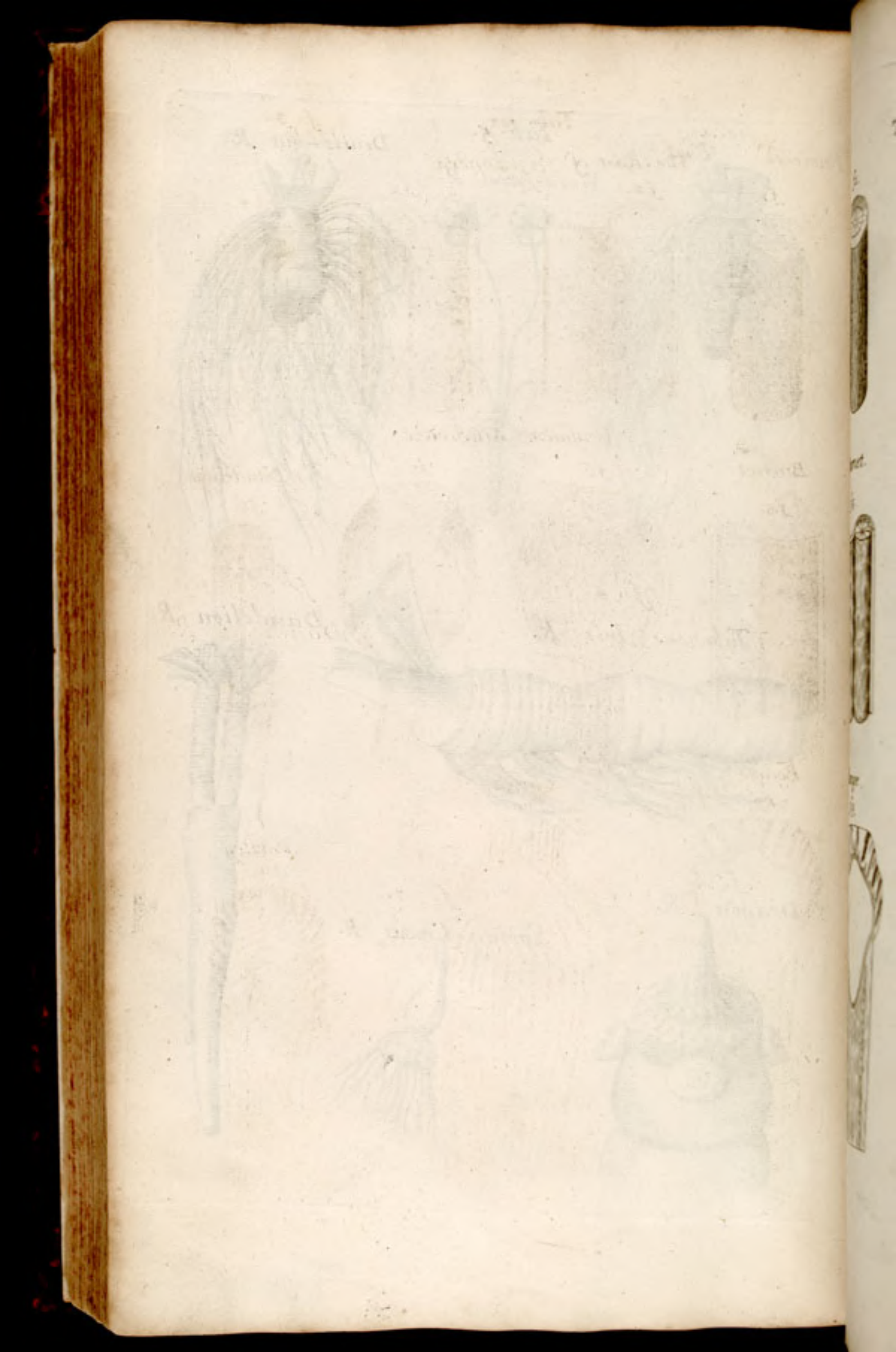
f. 4.
Tuberous Iris R.



f. 5.
Dandelion R.

f. 6.
Dragon R.

f. 7.
Spring-Crocus R.



Tab: VI.

The Root of Scorzonera.

f.1.

f.2.

f.3.

f.4.

Ierusalem Artichoake.

Burnet.

f.5.

f.6.

f.7.

Dandelion.

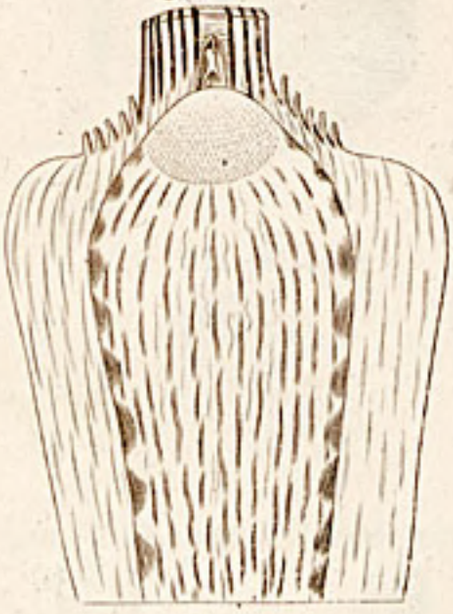
f.8.

Bonage.

f.9.

Carrot.

f.10.



Parsley.

f.11.

Tab. VII. Roots w.ch Bleed little or nothing.

Marsh Mallow. 1

Patience.

Iris.

2

3

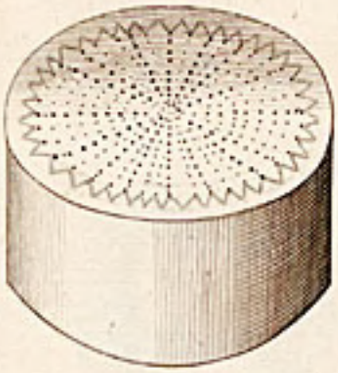
Peony.

Bistord.

Roots which Bleed a Lympha.

Bugloss.

Bryony.



Borage.

Black Henbeane.

Horse Radish.

Deadly Nightshade.

Brownwort.

Non Bulbous Lily.

Asparagus.

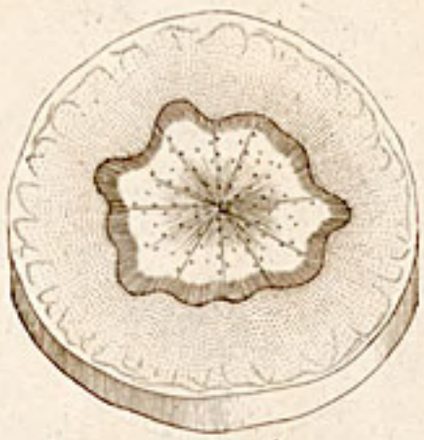
Columbine.

Tab. VIII. Roots which Bleed a Lympha.

f. 2. Carrot

f. 1. Parsnep

f. 3. Beet



f. 5. Nettle

f. 4. Ierusalem Artichoak

f. 7. Dropwort

f. 6. Valerian

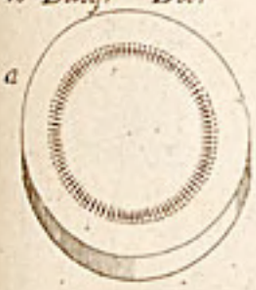
f. 8. Lychnis

Roots which Bleed a Milk or Oyly Sap

f. 10. Butyr Bur

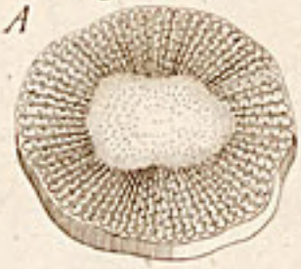
Lovage f. 9.

a



b

A



f. 11. Dandelyon

f. 12. Great Celaudine

B

f. 13. Cychory

f. 15. Bishopsweed

f. 14. Goatsbeard

Tab: 9.

Roots with Milky or Balsamick Vessels, and Lymphæducts, both apparent.

F: 1. Fenil.

F: 2. Enula camp:

F: 3. Trachelium.

F: 4. Wormwood.

Roots with two sorts of Lymphaticks; in some, Aquæducts and Muciducts.

F: 5 Gard: Scurvygrass.

F: 6. Wild Cucumer.

A

F: 6. B.

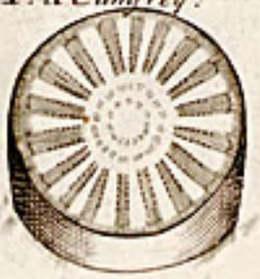
F: 7 Melilote.

F: 8. Potato.

F: 9. Cardwus benedictus.

F: 10. Eryngo.

F: 11 Cumfrey.

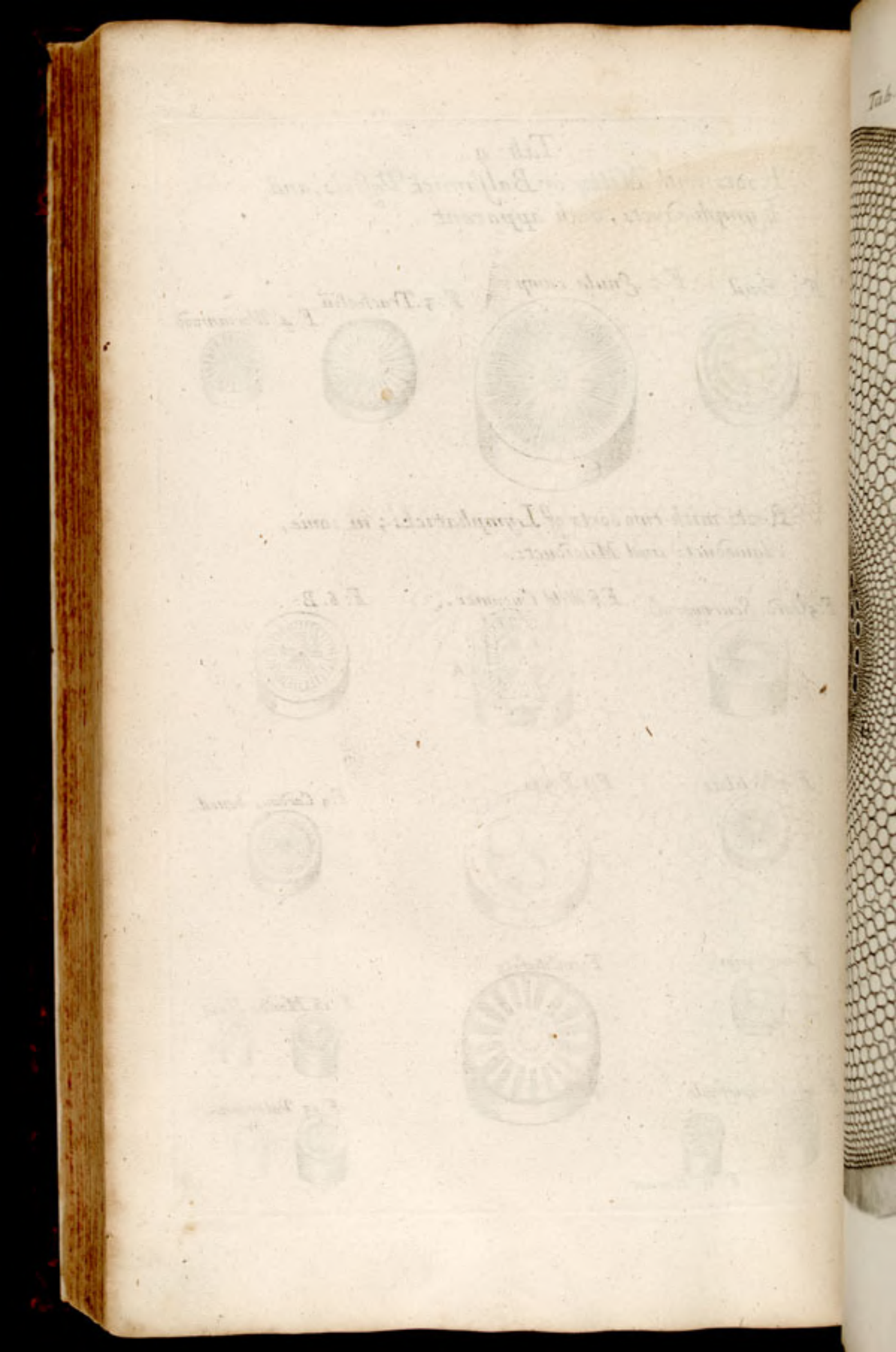


F: 12 Monks Hood.

F: 14. Cinquefoyle.

F: 15 Burnet.

F: 13. Valerian.



Tab. x.

Fig: 2. The same magnifyd

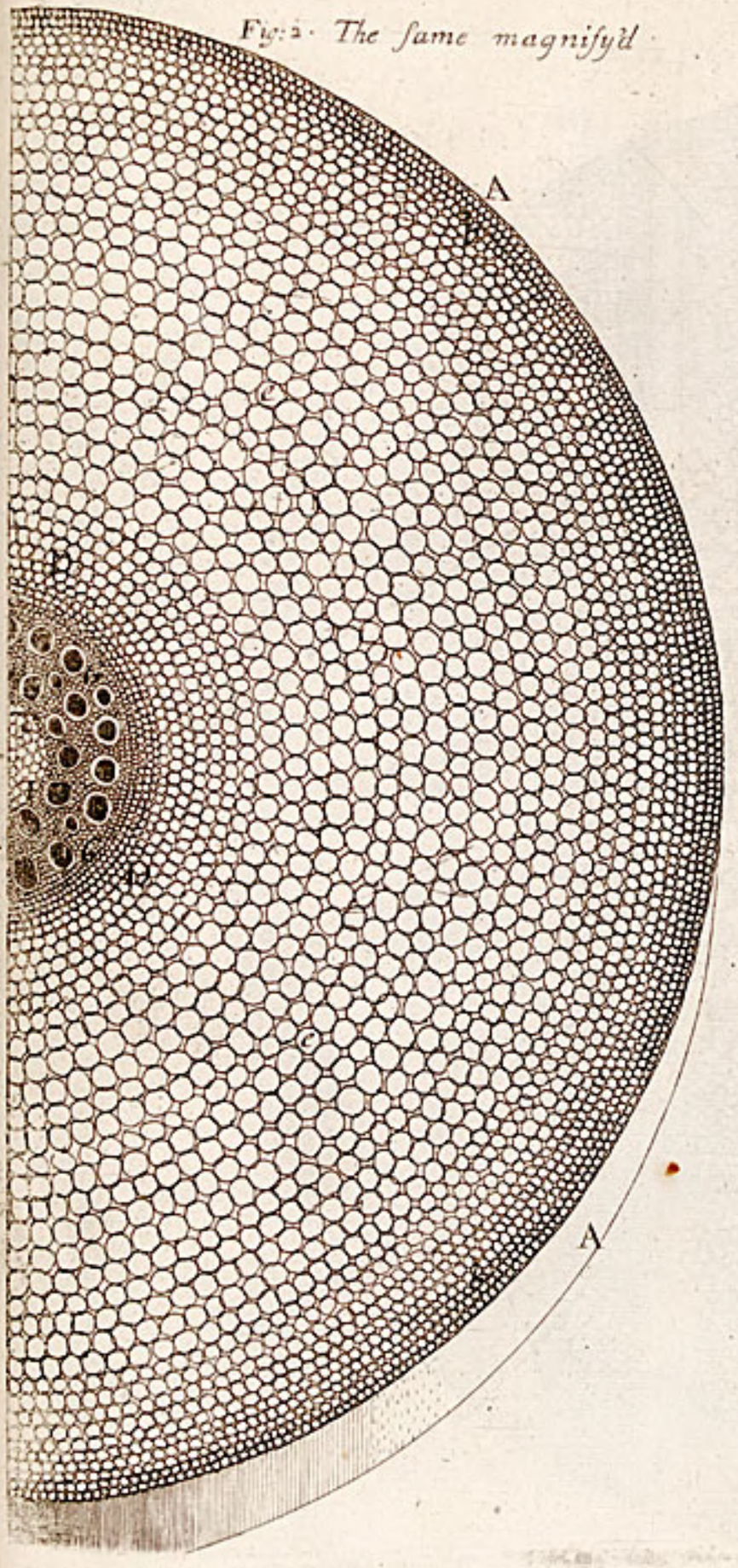


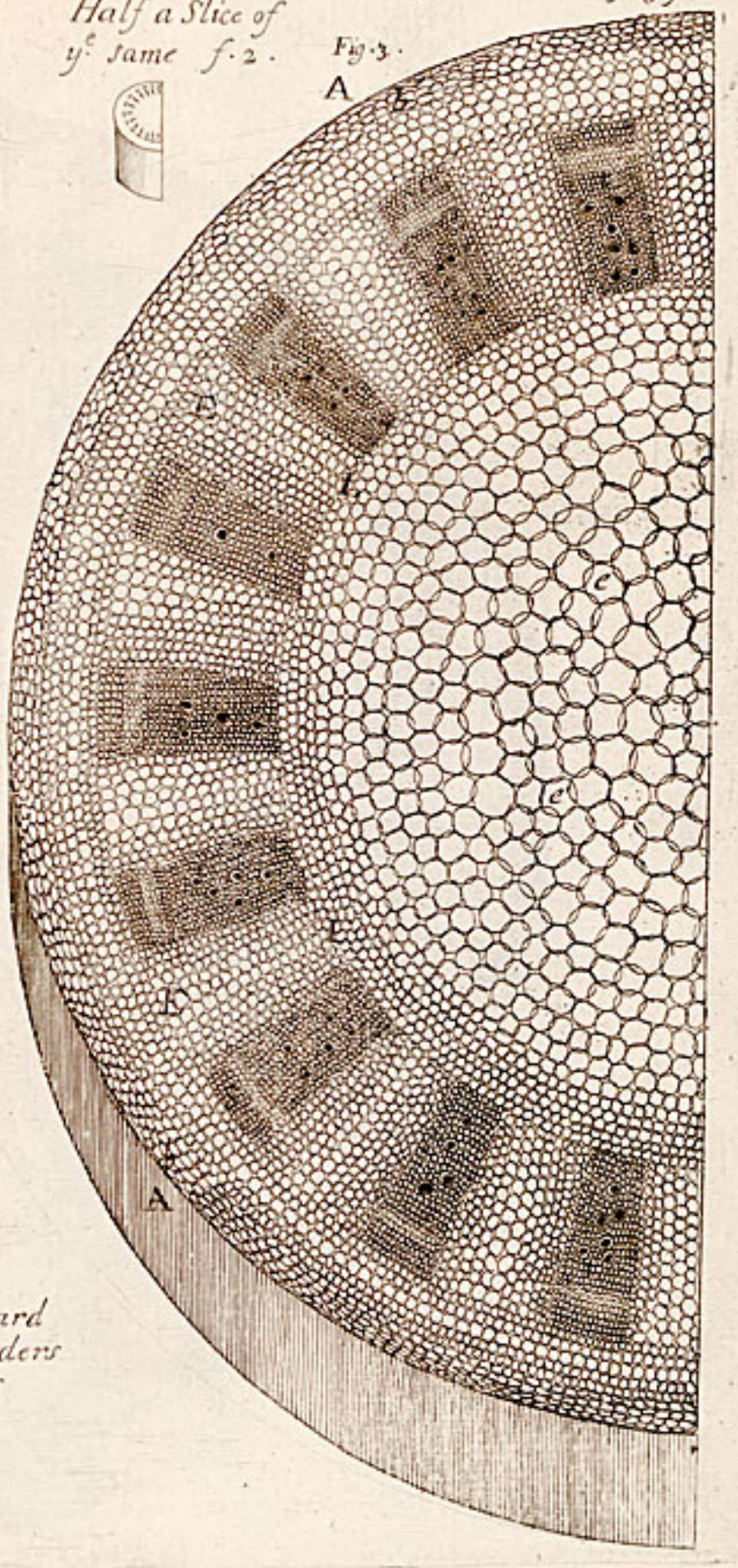
Fig 1
Small Root of
Asparagus

Root of Ierusalem Artichoak cut transversly fig. 1.

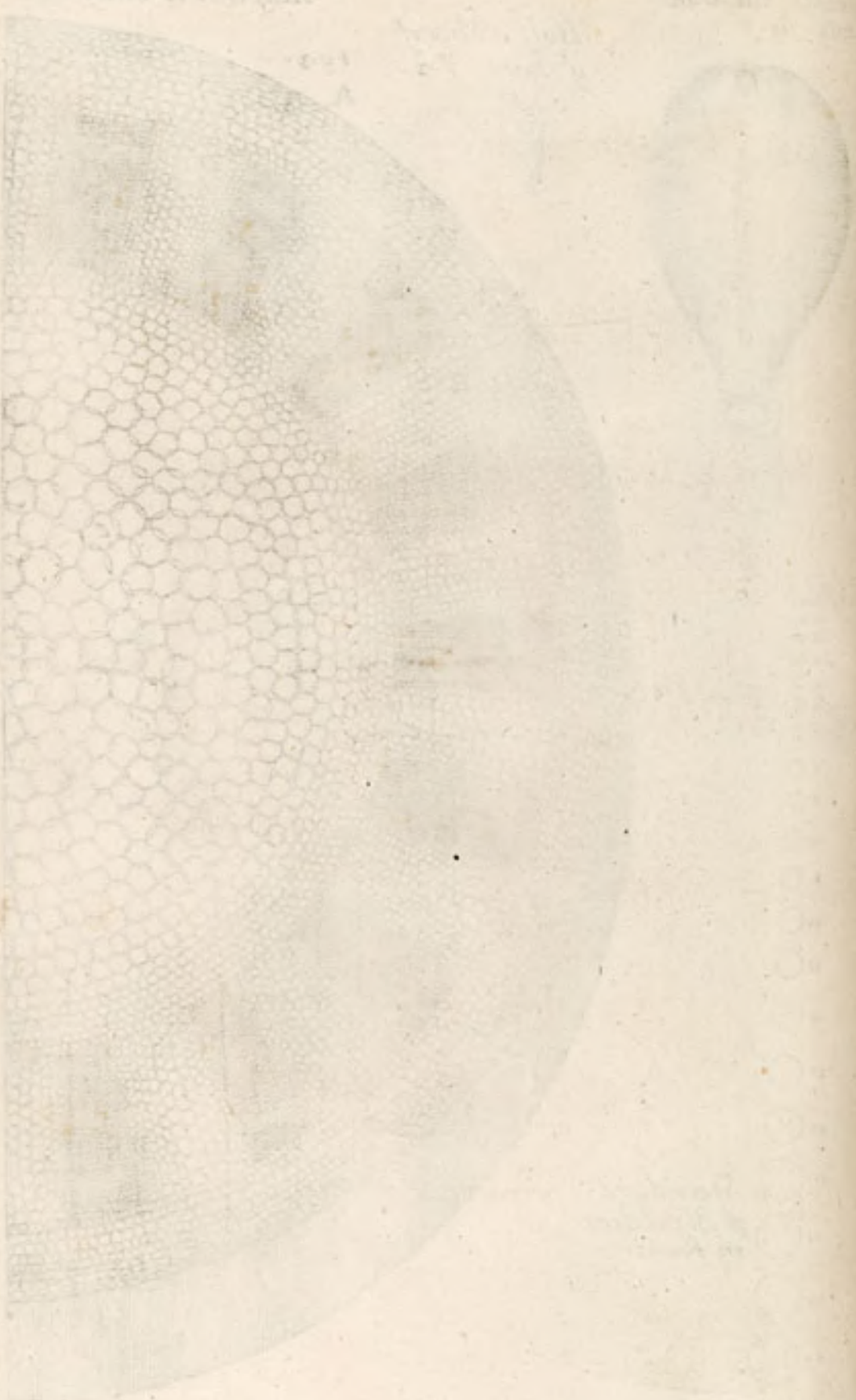
Tab. XI.

Half a Slice of ye same f. 2.

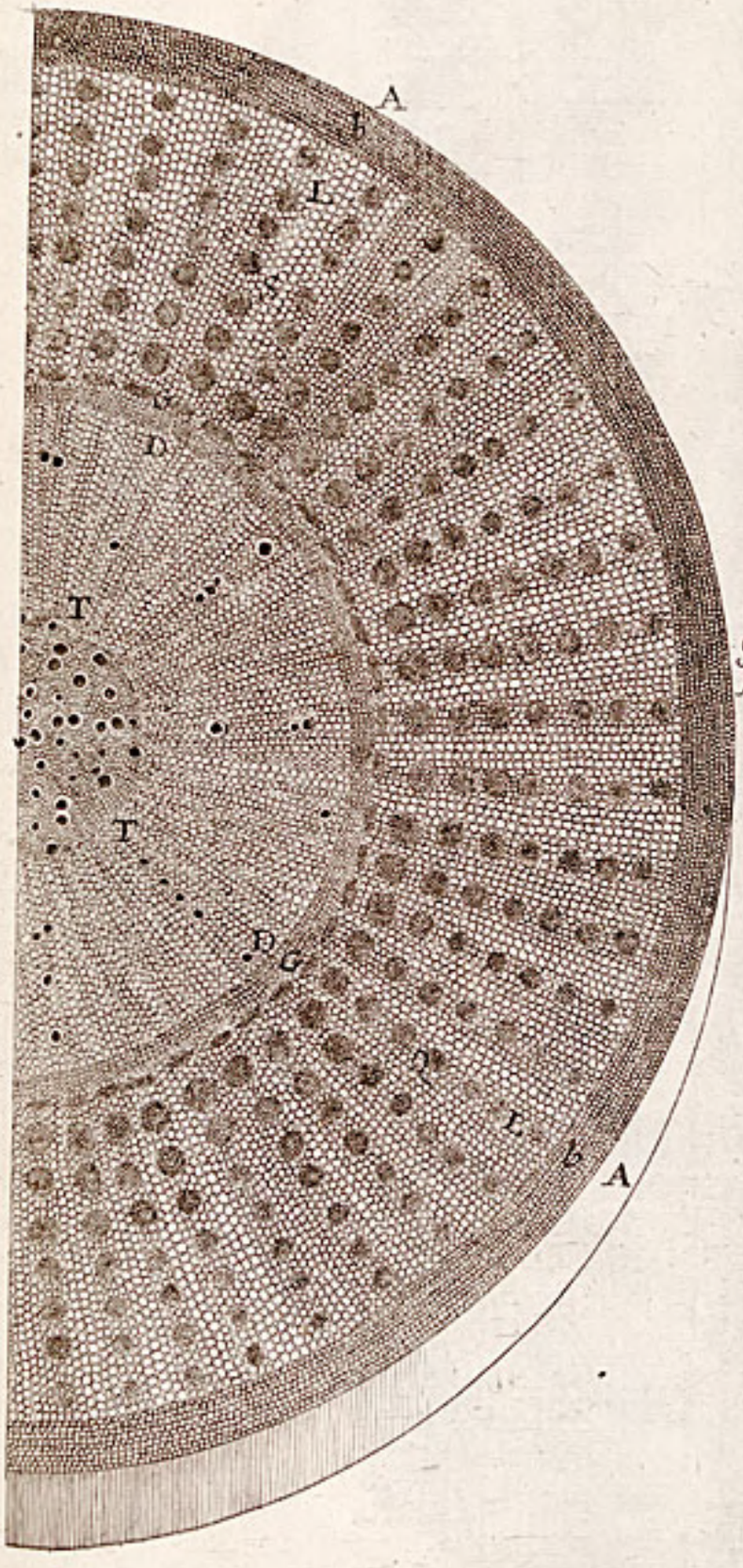
Half a Slice Magnifyd Fig. 3.



Standard of Bladders in Roots



The same Magnified Fig. 2.

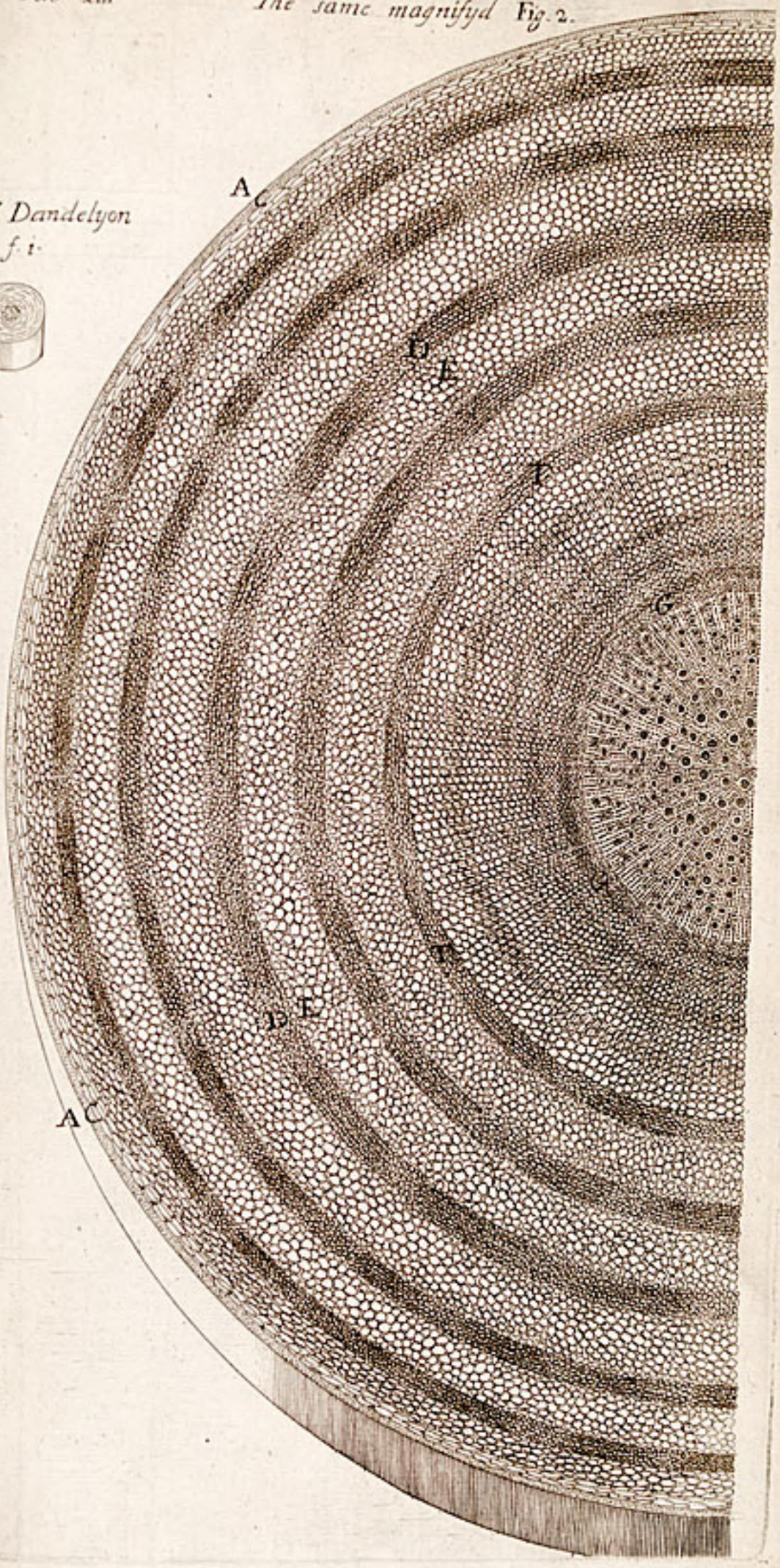


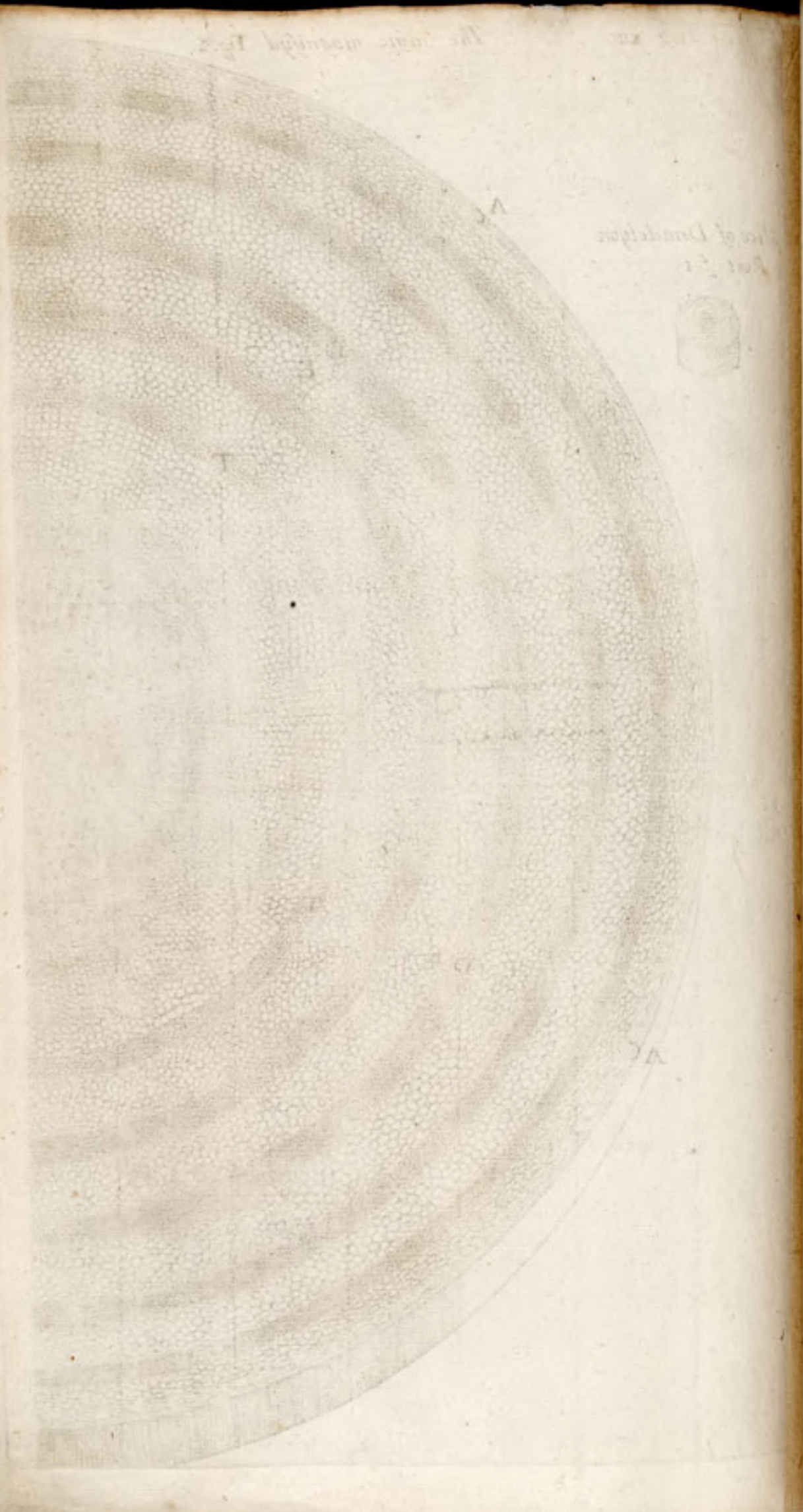
Slice of a small M. Mallow Root Fig. 1.

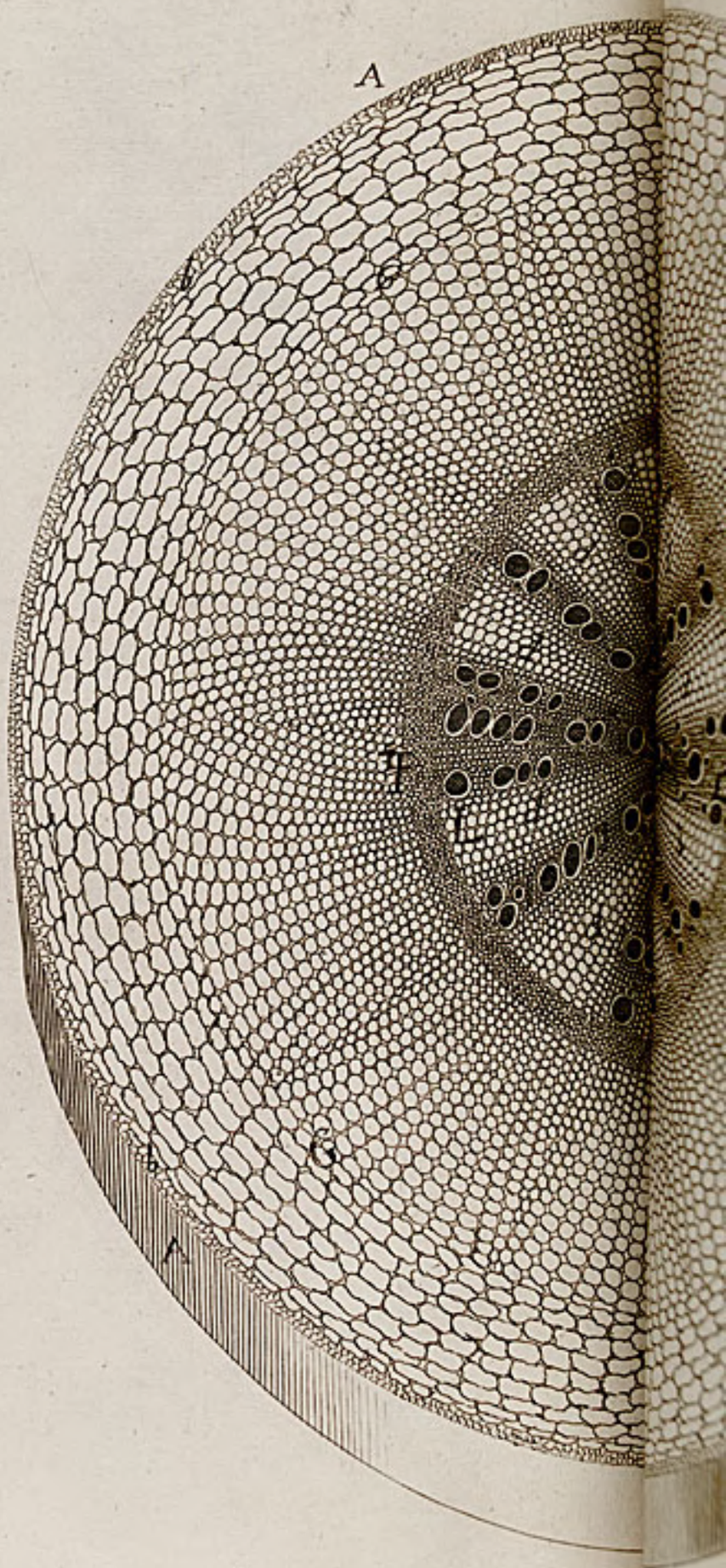
Tab XIII

The same magnifyd Fig. 2.

Slice of Dandelyon Root f. 1.







The small end of a Bugloss Root

Fig. 1.

agnify'd

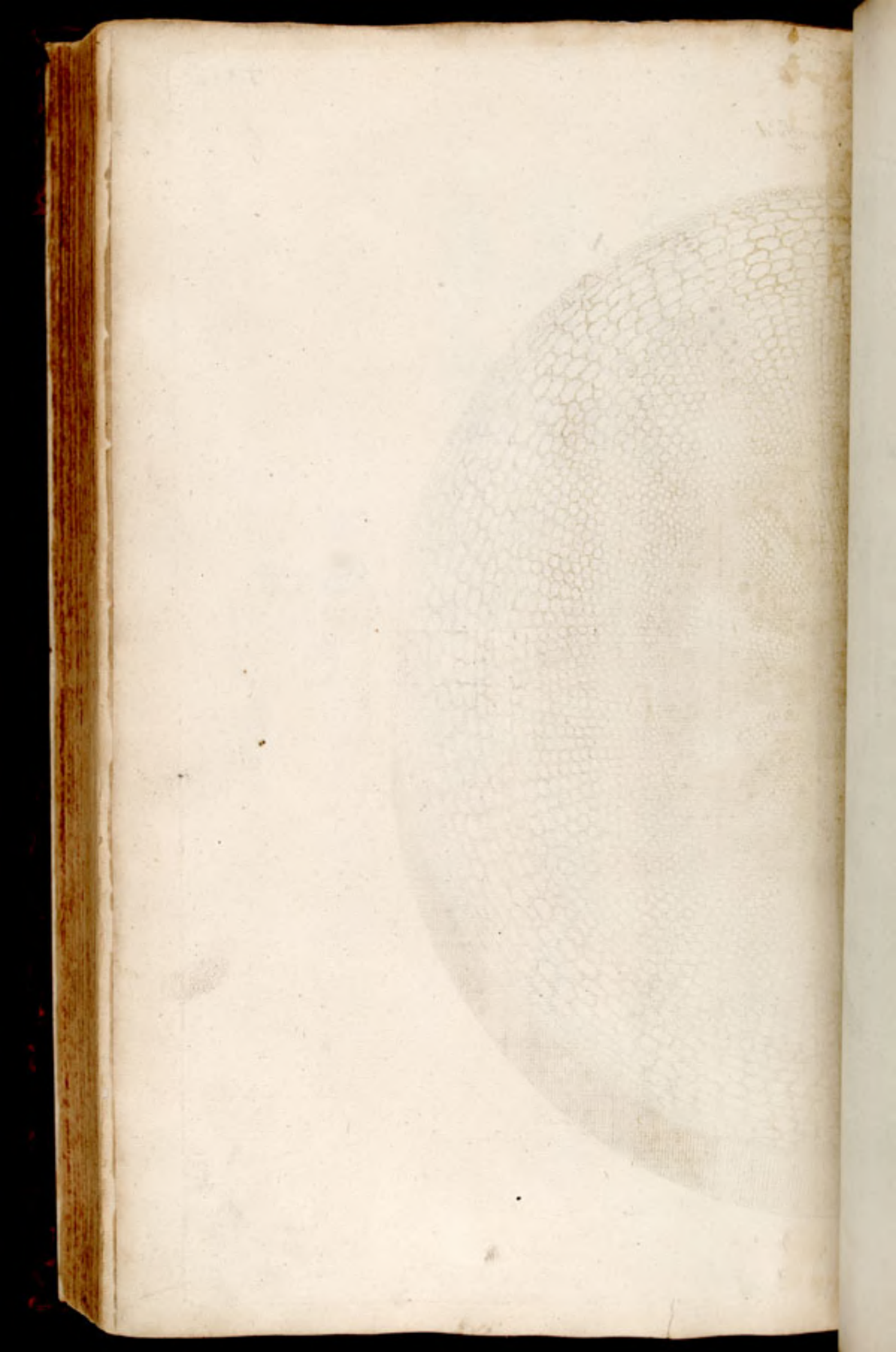
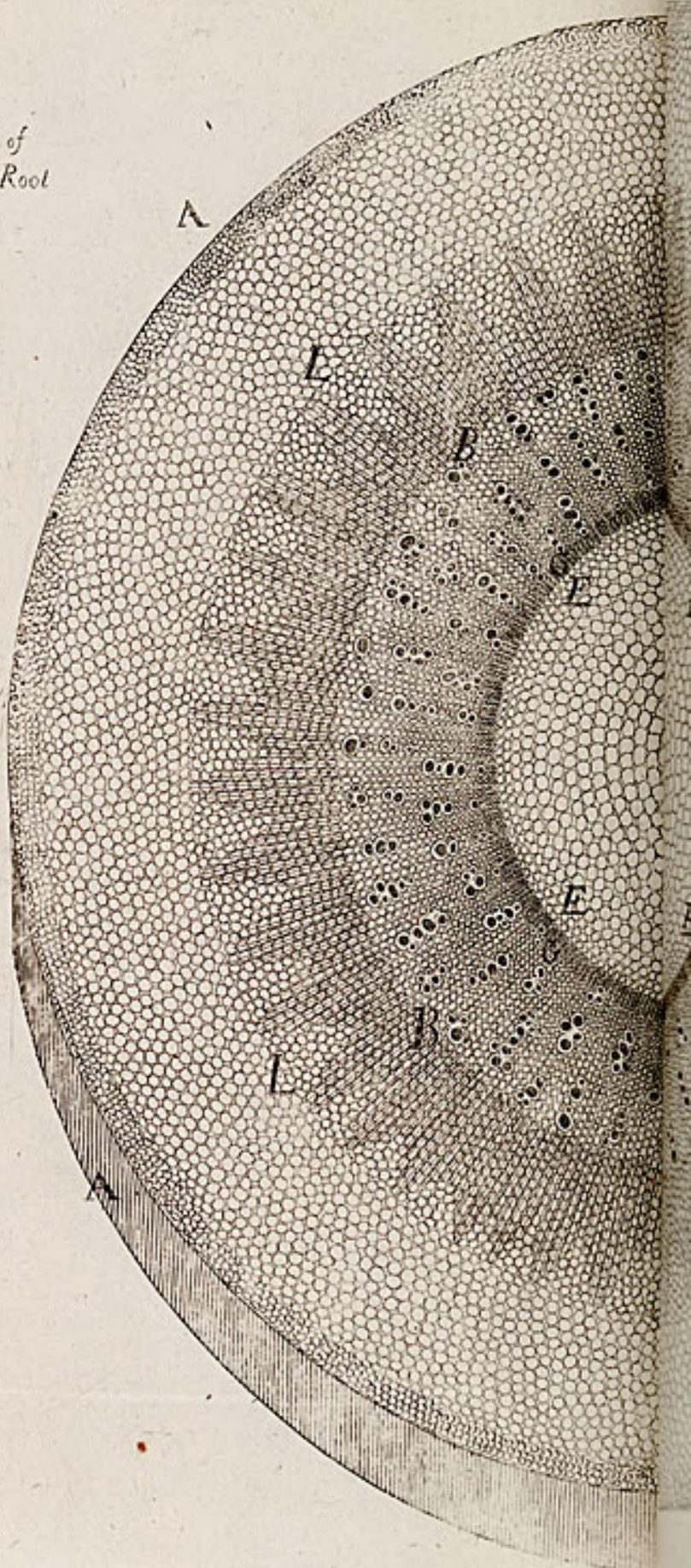
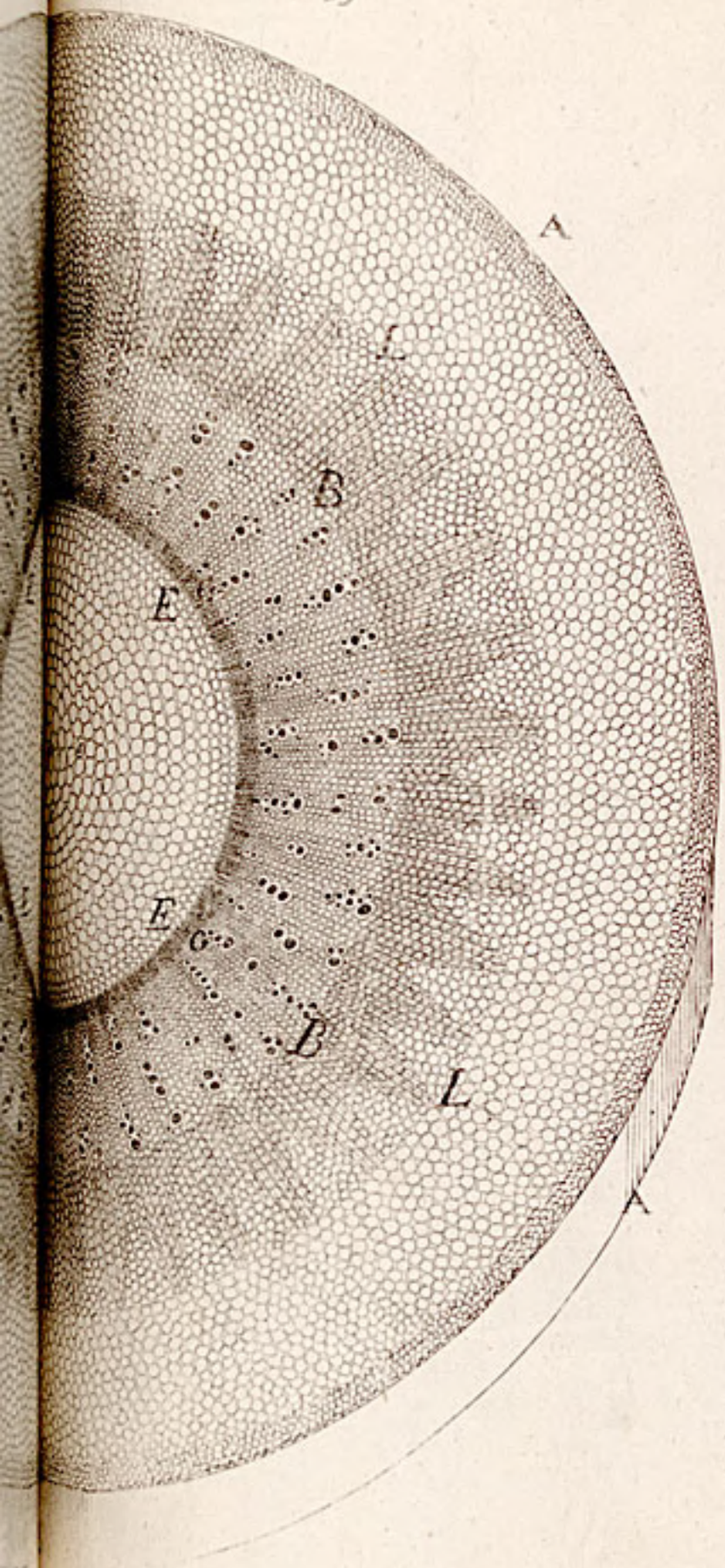


Fig. 1.

