

Particles and Spirits: Fundamental Processes of Nature in Mid-Seventeenth Century Studies of Plants

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- The role played by the thorough examination of the visible features of plants to the development of botany (Ogilvie 2006; Touwaide 2008, 69: 33-62; Egmond 2010)
- The therapeutic character of plants and their importance for the development of medicine (Reeds, 1991; Laroche 2009; Anagnostou, Egmond, Friedrich 2001; Bellorini 2016; Manning, Klestinec 2017)
- Plants served as a way to disclose secrets of nature (Dear 1991, 135-163; Bushnell 2003; Smith 2008, 290-305; Klein and Sparay 2010)

- Knowledge making in the seventeenth century - a bottom-up process which consisted of multiple layers and involved a number of actors (Gaukroger 2010; Steinle 2016)

Aim of the paper

- To look at experiments with plants in the second part of the seventeenth century as attempts to investigate the fundamental processes of nature
- Different theoretical assumptions
- Instrumental use of plants
- Operational vocabulary
- Case studies: John Evelyn (1620-1706) and John Beale (c. 1608-1683)

John Evelyn - Fermentation as a Universally Generative Process of Nature

- *Elysium Britannicum* (started in the late 1650s-contemporary edition 2001), his introductory study to the translation of Lucretius's *De rerum naturae* (1656) and *A Philosophical Discourse of Earth* (1767)

John Evelyn - Fermentation as a Universally Generative Process of Nature

“reconciling” Epicurean atomism (via Lucretius) with the universally generative and qualitative theories of the three alchemical principles and the four Aristotelian elements (Evelyn 2001, 40)

John Evelyn - Fermentation as a Universally Generative Process of Nature

- Universal spirit of the world - “invisible Seede or Sperme{awne} [...] the offspring of a more sublime original by which it becomes {permanent &} immortal.” (Evelyn 2001, 40) – seminal agent
- Secondary matter (mercury, sulphur, salt)
- Idea
- Particles of matter (atoms)

John Evelyn - Fermentation as a Universally Generative Process of Nature

“It is Mechanicall but accidentally, as it has use and neede of fyre, and manual action ... having its principium motus from heaven itself ... [its matter] it is called Quintam Essentiam, which matter being rightly disposed, is indued with a Celestiall nature, by virtue whereoff other things of the same kind and spieces, are transmuted & altered into its nature. Thus it is Supernaturall and metaphisicall as in relation to the natural causes knowne it is physicall and naturall;”
British Library, Add. MS 78335, f.6.

John Evelyn - Fermentation as a Universally Generative Process of Nature

“Now the manner of this Spirits operation by the means of the three ~~primarie~~ {primarie} Substances, with which it composes all ~~other Individuals~~ {the vulgar Elements}, ... consists in its specifying or modifying the particles of Matter ...”(Evelyn 2001, 39)

John Evelyn - Fermentation as a Universally Generative Process of Nature

The universal spirit of the world “gives {all} ~~every~~ thing{s} {their due} *fermentation*, that is, *Motion* and emissions whereby they act one upon another {&have life} according as they are more or lesse quickened by and susceptible of it.” (Evelyn 2001, 41)

John Evelyn - Fermentation as a Universally Generative Process of Nature

“That these Seminall and apt masses convening under the Earth, in proper, but variously dispos’d and characteris’d recipients, being {as we affirm’d} actuated and fermented by the universal Spirit (which imparts to them both heate and moisture) ~~they~~ come to put forth themselves in a circular motion, piercing the womb of their teeming mother [*i.e. earth*] in a perpendicular progresse towards the Surface, because there the pressure is loose, and lesse impenetrable towards that ~~part~~ {side} of the particles of matter.” (Evelyn 2001, 78)

John Evelyn - Fermentation as a Universally Generative Process of Nature

“[Vegetables] They all consist of the very same *Atomes* and *Corpuscles*, however different and remote they seem to be, as being generally composed of the same common matter; and therefore since all *Sublunary* things have their principles common with the *Celestial*, it is not hard to conceive how things are thus daily repaired and nourished, by participating their aid and influence ...So neither in these *Natural things*, *Atomes* are not in general to be thought fit, and apt to produce and constitute all sorts of *Concretes*; but such onely as are indued with a particular and prone disposition. The same is likewise to be conceived of their final *dissolutions* and destruction.”
(Evelyn 1656, 155-156)

John Beale – Fermentation and the Motion of Spirits

- *Herefordshire Orchards* (1657), *Pomona, or, an Appendix Concerning Fruit-trees in Relation to Cider* (1670), contributions to the *Philosophical Transactions* in the 1660s and 1670s

John Beale – Fermentation and the Motion of Spirits

“Here you can more closely discriminate Spirits, & Juices by their severall Indications; & call for the proper use of the Microscope to discover the contextures proper for severall kinds of Vegetation.” (Beale to Boyle, 13 July 1666, *The Correspondence of Robert Boyle*, Vol III, 186-193 on 192)

