New Europe College
Ştefan Odobleja Program
Yearbook 2018-2019

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This volume was supported by a grant of the Romanian National Authority for the Scientific Research and Innovation, CNCS/CCCDI – UEFISCDI, project number PN-III-P1-1.1-BSO-2016-003, within PNCD III

ISSN 1584-0298

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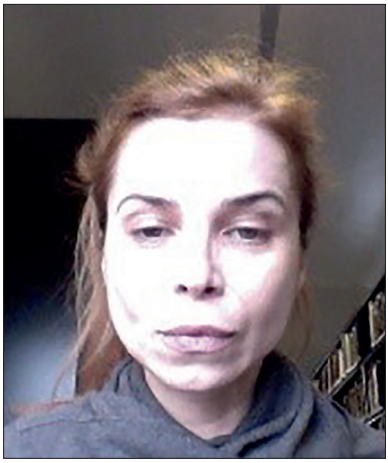

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PLANTS AS INSTRUMENTS OF KNOWLEDGE IN EARLY MODERN NATURAL PHILOSOPHY

Abstract

The study of plants in mid-seventeenth century England concentrated less on the external and internal features of plants for taxonomic purposes and more on the investigation of fundamental processes of nature such as vegetation, fermentation, germination, etc. It constituted itself into a novel discipline that opposed scholasticism by trying to identify alternatives ways of interpreting nature and it was based on a process of empirical investigation of nature that included new methods and techniques such as direct observation and experimentation, or the use of instruments and measurements. This new discipline used plants as instruments of inquiry into nature in a bottom-up methodological framework that had more to do with practices and experiments than with theoretical commitments.

Key-words: the study of plants, fundamental processes of nature, experiments, natural history, natural philosophy

The study of plants and vegetal bodies has always played an important role in the process of acquisition of natural knowledge both for theoretical and practical purposes. In the Middle Ages, the study of vegetation lacked disciplinary autonomy and was mainly an aspect of medical training, plants and their properties serving medicinal or pharmacological uses.[1] Sources for those interested in plants were generally restricted to Dioscorides' *Materia medica,* Galen's *De simplicium medicamentorum temperamentis ac facultatibus*, Pliny's *Naturalis historia*, or Theophrastus' *De causis plantarum*.[2] The late Renaissance brought a change of disciplinary approach, the late fifteenth and early sixteenth centuries witnessing an increase of theoretical interest for the study of plants. These transformations took the form of a slow transition to a botanical discipline more concerned with observations and the description of the visible features and inner

structure and nature of plants. Plant collecting, *res herbaria*, and catalogues formed an important part of the knowledge of plants that was directed at gathering information about nature and ways to classify plants.

In parallel with this enterprise, another direction of investigation concentrated on the chemical investigations into the inner principles and properties of plants. Alchemical physicians and scholars, such as Paracelsus (1493/4-1541), Joseph Du Chesne (1546-1609), Oswald Croll (1560-1608), and Daniel Sennert (1572-1637) used plants in their experimental inquiries into the sympathetic relations uniting the vegetal realm with minerals, stars, and parts of the human body. For them plants served as instruments for investigating the hidden properties of nature and as a key to unveiling the latent processes of life. From these various approaches, a "science" of plants emerged, shifting its focus from a pharmacological perspective to an epistemic and instrumental one. This new discipline provided knowledge about the visible elements, internal organization, structure and functioning of plants but also used plants as instruments of inquiry into the fundamental processes of nature (such as vegetation, fermentation, growth, maturation, and putrefaction). The aim of this paper is to trace the methodological contours of this new seventeenth-century discipline called, in actors' categories, "vegetable philosophy" (Ralph Austen), "chemical history of vegetable bodies" (Francis Bacon), or "science of vegetation" (Kenelm Digby). This discipline, at a first glance, seems to be concerned with the study of plants but its final aim is to discover the transformations taking place in natural bodies endowed with sensitive life. It is not botany, because in parallel with the study of plants, it aims at developing technologies able to produce effects for multiple kinds – plants, animals, humans. It is not agriculture, because it encompasses a transmutational perspective of the inferior into the superior which brings it closer to alchemy. It is not natural magic because of its distinct interest in methodological details. It is not natural philosophy, because it has a practical and operative side, concerned with technological advancement and amelioration. This "new science" was a complex phenomenon that did not restrict itself to collecting information about the vegetal world but was ultimately a science of life (of life generation and investigating life forms), characterized by two main features. On the one hand, it opposed scholasticism (although in many ways encompassing its principles) by trying to identify alternative ways of/frameworks for interpreting nature and, on the other hand, it was founded on a process of empirical investigation of nature that gave rise to new questions and new methods