The small end of Hors-Radish Root



The same magnifyd

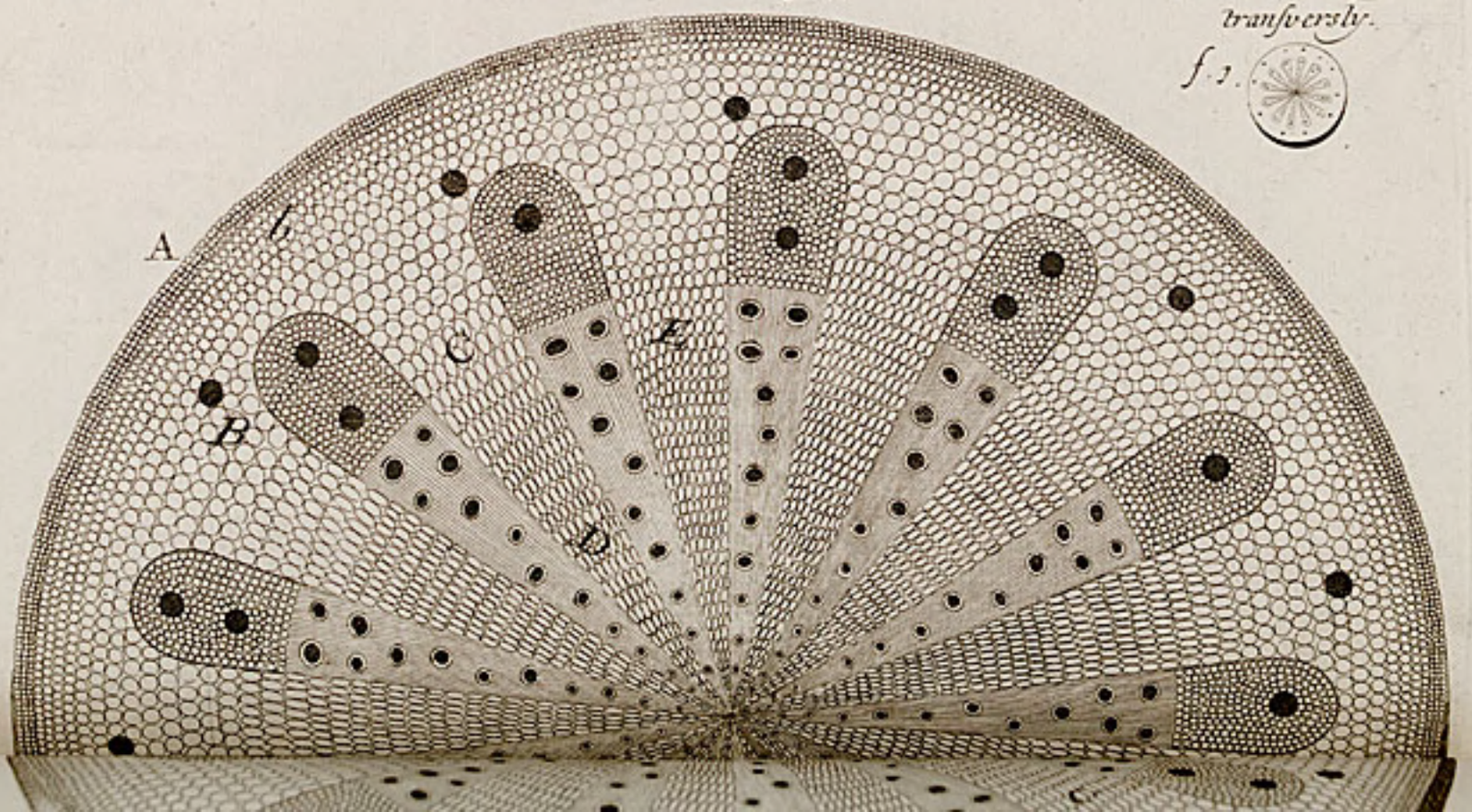


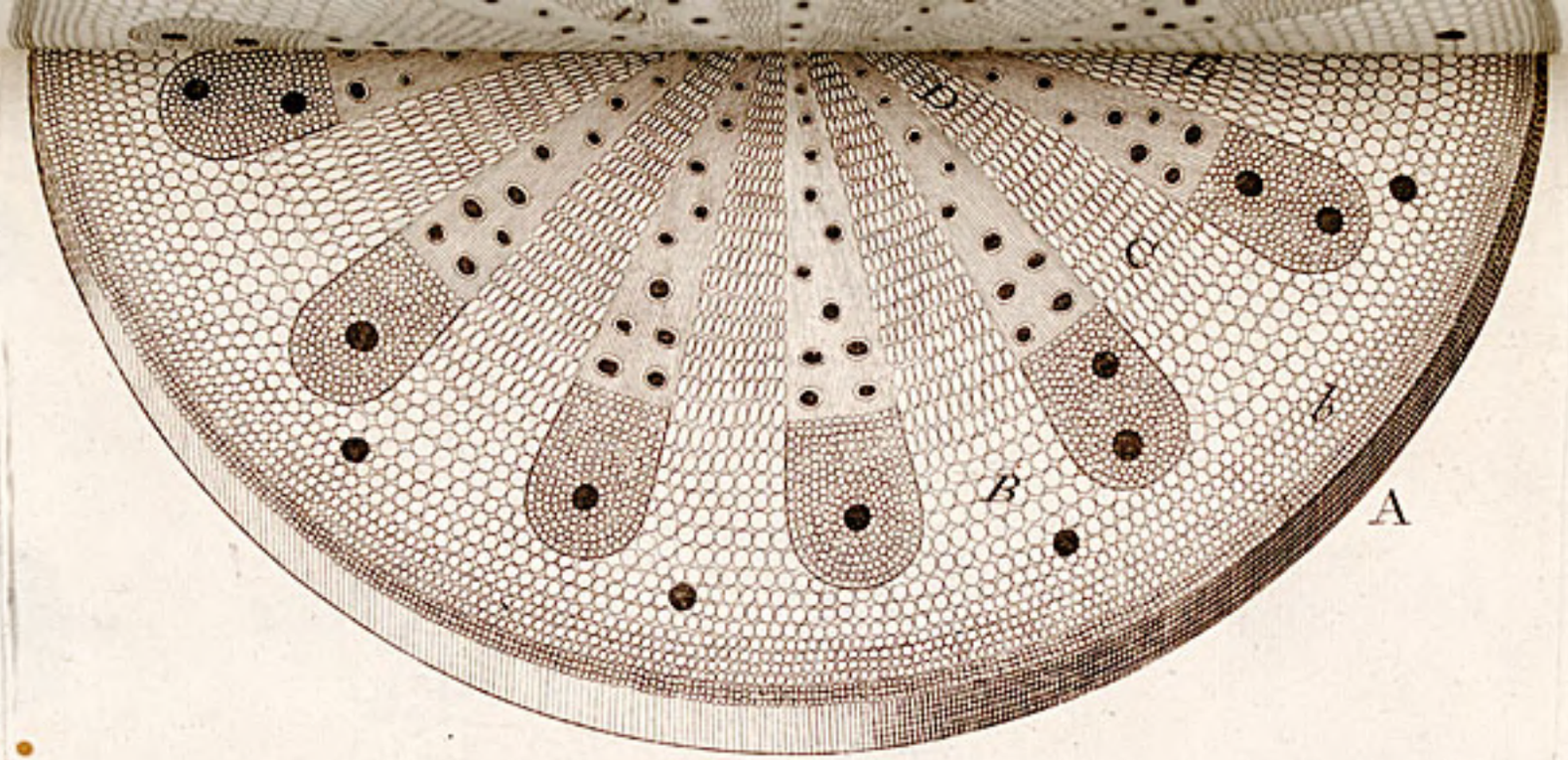
Tab. XVI.

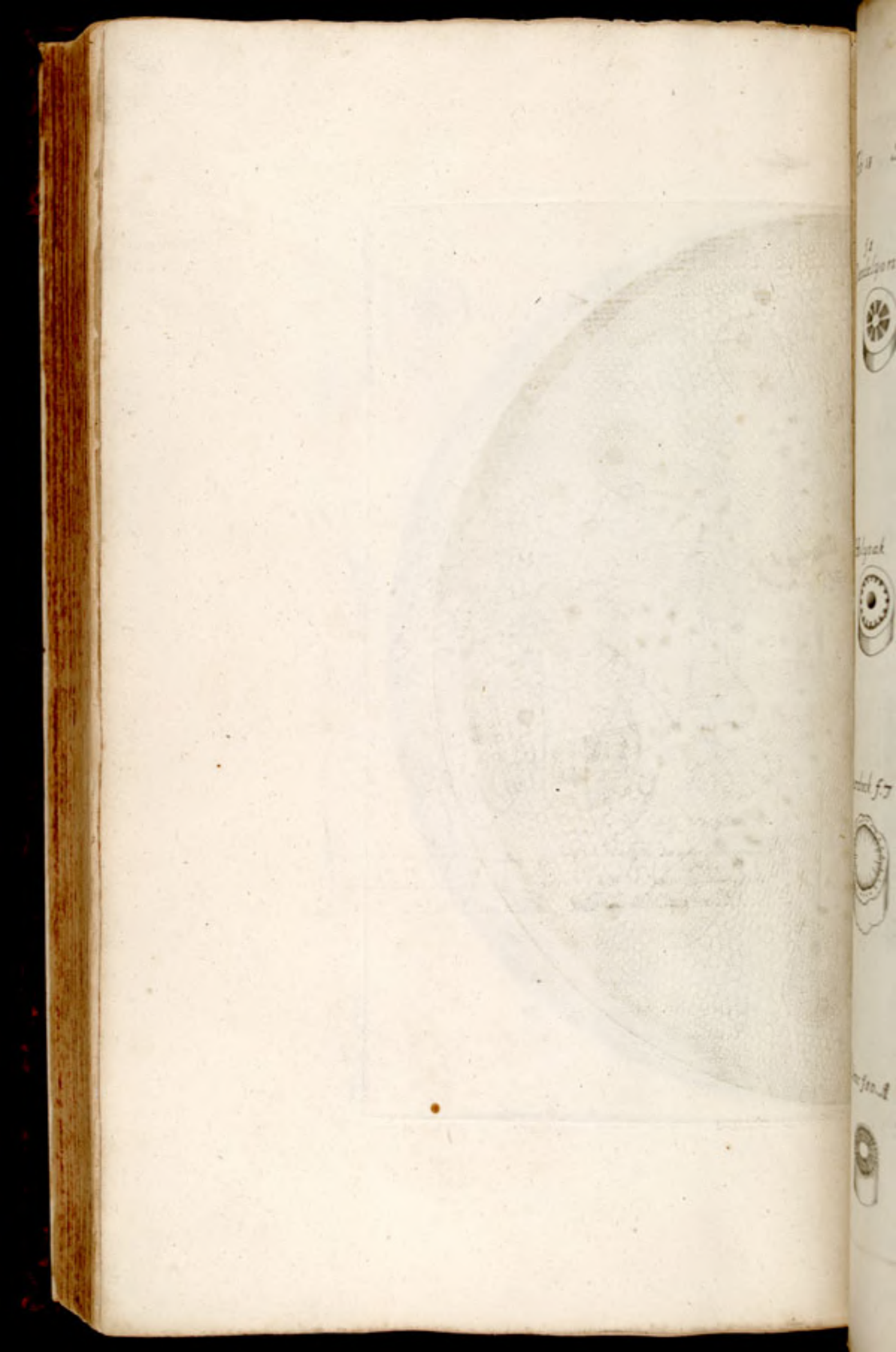
f. 2. The same Magnify'd.

Wormwood Root cut transversly.

f. 1.




D
C
B
A

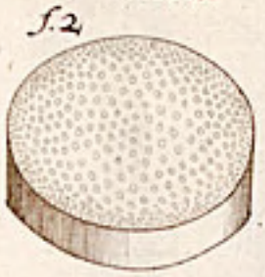


Tab 18 Stalks & Branches cut transuersly

Indian Wheat

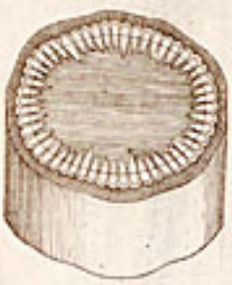
f.1
Dandelyon

f.2



Borage f.3

Colewort f.5



f.4 Holyoak

f.6
Wild Cucumer

Burdock f.7

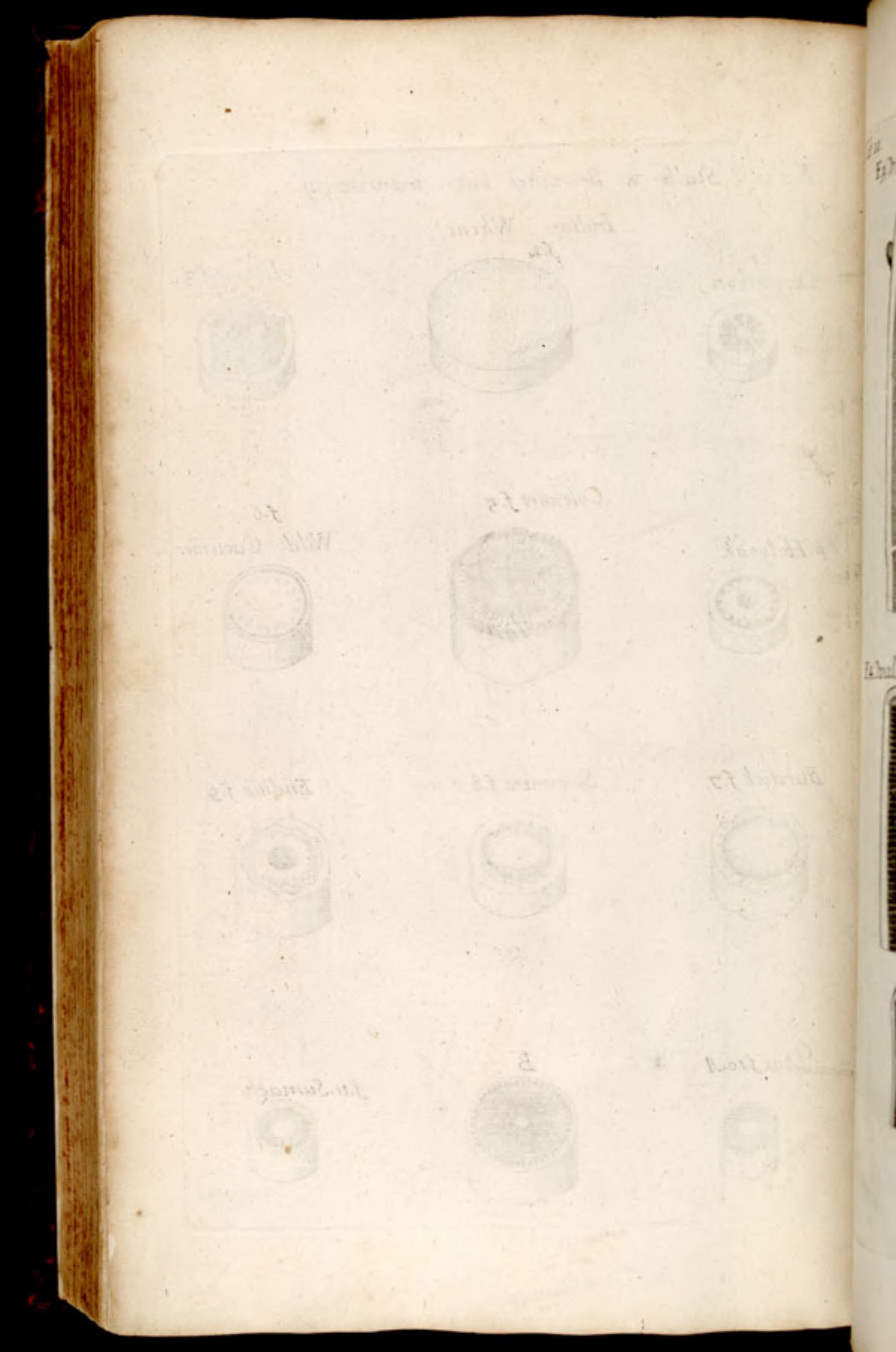
Scorzonera f.8

Endiue f.9

Vine f.10. A

B

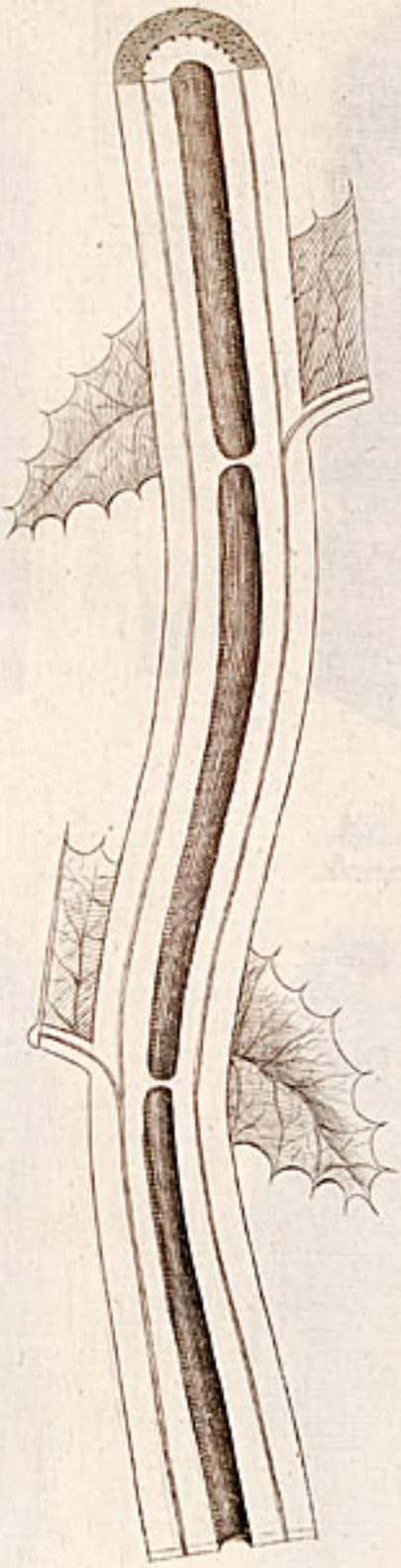
f.11. Sumach



Tab 19.

F.3. Vine.

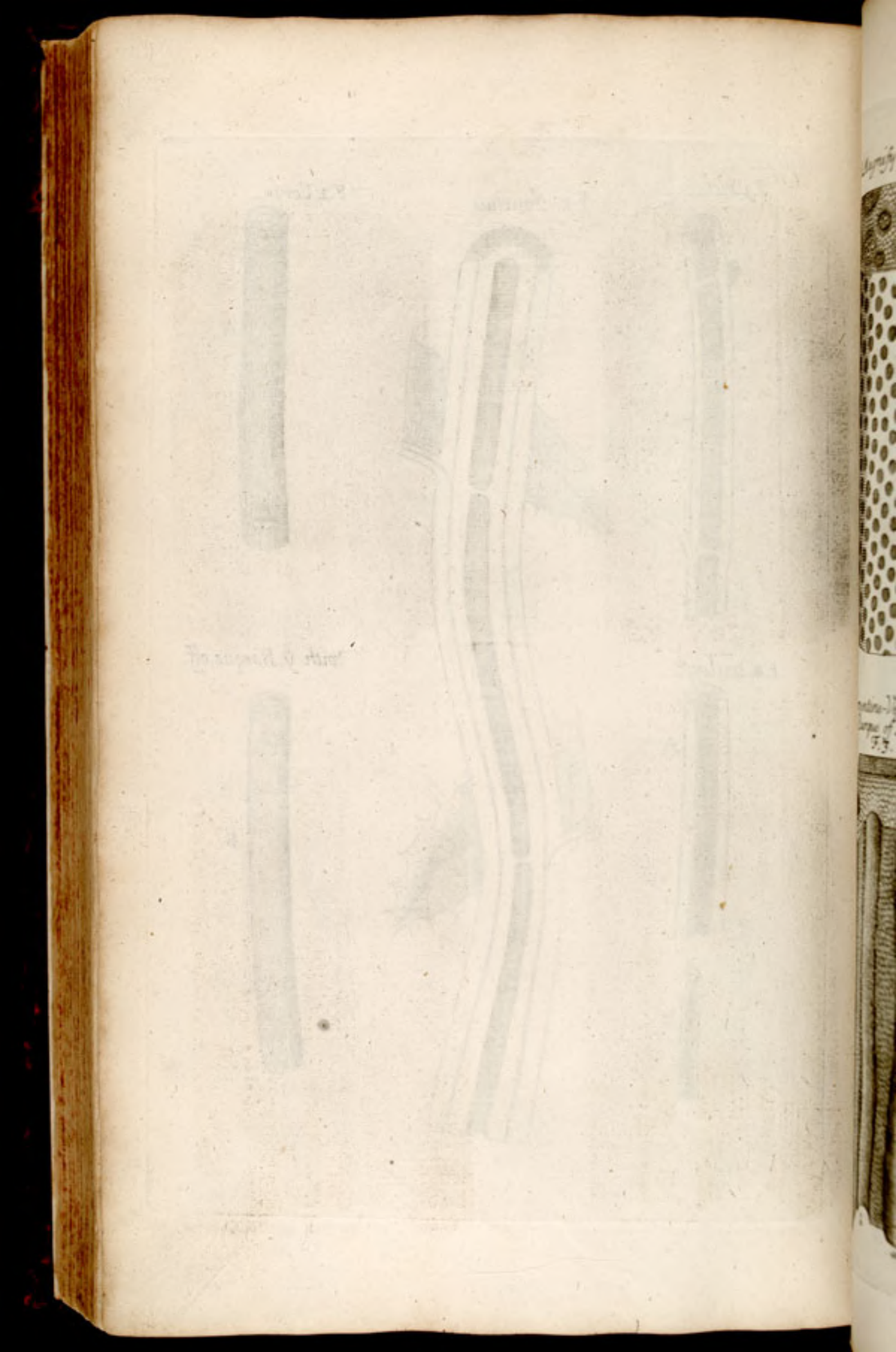
F.2. Sonchus.



F.1 Corin

F.4. Walnut.

with ye Barque off.



Tab. 20.

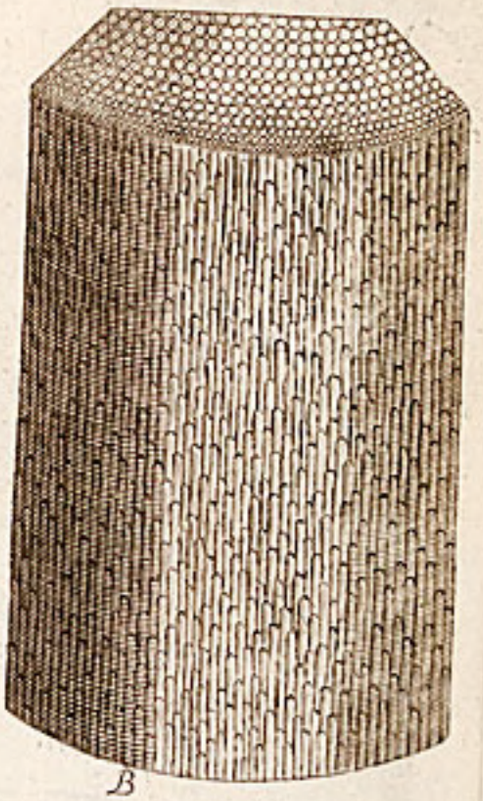
A Magnifyd.

A

the Surface of Walking-Cane. Fig. 1.

the Skin of Borage-Stalk. F. 2.

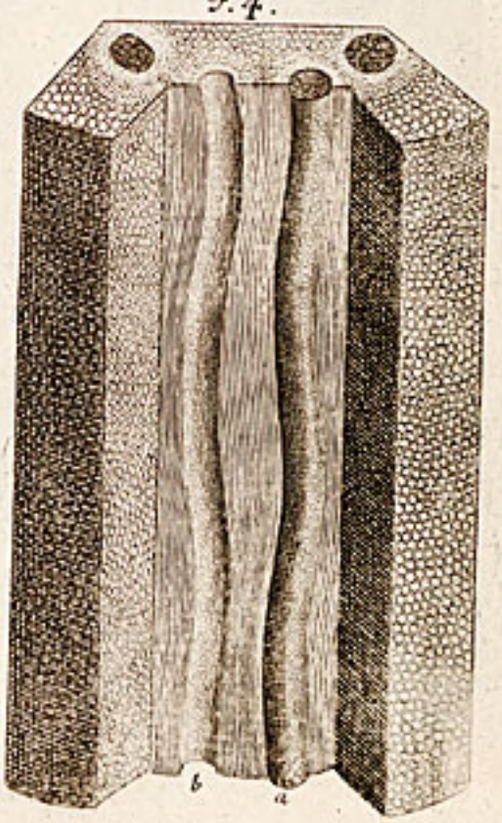
B Magnifyd.

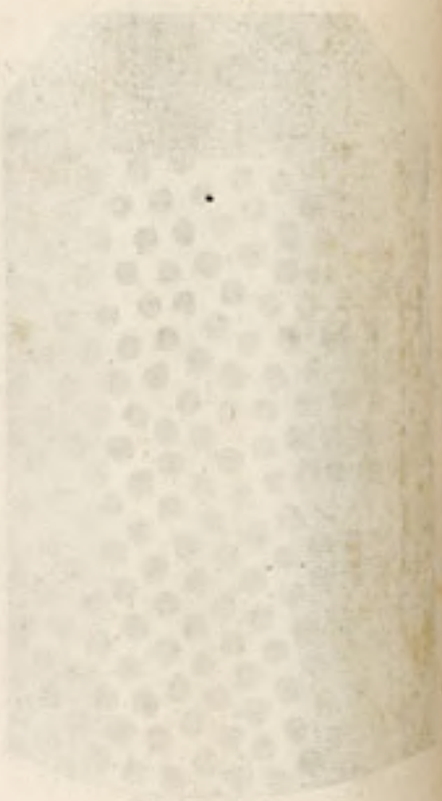


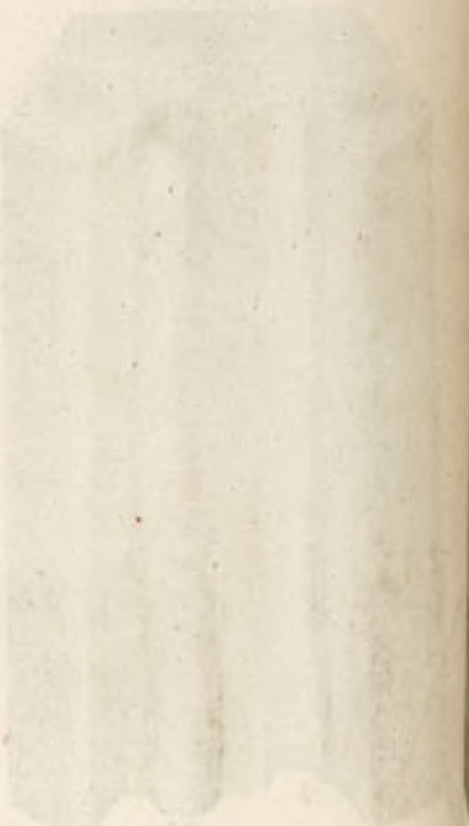
B

Turpentine-Vessels in the Barque of Pine. F. 3.

Milk-Vessels in the Barque of Sumach. F. 4.







AB Piece Cut out of (ab) and Magnifyd to Shew ye Lymphæducts & Aer-Vessels.

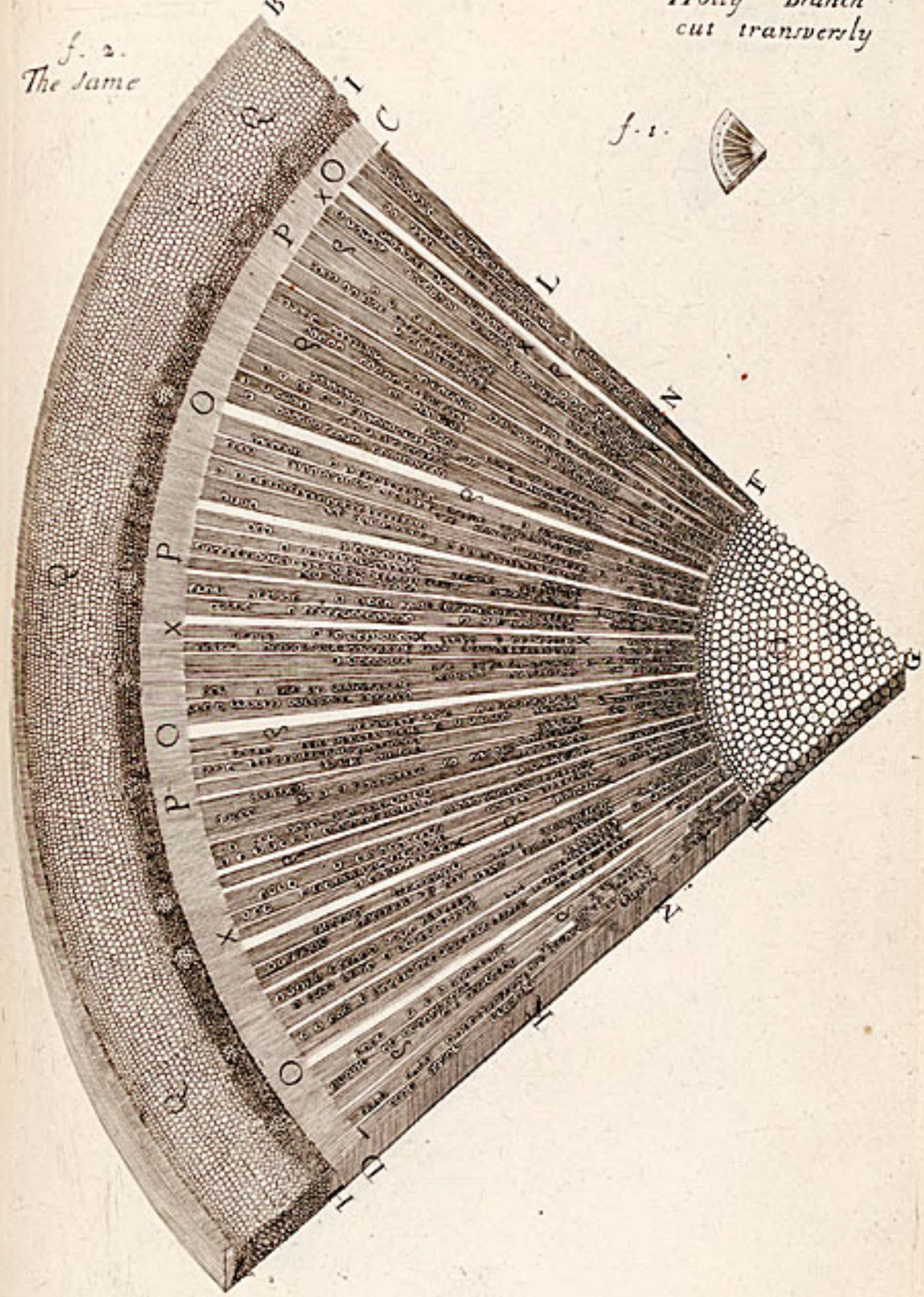
a.b Part of a Vine Branch Cut transversly

Tab. 22

Holly Branch
cut transverly

f. 1.

f. 2.
The same

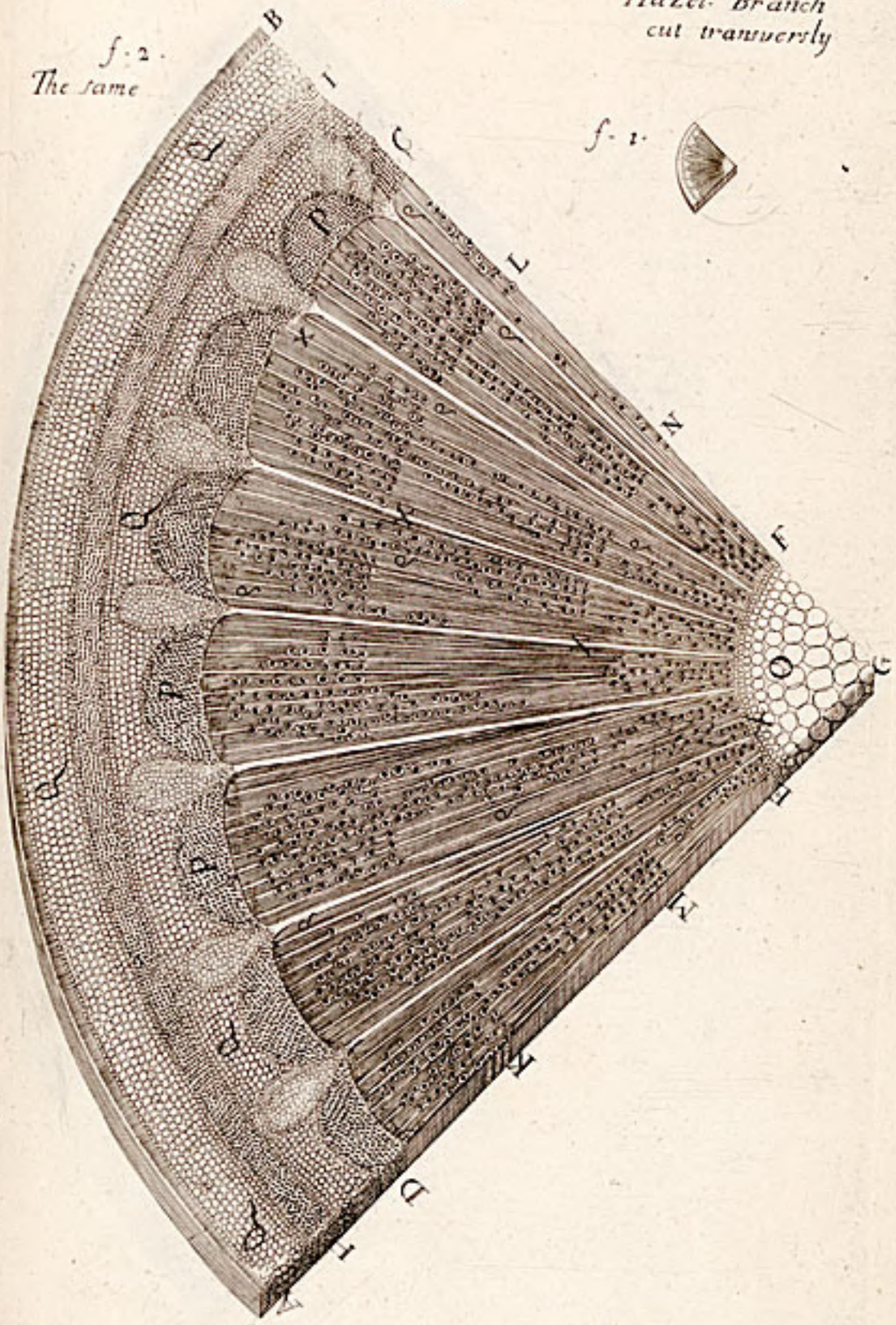


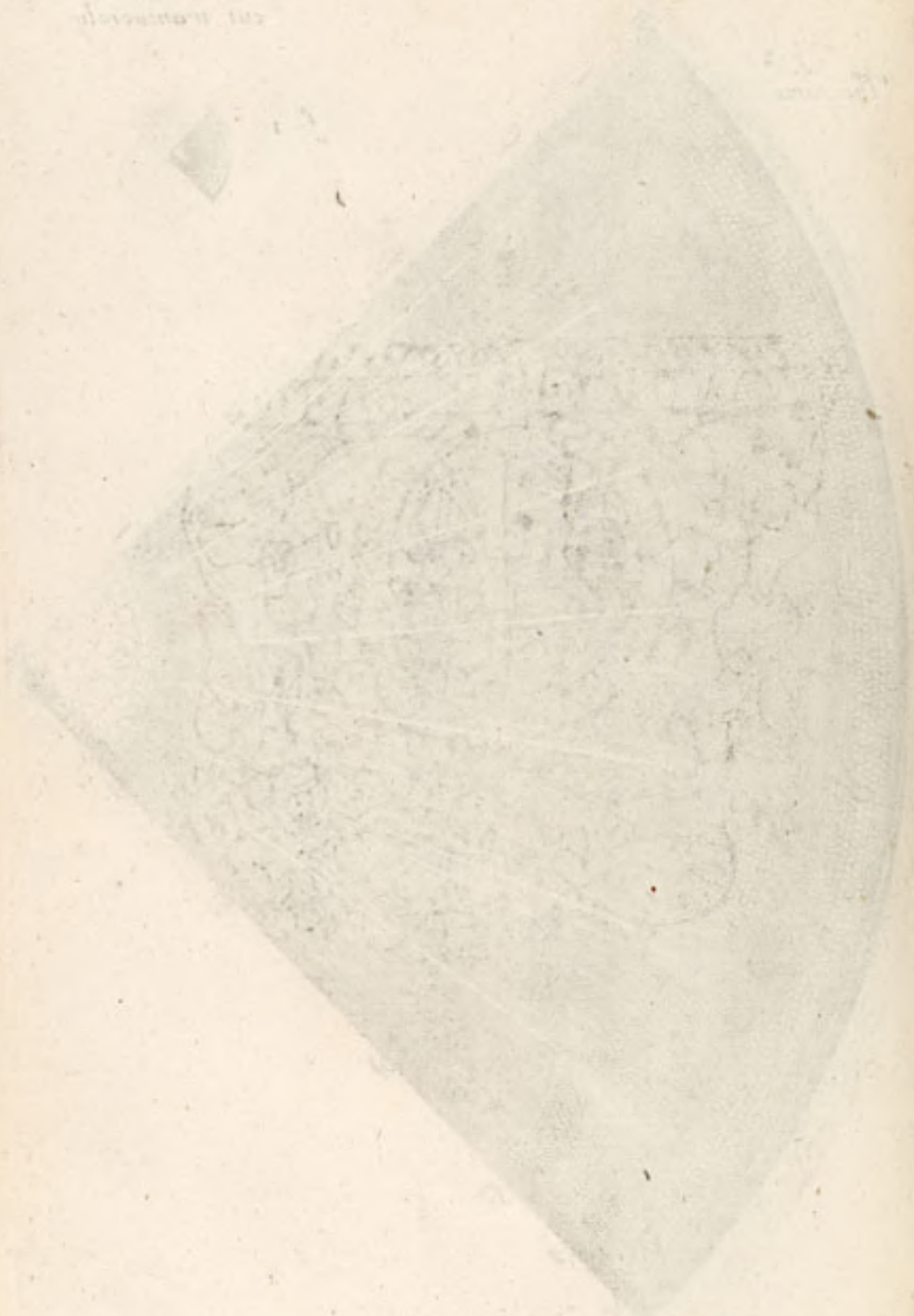
Tab. 23

Hazel Branch
cut transversly

f. 1.

f. 2.
The same



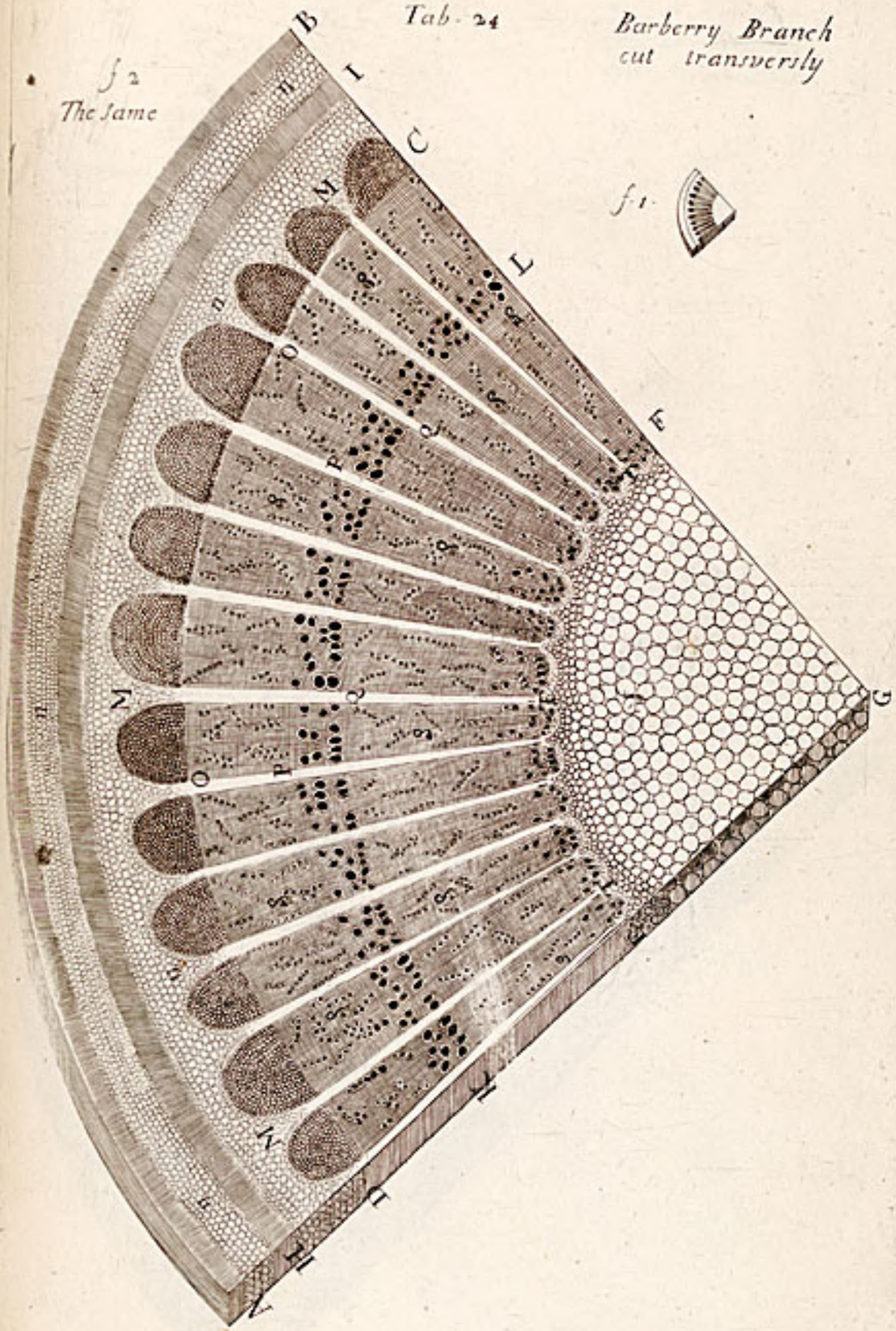


Tab. 24

Barberry Branch
cut transversly

f 2
The same

f 1.

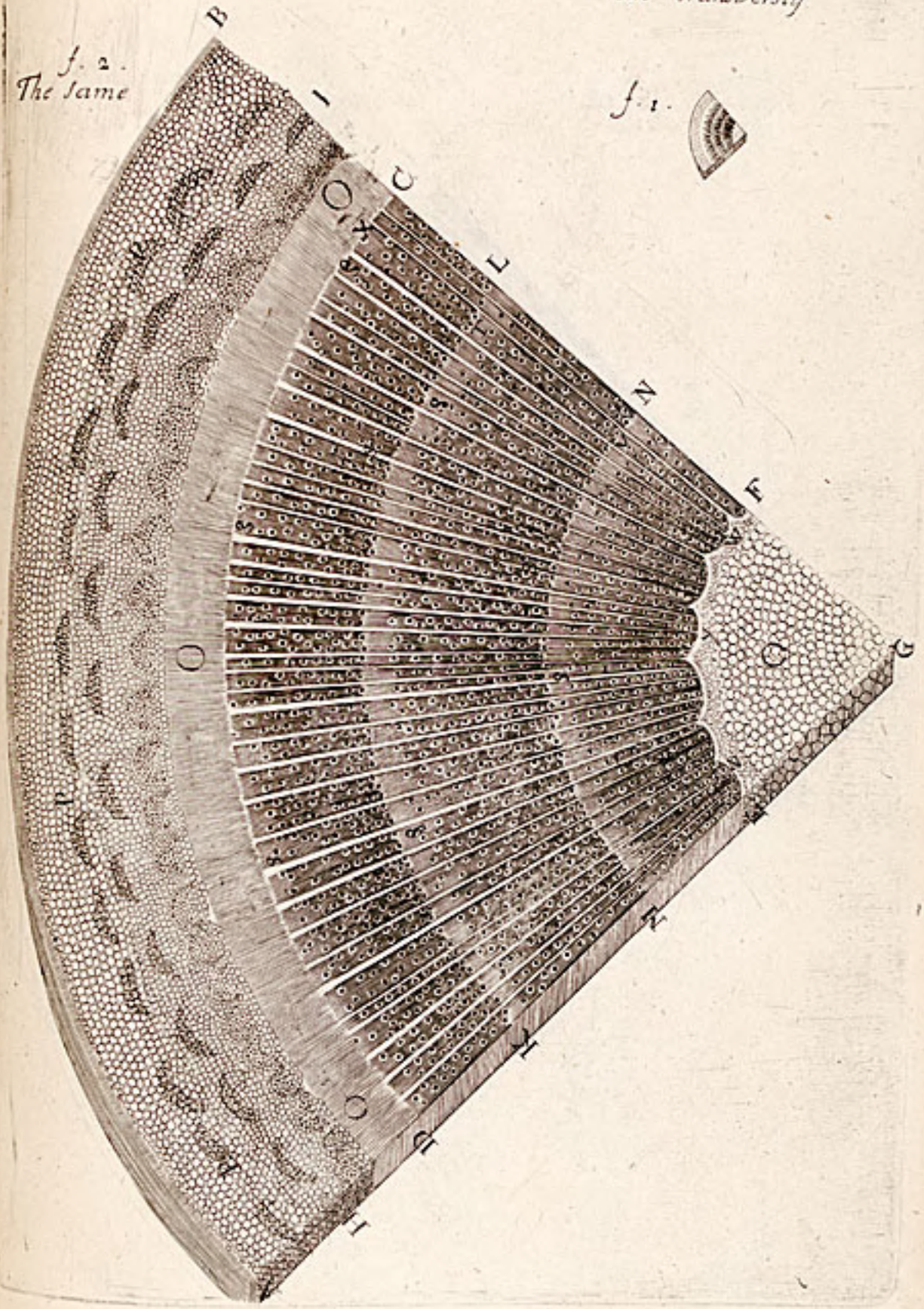


Tab. 25

Apple Branch
cut transversly

f. 2.
The same

f. 1.