John Beale – Fermentation and the Motion of Spirits

“[...] how the Seeds in their time, and afterwords the Roots, Stems and Leaves of Trees, may be the proper strainers to generate the peculiar saps and Juyces; and perhaps to ferment and boyle the Liquors [...]” (Beale, “The Causes of Mineral Springs,” *Phil. Trans*, 1669: 1131-1134, on 1133)

John Beale – Fermentation and the Motion of Spirits

“[...] sometimes seem to draw their whole substance, bulk and ornaments, whether annual or perennial, from the liquors they find in the same piece of ground [...]” (Beale, “The Causes of Mineral Springs,” *Phil. Trans*, 1669: 1131-1134, on 1132)

John Beale – Fermentation and the Motion of Spirits

“If thus we began softly, & in vulgar liquids & by obvious examples, wee might possibly arrive in due time to the configurations of all stones, mettalls, & other solids.” (Beale to Boyle 28 April 1666, *The Correspondence of Robert Boyle*, vol III, 157- 160, on 159)

John Beale – Fermentation and the Motion of Spirits

“This encouraged me to give you an accompt by Mr Oldenburgh, Of an Experiment, which shewes what kind of motion, both for figure, & celerity or vigor, gives the beginning, progresse, & advancement of Light or flame; & by the same view or rule to gather (as it were) into a methode the very principles & processes of fermentation, & of Vegetation, & of circulation of bloud & spirits in animals, & of configurations, colors, & ornaments, & their interruptions, both in concrete bodyes, & in fluides, all in a kind of Mathematicall demonstration.” (Beale to Boyle 28 April 1666, *The Correspondence of Robert Boyle*, vol III, 157- 160, on 157)

Horizontal and vertical explanations

- two levels of explanation:
 - one more theoretical (the level of vertical explanations)
 - one more empirical and experimental (the level of horizontal explanations) (Gaukroger 2010)

Horizontal and vertical explanations

“[...] it may be represented in favor of the Chymists, that, in one regard the Liberty they take in using names, if it be excusable at any time, may be more so when they speak of the substances whereinto their *Analysis* resolves mixt Bodies: Since as Parents have the Right to name their own Children, it has ever been allow'd to the Authors of new Inventions, to Impose Names upon them. And therefore the subjects we speak of being so the Productions of the Chymist's Art, as not to be otherwise, but by it, obtainable; it seems but equitable to give the Artists leave to name them as they please: considering also that none are so fit and likely to teach us what those Bodies are, as they to whom we ow'd them.” (Boyle, *The Sceptical Chymist*, 2001a, vol. II, 293-294).

Horizontal and vertical explanations

“If the Chymists [...] had been so modest, or so Discreet, as to propose their Opinion of the *Tria Prima*, but as a Notion useful among Others, to increase Humane knowledge, they had deserv'd more our thanks; and less of our Opposition.” (Boyle, *The Sceptical Chymist*, 2001a, vol. II, 328)

Horizontal and vertical explanations

“[...] so as granting this *Hypothesis*, we are less to wonder, that this matter [i.e. water] is above all other so disposed to Vegetation, and apt to produce Plants indued with Colour, Weight, Taste, Odour, and with sundry medical and other virtues, as I think that excellent Philosopher Mr. *Boyle* (an ornament of this *Society*) does somewhere make out from the various *Percolations, Concoctions, and Circulations* of that fruitful *Menstrue*: And if that be true, that there is but one *Catholic, homogeneous*, fluid matter, (diversified only by *shape, size, motion, repose, and various texture* of the minute Particles it consists of; and from which affections of matter, the divers qualities result of particular bodies;)”
(Evelyn 1676, 45-46)

Horizontal and vertical explanations

“By the *Odour* or *Smell*, containing (as my Lord *Verulam* affirms) the juice of Vegetables already as it were concocted and prepared.” (Evelyn 1676, 28)

Horizontal and vertical explanations

“But whether it be accidental, or essential, corporeal, or more spiritual, principal, or organical; or (to speak with the *Chymists*, and later *Atomists*,) whether communicated by *effluvias*, *salts embryonate*, or *indigested* and not *specificate*; from *ferments*, *spermatic vapours*, *influences Celestial*, or from liquor only impregnated and concocted, I leave to those who affect to wrap up easie notions in hard and uncertain terms, whilst the thing would be of use to the Philosophical *Husband-man*, were their reduction into just *Classes*, for the better discriminating of the several *Composts*.” (Evelyn 1676, 108-109)

Horizontal and vertical explanations

“ To assign which are the certine Principles & true Causes of Things ... especially as they concern the order of Generation & Vegetation & government of Plants may be rather laudably attempted than positively concluded.” (Evelyn 2001, 36)

Conclusion

- matter is made of particles
- some natural processes (such as the generation of living bodies) cannot be exclusively reduced to mechanical explanations
- formative agents or/and qualities
- experimental arguments
- they used experiments with plants to develop tools, hypotheses, and operational concepts which travelled from one to another, allowed collaboration, and put experimental reports and knowledge in circulation