(such as direct observation and experimentation, the use of instruments and measurements, etc.). It attracted practitioners of alchemy, natural magic, natural history, and other experimenters bound together not by a common theoretical background but rather by a shared methodology based on an instrumental approach, oriented bottom-up. Key figures are seventeenth-century naturalists (Ralph Austen, Robert Sharrock), natural philosophers (Thomas Browne, Kenelm Digby, Robert Boyle), and projectors and developers (such as John Beale and John Evelyn). These figures are rarely treated together in the scholarship and most of the time with theoretical questions in mind. Quite often the reason for treating them together was their belonging to a particular matter theory or to a particular tradition: Aristotelian vs Paracelsian. When scholars looked into methodological aspects, they classified them as Baconian in the Kuhnian sense (namely qualitative, non-paradigmatic, fact-gathering).[3] I will look at their texts as recordings of inquiries based on a remarkable amount of shared knowledge. Only that this knowledge has more to do with practices and the epistemology of experimentation than with matter-theories or the formulation of causal mechanisms or causal explanations. Therefore I am investigating a corpus of texts studied by the history of philosophy in a different framework, one offered by recent developments in history of science regarding practices and the use of experiment.[4]

The purpose of this paper is to argue that this new discipline of plants is based on some common points. The first is an instrumental role attributed to plants regarded as (al)chemical laboratories used to investigate the chemical processes taking place in the natural world. The role of experiments is to investigate plants not as specimens with different external and internal features for taxonomic purposes, but rather to treat them as instruments able to perform chemical transformations of matter and to illustrate processes of nature. Often, their starting point was an experiment, investigation, or suggestion recorded by Francis Bacon in his *Sylva Sylvarum*.[5] Therefore, even if, most of the time, disguised under practical and experimental attempts, Baconian elements of matter theory are present in the literature on plants produced in mid-seventeenth century England. The second point refers to the methodological dimension of experiments with plants. My claim is that English naturalists of the mid-seventeenth century appropriated the Baconian method of experimentation and that was the key element connecting their diverse experimental investigation with plants, in spite of their different theoretical agendas.

To prove that I will first present Francis Bacon's matter theory of plants, identifying its reception in mid-seventeenth century England. Then I will discuss the appropriation of the more general Baconian method of experimentation in mid-seventeenth century England, discussing three particular cases: Ralph Austen's *Observations upon some part of S^r Francis Bacon's Naturall History*,[6] John Evelyn's gardening literature and his projects of compiling natural histories, and one anonymous and undated letter addressed to Samuel Hartlib.

1. Francis Bacon's Matter Theory of Plants

Francis Bacon's plan for the reconstruction of philosophy (1561-1626), outlined in his work *The Advancement of Learning*,[7] starts with the classification of knowledge into three main categories: history, poesy and philosophy. In his plan, natural history is a prerequisite for natural philosophy and, based on experimentation, has to provide the general laws and axioms of nature that will constitute the material for the construction of natural philosophy.[8] He proposed two ways of inquiring: *interpretatio naturae* (a new logic of research based on the collection of natural facts and their inductive investigation) and *experientia literata* (which proposed ways of extending experimental techniques). [9]

Apart from the more programmatic interests, Bacon himself wrote natural histories, some more theoretical (such as *Historia vitae et mortis,* published in 1623) and some more practical, such as *Sylva Sylvarum*. Published posthumously in 1626, *Sylva Sylvarum* contains a significant number of observations and experiments concerning plants. For the mid-seventeenth century generation of experimentalists, the Baconian method of experimentation was a very important source of inspiration, but so was the matter theory Bacon developed and sometimes even disguised under the screen of experiments. Such is the case of *Sylva Sylvarum*, where plants (inferior instances of life, easy to manipulate and experiment with) serve as the main characters in Centuries V, VI, and VII, where Bacon, through the use of experiments, discloses some elements of his matter theory as it regards the vegetal domain. Centuries V and VI disguise elements of matter theory behind experiments devoted to a great variety of "vegetals," from trees and herbs, to moss and mushrooms, while Century VII introduces some particularities of plants: they are animate bodies, made up of tangible and pneumatic parts, and have heat, motion and perception. In what

follows, I will present some of elements of Baconian matter theory that are revealed in relation to plants.