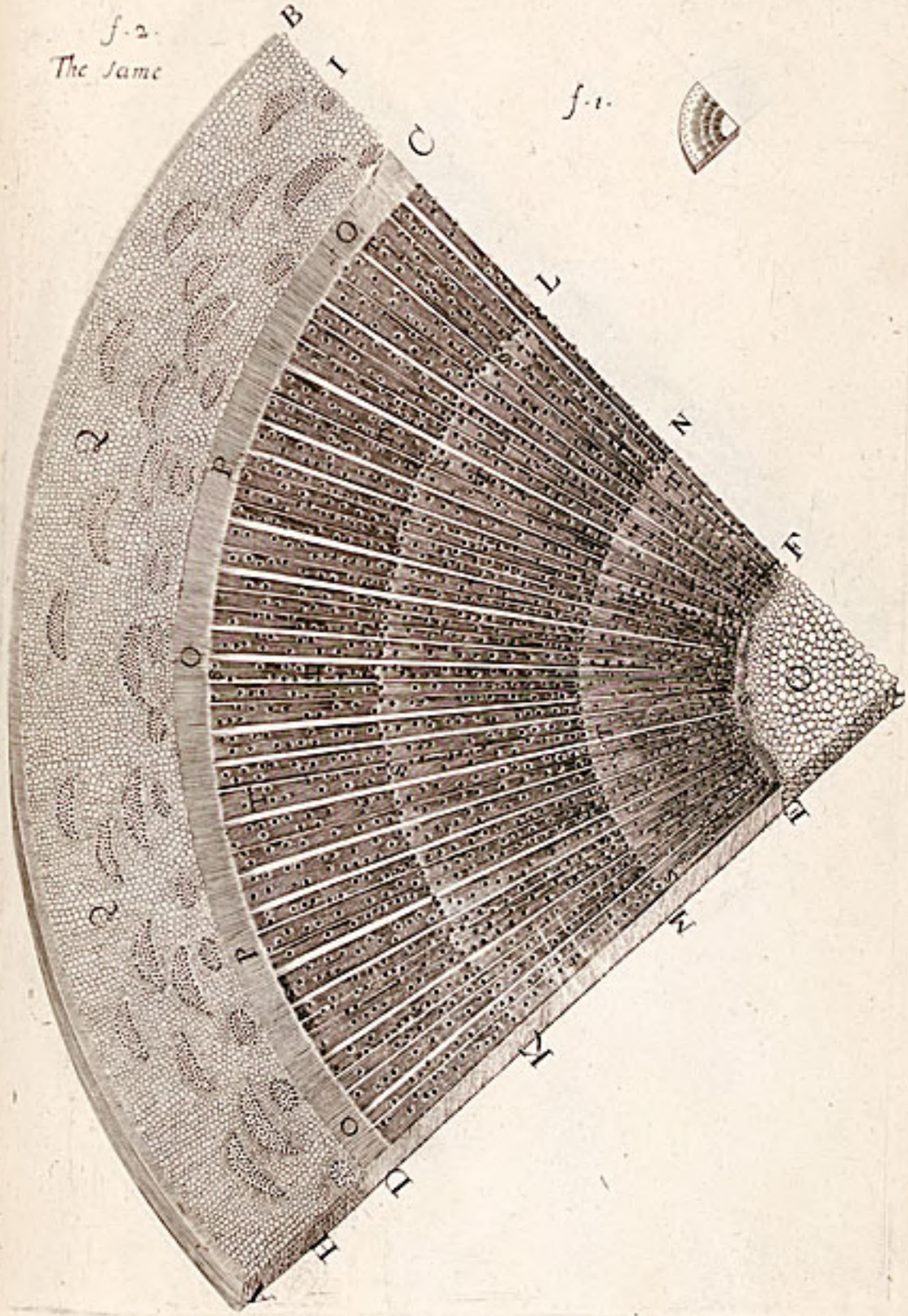


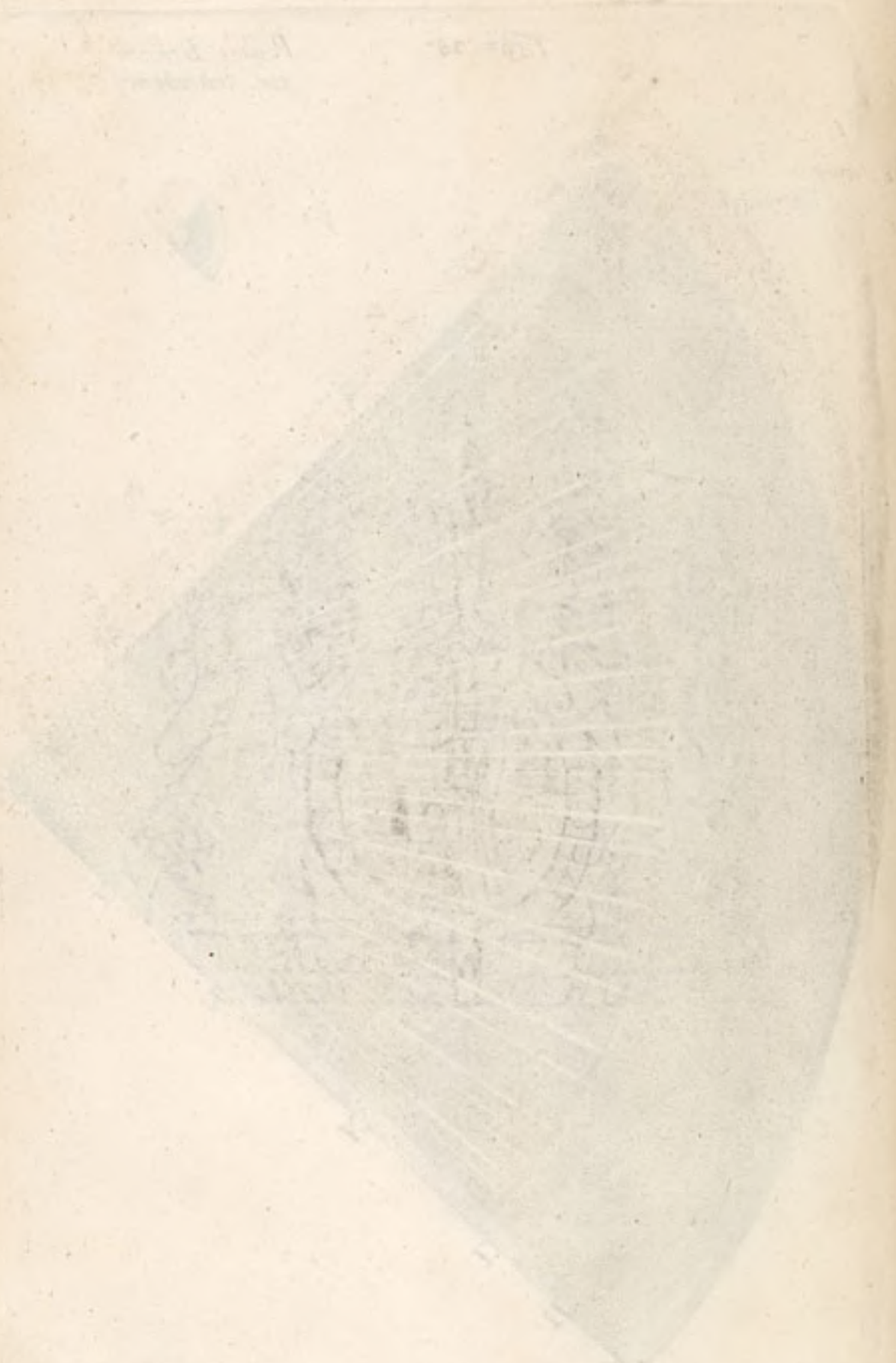
Tab. 26

Pear Branch
cut transversly

f. 2.
The same

f. 1.



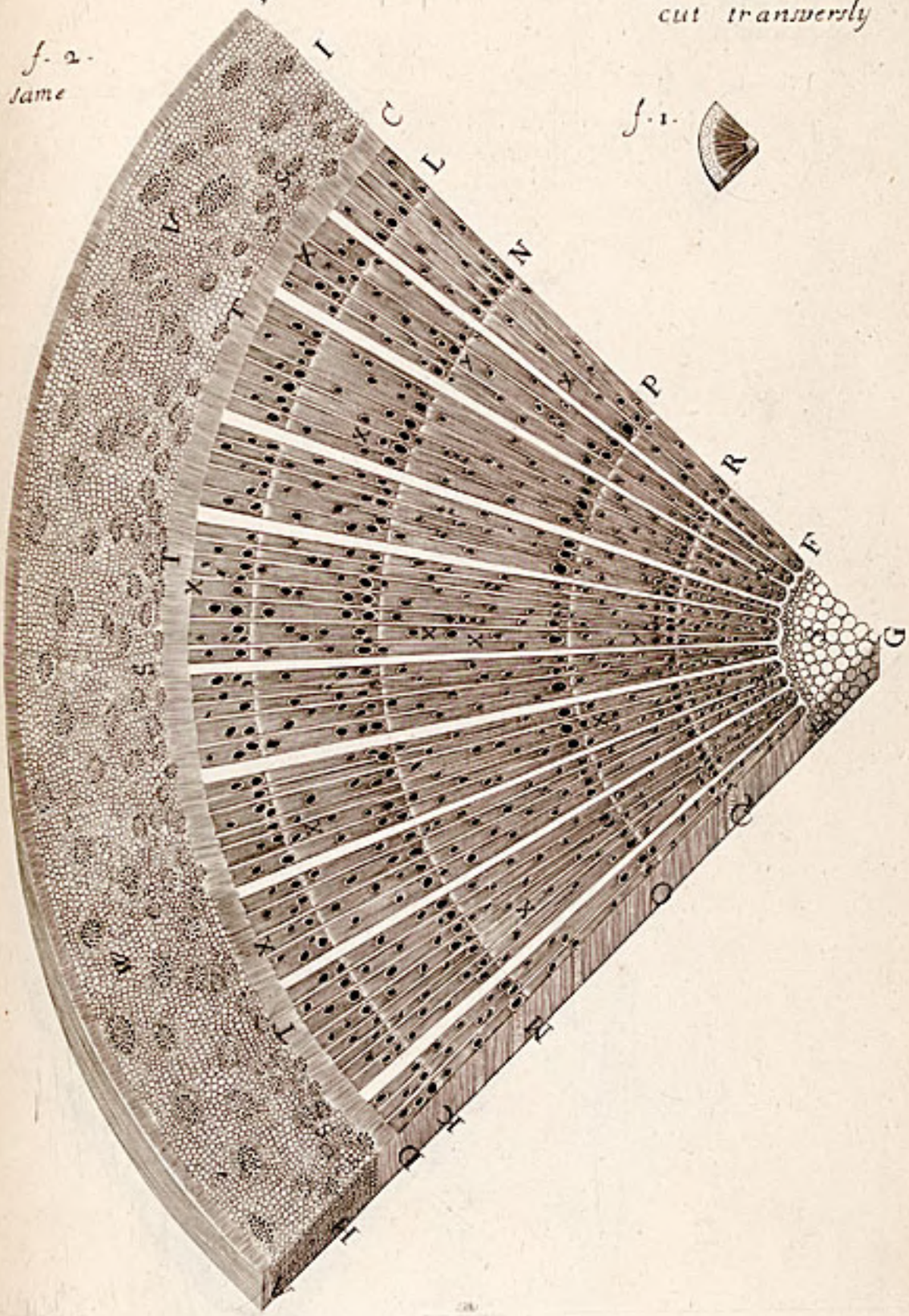


Tab. 27

Plum Branch
cut transversly

f. 1.

f. 2.
The same

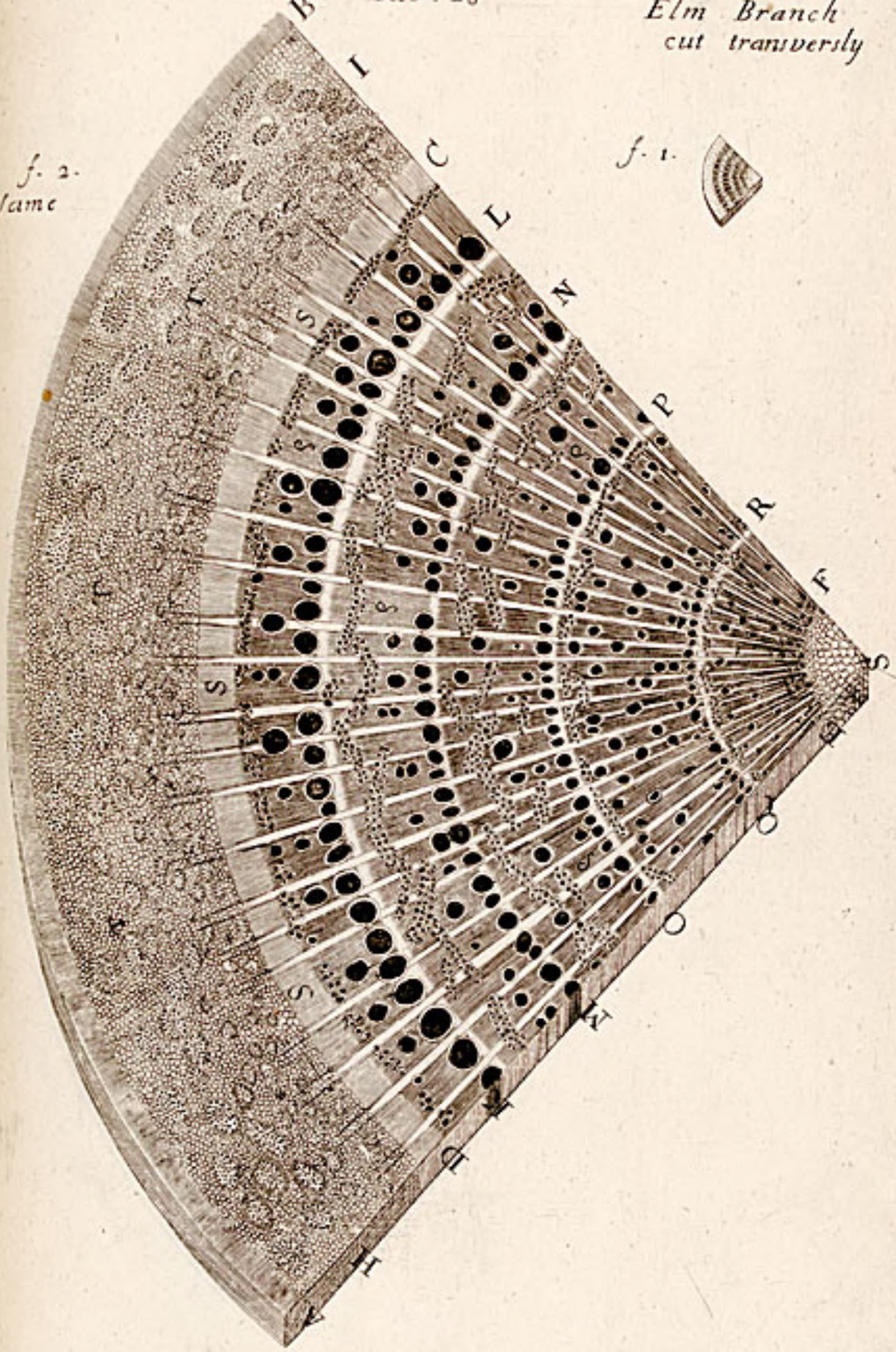


Tab. 28

Elm Branch
cut transversly

f. 1.

f. 2.
The same

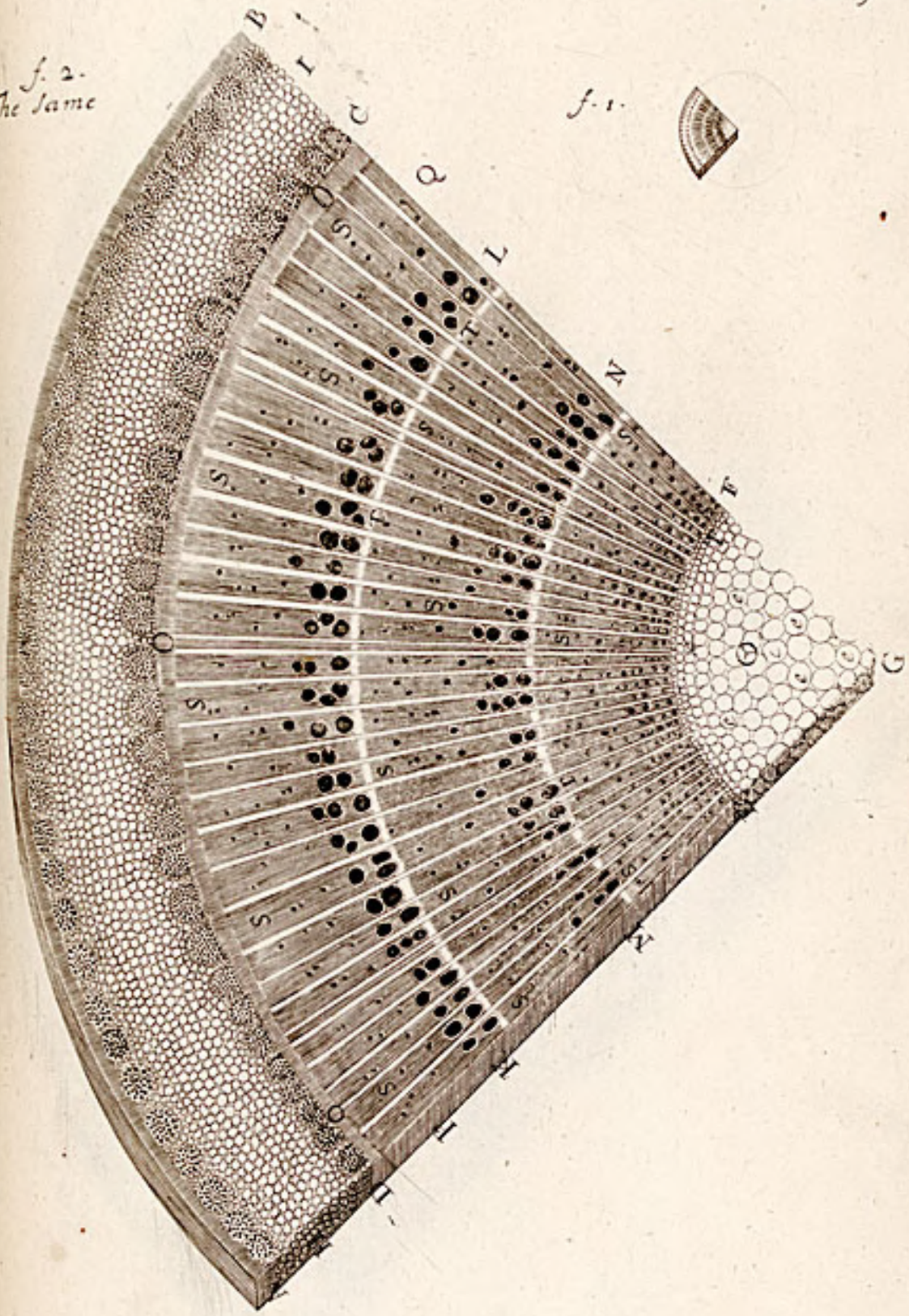

B
I
C
L
N
P
R
F
S
T
S
S
S

Tab. 29

Ash Branch
cut transversly

f. 2.
The same

f. 1.

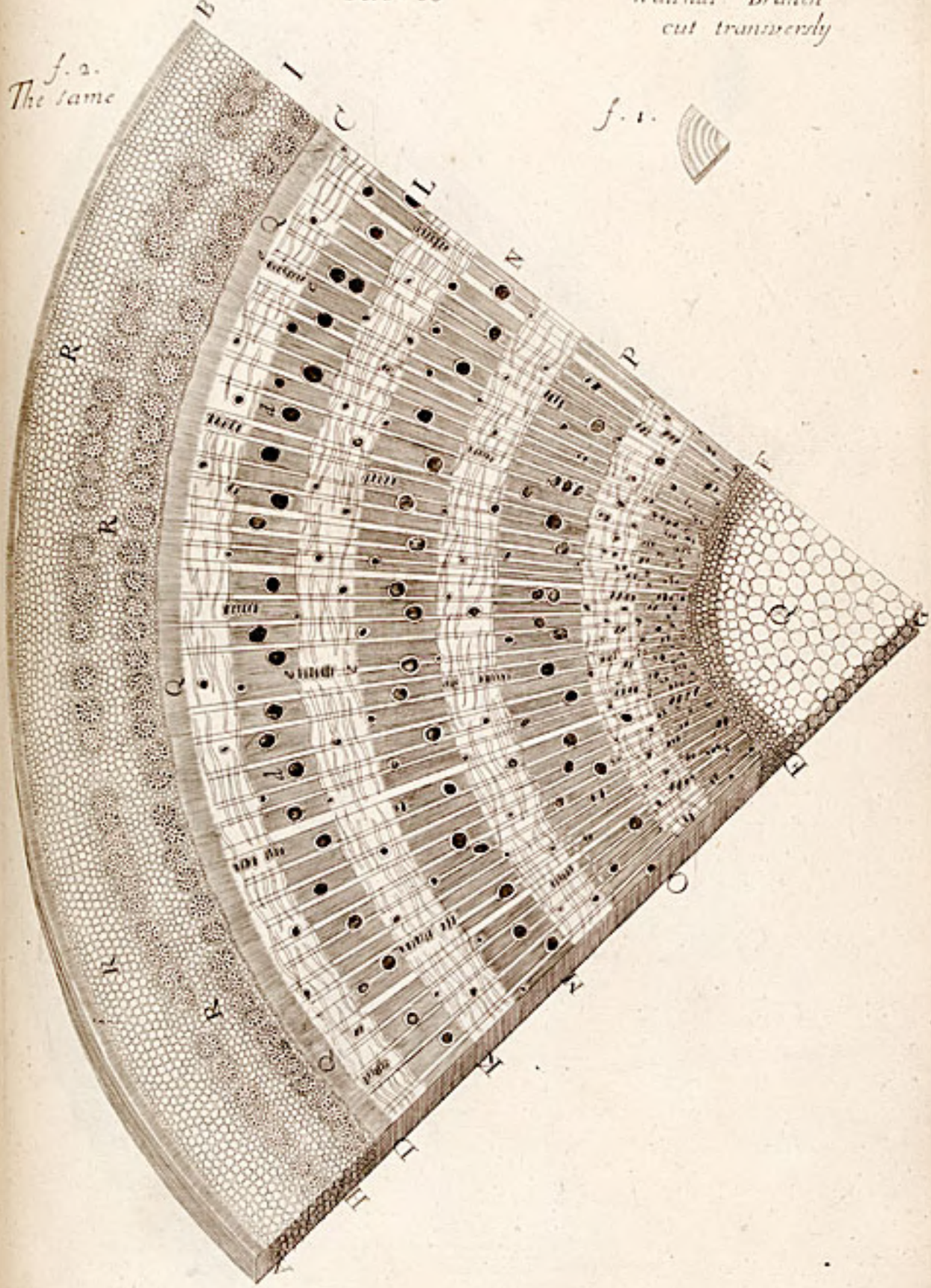


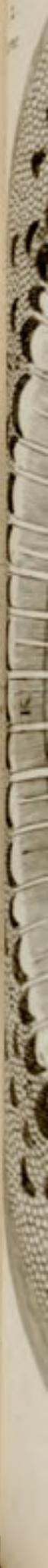
Tab. 30

Wallnut Branch
cut transverdy

f. 1.

f. 2.
The same



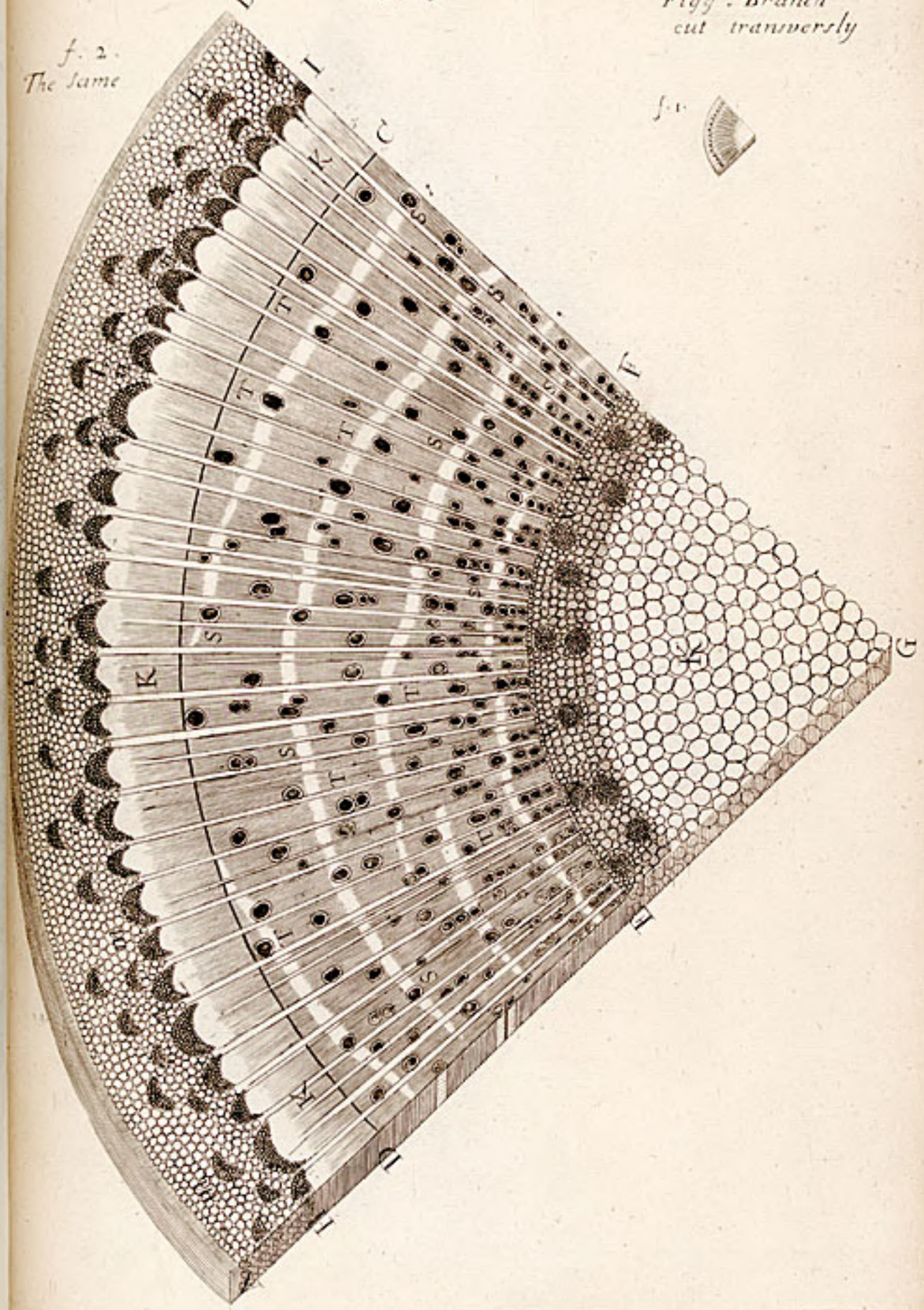


Tab. 31

Figg. Branch cut transversly

f. 2. The same

f. 1.

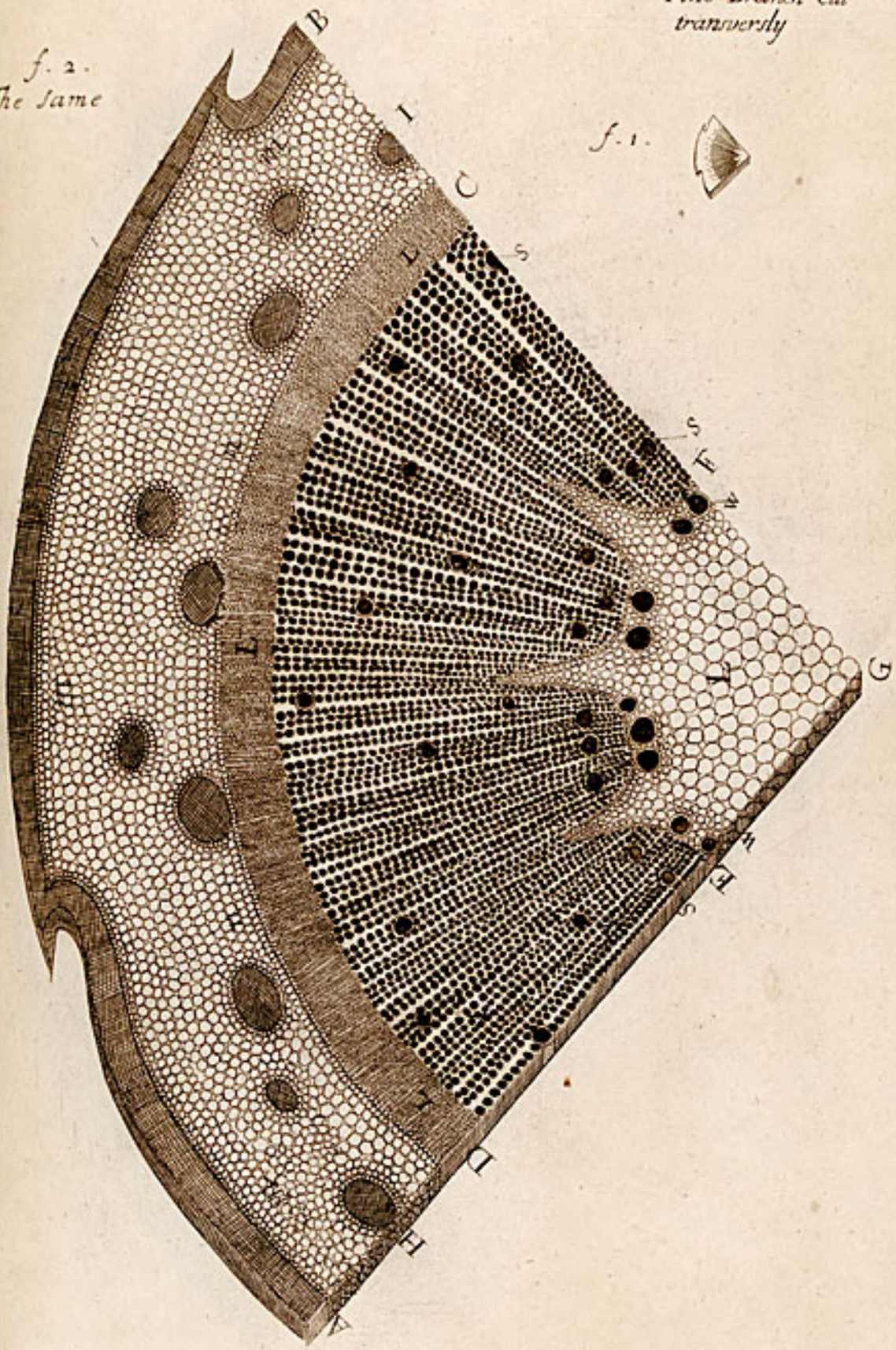


Tab. 32

Pine Branch cut tranversly

f. 2.
The same

f. 1.

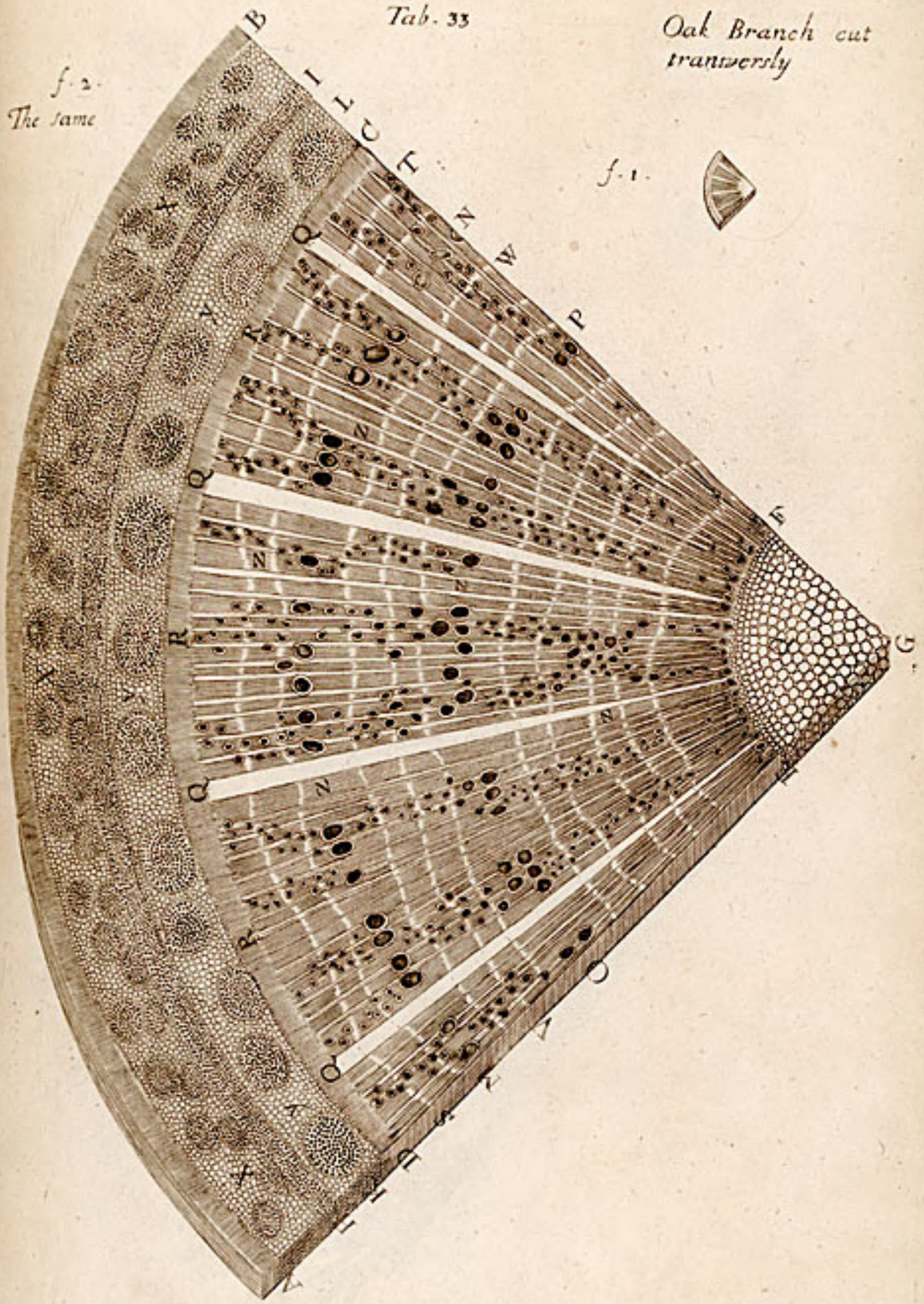


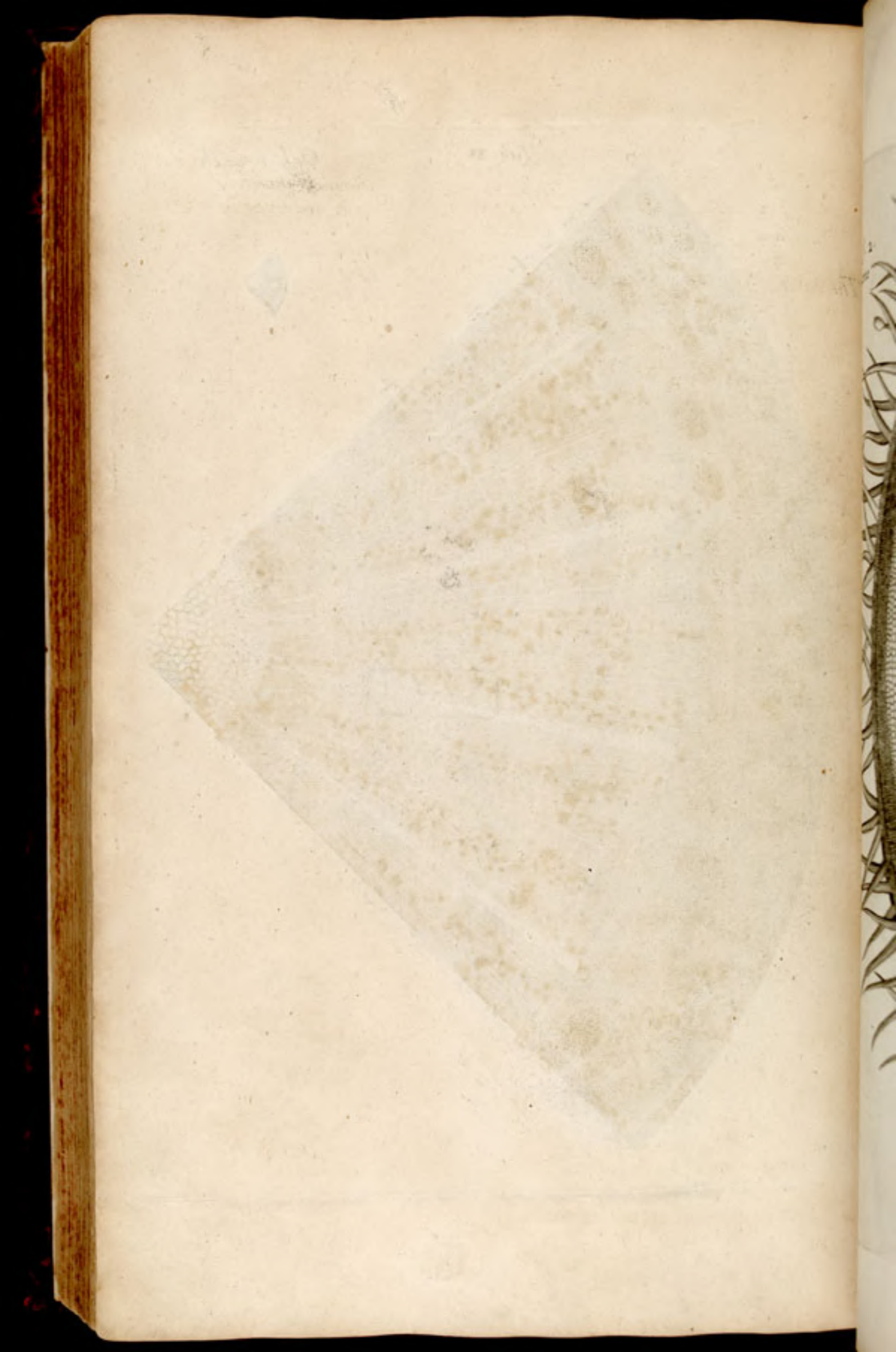
Tab. 33

Oak Branch cut transversly

f. 2. The same

f. 1.



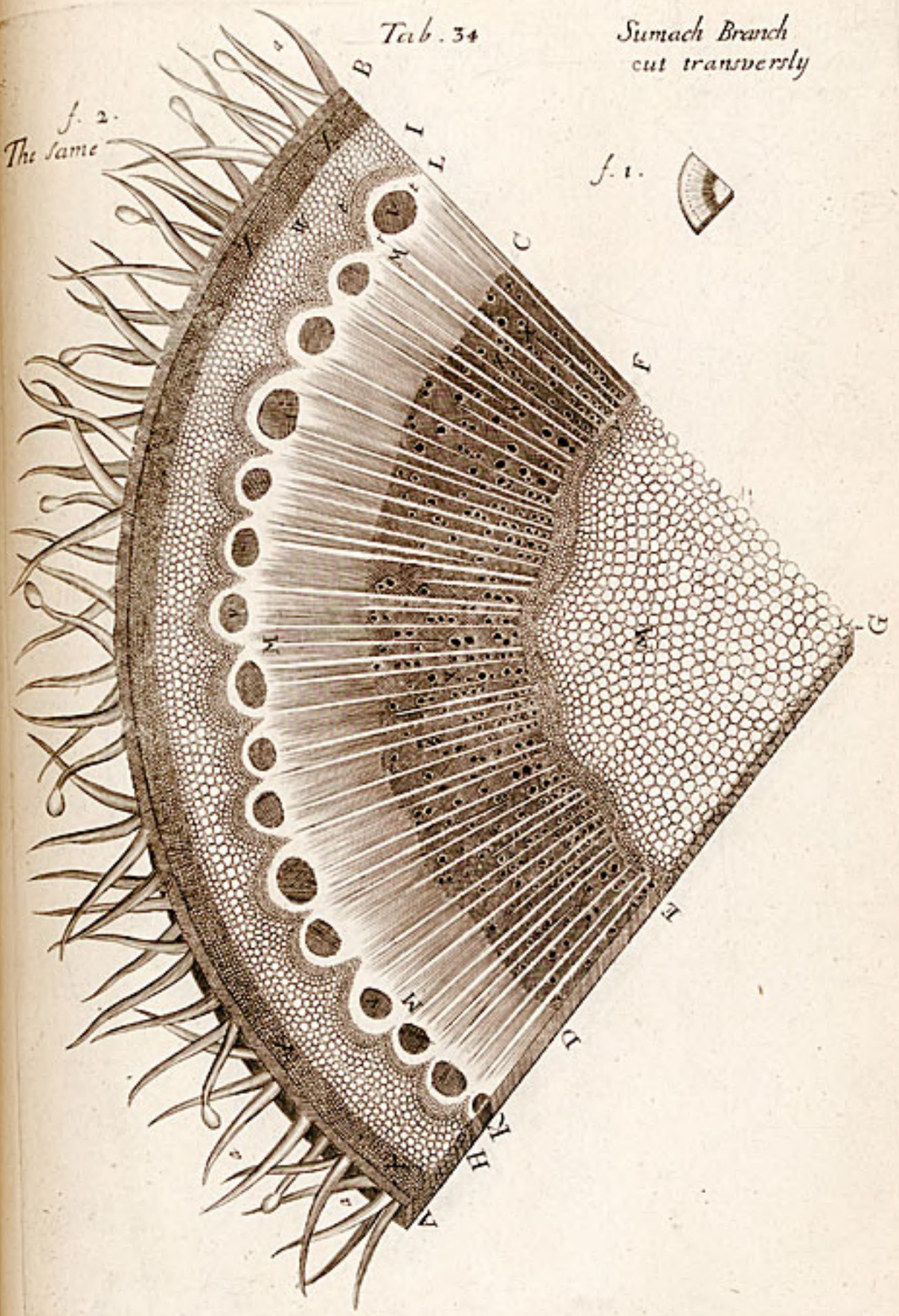


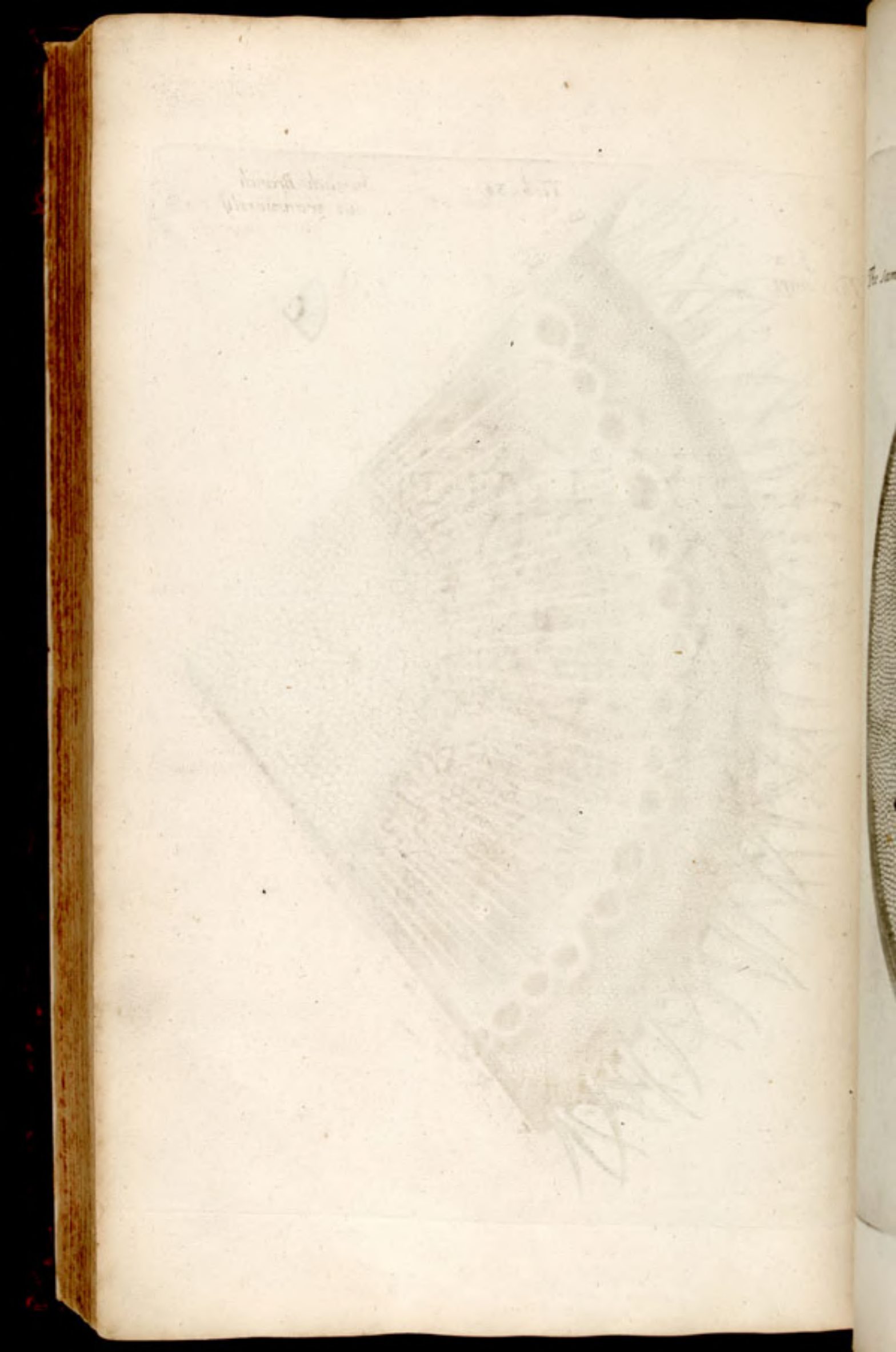
Tab. 34

Sumach Branch
cut transverrly

f. 1.

