CLASSIC INVENTIONS:

Of the Seed as Vegetating

Botany

THE ANATOMY OF VEGETABLES BEGUN. With a General Account of Vegetation Founded thereon. By Nehemiah Grew, M. D., and Fellow of the Royal Society. London, 1672.

One of the first experiments performed by young botanists of the present day (usually in the kindergarten years) is this of Grew's watching the growth of the "great Garden-Bean" as it pushes up its two "Dissimilar Leaves". Because he was one of the pioneers of botany, much of Grew's work has been superseded, but his advice is today as good as ever: *"Those that shall think fit to examine, as well as to peruse these Observations, we advertise them,* First, *That they begin, and so proceed till they end again, with the Seed: For they will hardly be able to avoid Errour and Misapprehension, if either partial or preposterous in their Enquiries.* Next, *That they confine not their Enquiries to one time of the Year; but to make them in several Seasons, wherein the Parts of a* Vegetable *may be seen in their several Estates.* And then, *That they neglect not the comparative* Anatomy; *for as some things are better seen in one estate, so in one* Vegetable, *than another."*

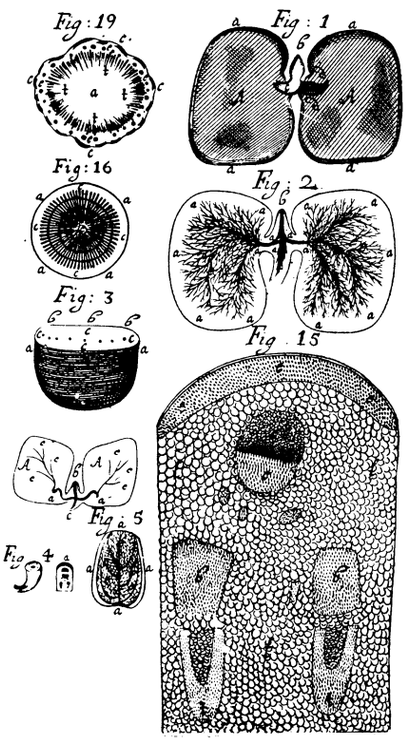
The Garden-Bean Dissected

Being to speak of Vegetables; and, as far as Inspection and consequent Reason may conduct, to enquire into the visible Constitutions and Uses of their several Parts; I chuse that Method which may with best advantage suit to 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.

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

If we take a Bean then and dissect it, we shall find it cloathed with a double Vest or Coat: These Coats, while the Bean is yet green, are separable, and easily distinguished. When 'tis dry, they cleave so closely together, that the Eye, not before instructed, will judge them but one; the inner Coat likewise (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.*

At the thicker end of the Bean, in the outer Coat, a very small *Foramen* presents it self: In dissection 'tis found to terminate against the point of that part which I call the Radicle, whereof I shall presently speak. It is of that capacity as to admit a small Virginal Wyer, and is most conspicuous in a green Bean. . . .



The Radicle Distinguish'd

This part is 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 I call the *Radicle*: by which, I mean the Materials, abating the Formality, of a Root. '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 almost as big as one of its Lobes.

The lesser of the two said Appendents lies occult between 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 color comes near that of the *Radicle;* and is founded upon the Basis thereof, having a quite contrary production, *sc.* towards the cone of the Bean; and being that very part, which, in process, becomes the Body or Trunk of the Vegetable. See *Fig.* 1.

For the sake of this Part principally it is, that the Bean is divided into Lobes; *sc.* that it may 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 have lain contiguous.

This Part is not, like the *Radicle,* an entire Body, but divided at its loose end into divers pieces, all very close set 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. 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 displayed, Leaves, intended for the said Trunk, and founded up in the same plicature, wherein, upon the sprouting of the Bean, they afterwards appear. In a French Bean, 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 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,* (*Turn to next page*)

Thyroid and Goiter Danger

Physiology

The thyroid, that very important gland in the throat whose pathologic enlargement we recognize as goiter, is not proportionately larger in females than in males, although a popular impression to that effect has long prevailed. Careful measurements of the thyroids of hundreds of ringdoves and pigeons has shown the contrary, Dr. Oscar Riddle of the Carnegie Institution of Washington reported to members of the Thirteenth International Physiological Congress.

There is a hereditary difference in thyroid size, some strains of birds showing consistently larger glands generation after generation. There is also considerable variability in thyroid size in any given strain, but the variability is much greater in strains with large thyroids than in those with small. In general, the tendency to develop abnormal thyroid size, known in humans as goiter, is more marked in females than in males. This agrees with the condition found in the human species, for women are afflicted with goiter more often than men are.

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Grew on the Seeds As Vegetating—*Continued*

the *Radicle,* and the *Plume,* are concurrent to the making up of every Seed; and no more than these.

Having thus taken a view of the Organical Parts of the Bean, 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.

The Cuticle Described

Dissecting a Bean then, the first Part occuring 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 superficially into the Bean, and then very gently bearing upward what you have cut, will separate and shew itself 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.

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.

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.* The Surface hereof is somewhat dense, but inwardly 'tis more porous, and of a laxer Contexture. . . .

The Inner Body

By what hath been said, that the *Parenchyma* 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. . . .

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 more, and 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.

This Seminal Root, as now we'll call it, 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 very thin Shives, 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. . . .

In the mean time, let us only take notice, that we say every Plant hath its Root, we reckon short; for every Plant hath really two, although not contemporary, yet successive Roots; its Original or *Seminal-Root* within 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.* . . .

Lobes Turn into Dissimilar Leaves

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,* mount also upwards, and advance above the Mould together with it, as all Seeds which spring up with dissimilar Leaves; the two (for the most part two) dissimilar Leaves, being the very Lobes of the Seed divided, expanded, and thus advanced.

The Impediments of our apprehension hereof as 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 phansie, 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, upon its advance above the Mould, it ever changed into a perfect Green. And why might not the same by parity of Reason be inferr'd 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. . . . 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. . . .

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 *Surfoyles;* but where the Lobes rise, there the *Plume* hath neither of them, being both needless.

Nehemiah Grew (1641-1712) studied medicine at Cambridge. He began his observations of plants at the age of 23, and wrote his "Anatomy of Vegetables Begun" during the next six years. The title was prophetic, for that small book eventually became the first part of his larger work, "Anatomy of Plants", published when the author was 41. Grew was identified with the Royal Society during its formative period. He became a Fellow at the age of 30, following the publication of the "Anatomy of Vegetables Begun". At 36 he became its Secretary, and for the two following years edited ist "Philosophical Transactions".