f. 2.
The same



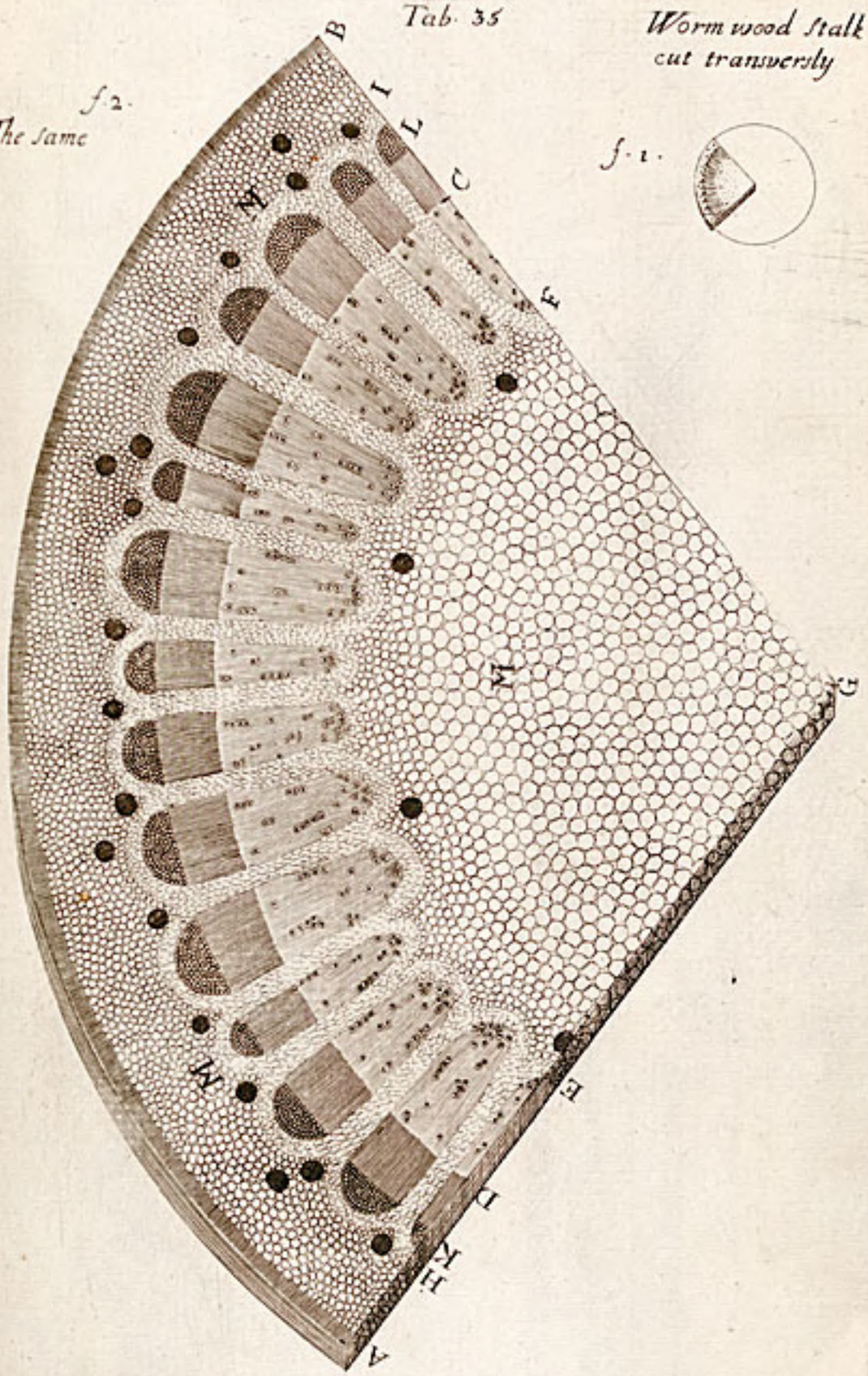


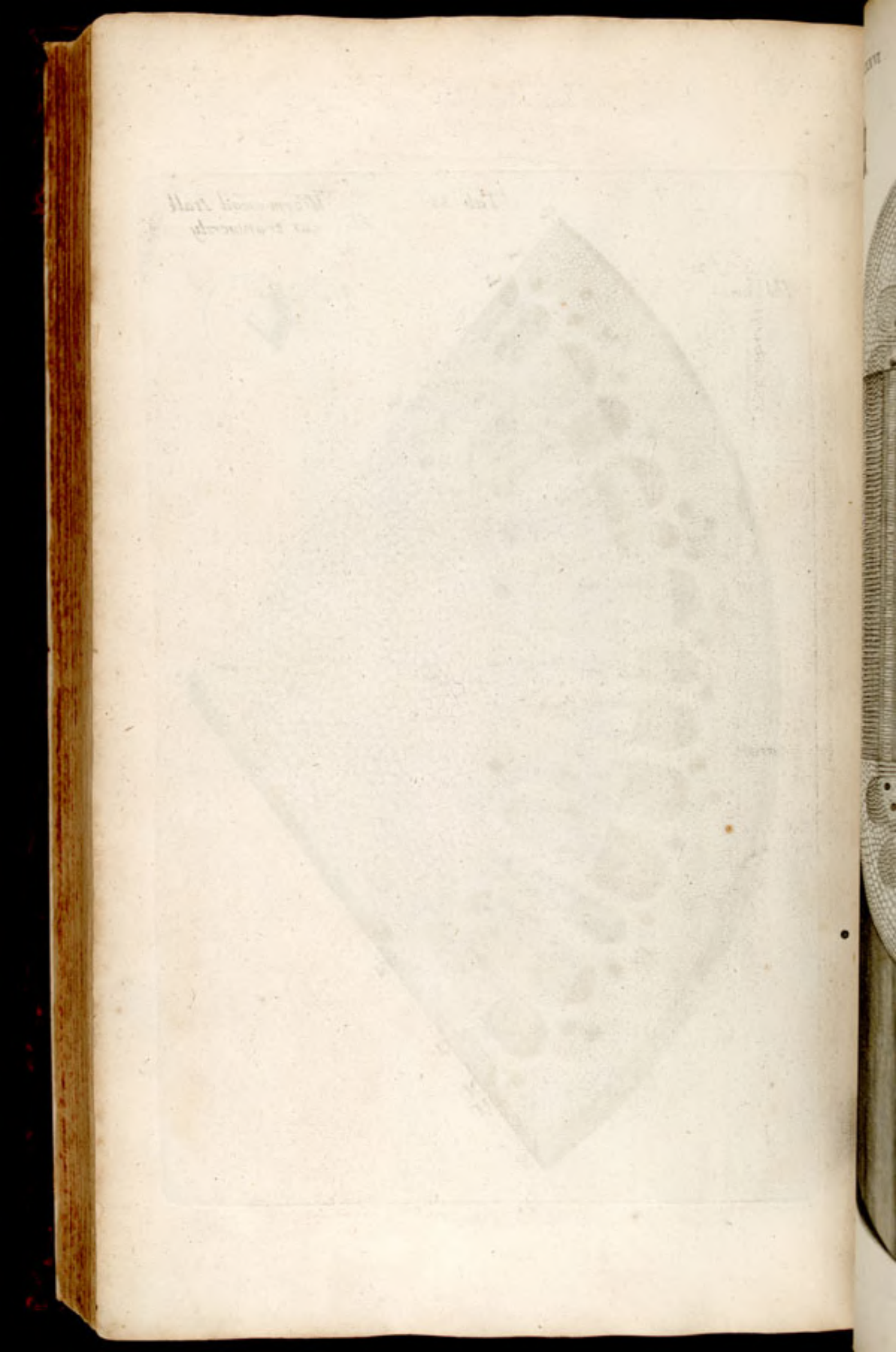
Tab. 35

Worm wood stalk
cut transversly

f. 1.

f. 2.
The same





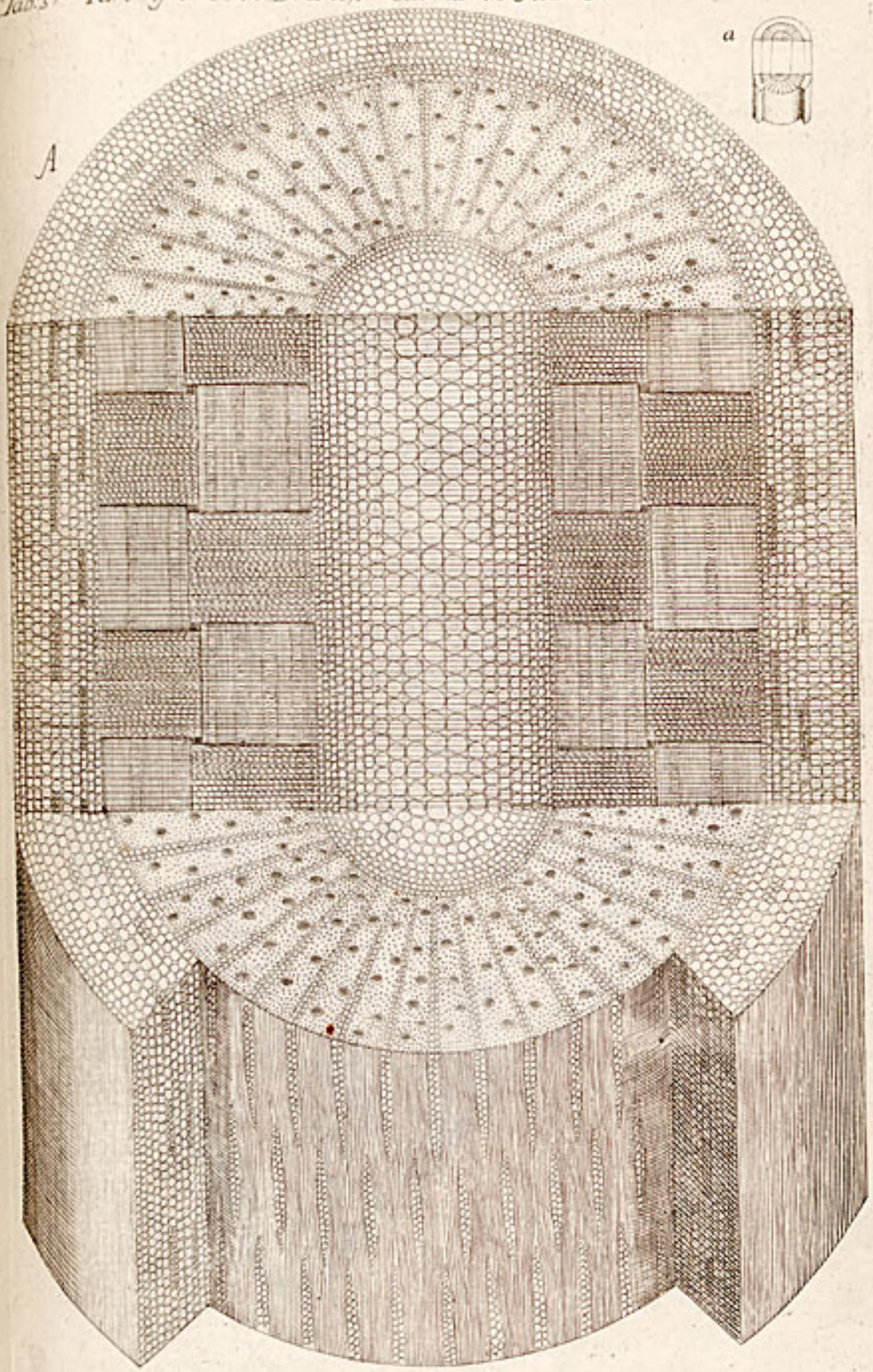
TAB. XXXVI.

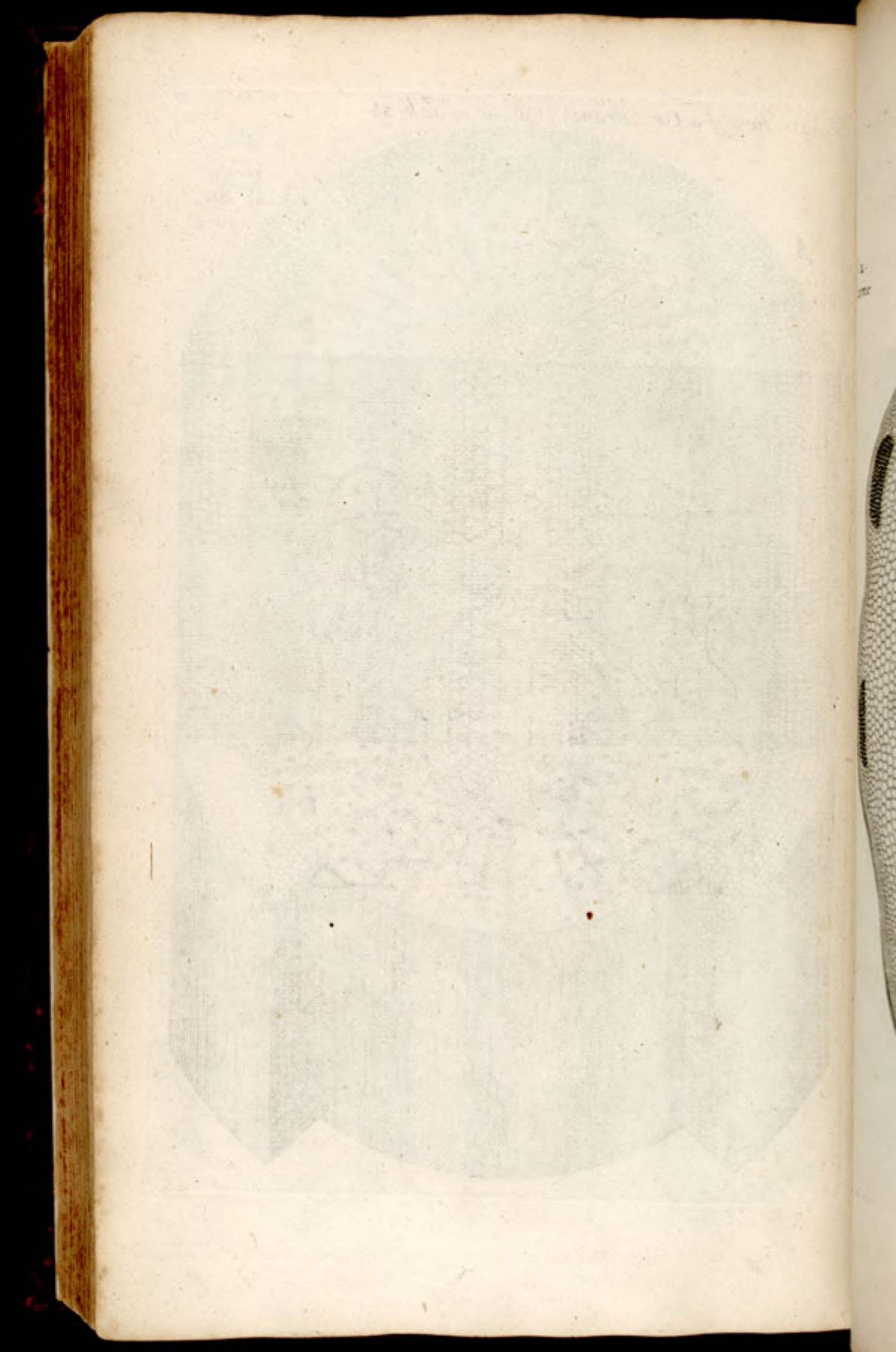
Part of a Vine Branch cut transversly and split half way downe ye midle

B

B

Tab: 37. *Part of a Corin Branch Cut as in Tab. 36.*



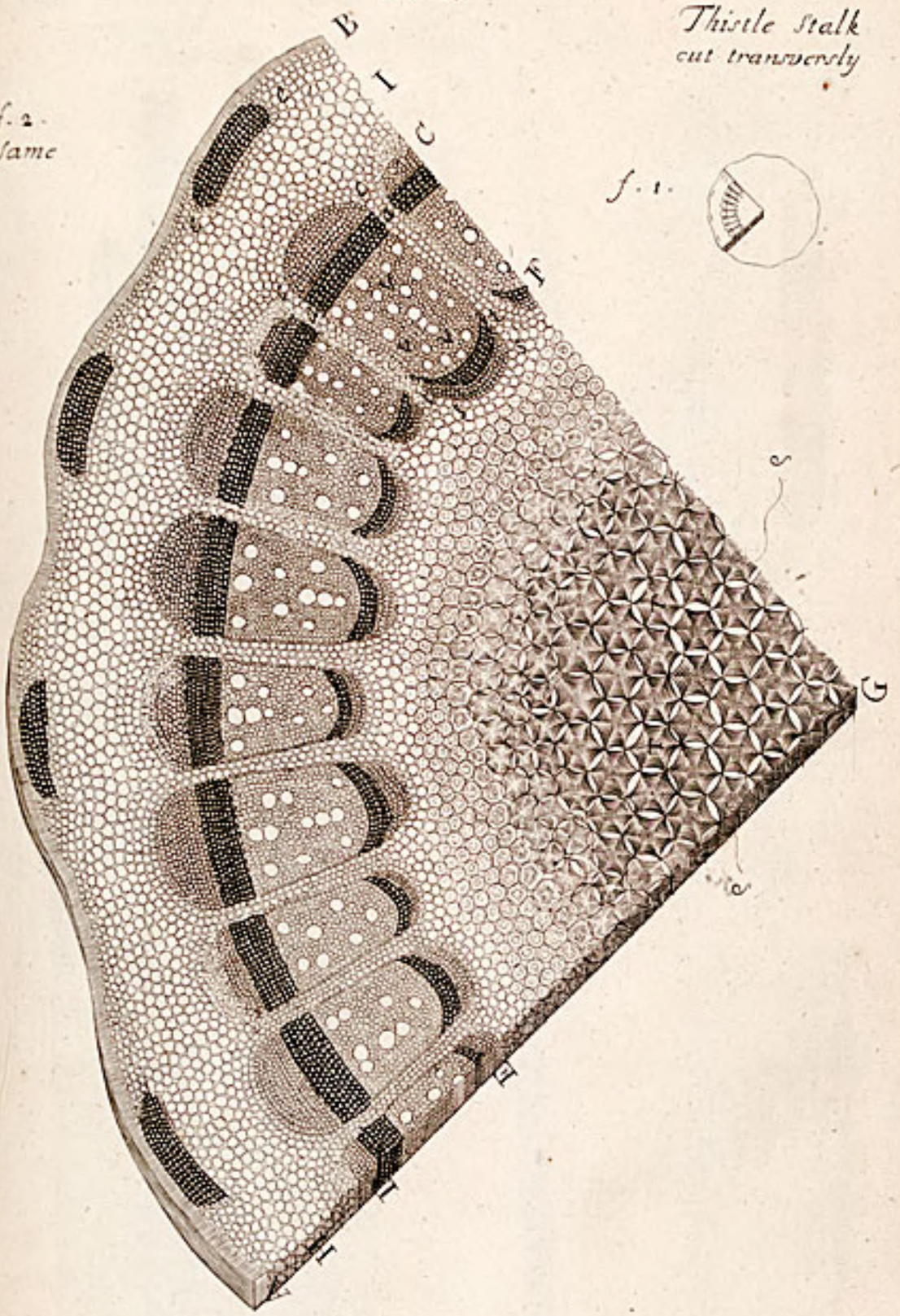


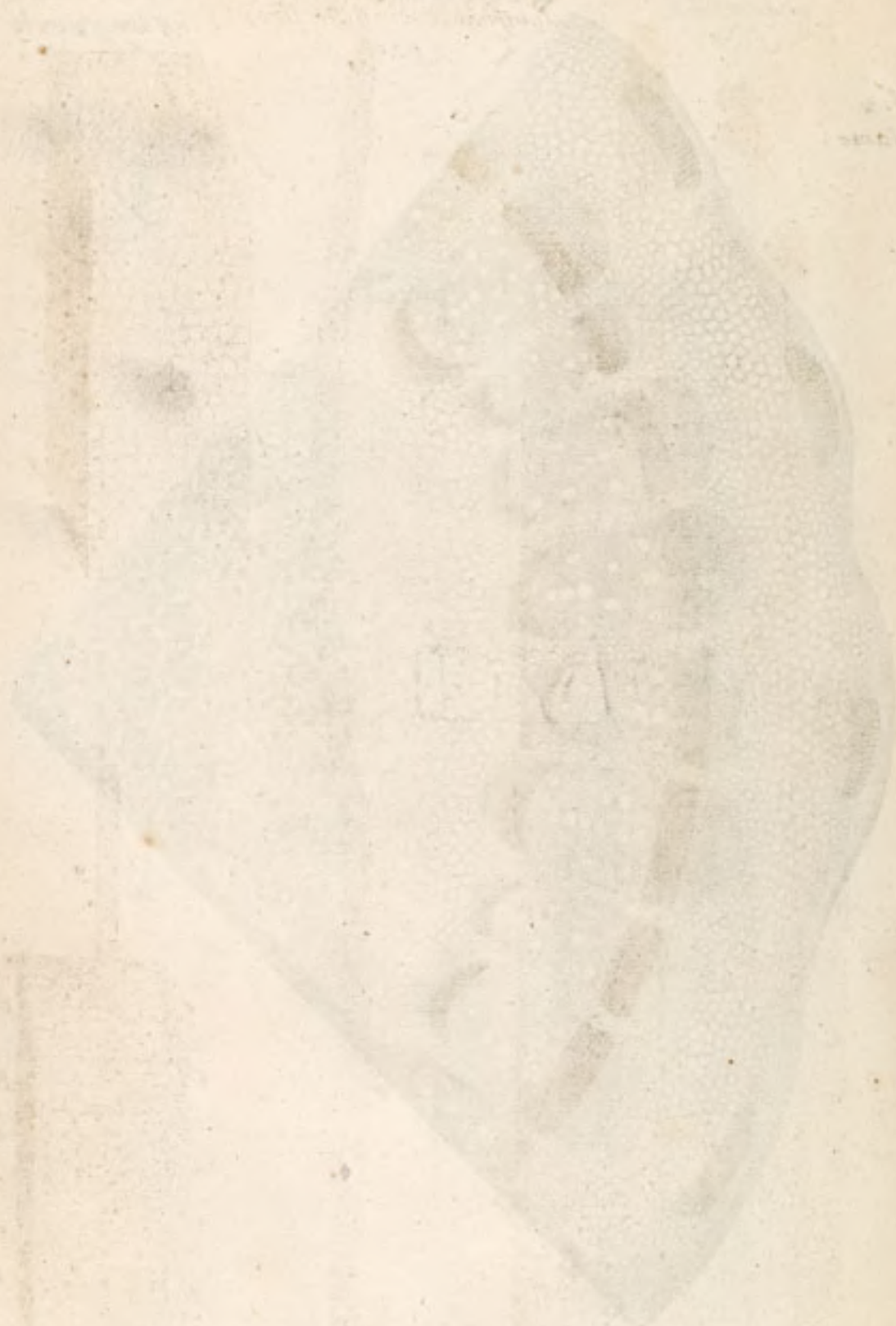
Tab. 38

Thistle Stalk
cut transversly

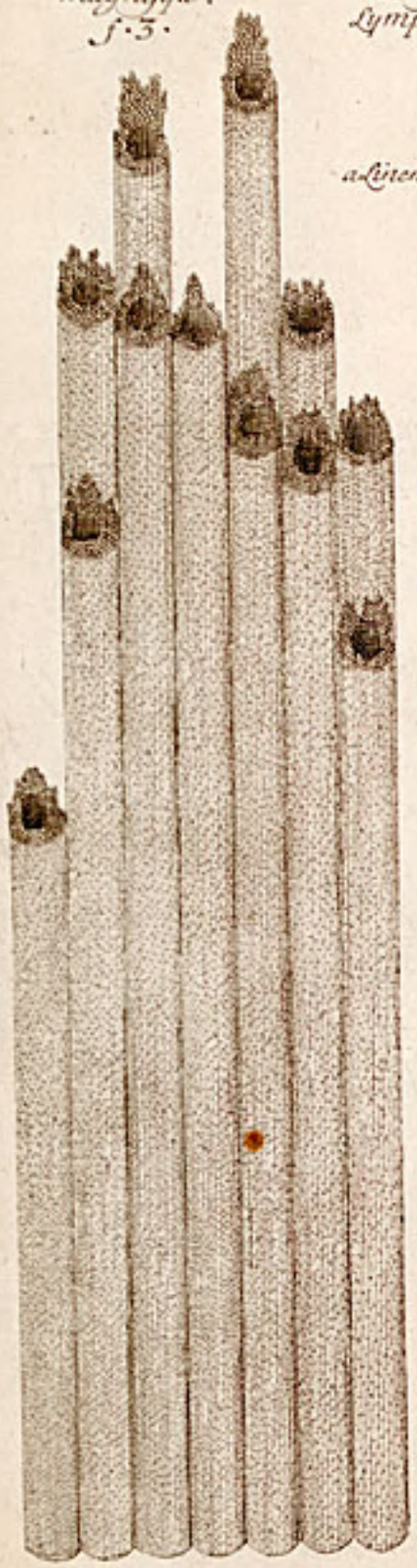
f. 2.
The same

f. 1.





The Small particle of Fir-wood (a) magnified.
f. 3.

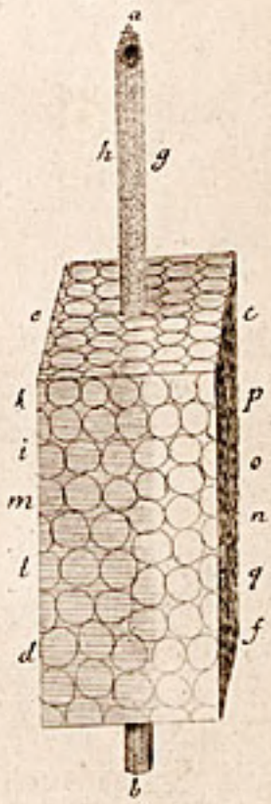


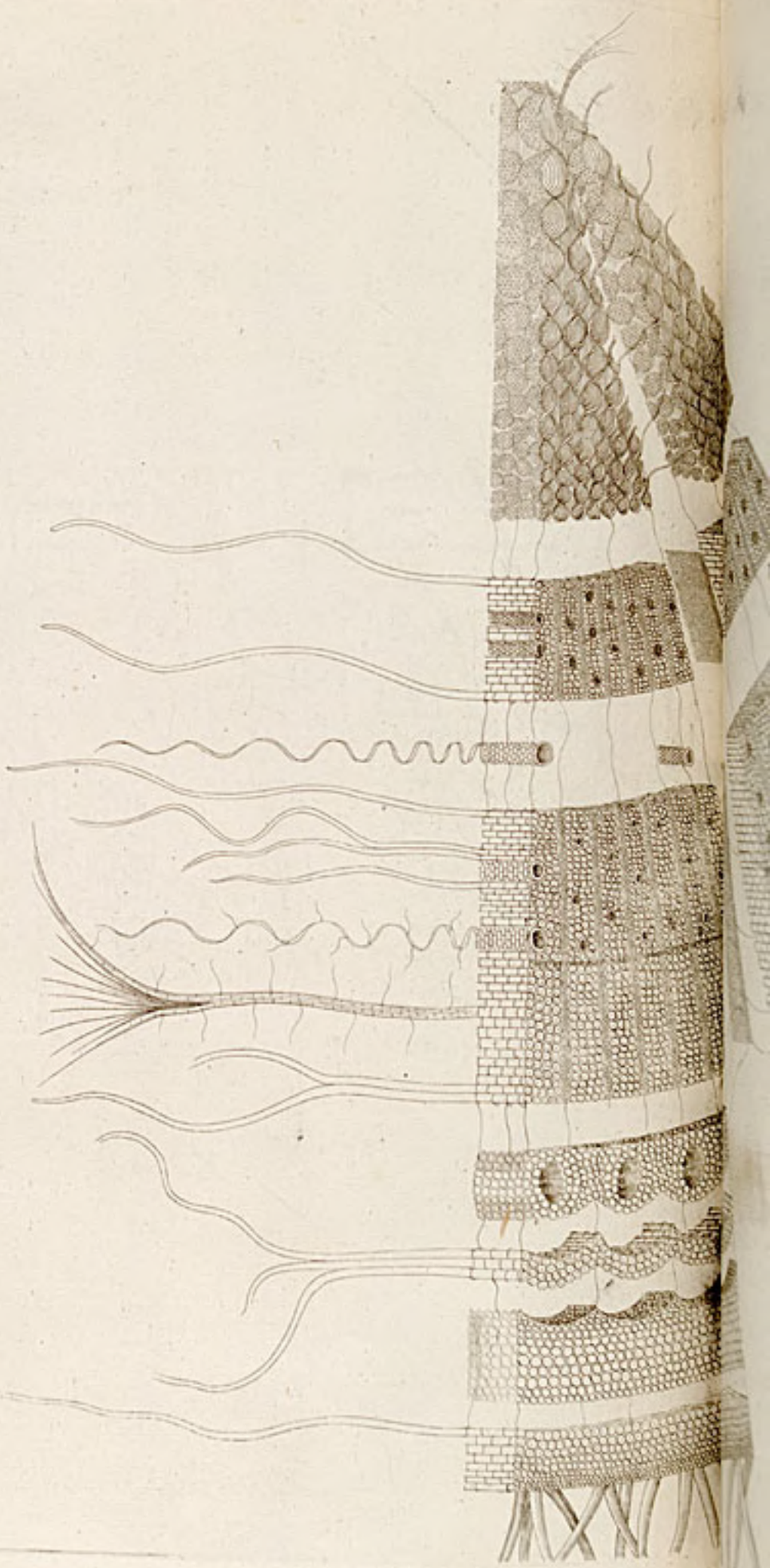
One of the Lignus Fibers or Lymphaducts (a) in the Thred (bc)
f. 2.

a Linen Thred
f. 1.

f. 5.

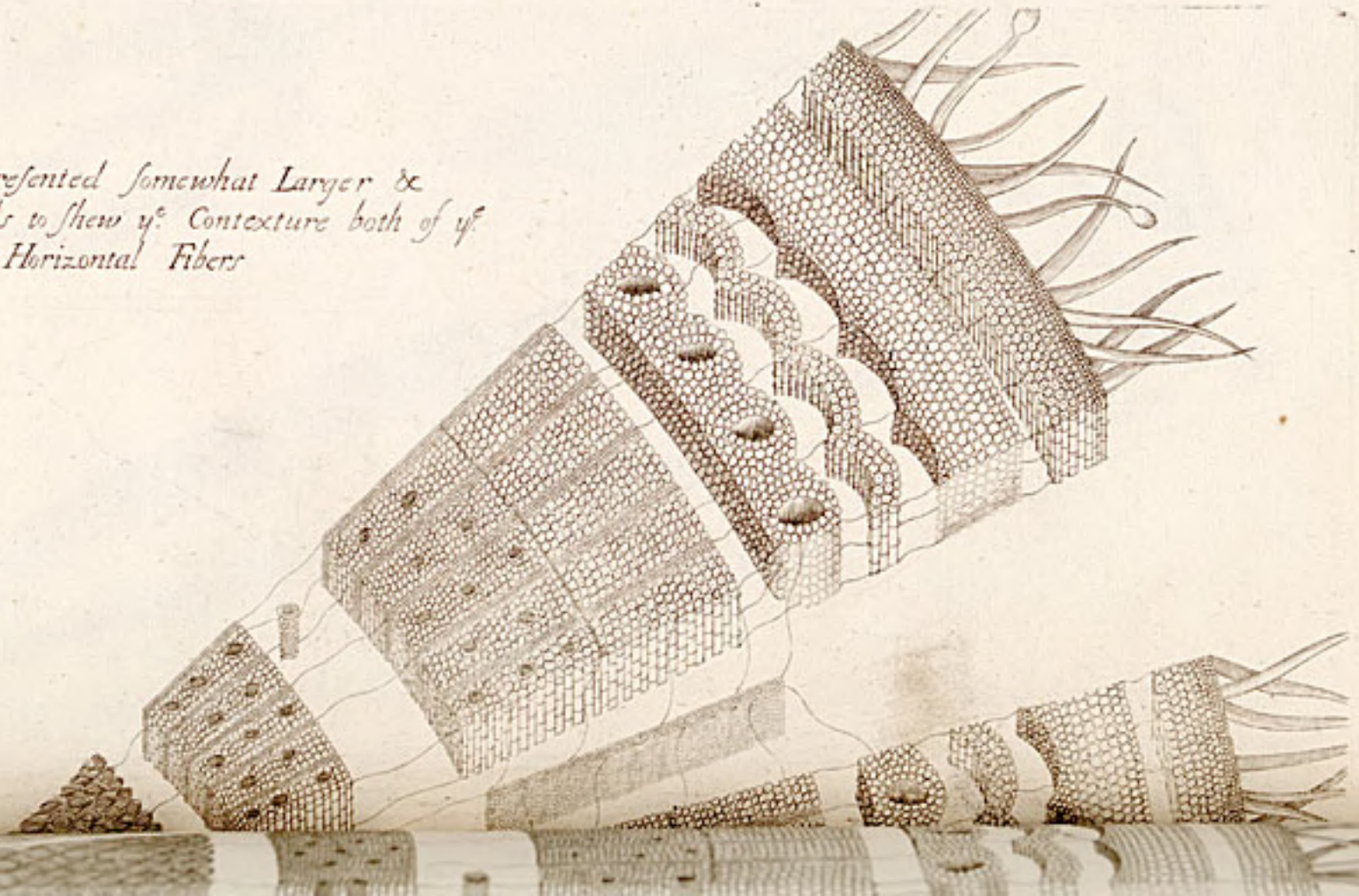
f. 4.





Tab: XL

Part of Tab. 34. represented somewhat Larger & with several Breaks to shew ye Contexture both of ye Perpendicular & Horizontal Fibers

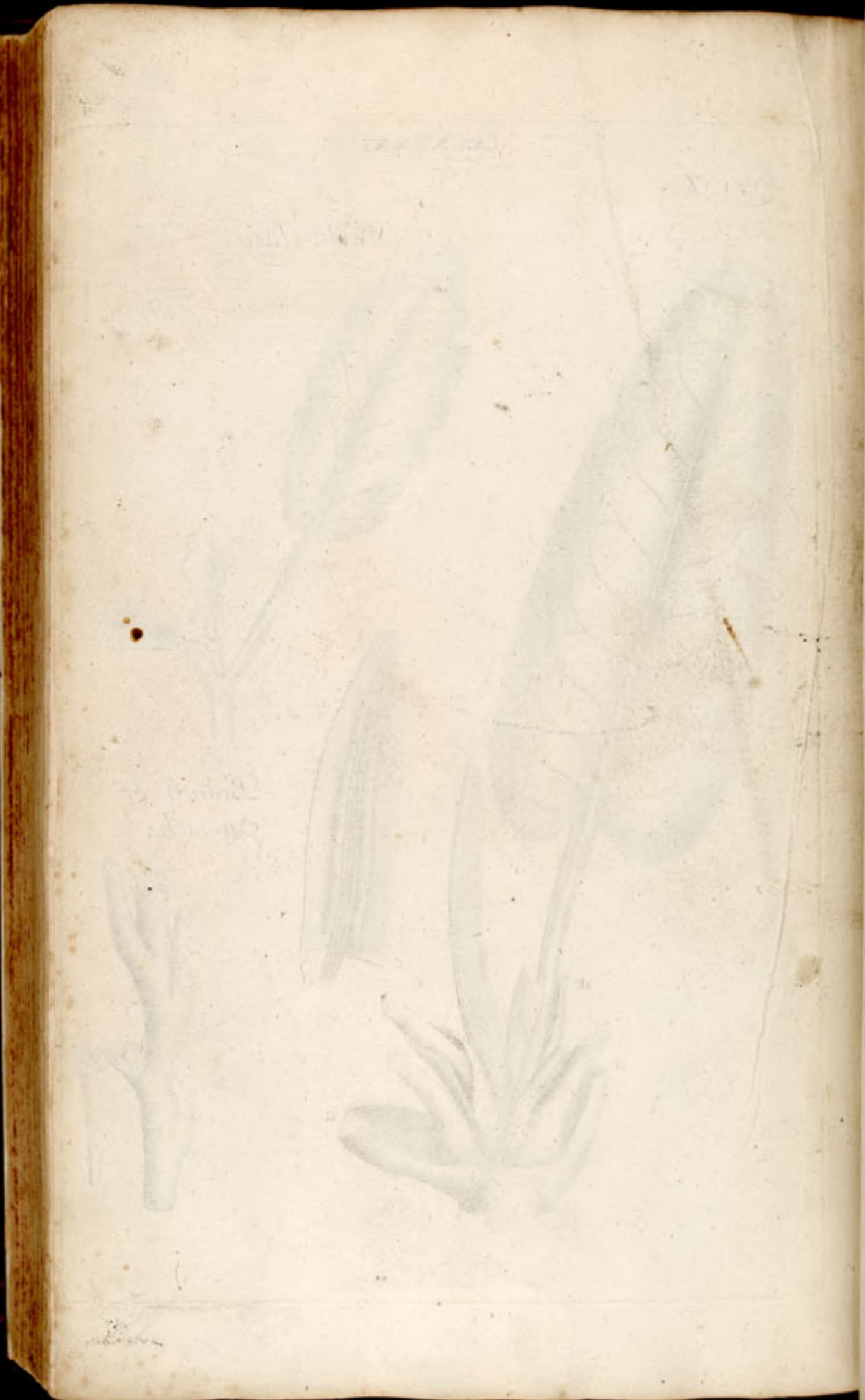


TAB. XXXXI

Leaf of Dock.

Wild-Clary.

Branch of Sumach.



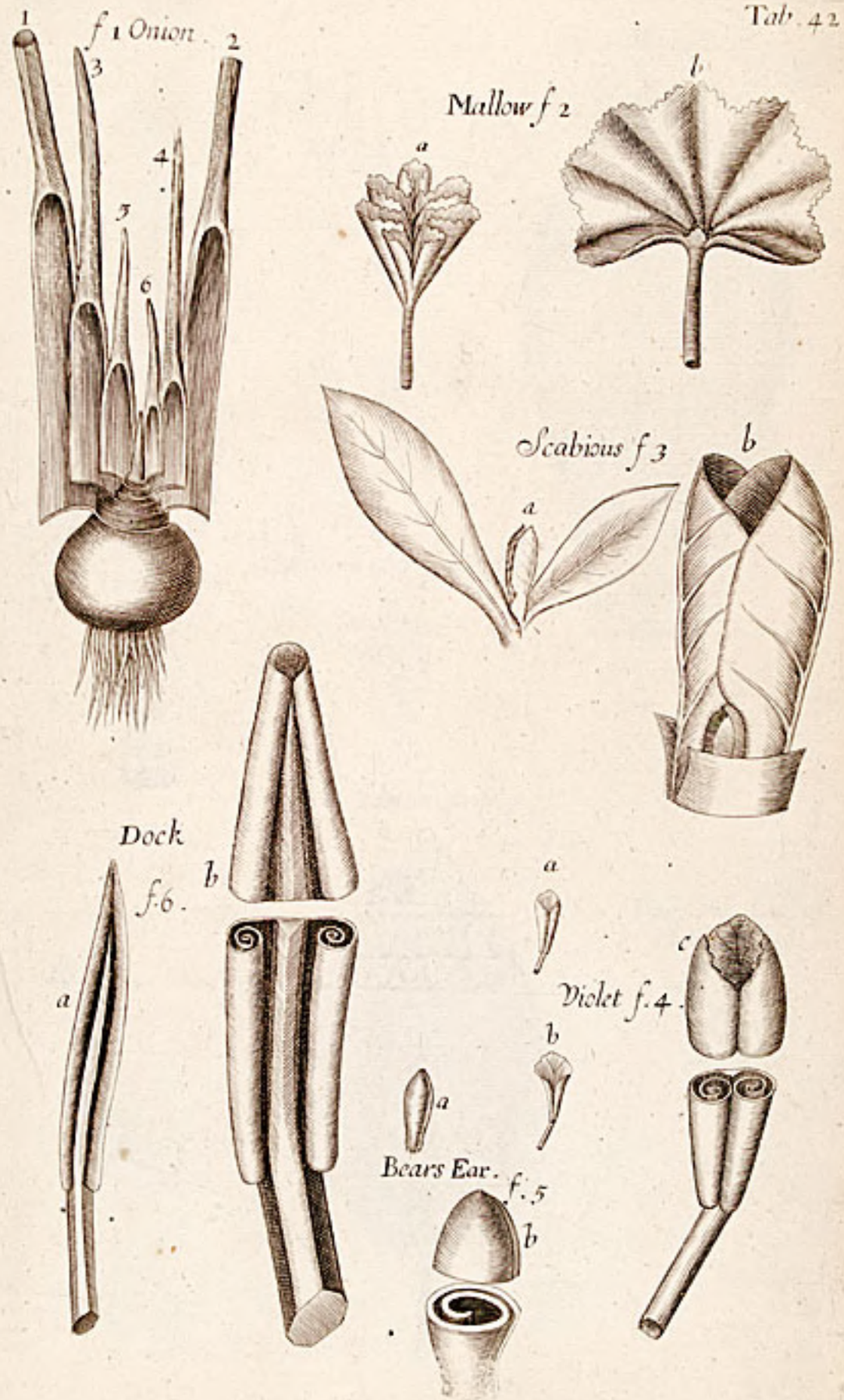

1
f 1 Onion.
2
3
4
5
6
Mallow f 2
a
b
Scabious f 3
a
b
Dock
f. 6.
a
b
a
Bears Ear.
f. 5
b
a
b
Violet f. 4.
c

fig: 2. Magnifyd.

Leaf of Goosgrass.

Fig. 1.

Of Bears Ear.

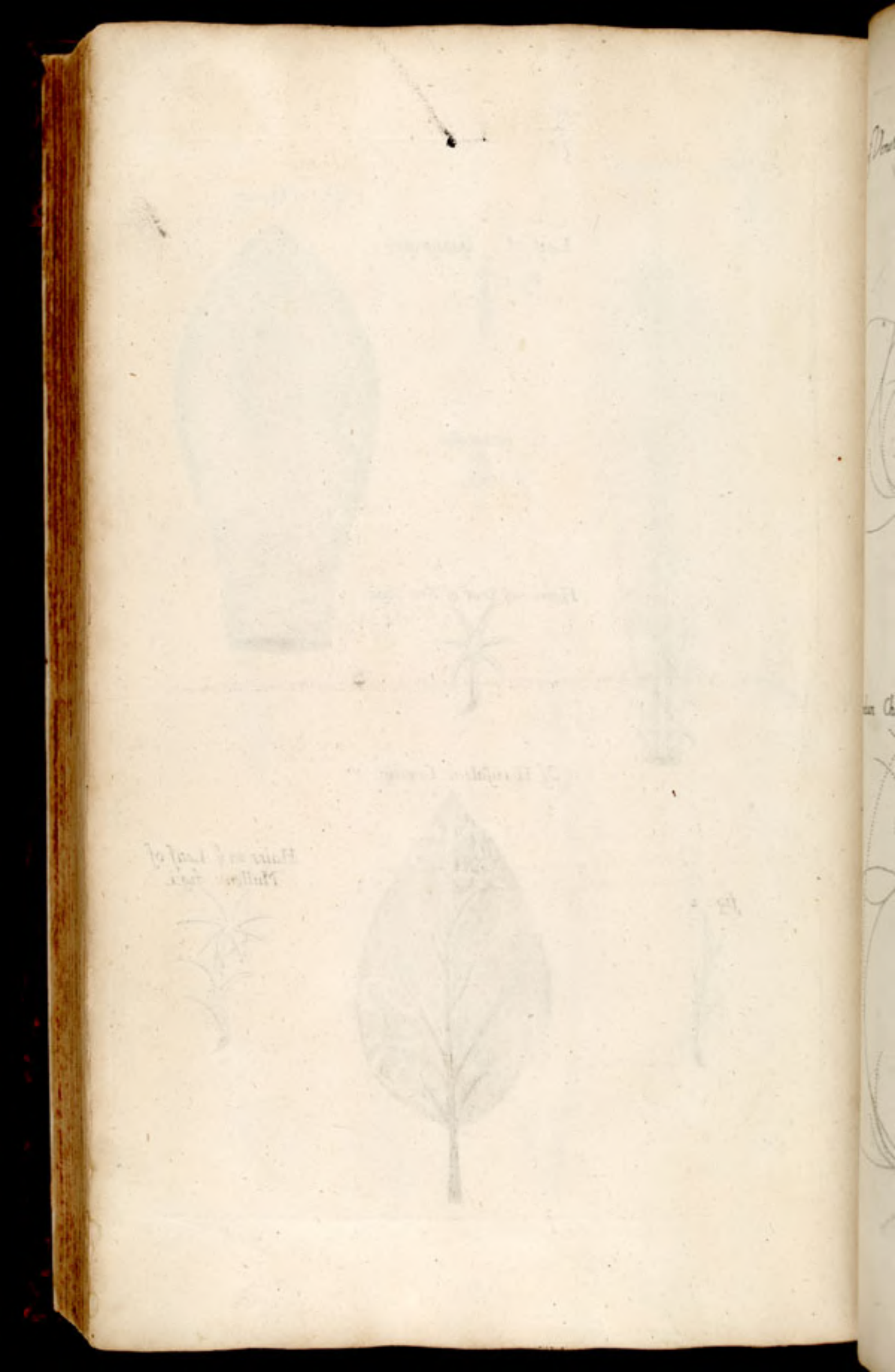
fig. 2.

Hairs on ye Leaf of Tree Sage.

Of Herusalem Cowslip.

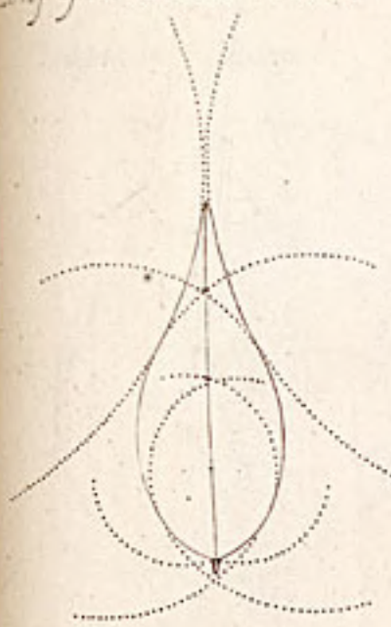
fig: 2.

Hairs on ye Leaf of Mullen. fig: 1.

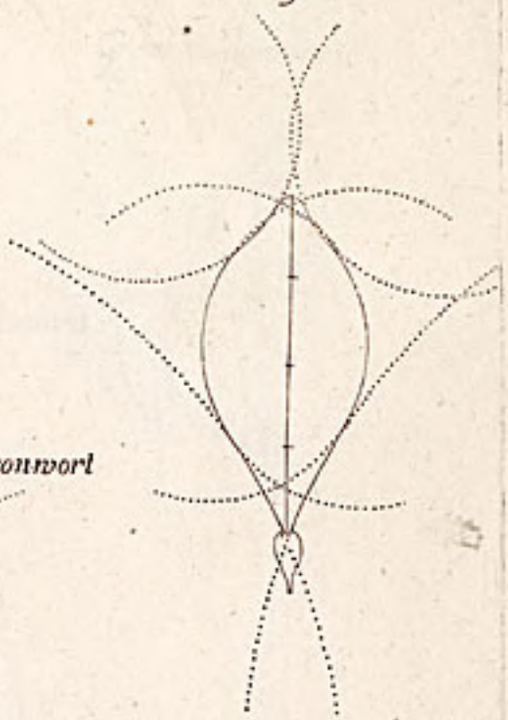


Tab XLIII.

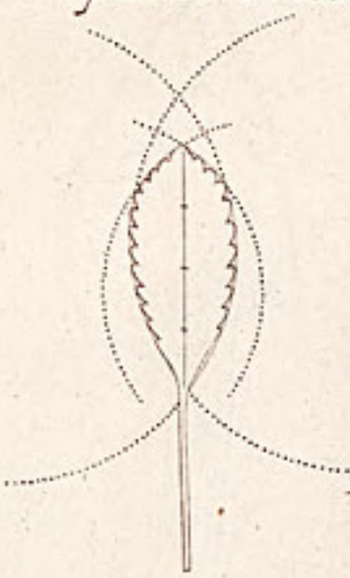
Leaf of Venetian Vetch



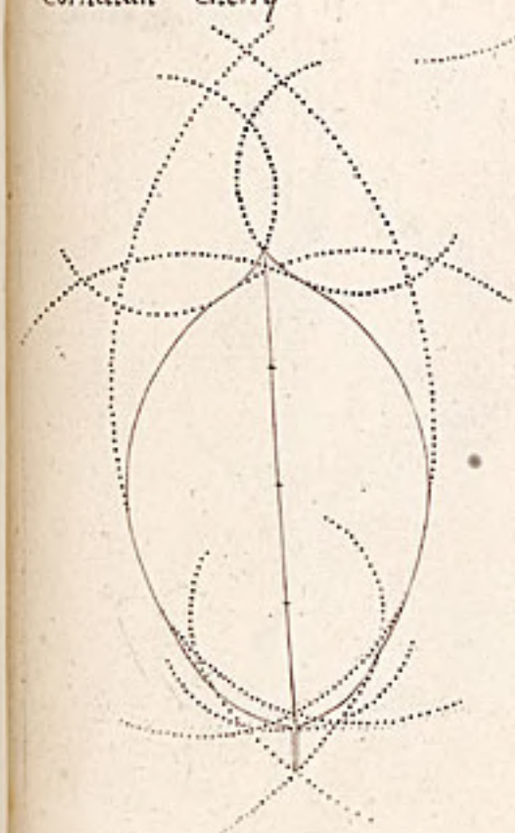
Orange



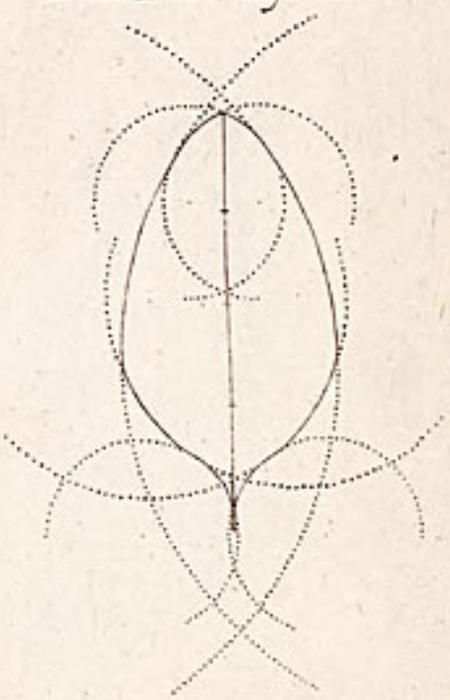
Sage-Leavd Ironwort

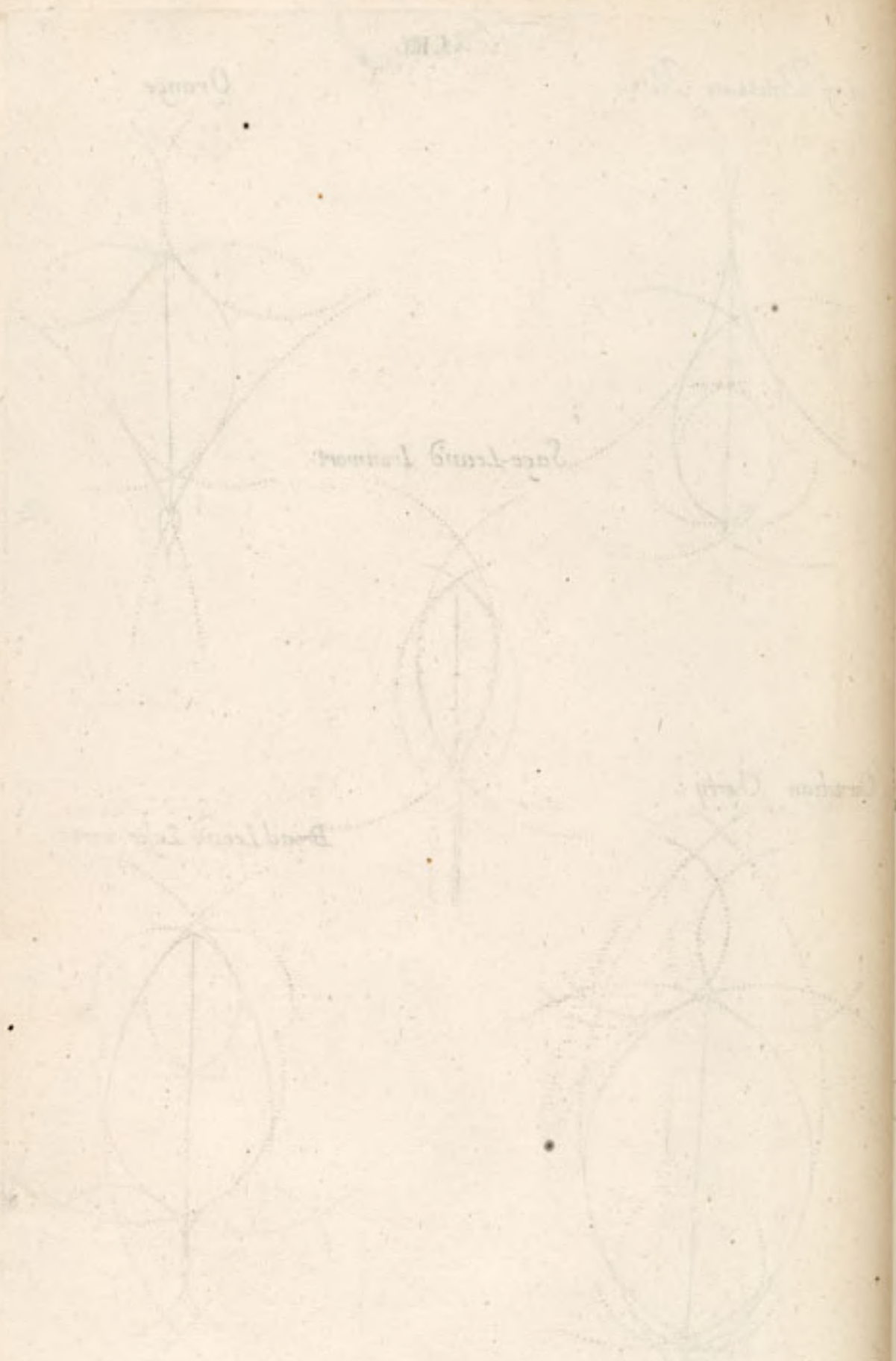


Cornelian Cherry



Broad Leavd Laser-wort

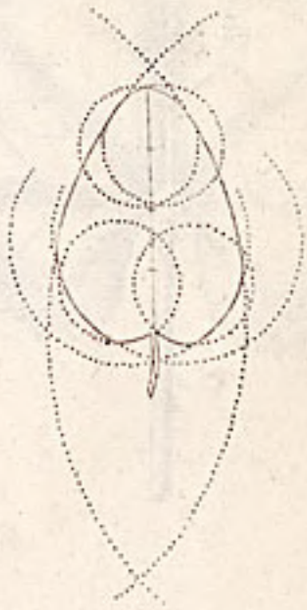




Tab. XLV.

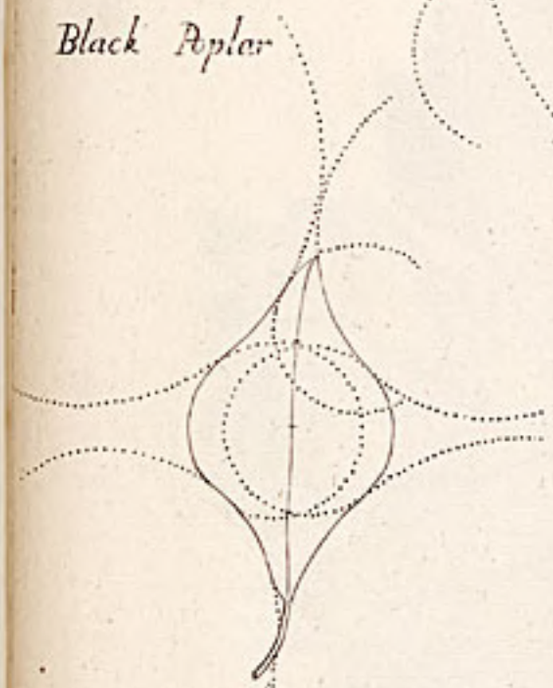
Leopards Bane

Great Laſerwort

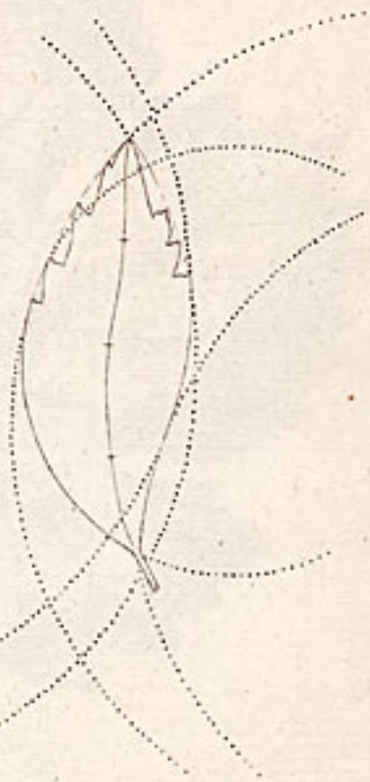


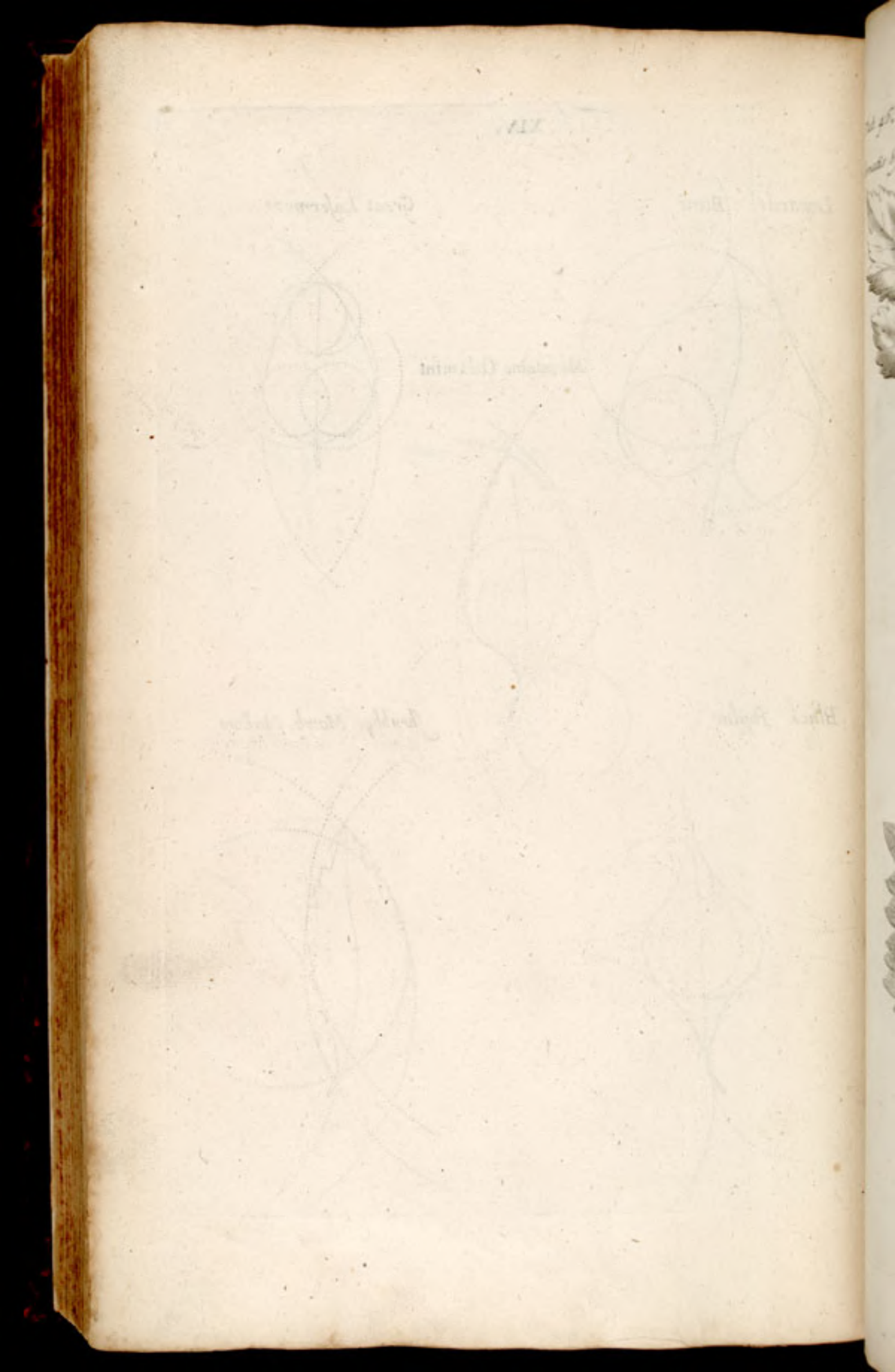
Mountaine Calamint

Black Poplar



Shrubby Mawk-Mallow



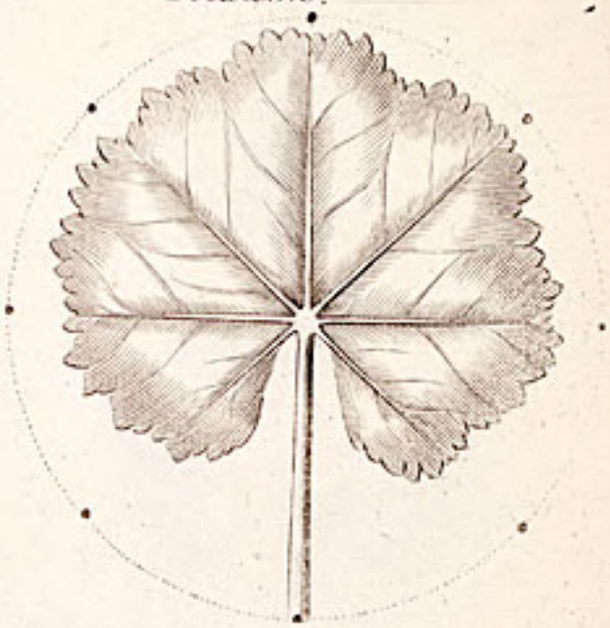


Tab. 46.

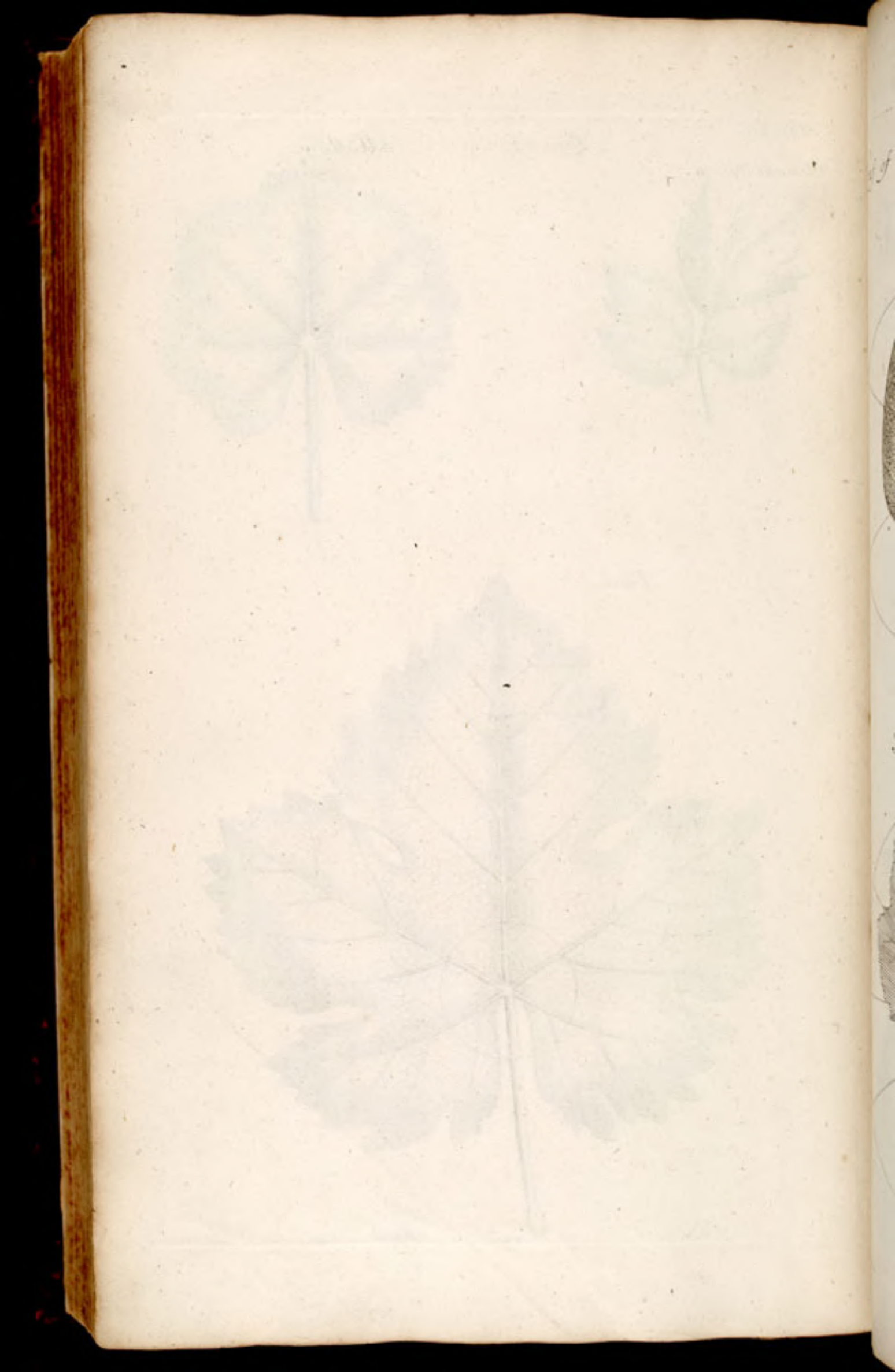
Leaves of.

Mallow.

Clematis Syl. m.



Vine.

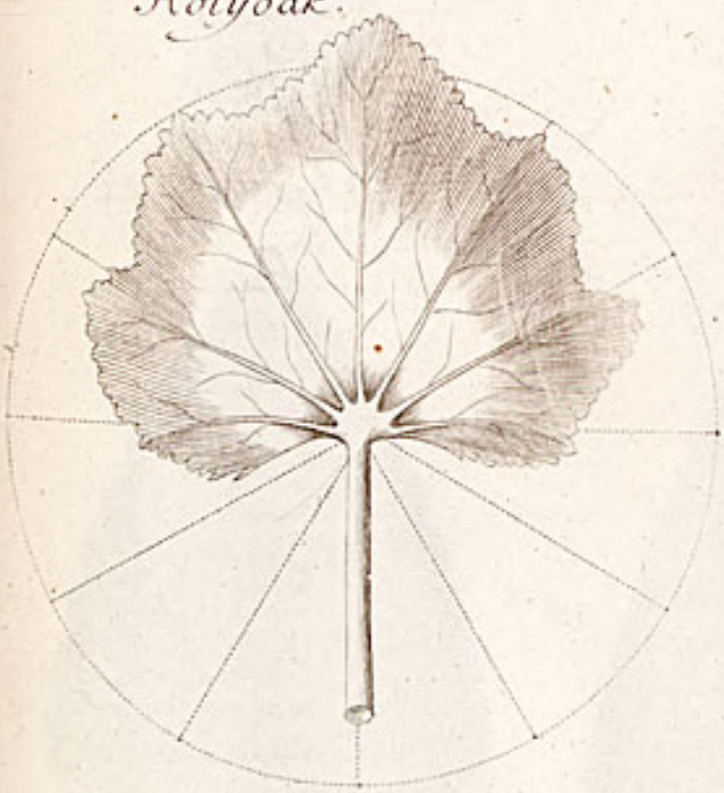


TAB XLVII.

Leaf of Syringa.

Hemlock.

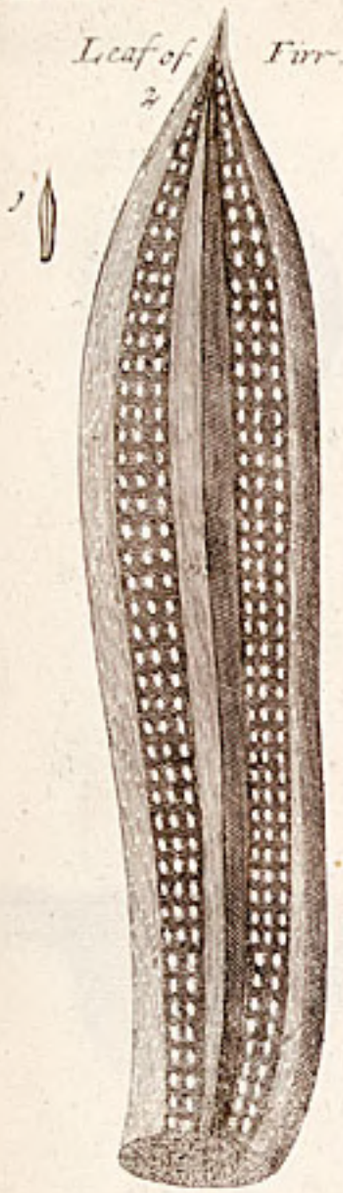
Holyoak.



Strawberry.

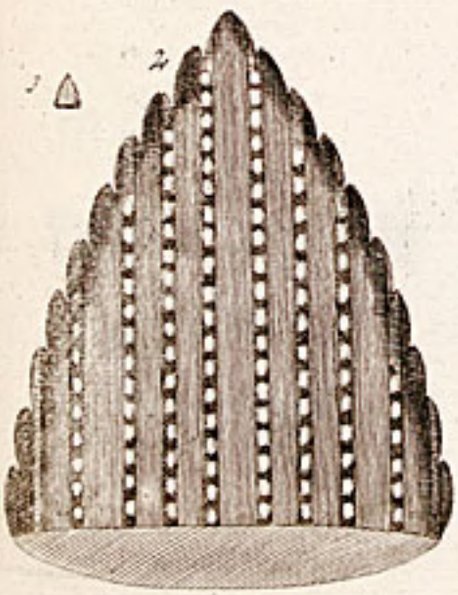
TAB. XLVIII.

Leaf of Firr.

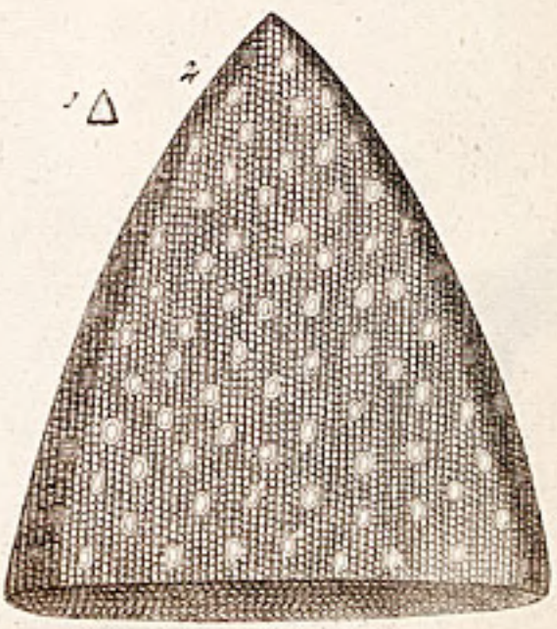


Rhamnus Salicis Folio.

The top of Pine Leaf.



The top of Lilly leaf.



TAB. XLIX. *Stalks of*

Mallow.

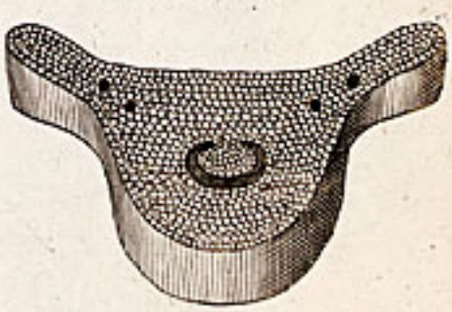
Dock.

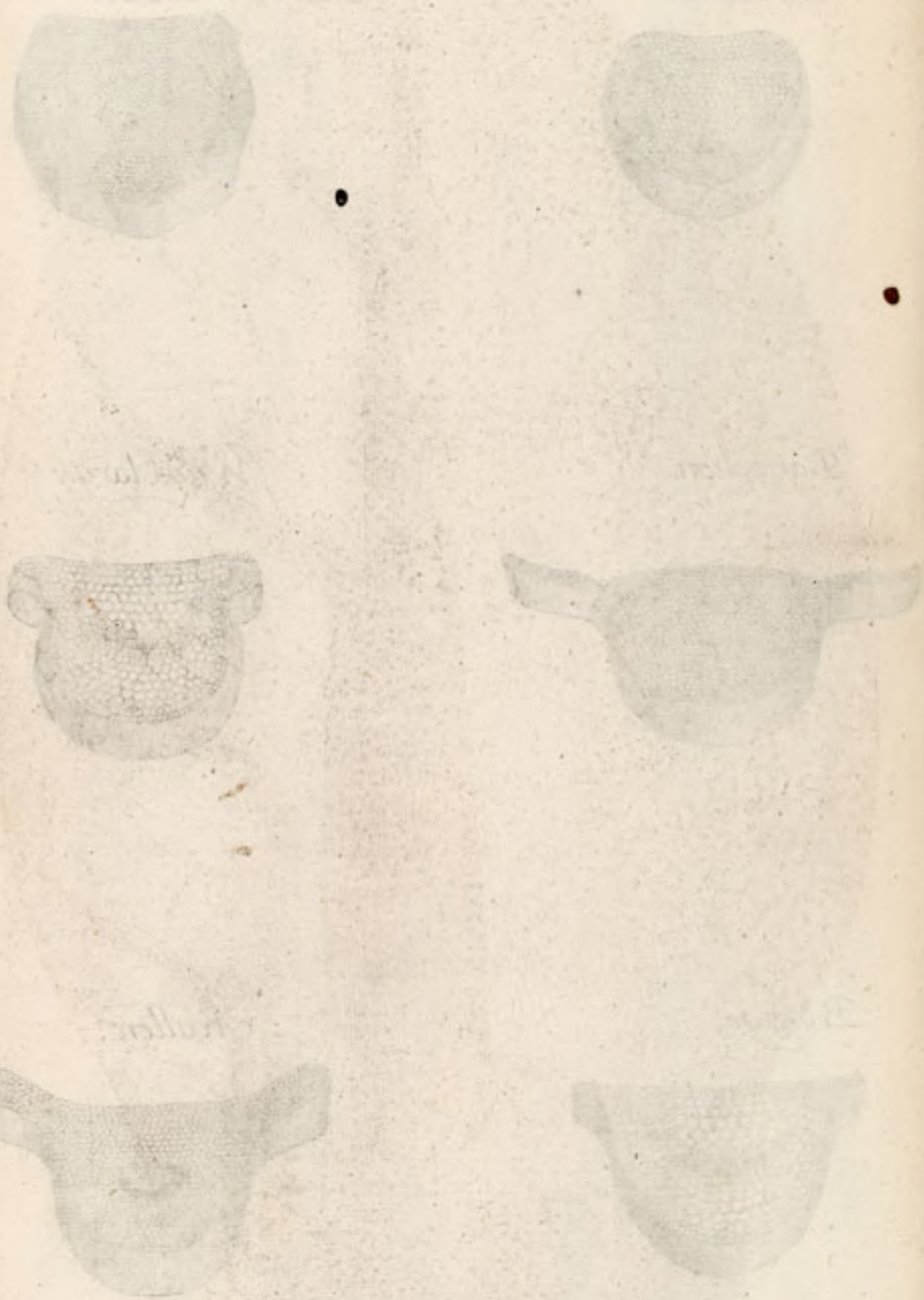
Dandelion.

Wild-Clary.

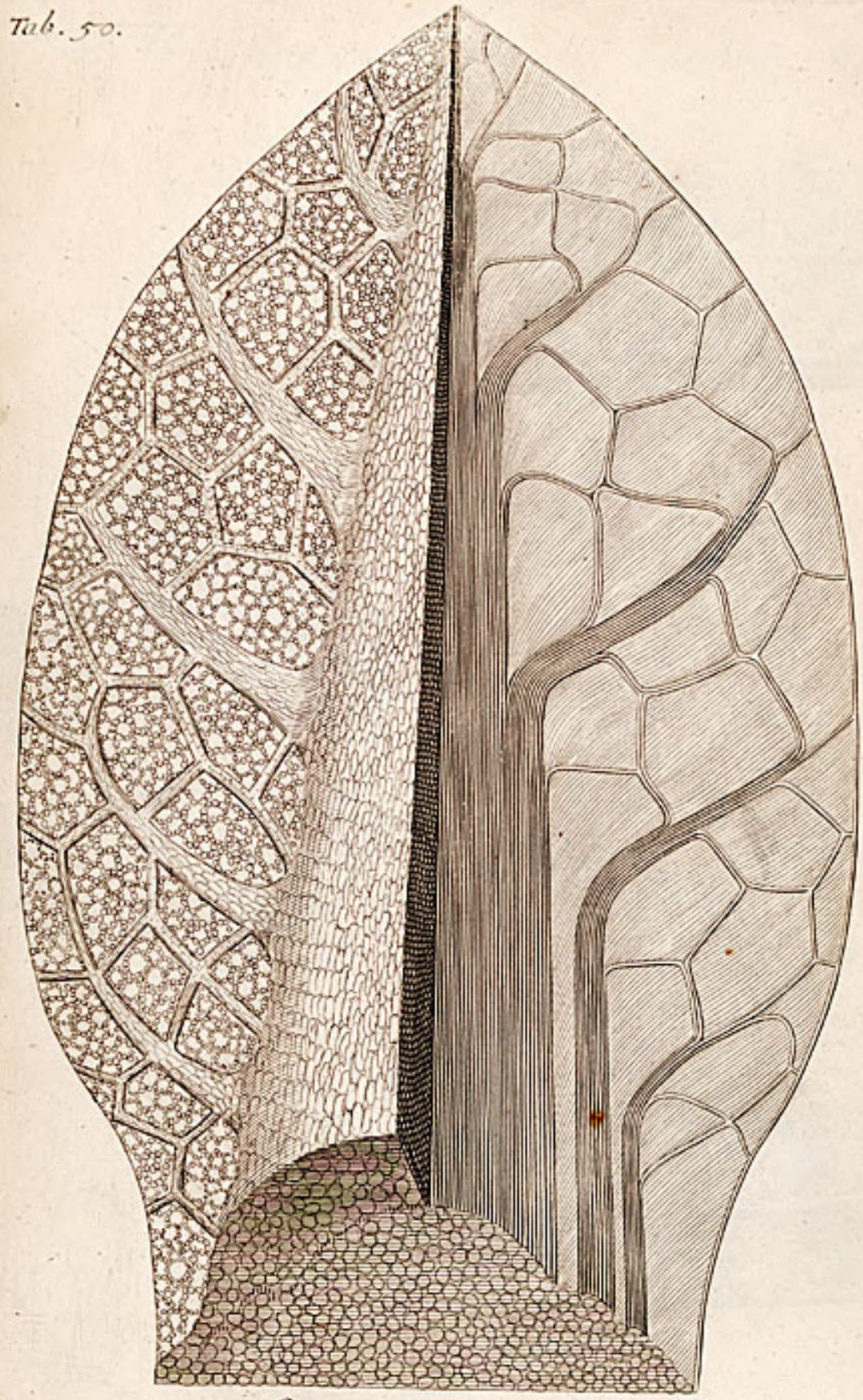
Borage.

Mullen.





Tab. 50.



A young Borage Leaf

Tab. 51.

The Aer-Veſsels unroaved in a Vine Leafe.

Fig: 3.

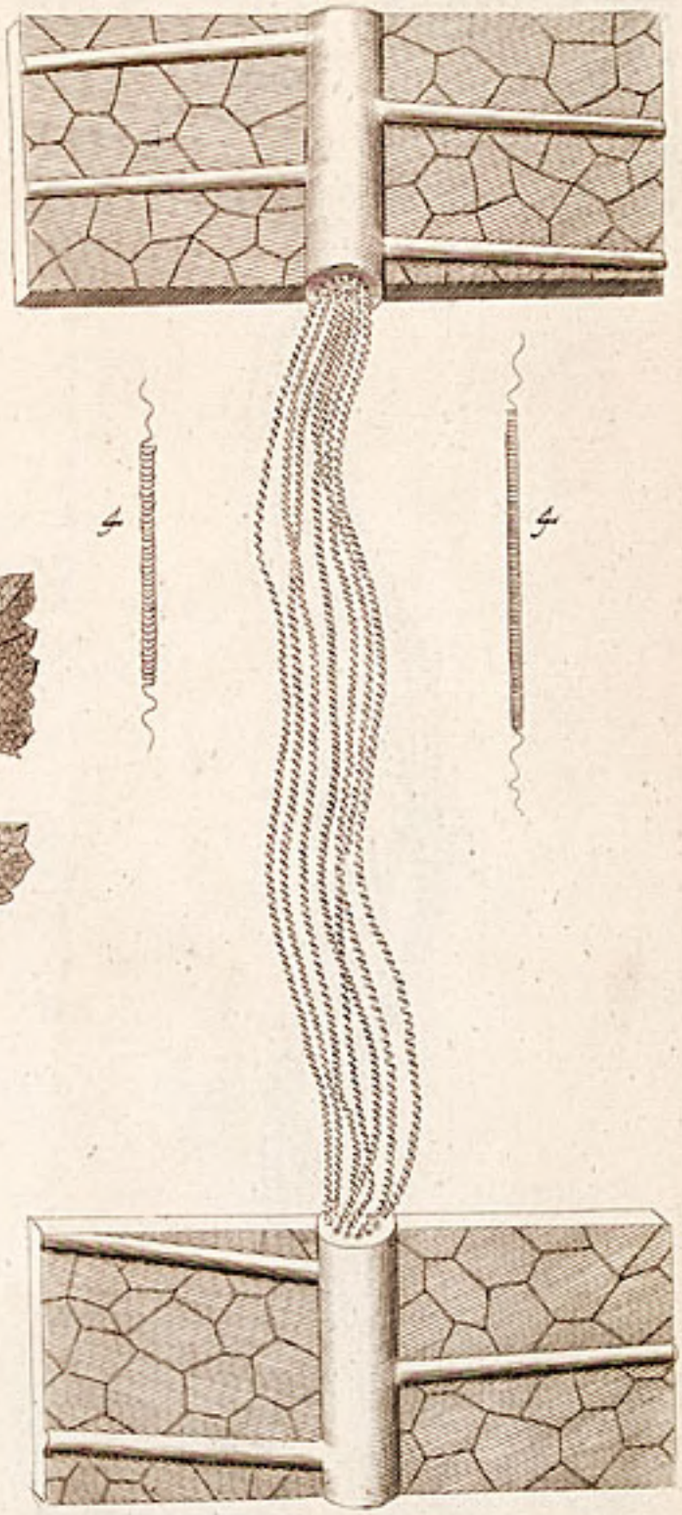


Fig: 1.

Fig: 2.

Tab. LII

The Aer-Vessels unwaved in a Scabions Leafe.

Fig. 1.

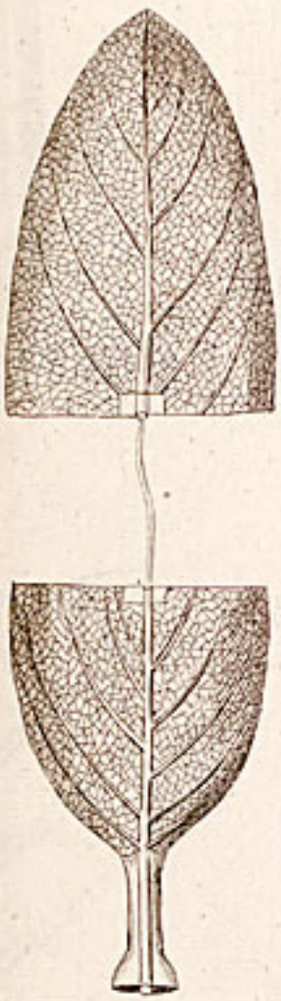


Fig. 3.

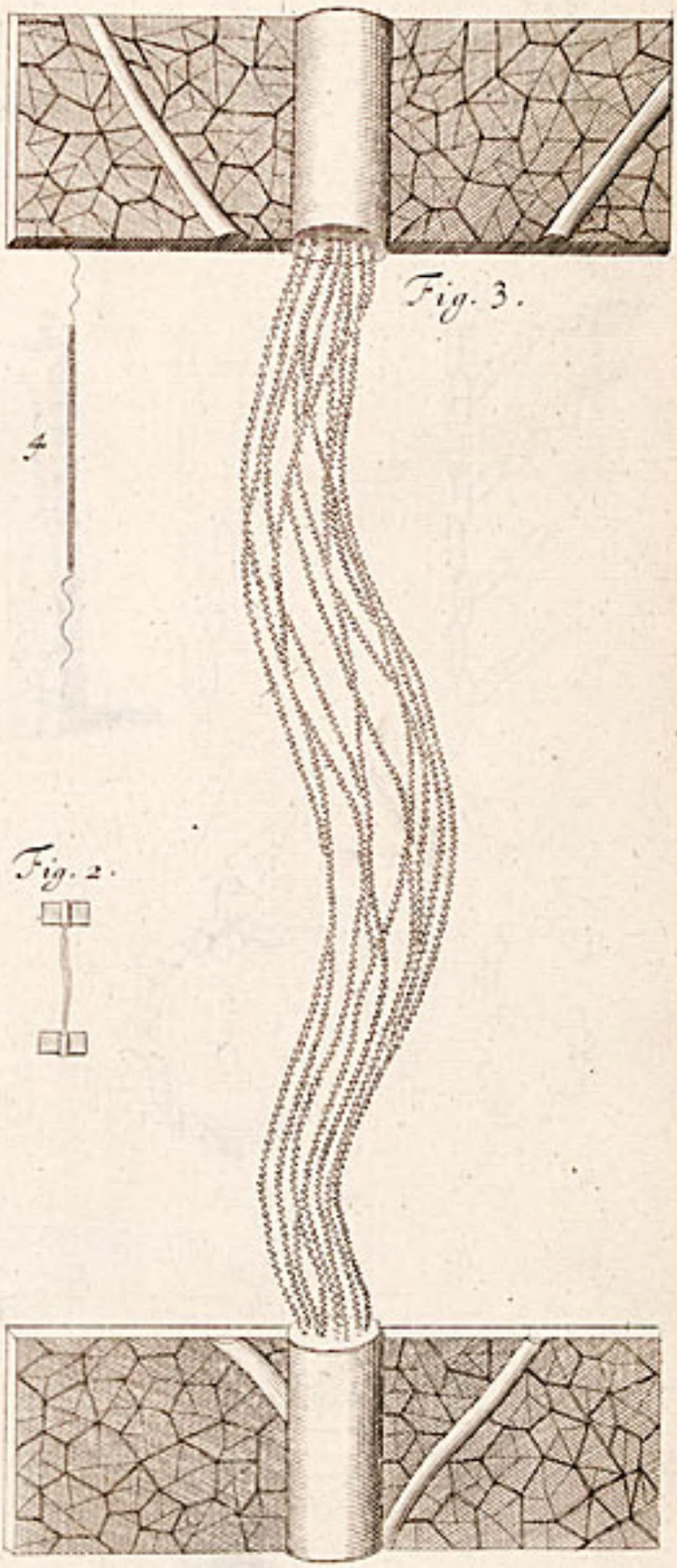
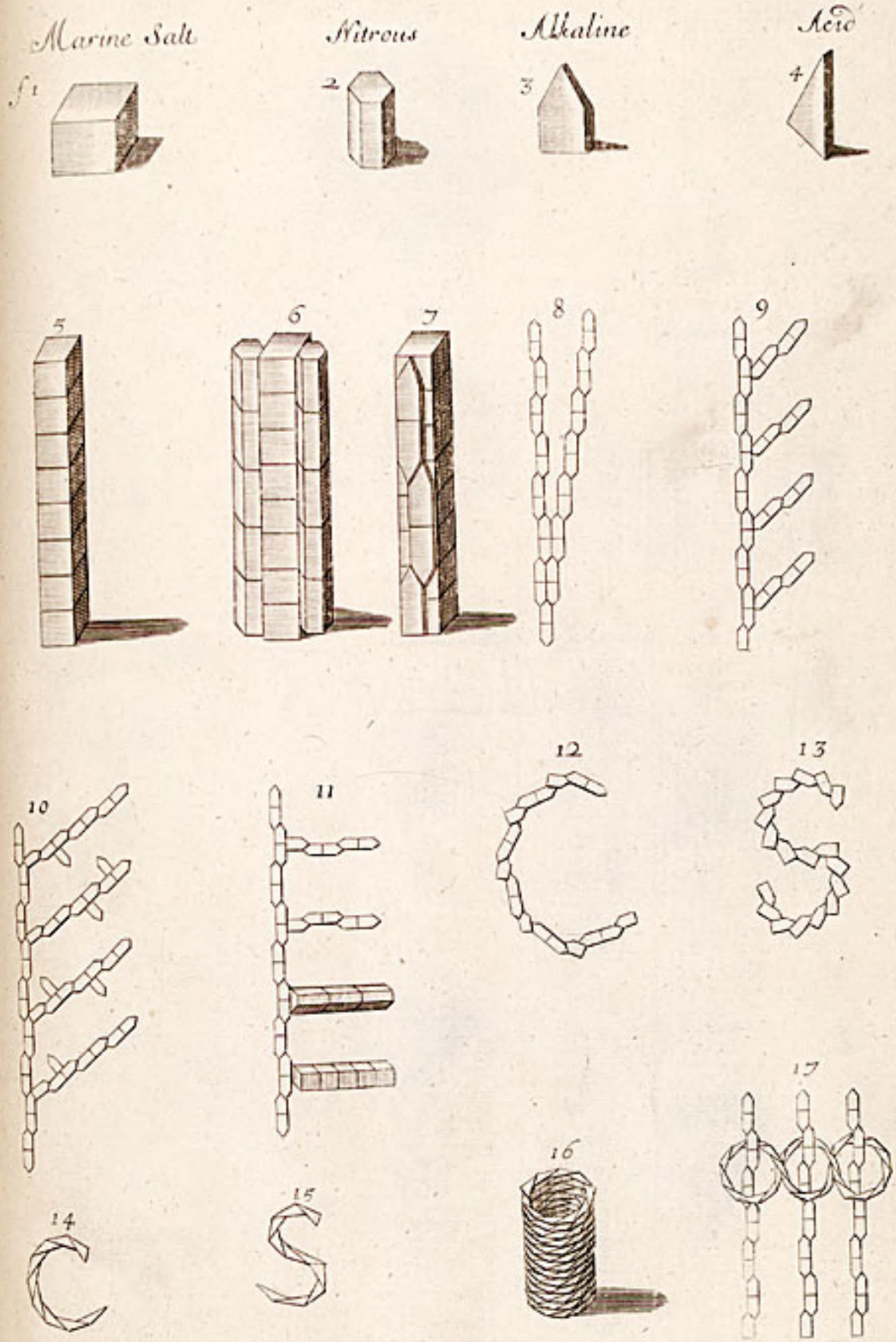
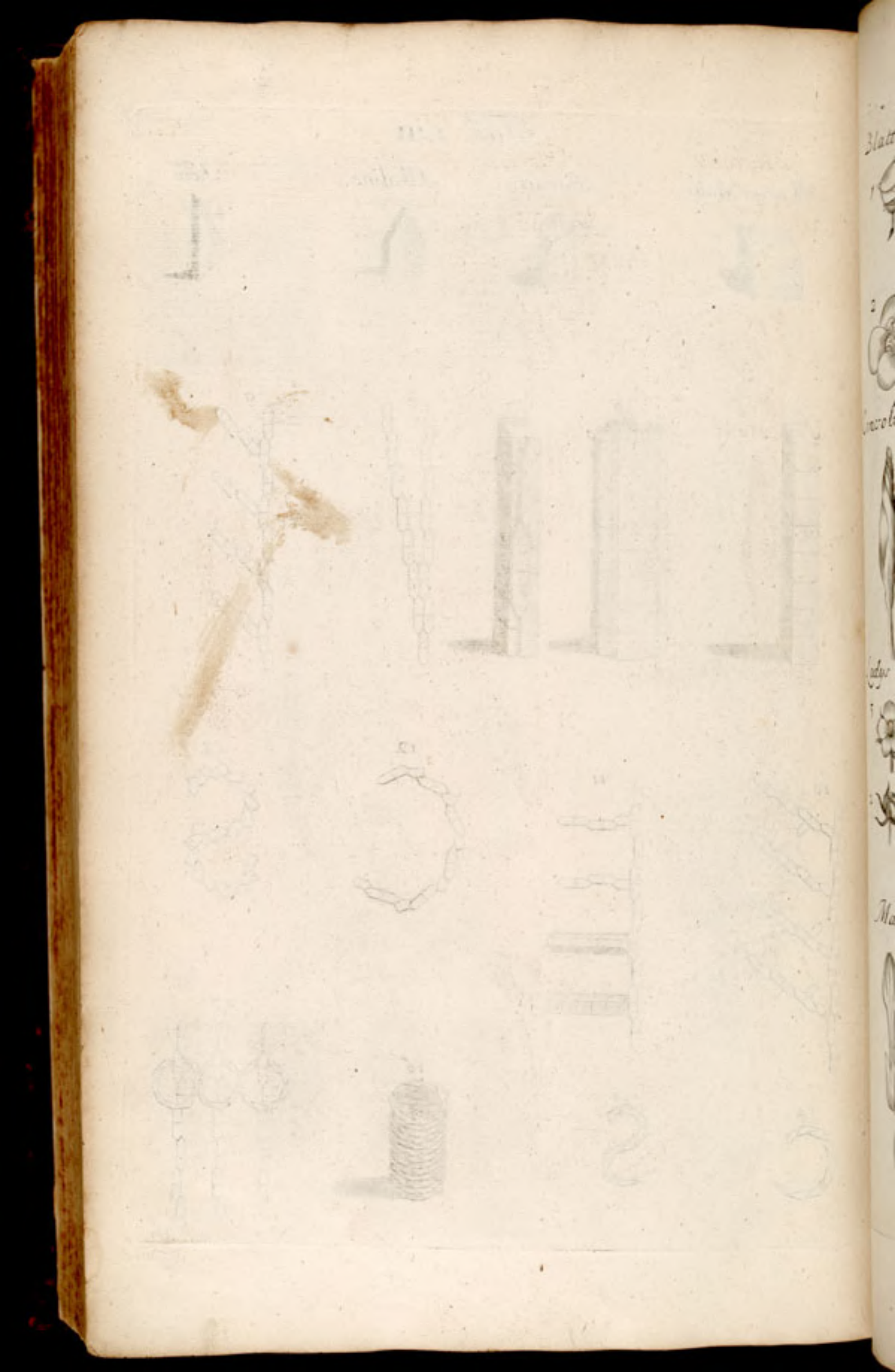


Fig. 2.

Tab. LIII


Marine Salt
Nitrous
Alkaline
Acid
f 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17



Blattana

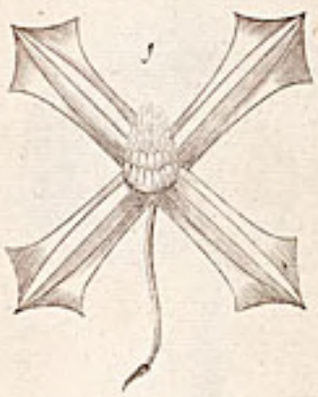
Flowers of Starwort

Convolvulus Mallow

Poppey

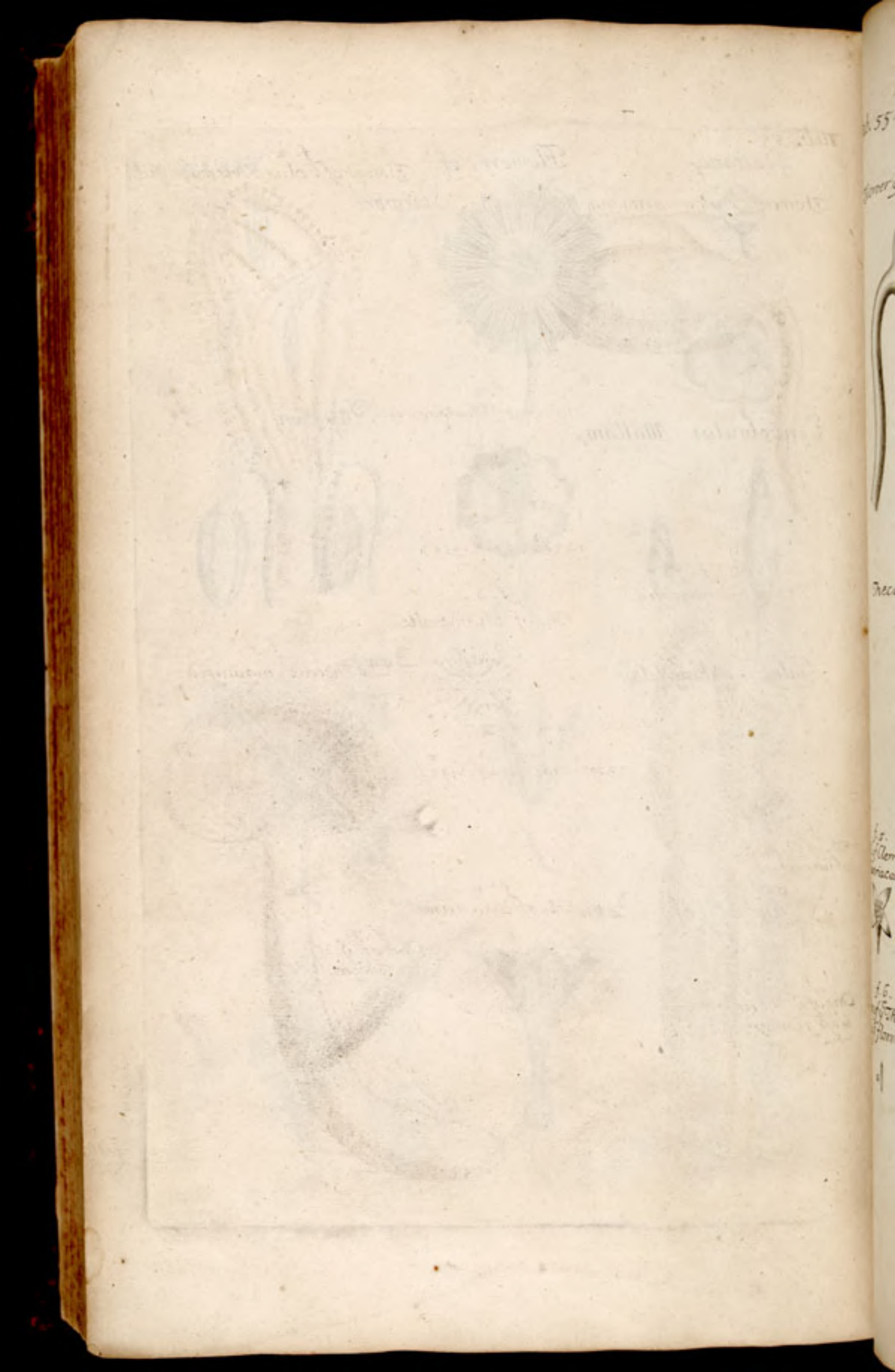
Ladys Looking Glass

Ladys Bower



Marvel of Peru

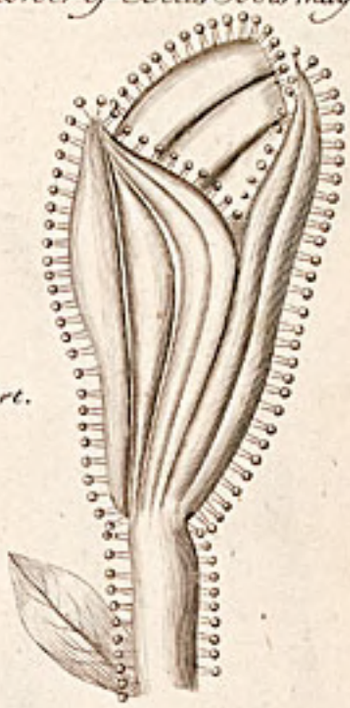
Cichory



Tab. 55.

f. 1.
Flower of Dulcamara magnified.

f. 2.
Flower of Colus Jovis magnified.



f. 3.
Flower of St James's wort.

1 2 3 4 5 . 1 2 3 4 5 . 1 2 3 4 5

f. 7.
Theca (a) magnified.

f. 4.
Fl. of Chamemile.

1 2 3 4 5 . 1 2 3 4 5 . 1 2 3 4 5 . 1 2 3 4 5.

f. 10.
The Theca (c) magnified.

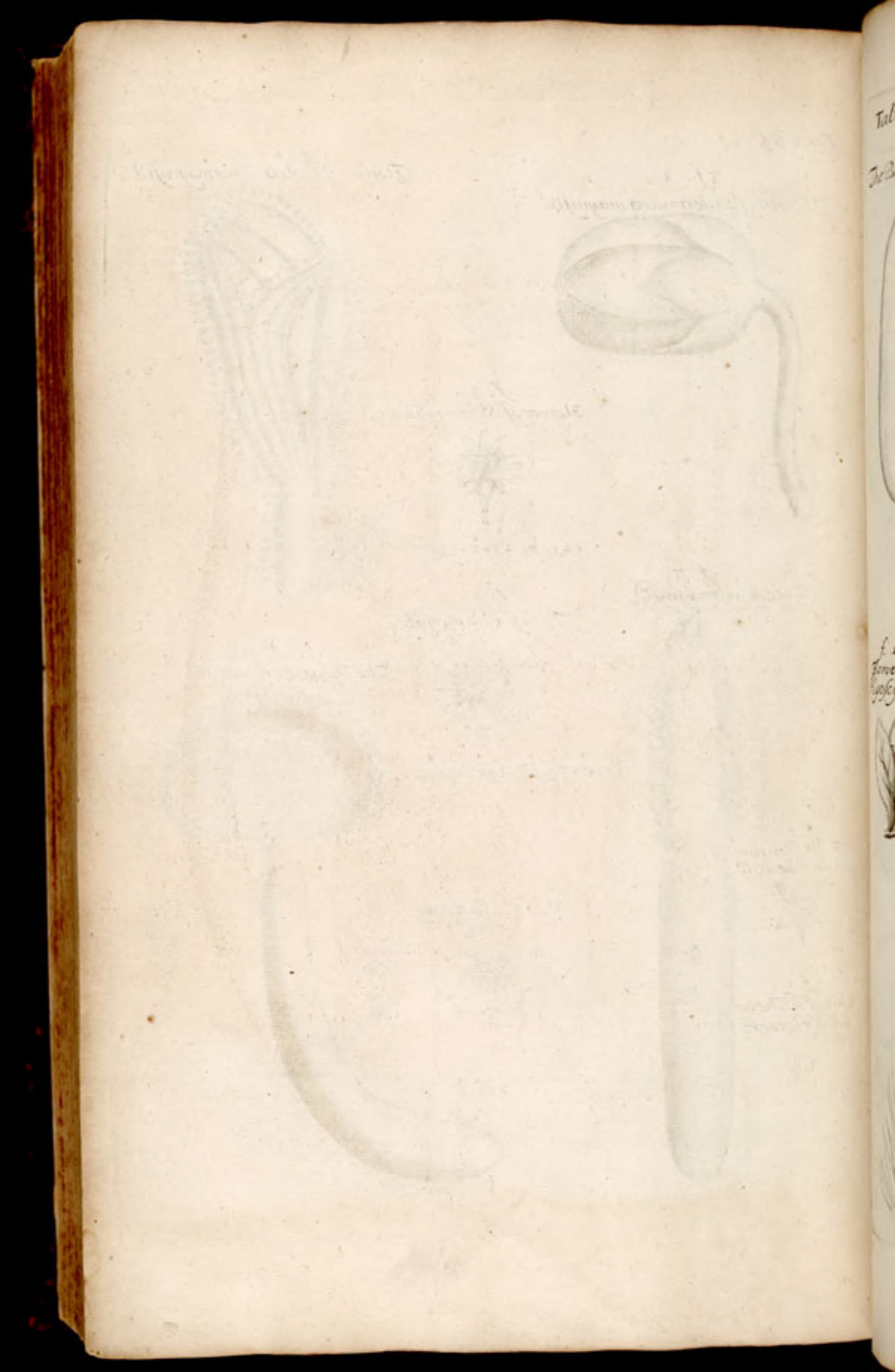
f. 5.
Fl. of Clematis Austriaca.

f. 8.
Fl. of Blattaria.

f. 9.
One of y^e Theca.

f. 6.
One of y^e Theca in y^e flower.

a



Tab. 56.

f. 3.
The Backside of ỹ Theca. (a)

f. 7.
The Column (e) Magnifi'd.

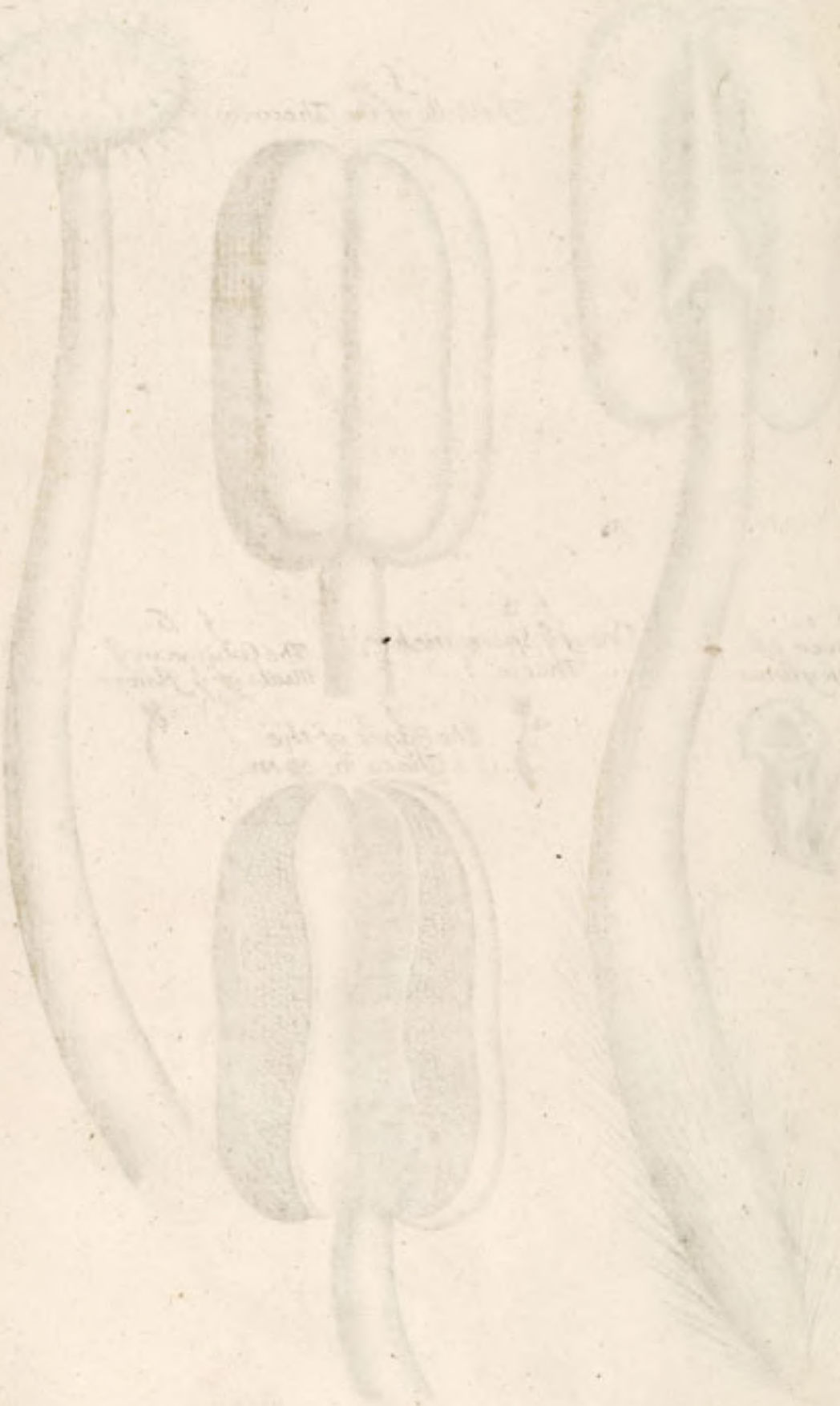
f. 4.
The Belly of the Theca. (a)

f. 1.
Flower of Hyoscyamus.

f. 2.
One of ỹ Spermatick Theca.

f. 6.
The Column in ỹ Midle of ỹ flower.

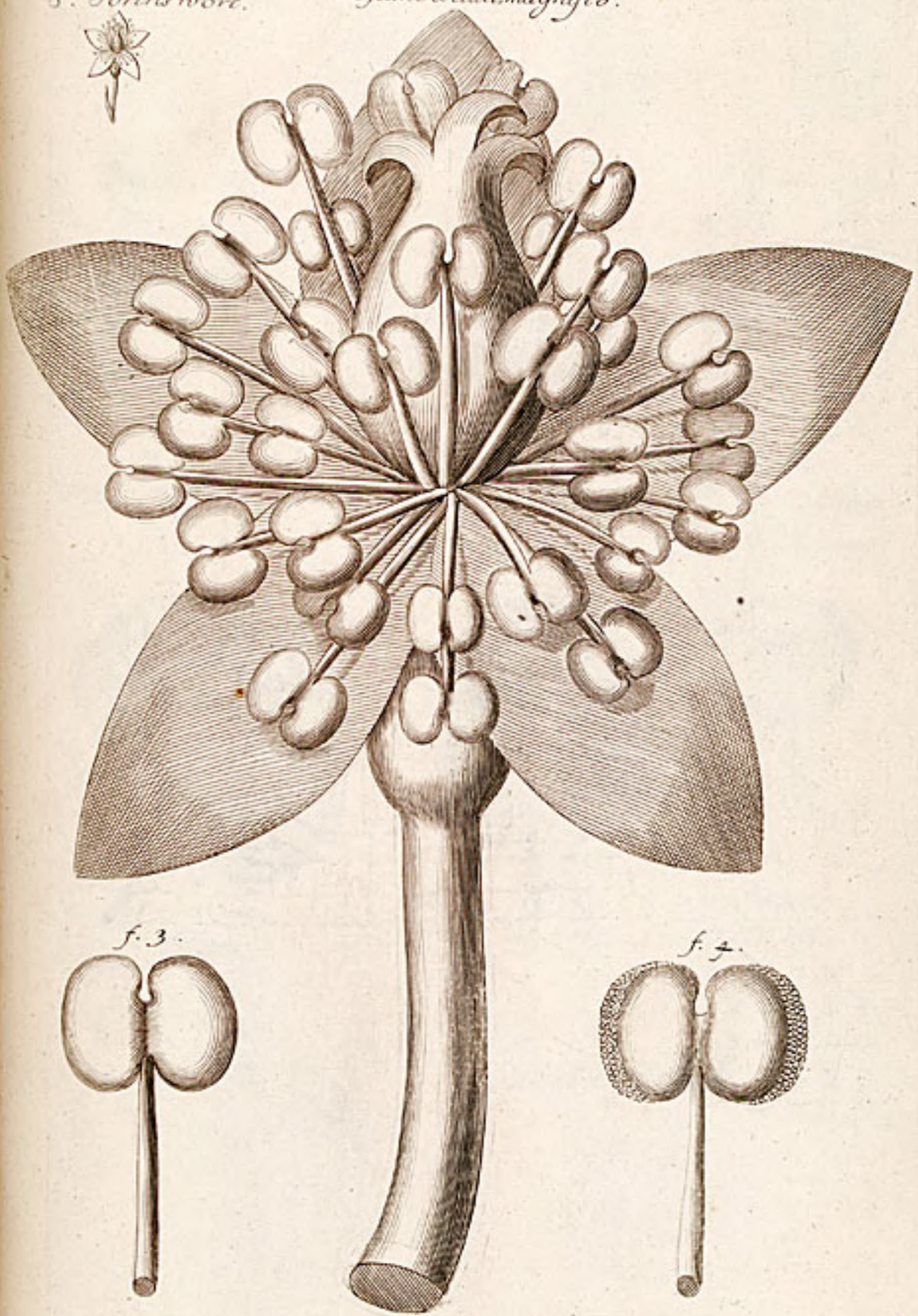
f. 5.
The Edges of the Theca (a) open.



f. 1.
Flower of
St. Johns wort.

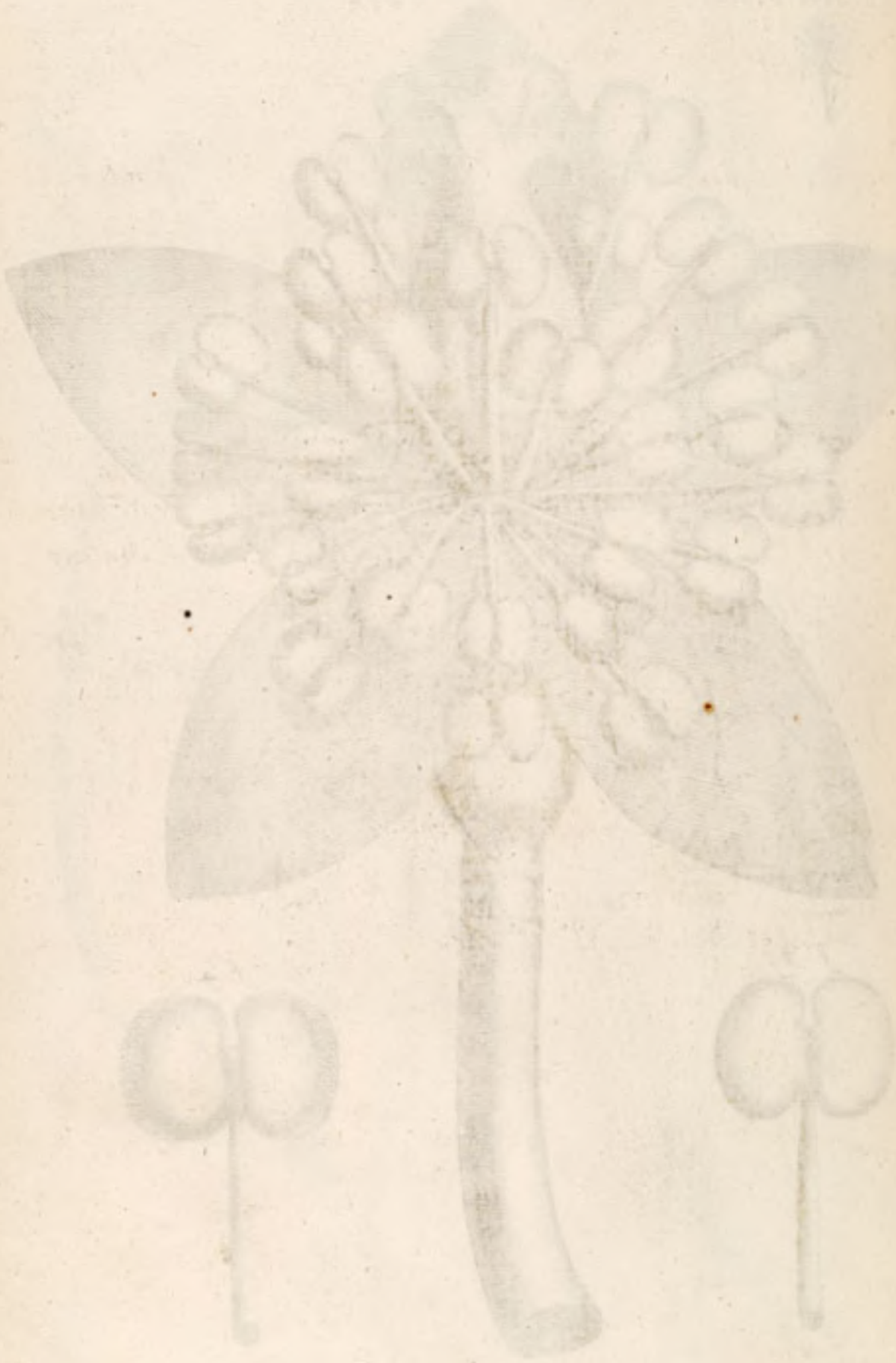
f. 2.
The same a little magnified.

Tab. 57.



f. 3.

f. 4.



Tab. 58.

Snapdragon
f. 1.

The Sperme of
Plantaine
f. 2.

Bearsfoot
f. 3.

Carnation
f. 4.

Derils-bit
f. 6.

Mallow
f. 14.
The Spermatick Globulets in f. 13.

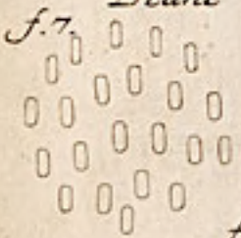
Bindweed
f. 5.

f. 13.
One of ye Theca (t)
in f. 12.

f. 12.
The Attire (c)
in f. 11.

f. 11.
The Flower
of Mallow

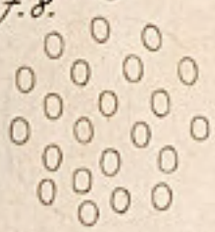
Beane
f. 7.



Pancy
f. 10.

Deadly Night Shade

Lily
f. 8.



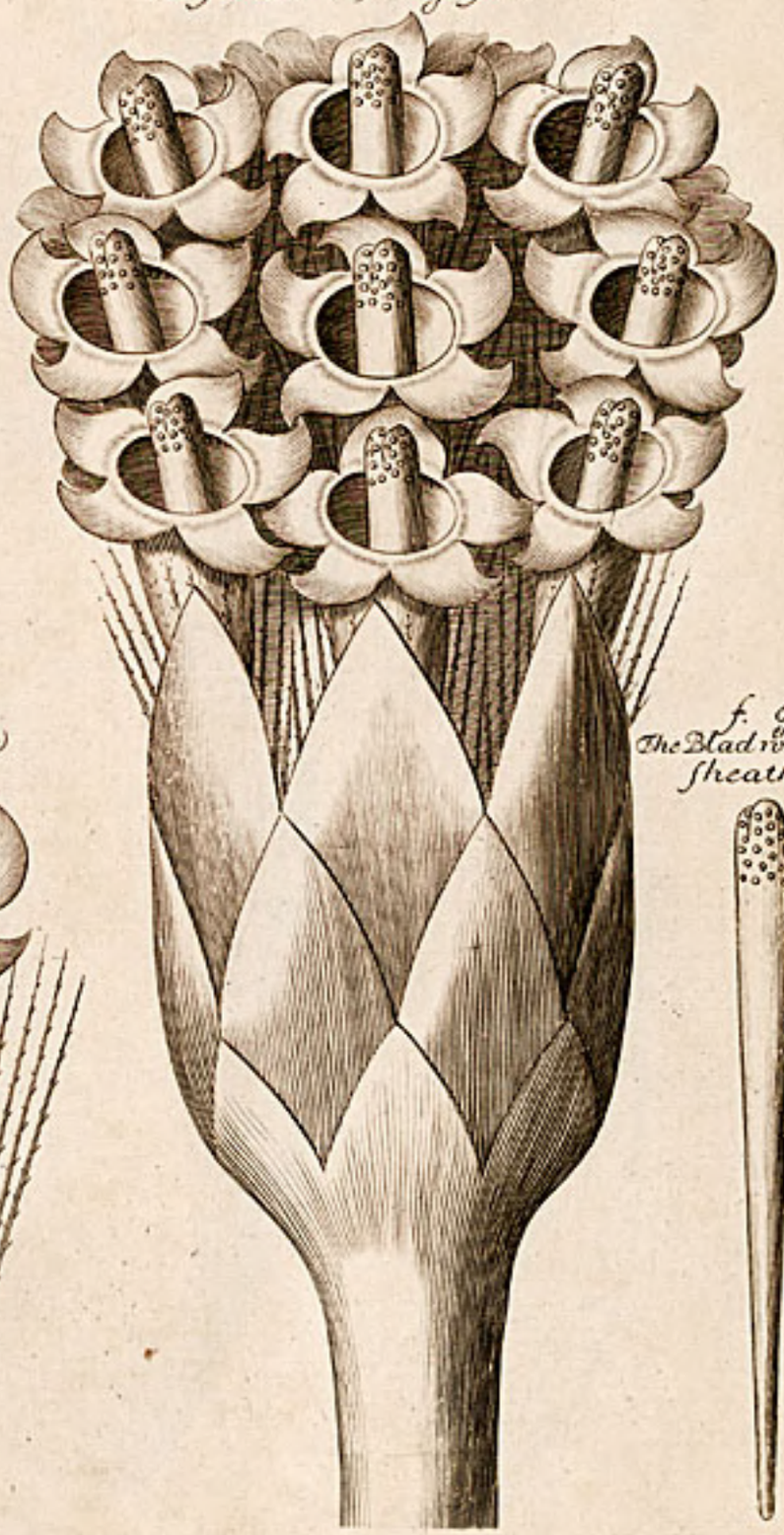
Tab. 59.

f. 1.
A sprig of Golden-Rod flowerr.

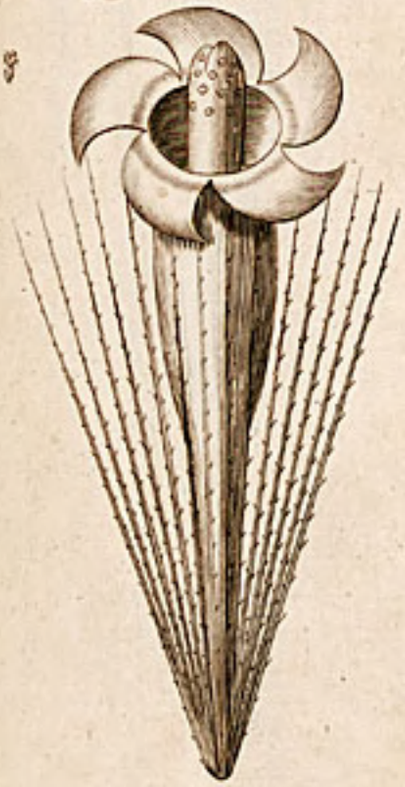
f. 2.
One flower.

a

f. 3.
The flower (a) magnifid.



f. 4. & 5.
One suit of ij flower (a)



f. 6.
The Bladdr. in ye sheath (c).

Tab. 60.

f. 1.
A French Marigold.

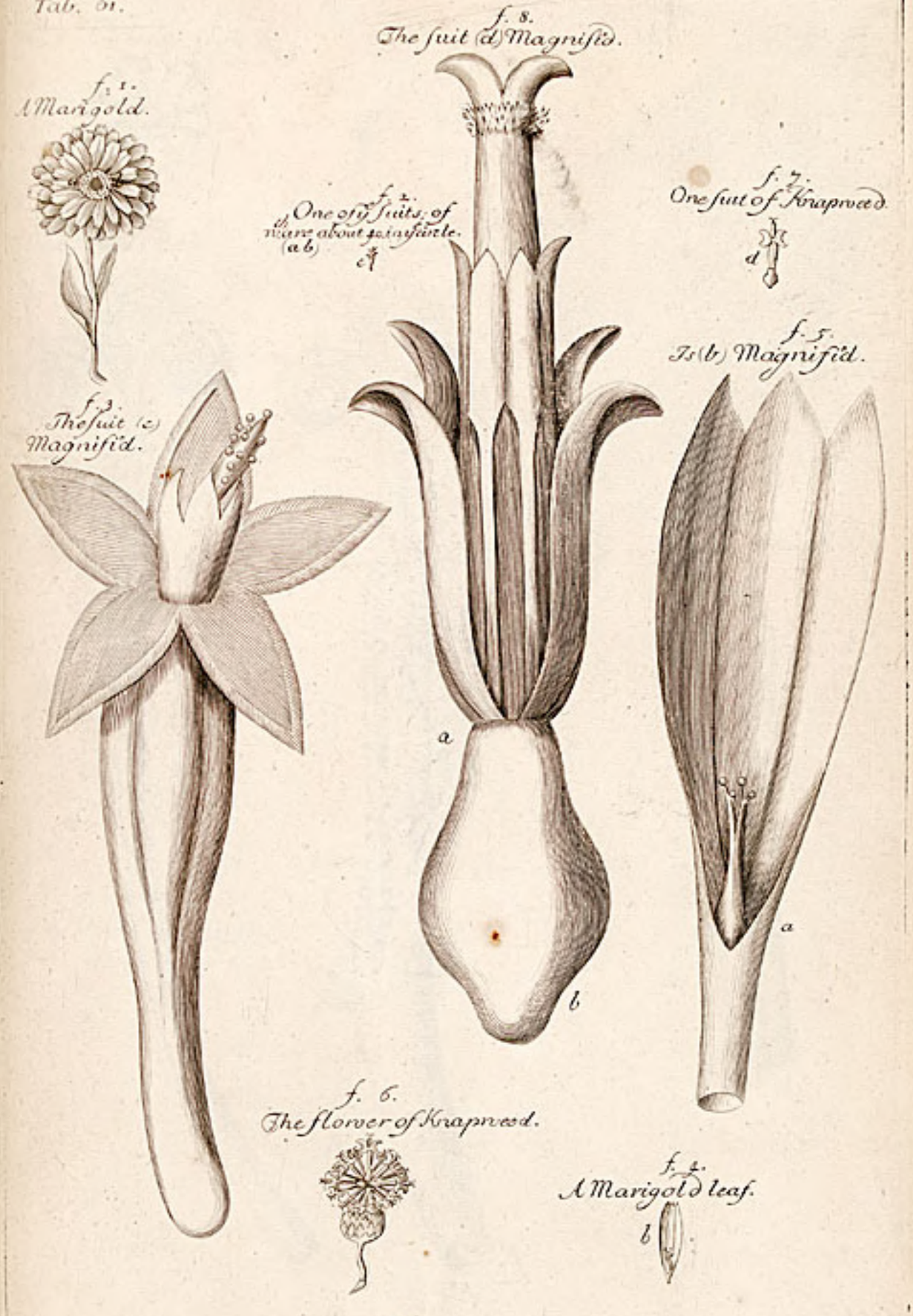
f. 2.
One suit of which about 12 are within ye circle. (ab.)

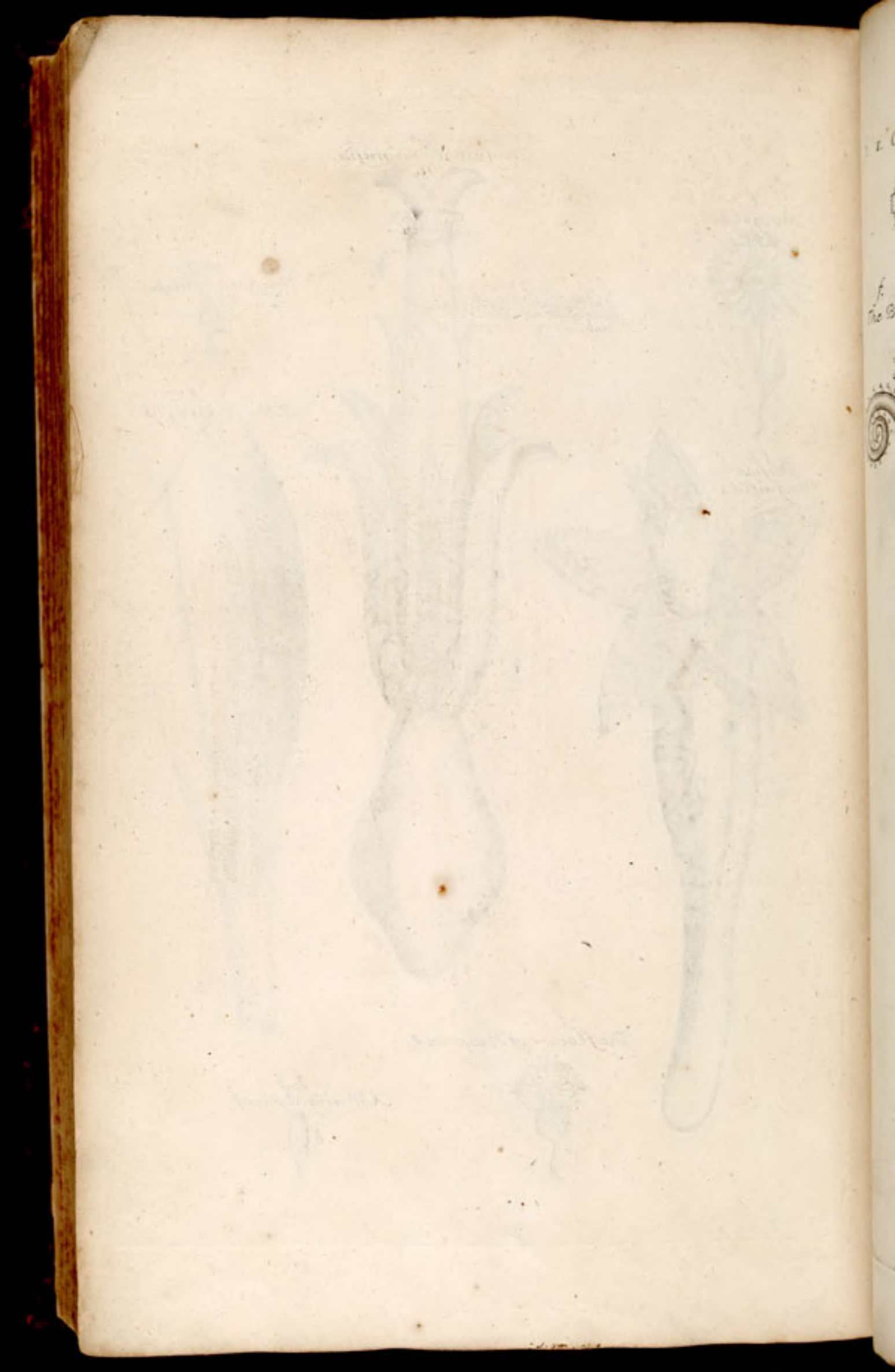
f. 3.
The suit (c) magnified.

f. 4.
The Blade (c d) taken out of ye sheath (c).

f. 5.
One suit of Chrysanthemum Creet. of wch about 20 are in every flower.

Tab. 61.


f. 1.
A Marigold.
f. 2.
One of ye suits of
the wane about 40 in a scintle.
(a b)
c
f. 3.
The suit (c)
Magnifid.
f. 8.
The suit (d) Magnifid.
a
b
f. 7.
One suit of Knapweed.
d
f. 5.
Is (b) Magnifid.
a
f. 6.
The flower of Knapweed.
f. 4.
A Marigold leaf.
b



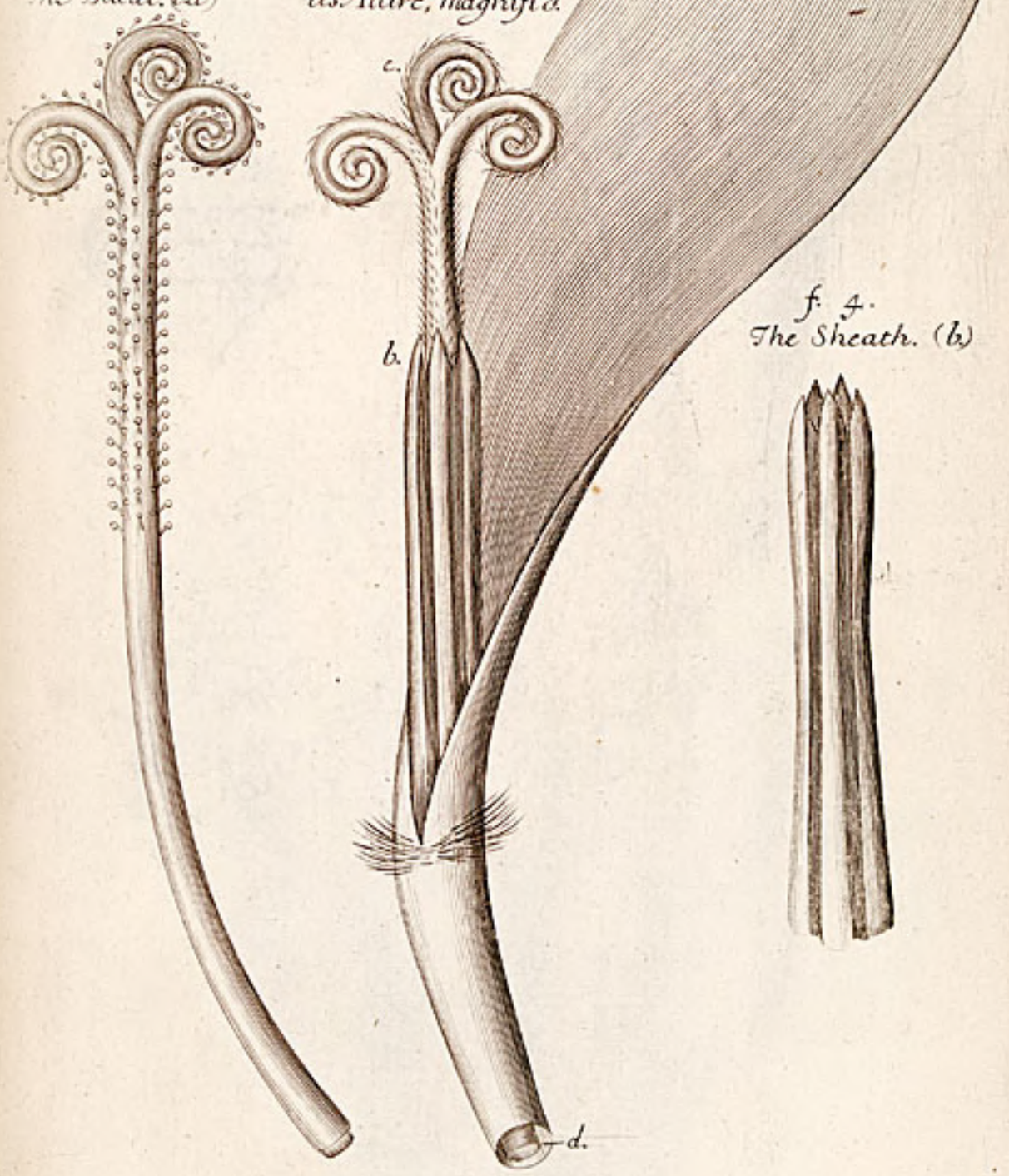
f. 1. Cichory flower.

Tab. 62.

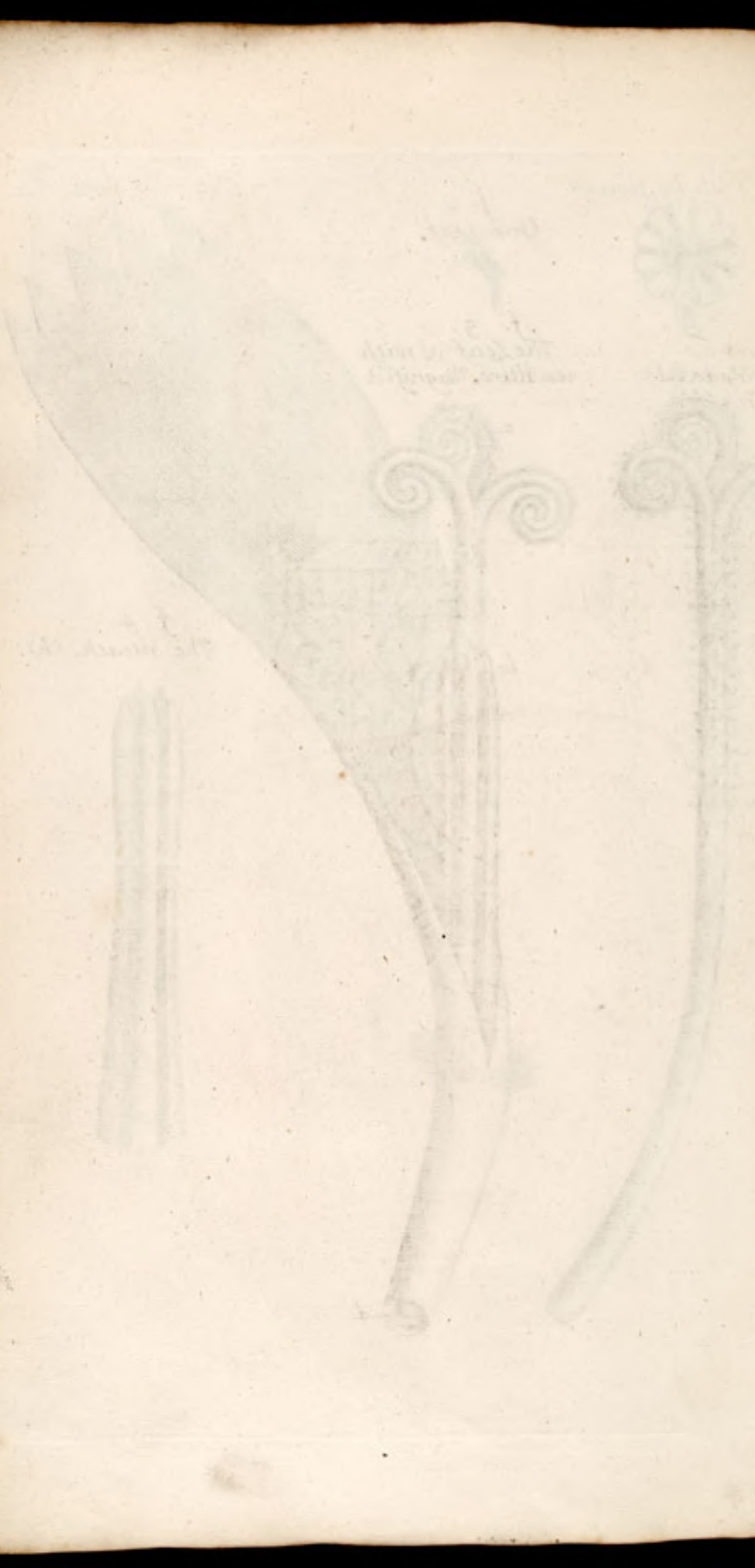
f. 2.
One Leaf.

f. 3.
The Leaf (a) with its Attire, Magnified.

f. 5.
The Blade. (d)



f. 4.
The Sheath. (b)



Tab. 63.

f. 2.
One of ye Flowering
Bud (a) magnified.

f. 4.
Sheweth a young Tulip
(a) as it is formd in ye bottome
of ye Root in September.

f. 1.

a

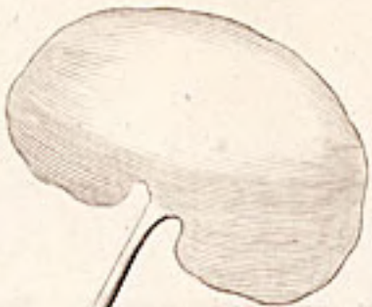
a

f. 3.
The same flower cut open,
shewing ye Spermatick Theca,
& ye Uterus.

Tab. 64.

f. 6.
Is (c) or ij Column Naked.

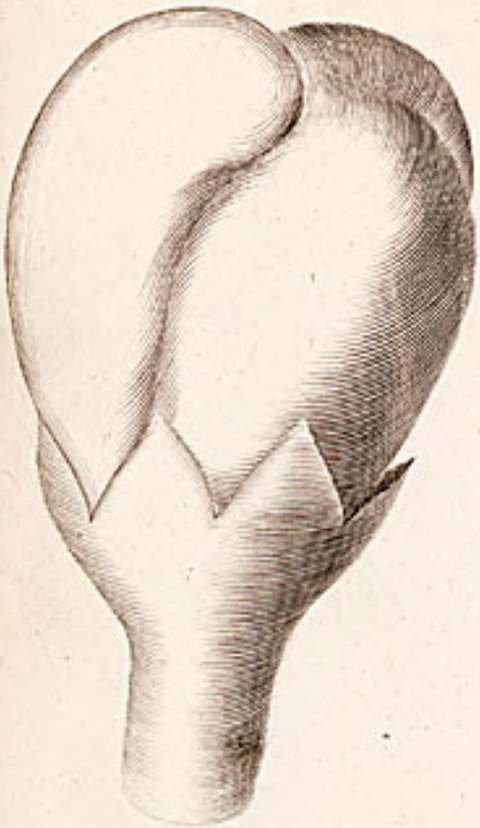
f. 2.
The Same Opend.



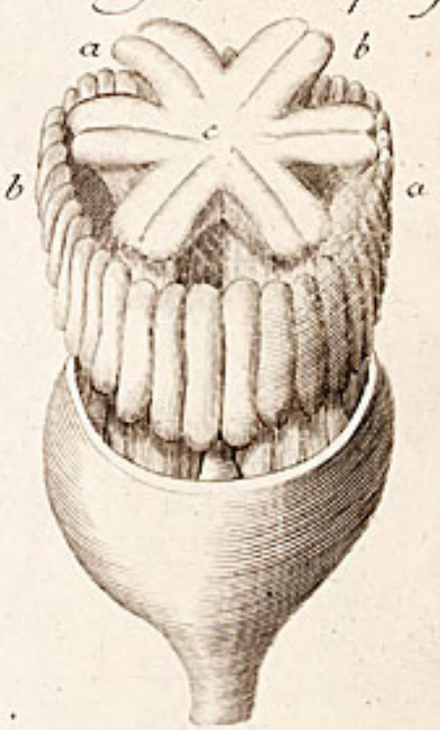
f. 5.
One of ij Thee a (a. b.)
Surrounding (c.)

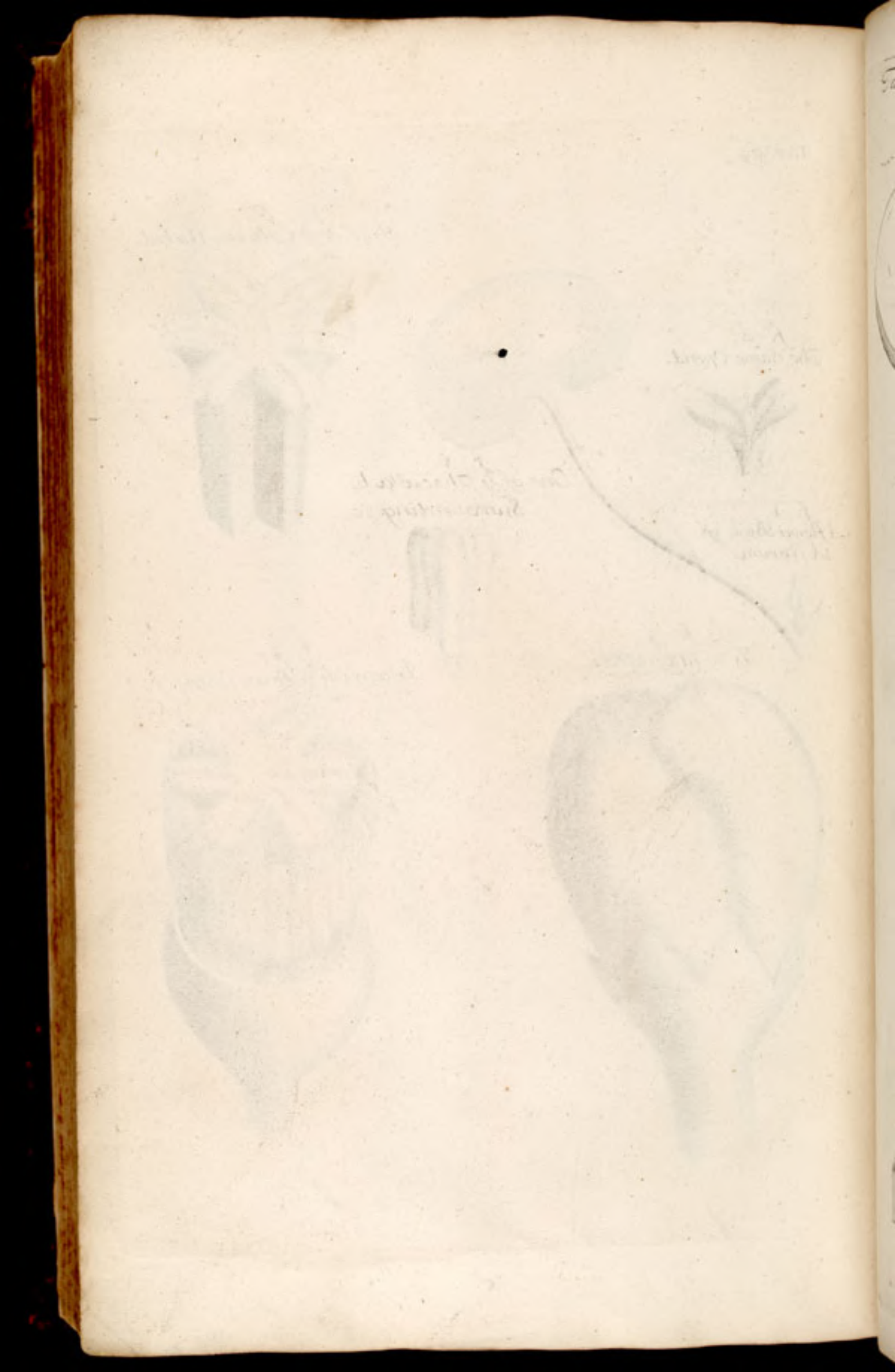
f. 1.
A flower Bud of
A Sarum.

f. 3.
Is (a) Magnifid.



f. 4.
Is (a) with ij Leaves Strip'd of.

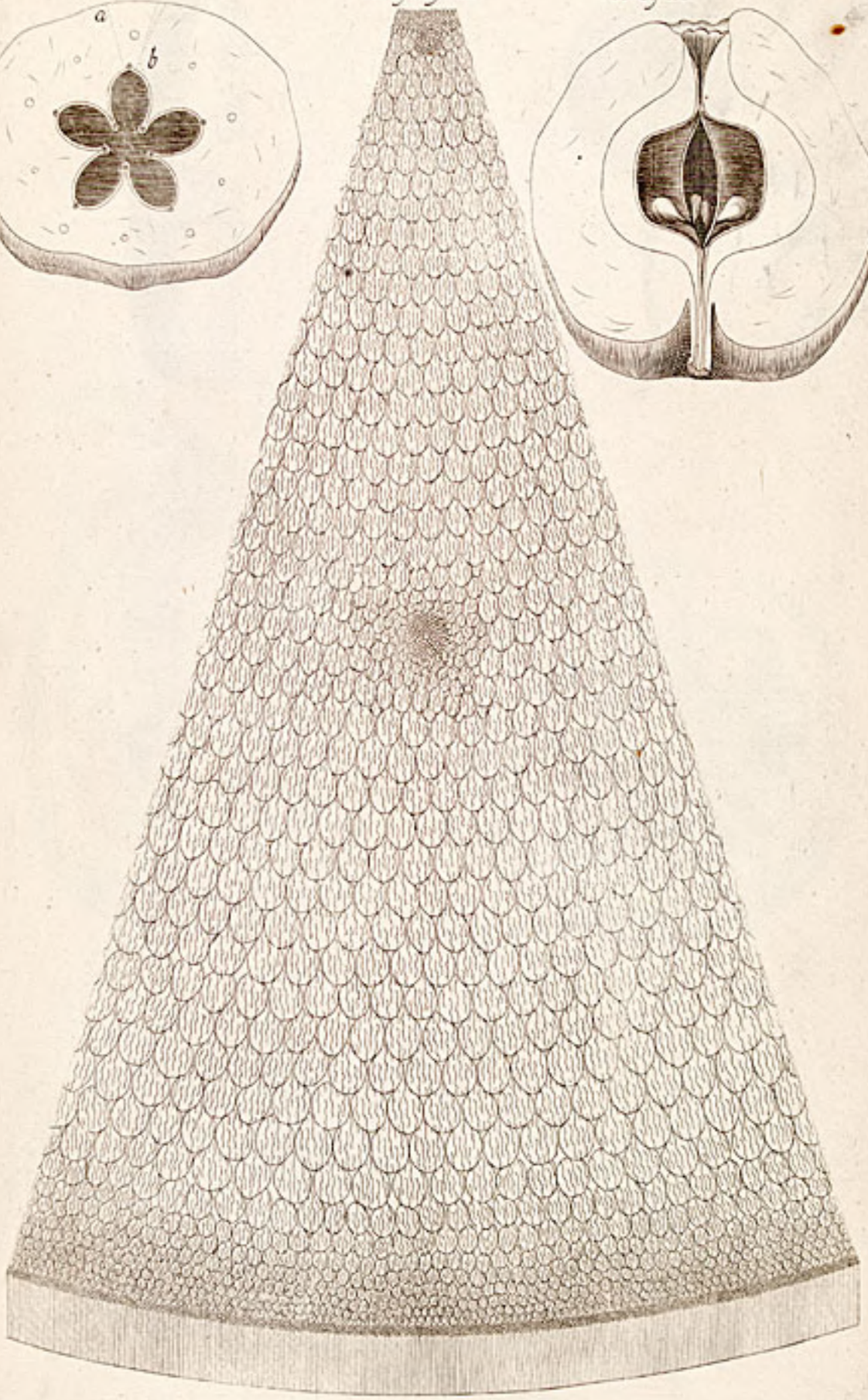




Tab 65

f.2
Cut transversly

f.3
The piece (ab)
magnified



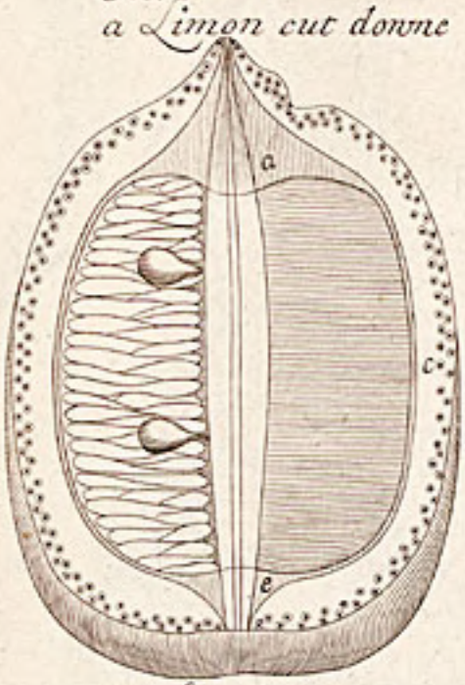
f.1
an Apple cut by the
length

Tab. 66.

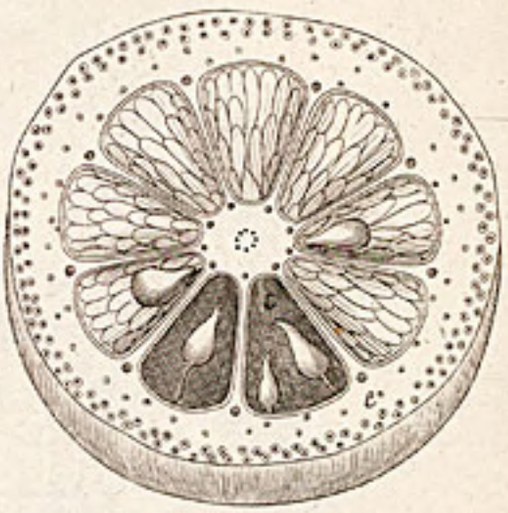
f. 3 great
One of the Baggs, a.c.e.

f. 4
One of the little Baggs
c.e. cut transversly

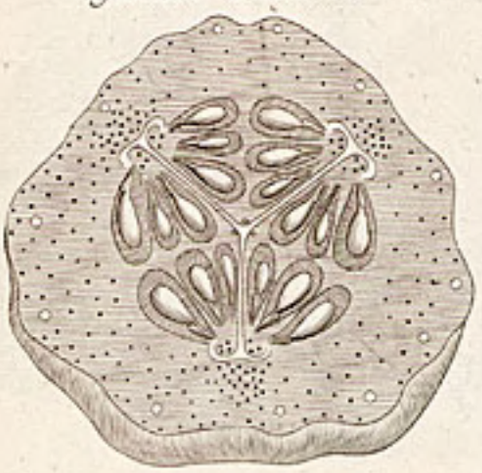
f. 1.
a Limon cut downe



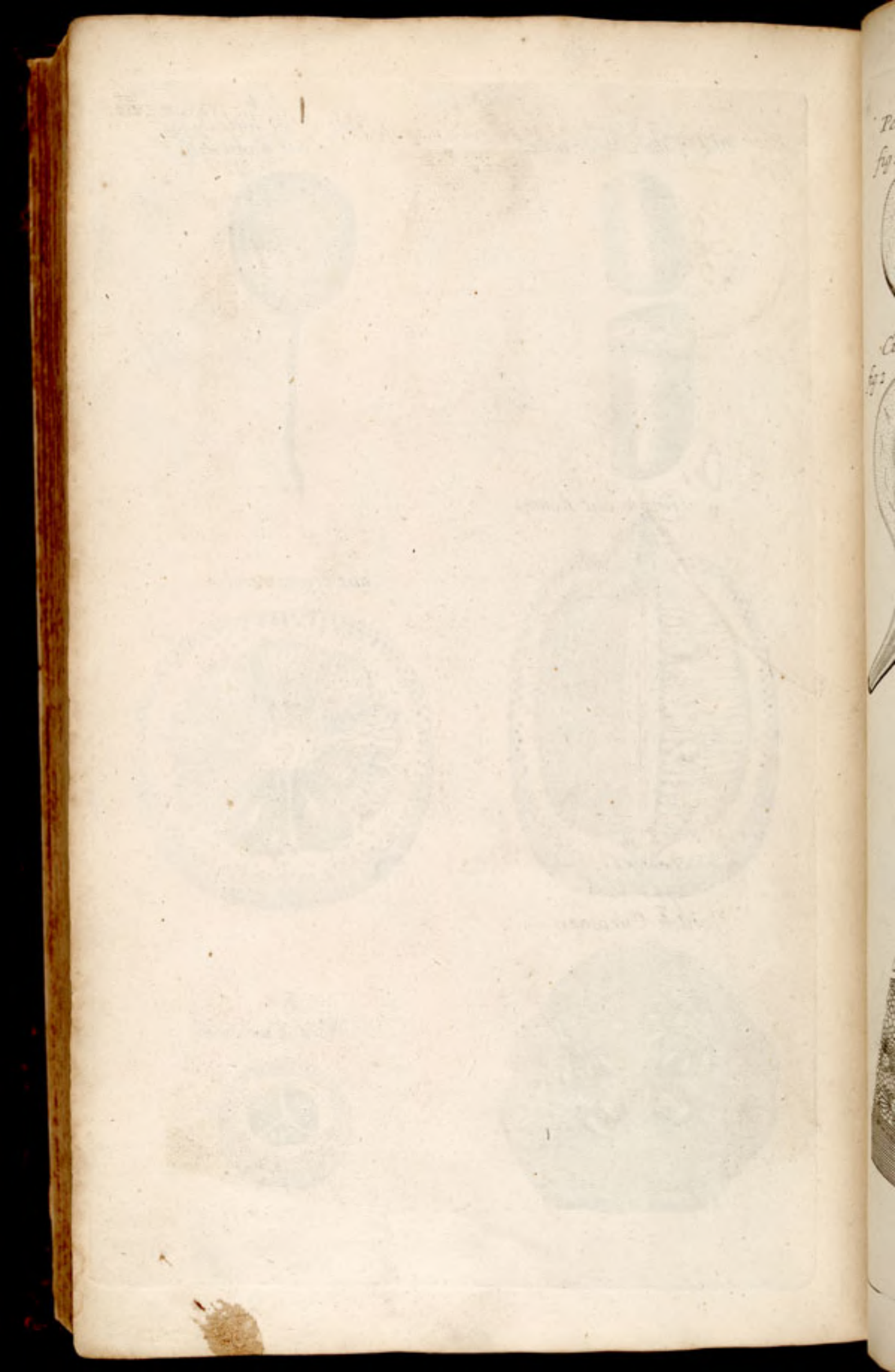
f. 2.
cut transversly



f. 5
Garden Cucumer



f. 6
Wile Cucumer

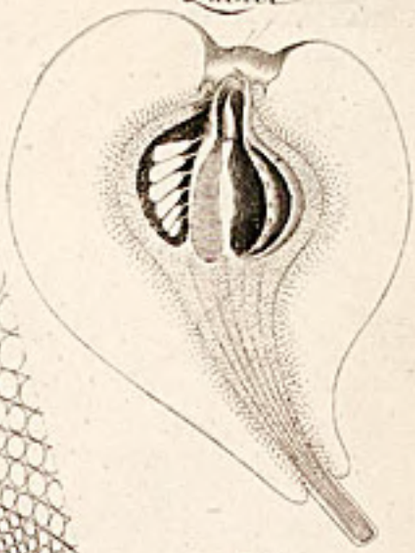


f. 4.
The peice (a.b) magnify'd.

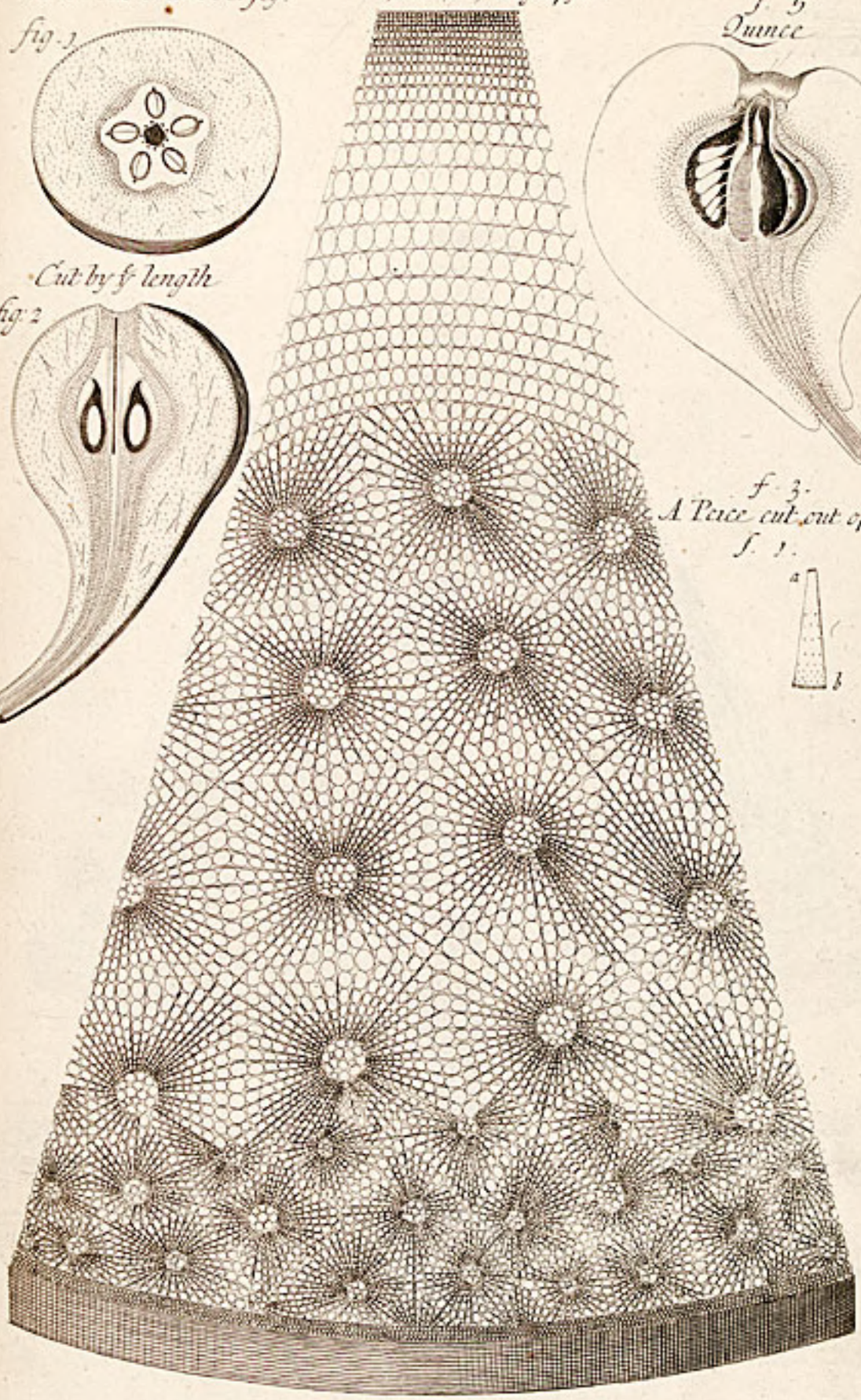
Pear cut transversly.
fig. 1

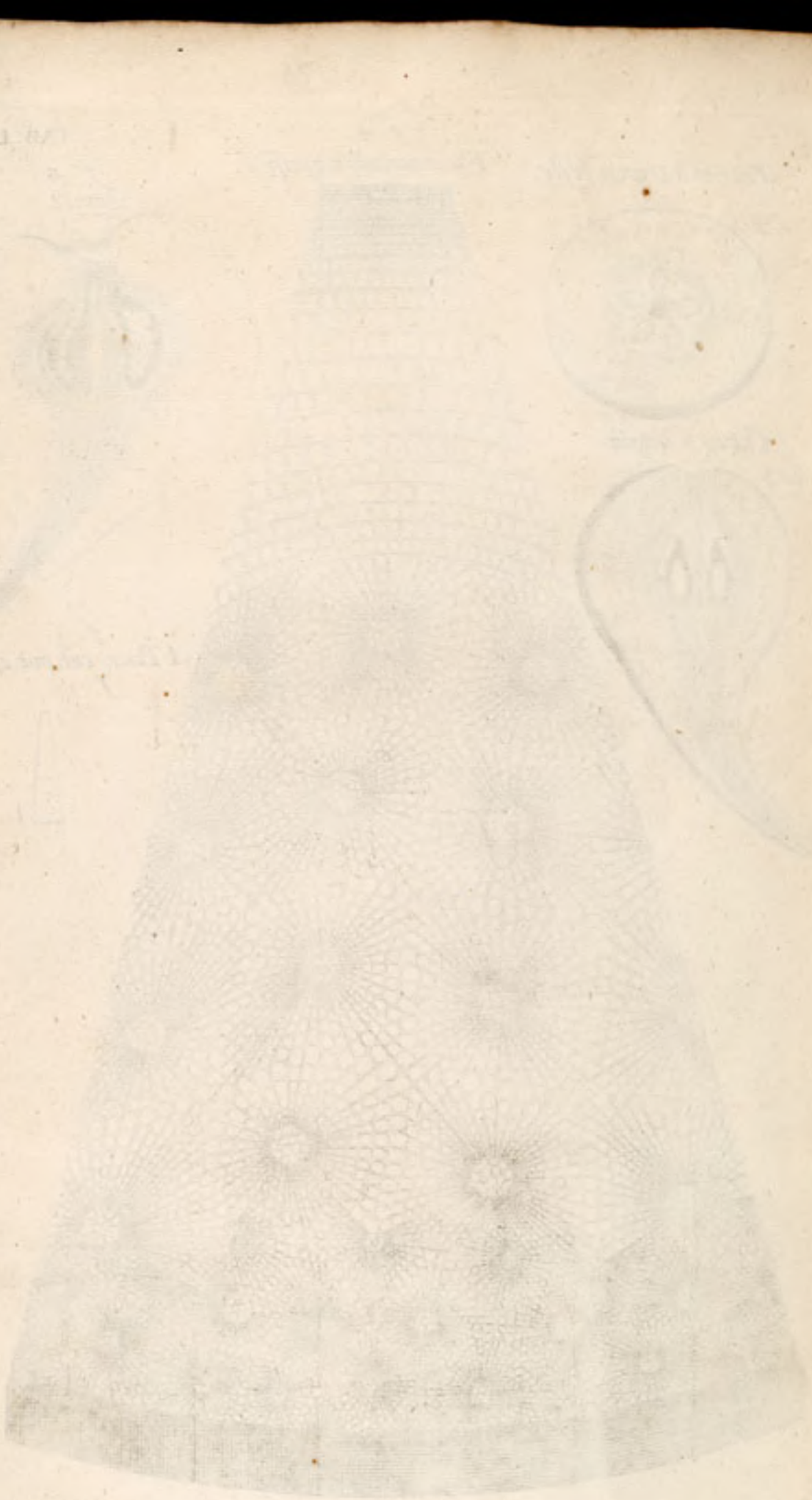
Cut by ye length
fig. 2

f. 5
Quince



f. 3.
A Peice cut out of
f. 1.





Tab. 62.
(See Tab. 20. &c)

f. 1.
a plum cut transversly

f. 2.
an Aprecock cut transversly

f. 3.
a piece taken out of f. 2.

f. 4.
the piece a, Magnifyd

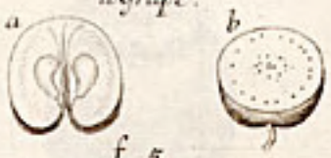
f. 5.
A young one wth ye now bulky Coats of ye Seed

f. 6.
the same by ye Length

f. 7.
One with the kernell full grown

Tab. 69.

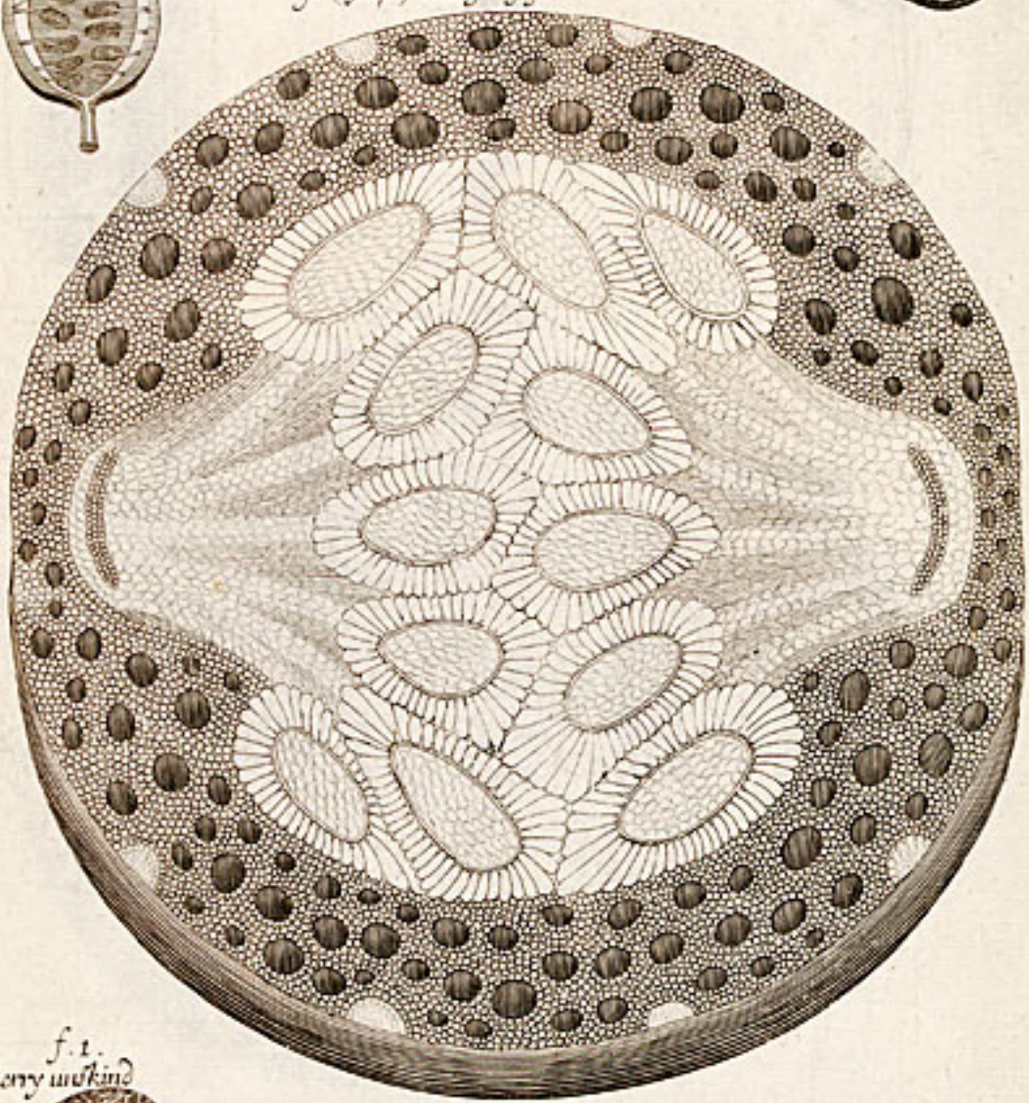
f. 2.
a Grape.



f. 3.
a Goosbery cut downe.

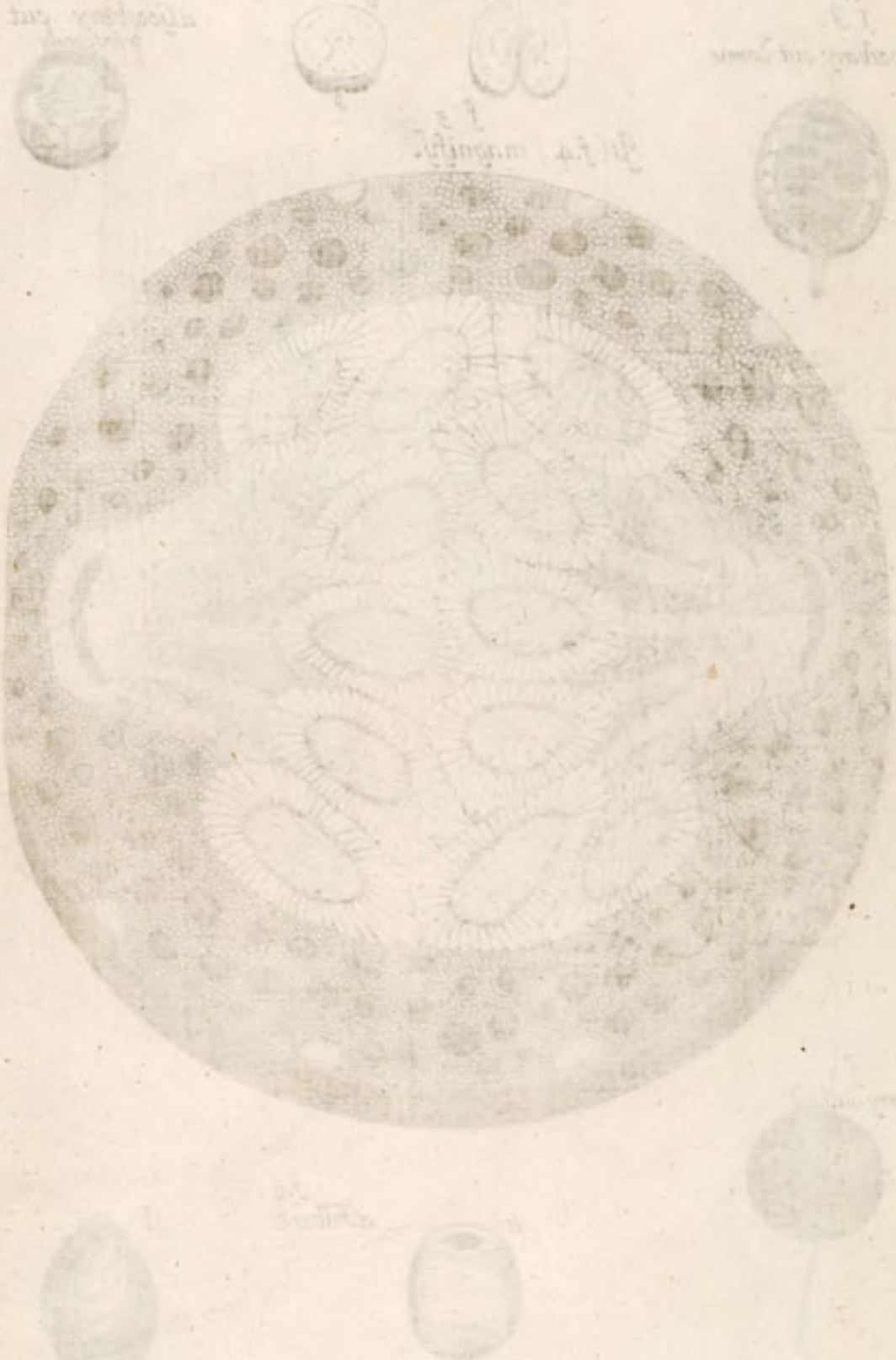
f. 4.
a Goosberry cut transversly.

f 5
Is (f. 4.) magnifyd.



f. 1.
a Cherry unskind

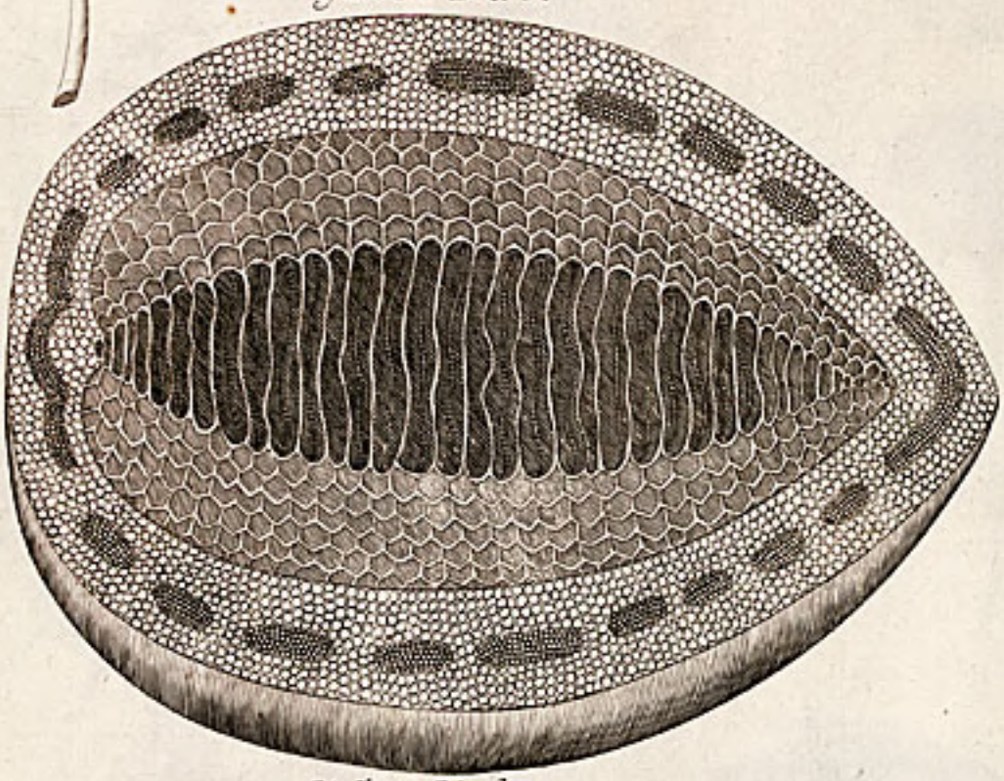
f. 6.
a Filbert



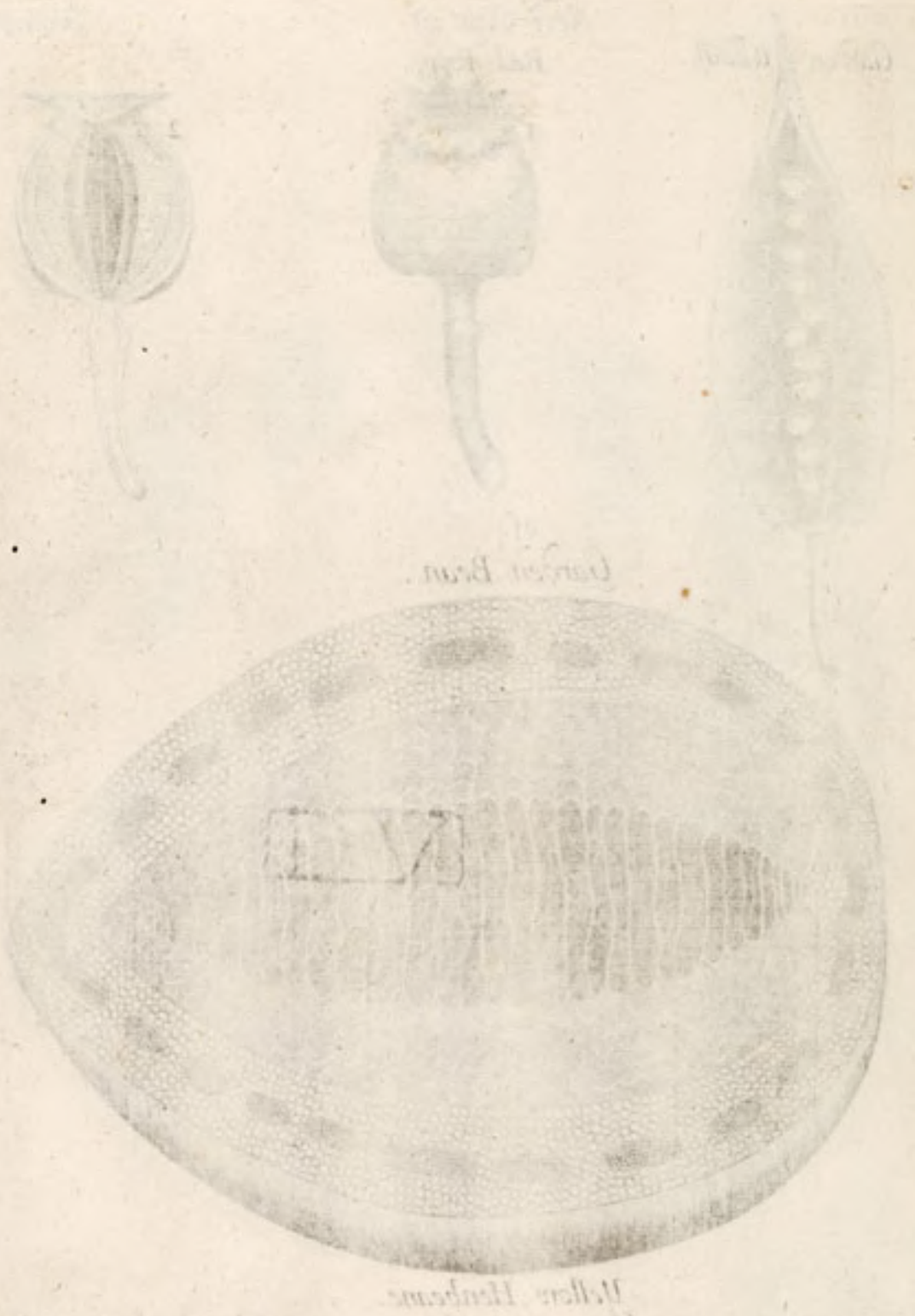
Garden Radish.

Seed-Case of Red Poppy.

of.
Garden Bean.



Yellow Henbeane.

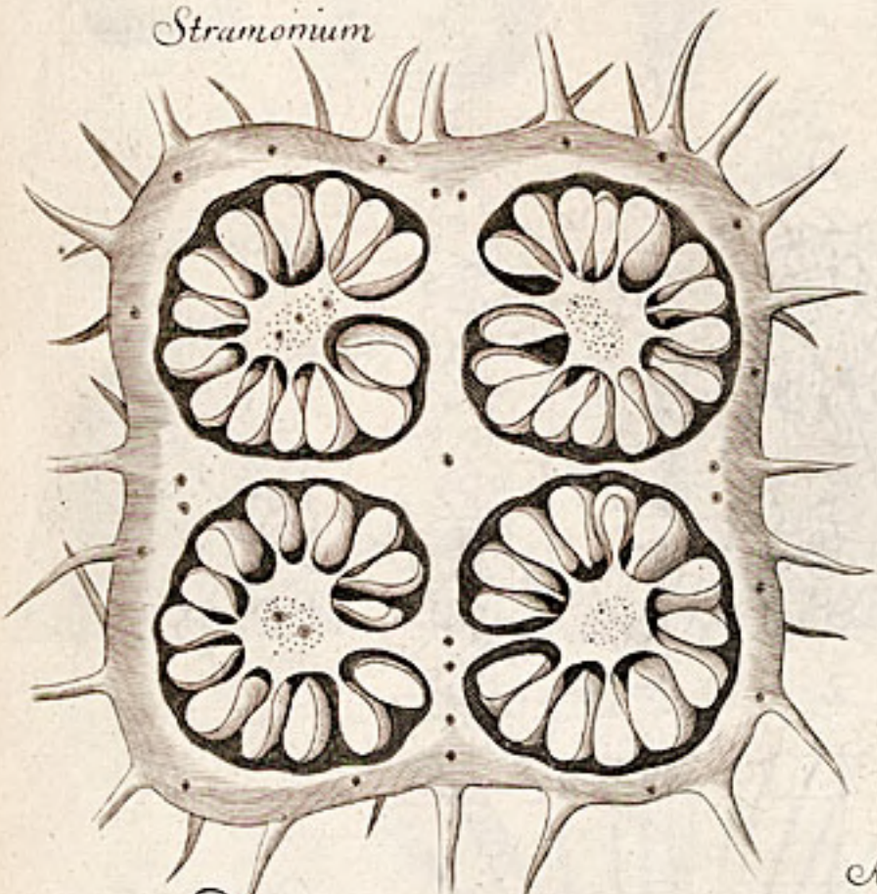


Tab. LXXI.

Tulip.

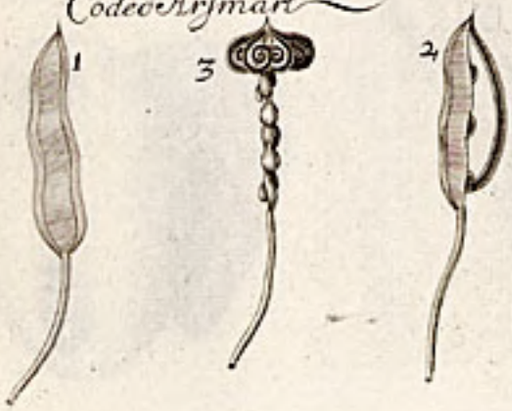
Seed Case of

Stramonium

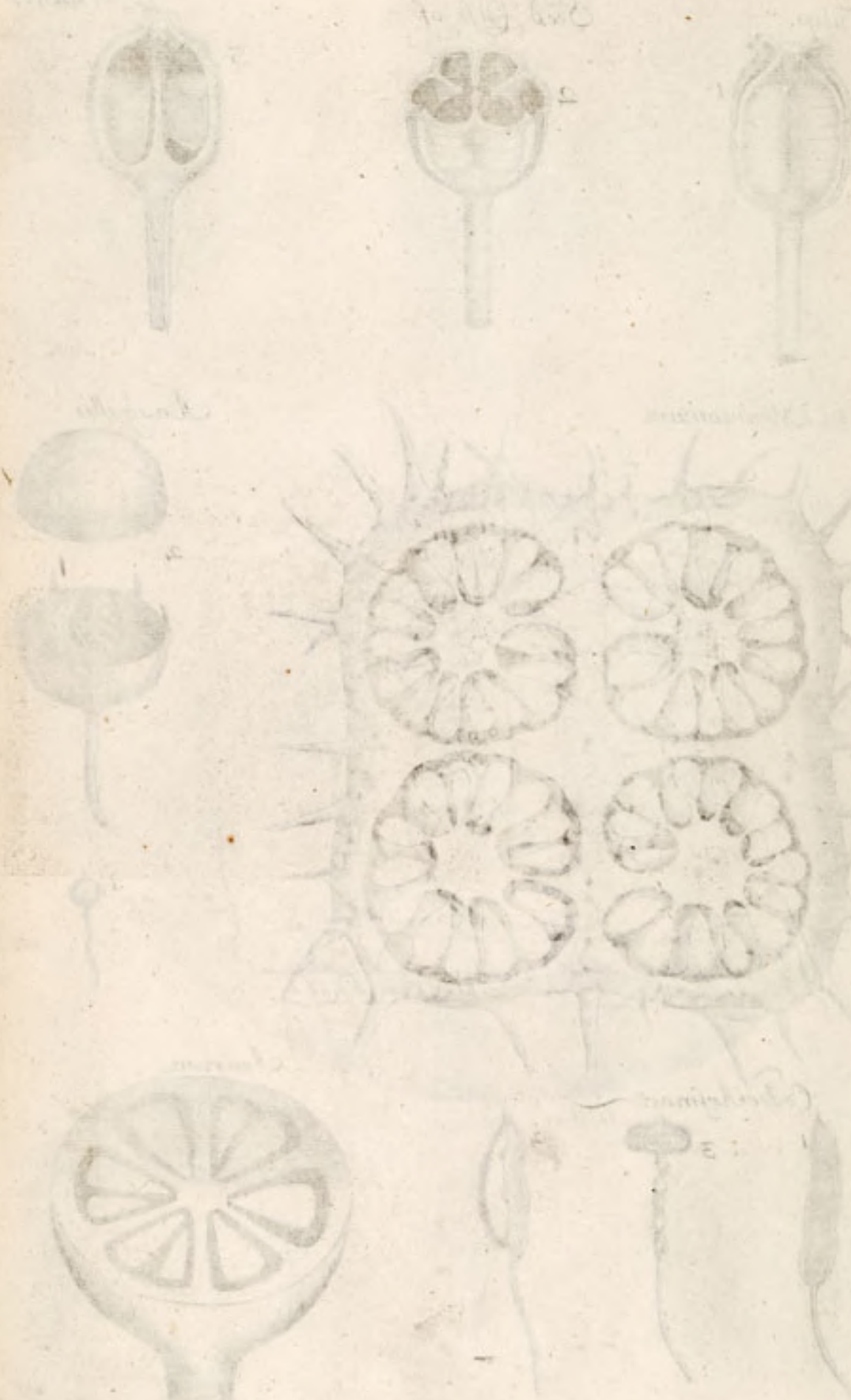


Anagallis

Codeo Arsmart



Azarum.



Tab LXXII

Plum-Stones

French-Bean

Chesnut

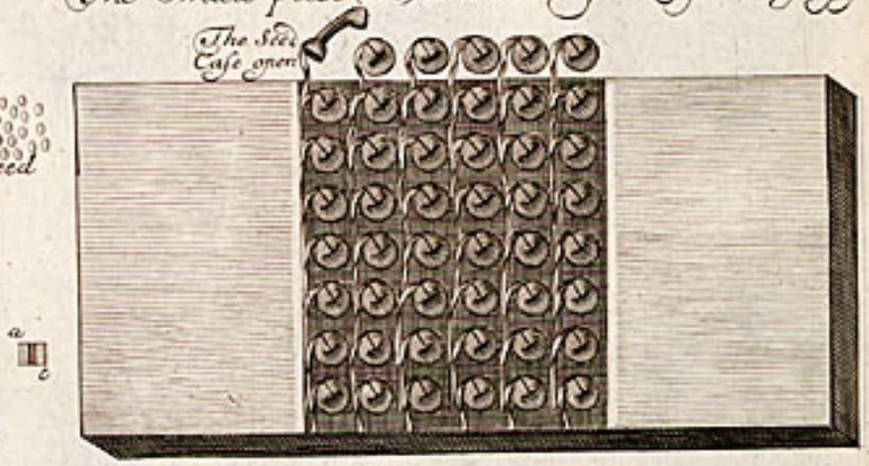
Stone of Bellir: Mgrobal

P. Christi S

Orange S.

The Small piece (a c) taken out of the Leafe & magnify'd

Leaf of Harts tongue



Seed of Typha Maior

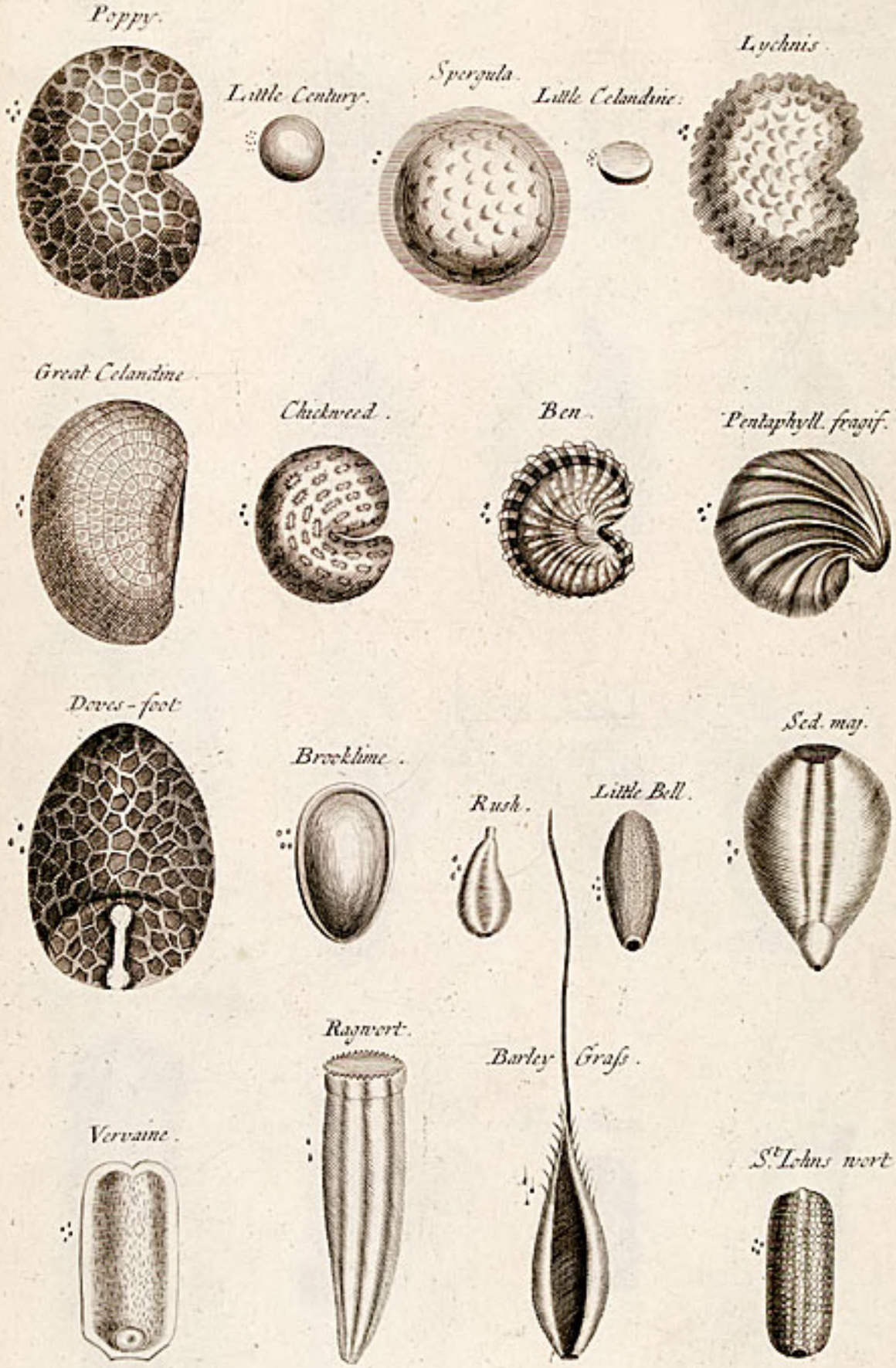
Seed of Pine

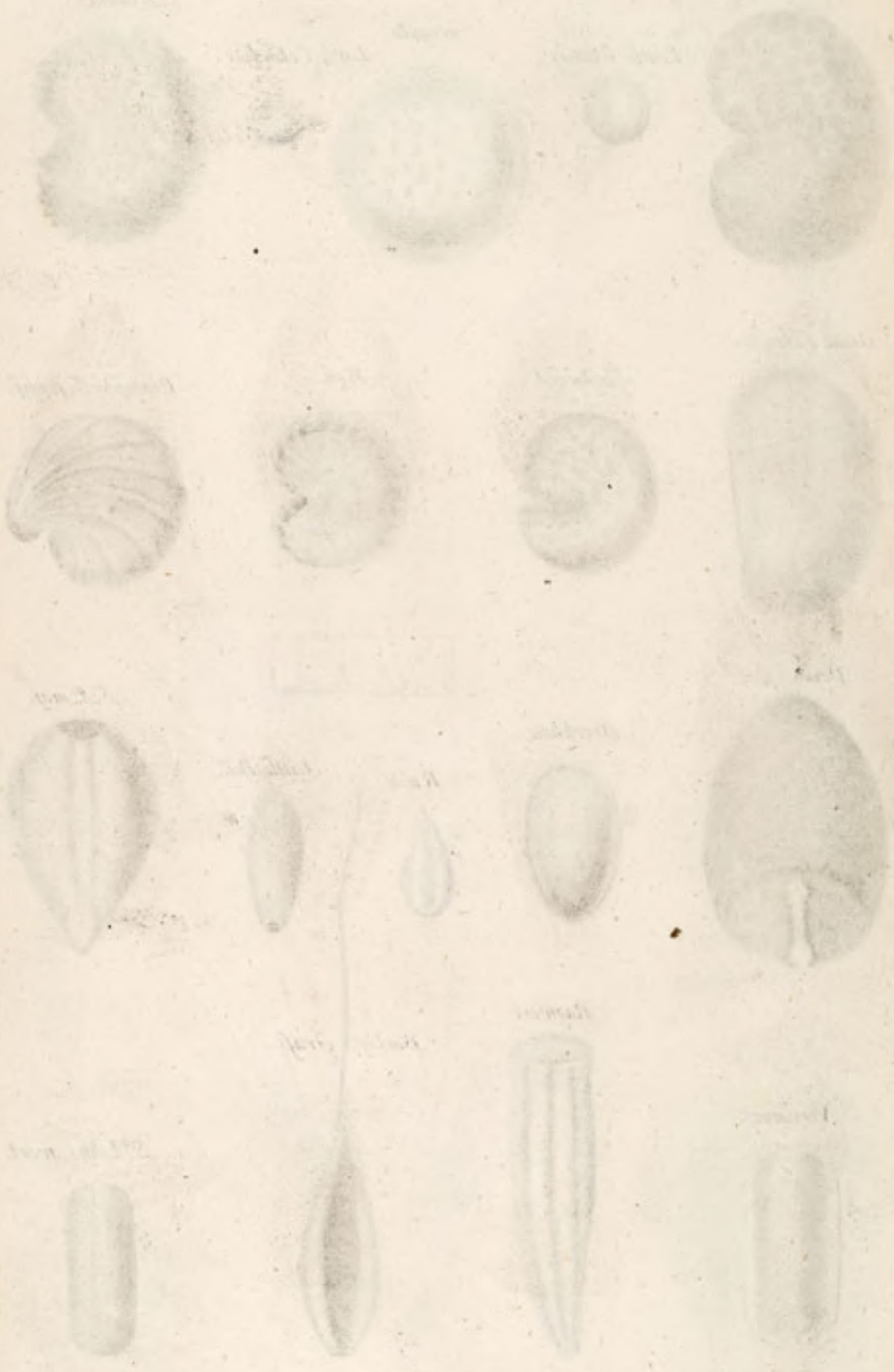
Wood Sorrel Seed

S. of Goos Grass

TAB. LXXIII.

Seeds of





Seeds of

Tab LXXIII

Nettle

Eyebright

Wormwood

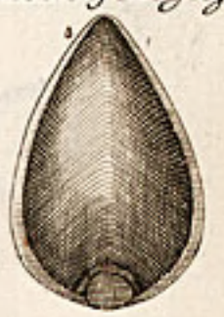
yarrow

Sorrel.

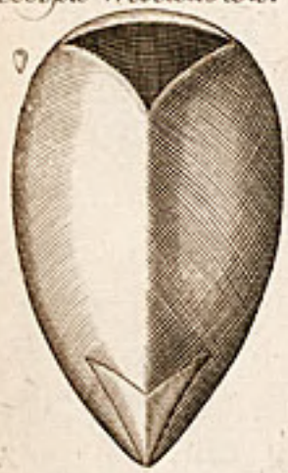
Anagallis

Nigella.

a Sort of Bugloss



Melissa Moldavica.

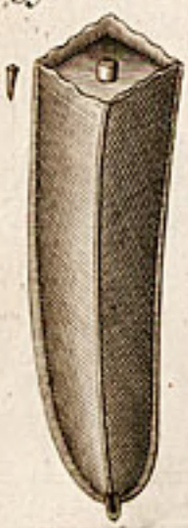


Bellis Tanaceti folio annua.

Stachas Arabica.

Wart Wort.

Chrysanthis Amerie:



Blattaria.

Foxe Glove.

Tansey.

Seeds of

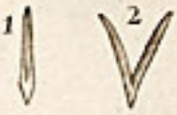
Tab: 75.

Date.

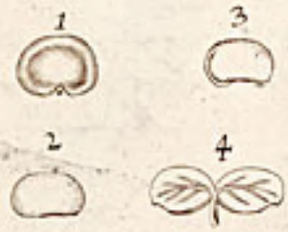
Hounds tougne.

Cucumer

Scorzonera.



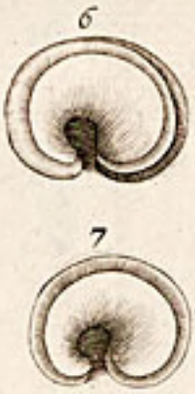
Viola lunaris.



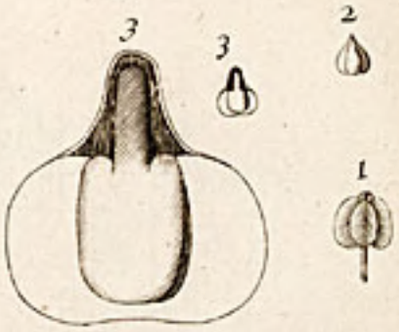
Woad.

Great blew Lupine.

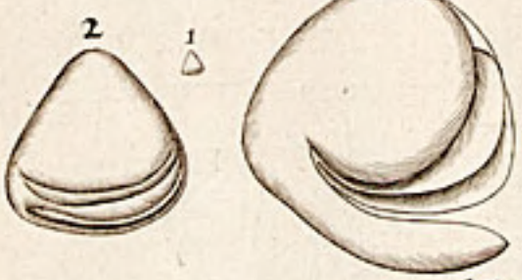
Orach



Rhapontick

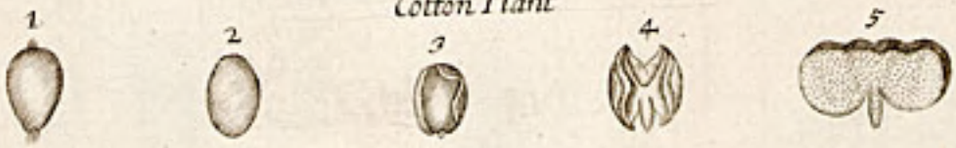


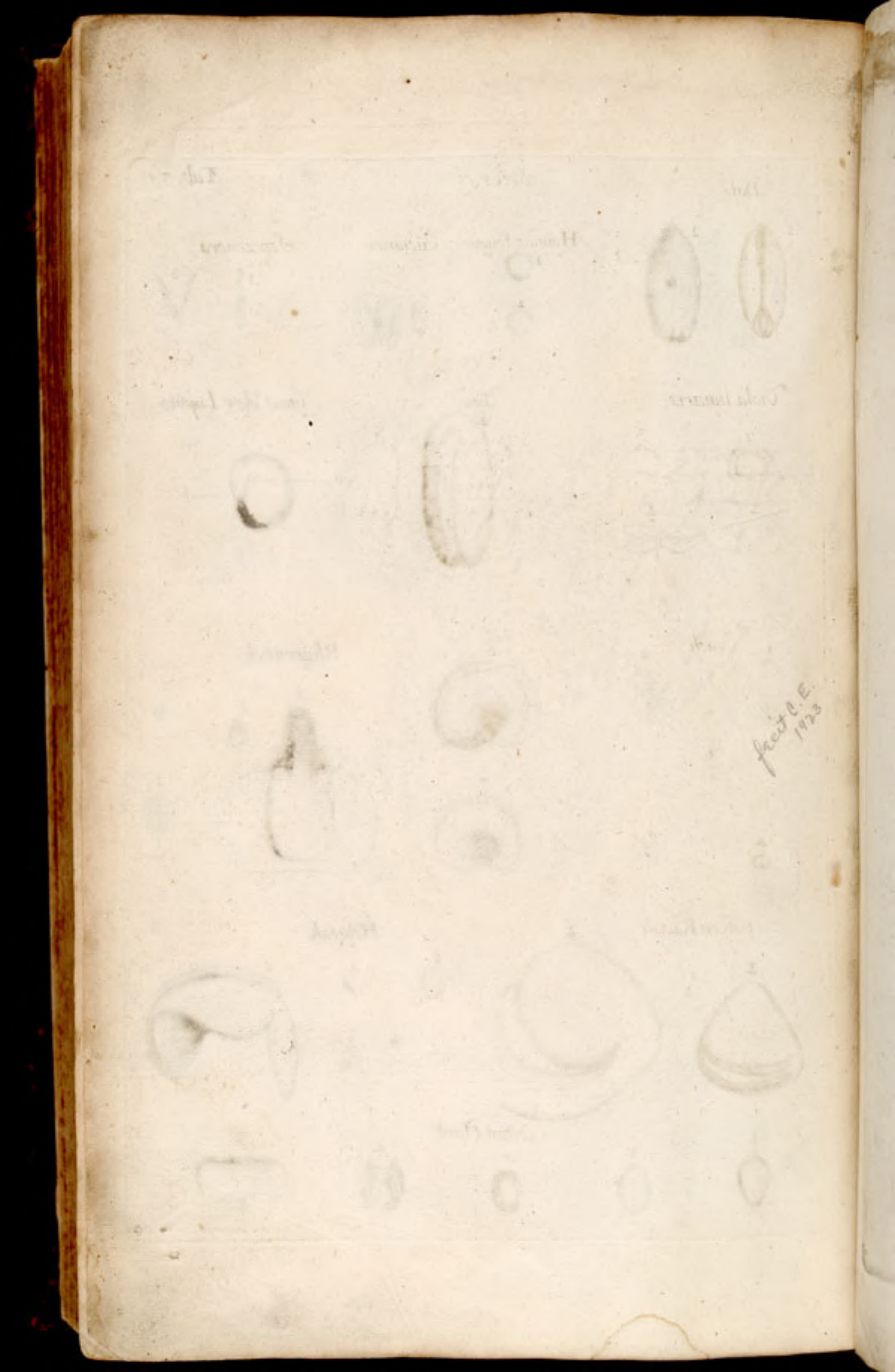
Garden Radish



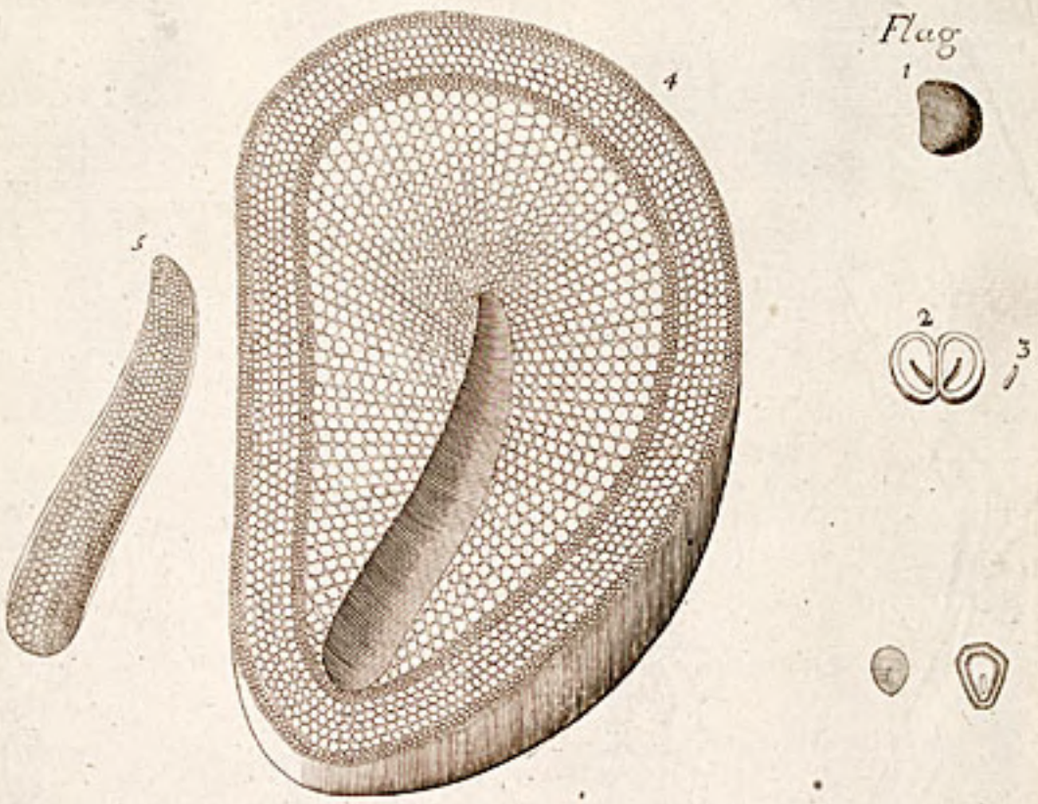
Holyoak

Cotton Plant





Tab: 76 Seeds of

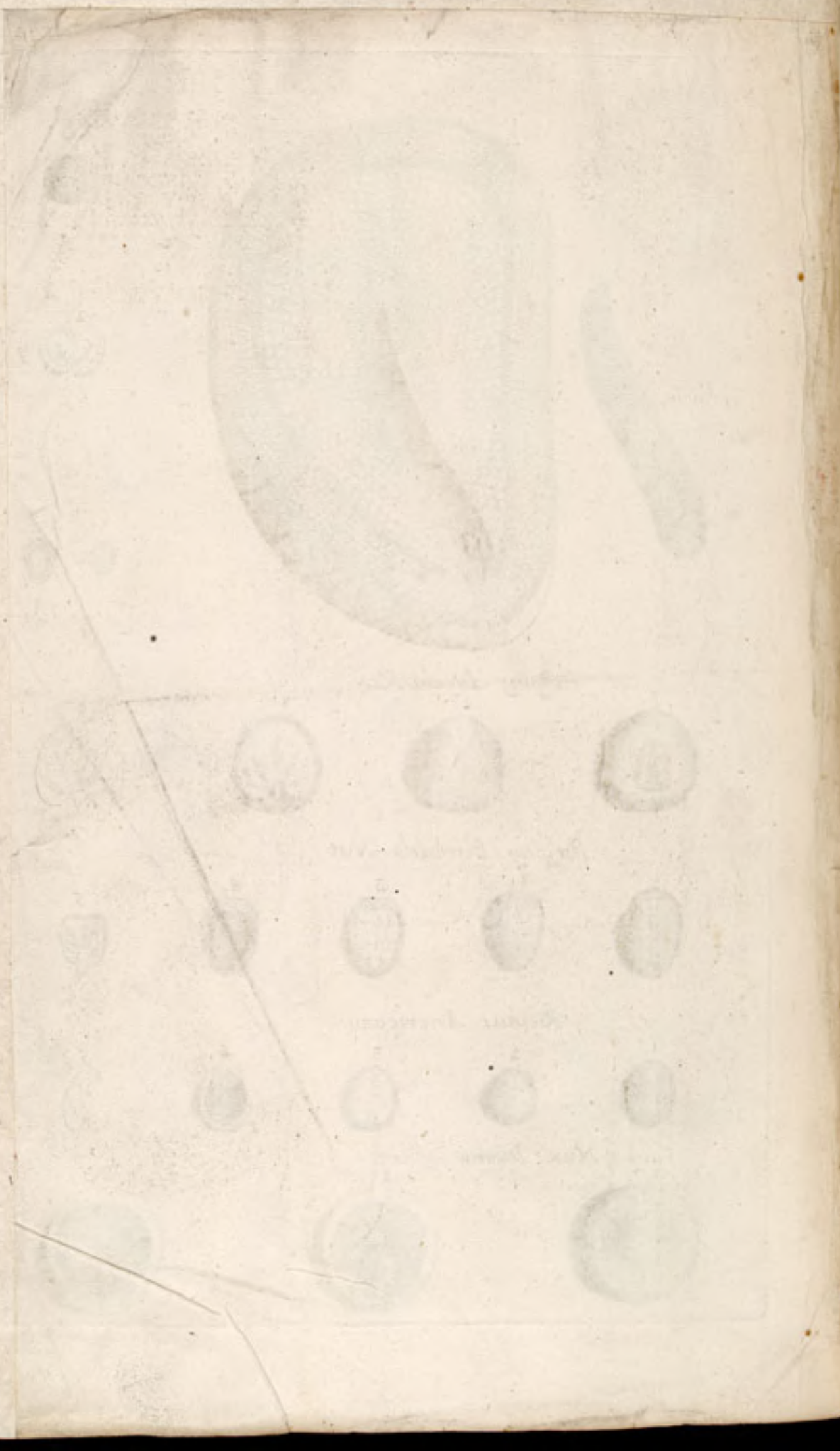


Purging Angola-Nut

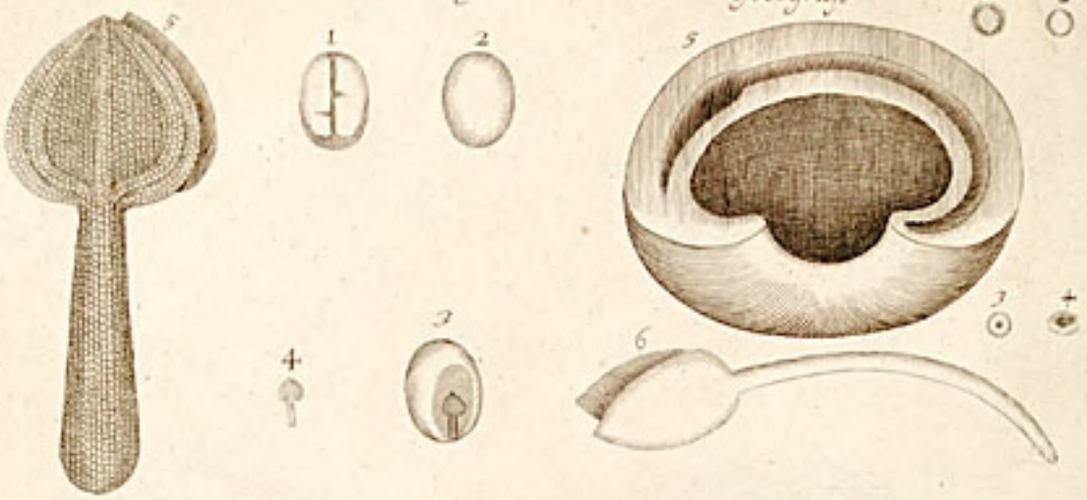
Purging Barbado-Nut

Ricinus Americanus

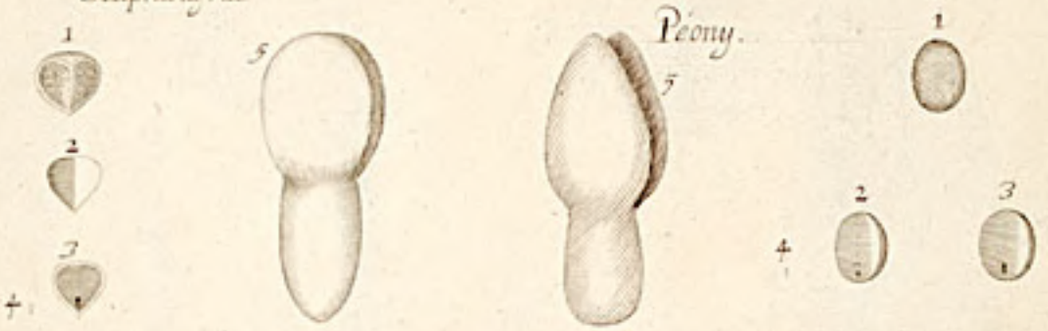
Nux Vomica officin:



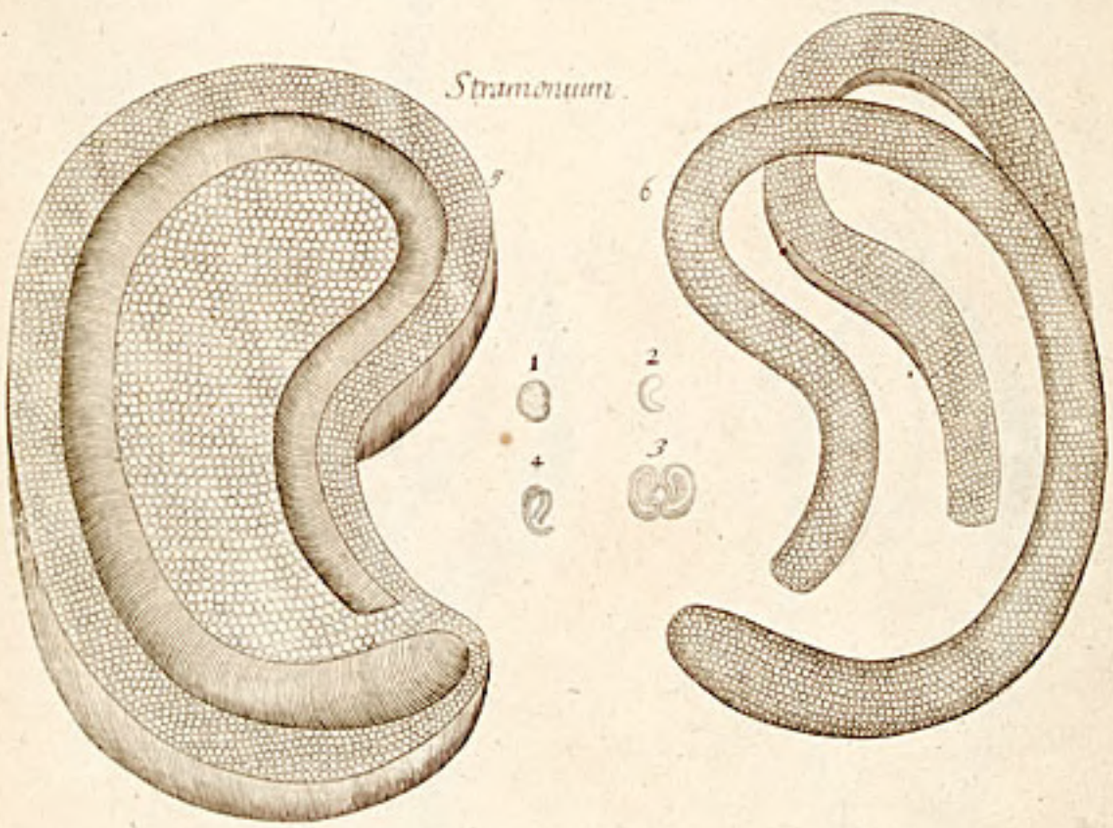
Tab 77. Coffee. Seeds of Goosgrass



Staphisagria. Peony.



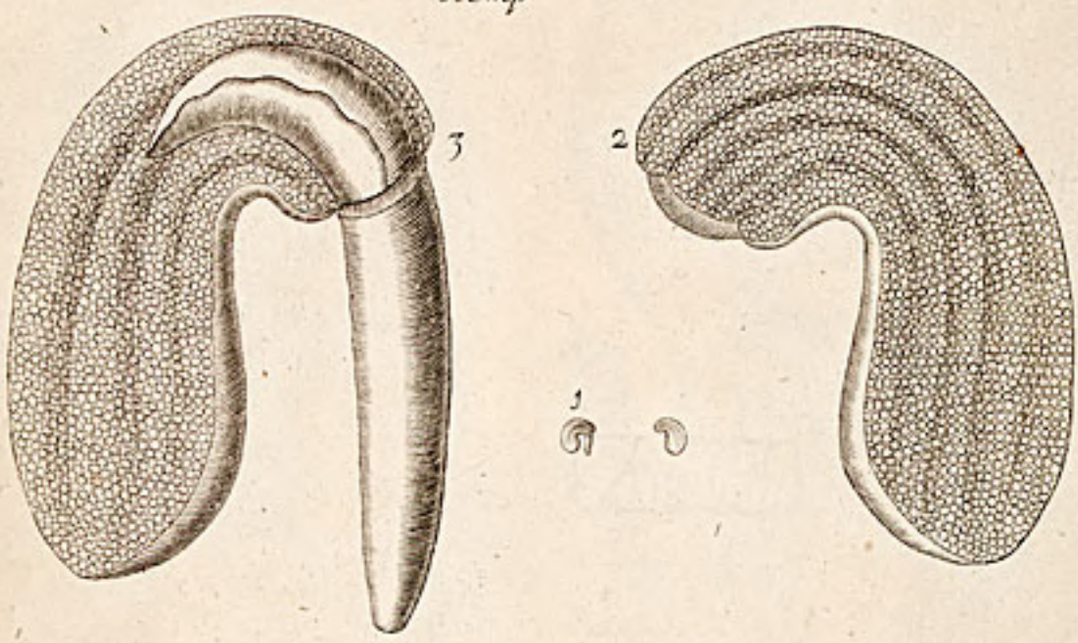
Stramonium.



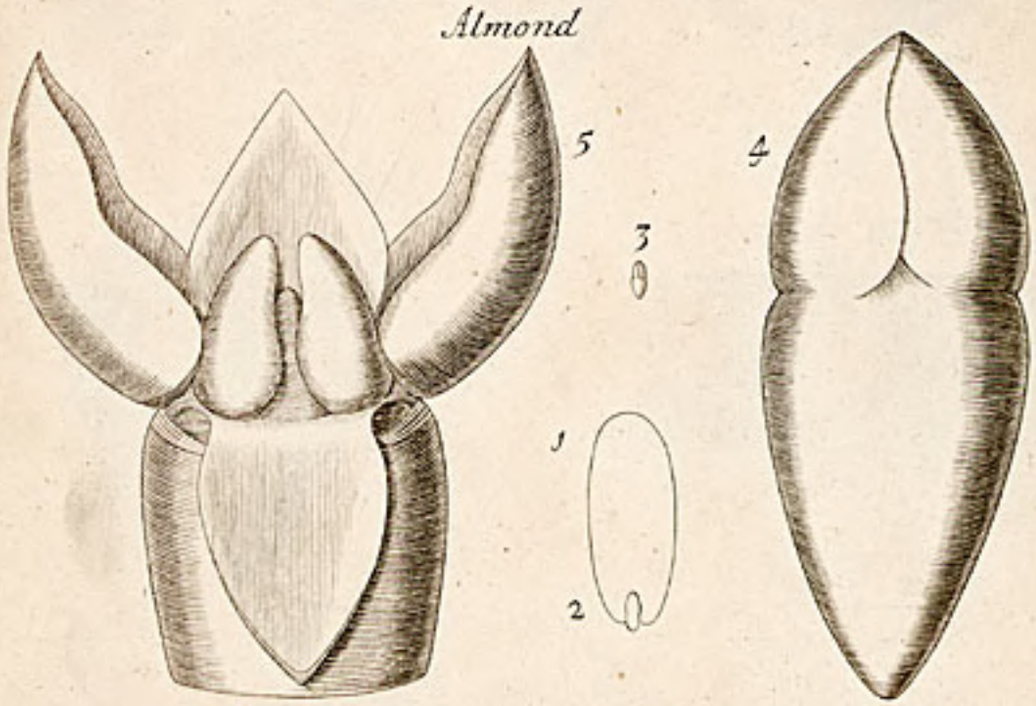
Tab. 78. Seeds of Cardnus bened

Sena

Hemp

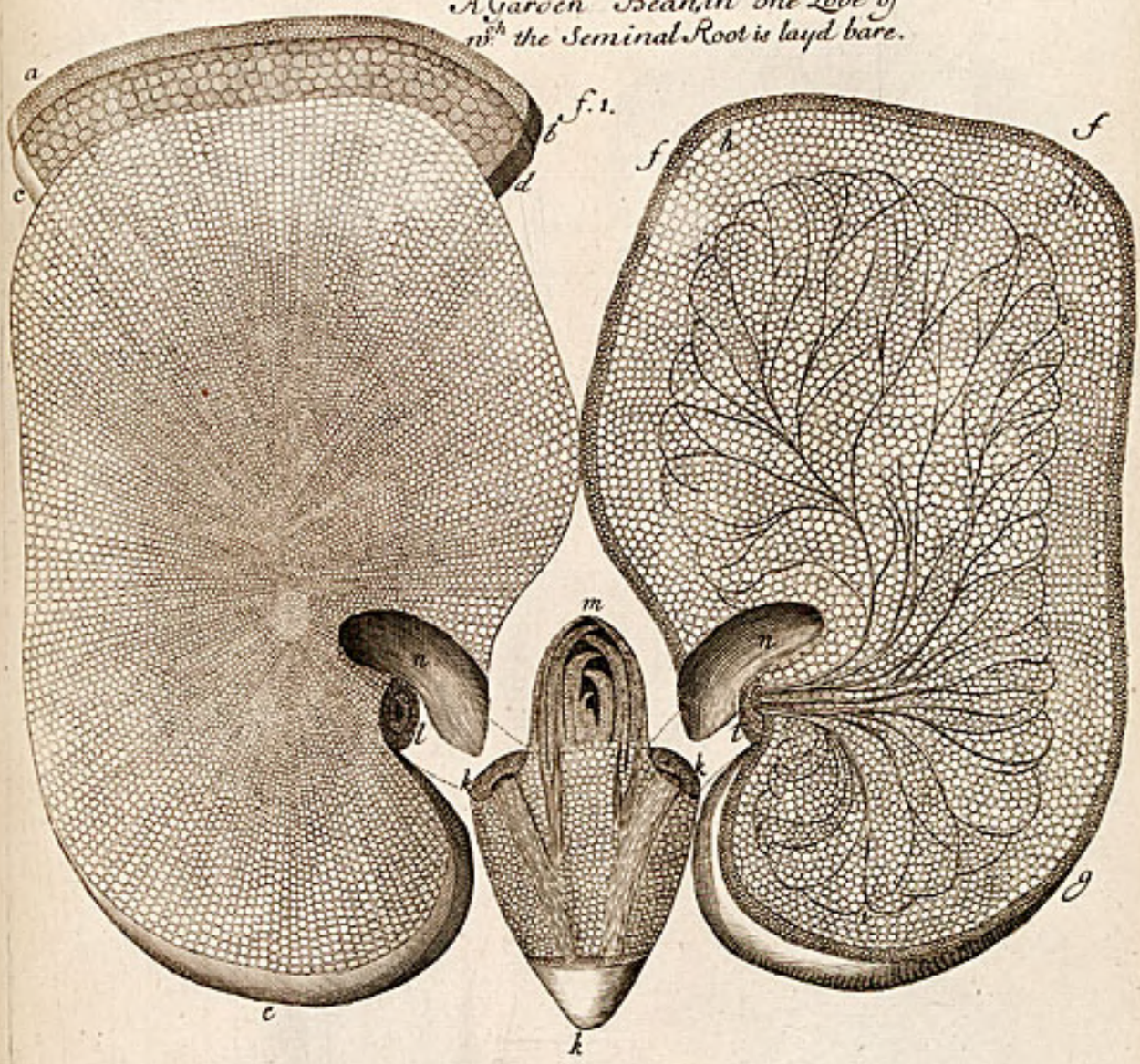


Almond



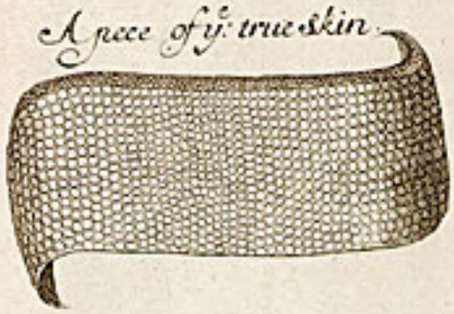
Tab: LXXIX.

A Garden Bean in one Lobe of
wch the Seminal Root is layd bare.



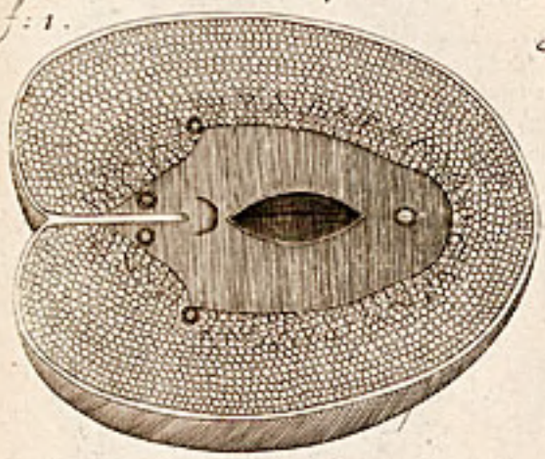
The Radicle cut transversly.
f. 2.

A piece of ye true skin

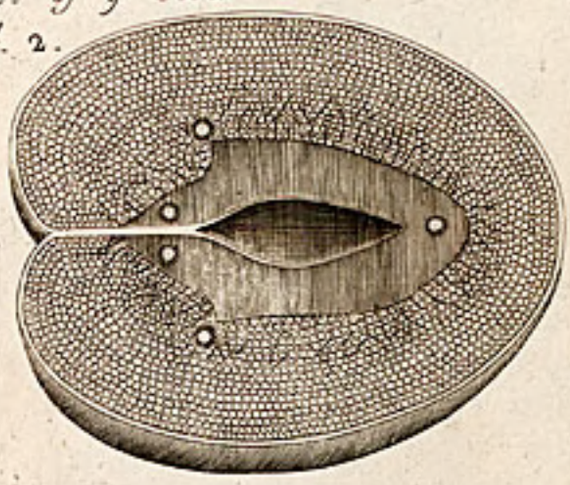


Tab. 80 *Sheweth y^e Structure of y^e Stone & y^e two uper Membranes of y^e Seed*

f. 1.



f. 2.

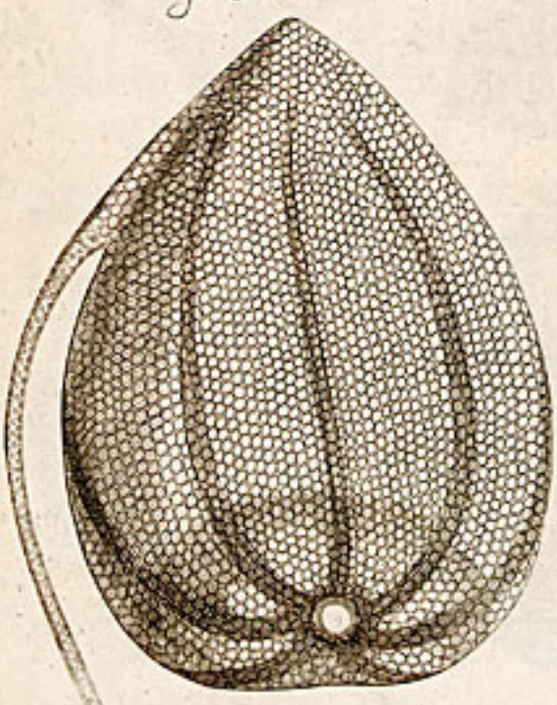


f. 4.

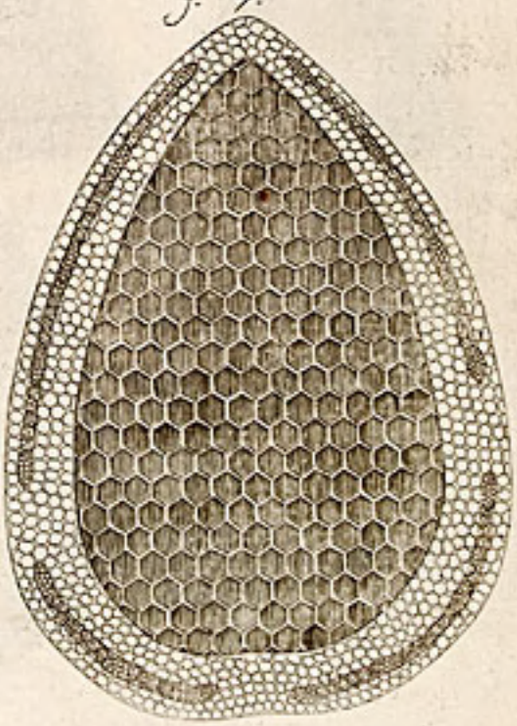
f. 5.

f. 3.

f. 6.

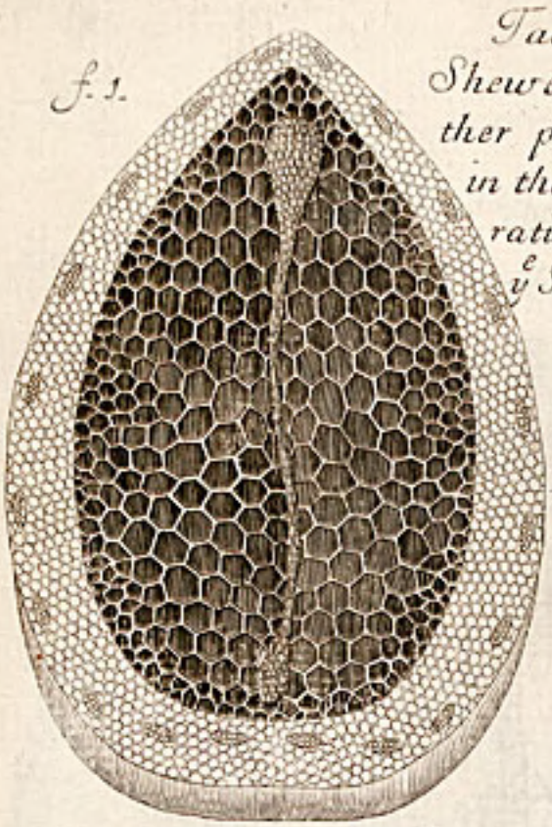


f. 7.

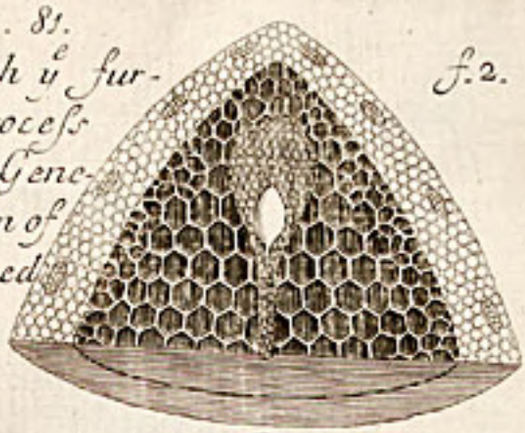


Tab. 81.
Sheweth ye further process in the Generation of ye Seed

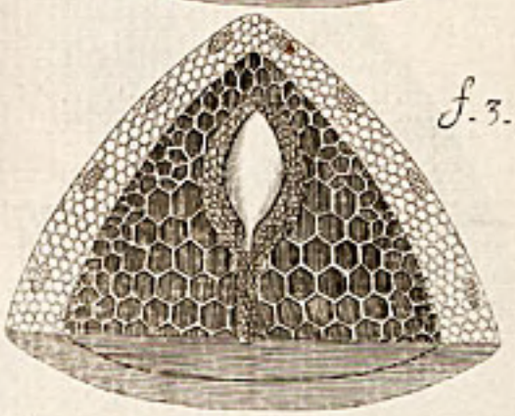
f. 1.



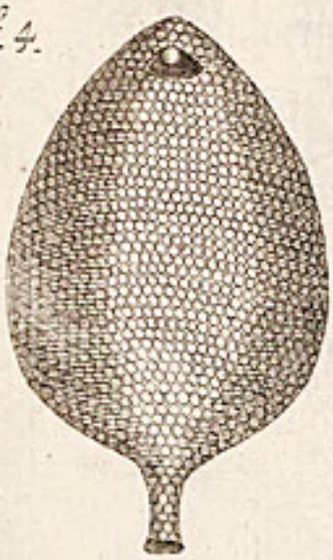
f. 2.



f. 3.



f. 4.



f. 5.

f. 6.

f. 7.

f. 8.

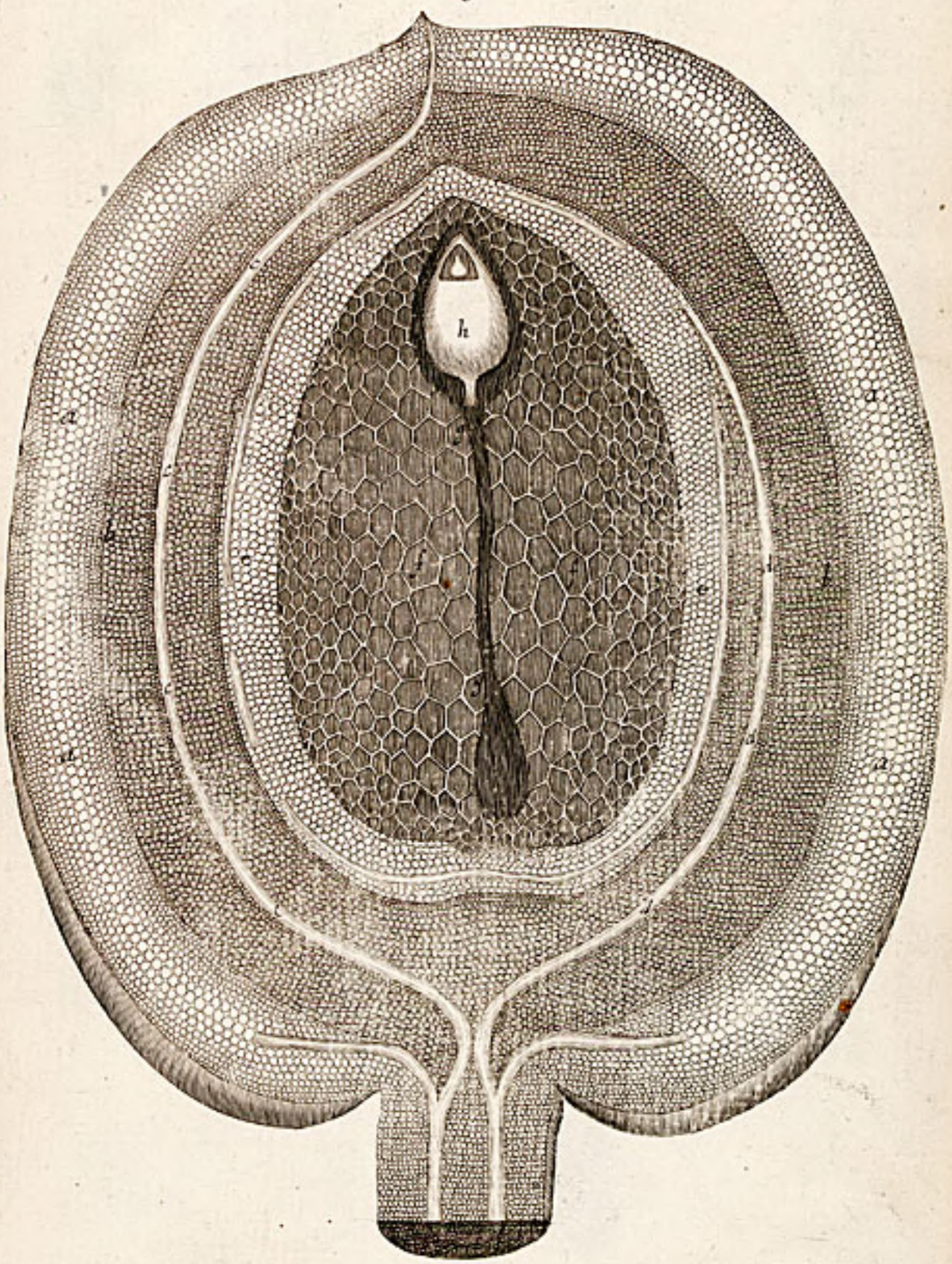
f. 9.

f. 10.

f. 11.

Tab 82.

The young Fruit, Three Membranes,
& Seed now loose.



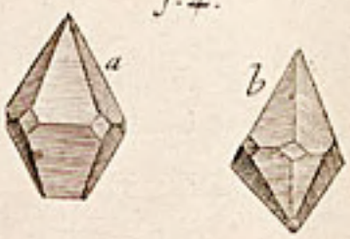
Tab. 83

Essent: Salts of Plants.

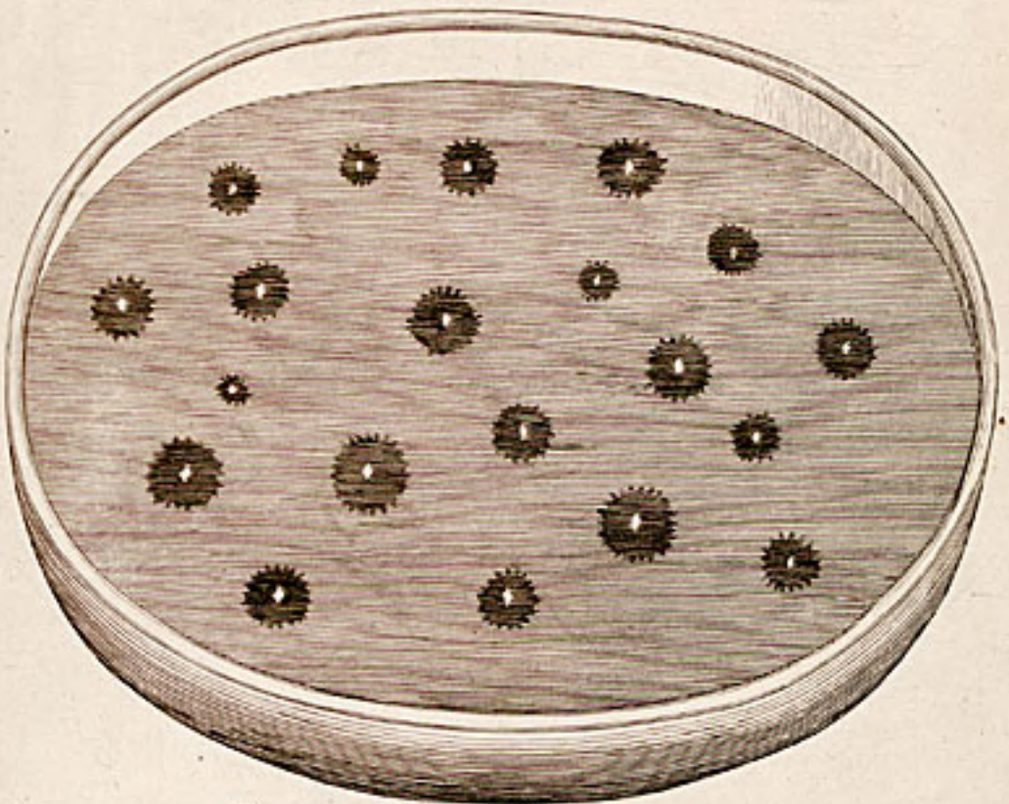
f. 2.

f. 3.

f. 4.



f. 1.



Manne Salts of Plants.

f. 5.

f. 6.

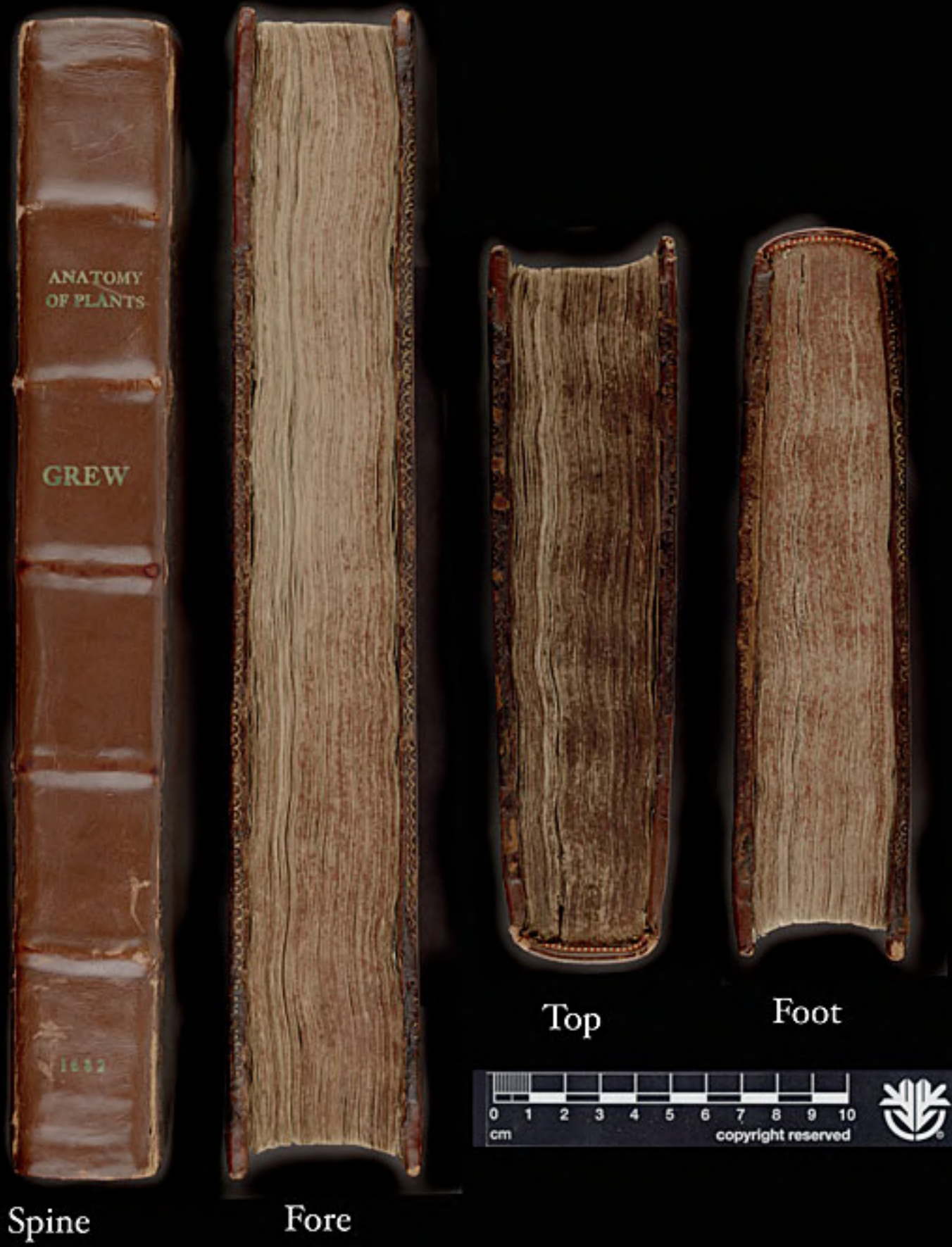
f. 7.

f. 8.

f. 9.

f. 10.

f. 11


ANATOMY
OF PLANTS
GREW
1682
Spine
Fore
Top
Foot
0 1 2 3 4 5 6 7 8 9 10
cm
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MO