The Baconian matter is of two types: tangible and pneumatic.[10] Tangible matter is heavy, gross and inert, while pneumatic matter is corporeal, weightless, invisible, restless, and animated by spirits. The universe has three zones: the core of the Earth (solid, passive, and filled with tangible matter); the heavens (filled with pneumatic matter); and the frontier zone, at the surface of the Earth, where minerals, plants, animals, and humans live and where pneumatic matter mixes with tangible matter. The spirits and activity of the pneumatic matter are the primary cause of the majority of observable phenomena in nature. In the Baconian matter theory, spirits are of multiple kinds. Whether they are called non-living (mortuales) or vital, innate or hidden, native or invisible, they are material, fine substances, combined from air and fire and with motion attached. Spirits are constitutive for Bacon's theory of matter and endowed with power and motion ("appetition" and "perception"). Sharing a central role in the Baconian matter theory, motions, schematisms, and appetites are the main causes of activity in nature. Critical discussion regarding the relation between the three elements is still ongoing and it is not the intention of this paper to delve into it.[11] Still, for a better understanding of the Baconian matter theory of plants, I will try to elucidate some characteristics that can distinguish between the three elements. Bacon uses "motion" as a change or a propensity for change.[12] Motions are simple and compound, the compound motions being a sum of simple motions.[13] "Schematism" has more complex meanings. First, it designates the structure of the universe as a whole and, secondly, it refers to the occult structure of matter and the subtle, invisible processes that take place in complex bodies, such as "consent" or "sympathy."[14] "Appetites" are described by Bacon as primary properties of matter that cannot be altered or erased, but can be manipulated. Appetites manifest themselves as tendencies to follow what is agreeable and to reject what is not.[15] In *Abecedarium novum naturae*, Bacon presents a scheme of four appetites with sixteen motions attached (four motions to each appetite). In the Baconian theory of matter, we find another element in close relation with appetites, namely "perception", which is "a kind of choice in receiving what is agreeable, and avoiding what is hostile and foreign."[16] What differentiates appetites from perception, although they seem to manifest similarly, is that appetites belong to matter in general, while perception is a property of bodies in

particular. To sum up, perception is a source of appetites: it generates the appetites of matter, while the appetites determine motion.

In this general scheme of matter theory, in *Sylva Sylvarum*, Century VII, Bacon encloses a discussion about plants, presenting some of their characteristics in comparison to living creatures and inanimate bodies. Plants are included in the category of animate bodies and, as all bodies, whether animate or inanimate, besides tangible elements, possess spirits and pneumatic parts.[17] The differences between animate bodies (such as plants) and inanimate bodies (such as minerals and metals) are twofold. Firstly, spirits of animate bodies "are continued with themselves, and are branched in veins and secret canals, as blood is", while spirits of inanimate bodies, by contrast, are "shut in and cut off by the tangible parts, and not previous one to another."[18] Secondly, animate bodies have their spirits kindled or inflamed in certain degrees, while spirits of inanimate bodies are not inflamed or kindled.[19] In addition to these two main differences, there are others that derive from them. Therefore, plants are figurate and determinate (due to the capacity of the spirit of plants "to spread and continue with itself"), nourish themselves, have a period of life, are succeeded by and further propagate their kind, and have parts that grow under and above ground.[20] Another distinctive element for plants in relation to inanimate bodies is the plants' capacity to generate new plants or other living creatures out of putrefaction.[21]

As for the comparison to living creatures, Bacon claims that spirits of living creatures have not only branches, but "certain cells or seats, where the principal spirits do reside, and whereunto the rest do resort."[22] Spirits of plants do not have cells or seats, and also have less flame than spirits of living creatures.[23] In addition to these two main differences, plants are also fixed to the ground, do not have local motion, nourish themselves from their roots, have their seminal parts located in their upper parts, have no precise figure, and no diversity of organs, sense, and voluntary motion.[24] Because in the Baconian matter theory plants do not possess senses, perception is the property that acts as a sense for them, enabling them to distinguish what is beneficial and to reject what is not. In the Baconian theory of matter, perception is present everywhere in the universe; it is what individuates the body.[25] All bodies have perception, even those that do not possess sensory organs (inanimate bodies and plants), and, in those bodies that have perception and senses, the former is more subtle than the later. It can work very well at touch and at a distance and it represents the major cause for interactions between bodies and a source of activity

in matter.[26] For Bacon, perception in plants offers a very good example of how the appetitive matter acts.

Although recent scholarship argued that almost no one in the mid-seventeenth century engaged with the Baconian matter theory of appetites, there are at least two examples that contradict this opinion.[27] These are the cases of Francis Glisson and Ralph Austen.[28] Inspired by Bacon, Ralph Austen's matter theory of plants claims that spirits are the entities that animate the bodies and, in an argument I consider to be of Baconian provenance, that plants have perception which acts as an appetitive property of matter. In a very interesting fashion, Ralph Austen used both Bacon's matter theory and his methodology of experimentation to frame his own projects of natural history of plants. Although perception belongs to the tradition of natural magic, what I consider to be of Baconian provenance for Austen's perspective on perception, apart from the experimental context in which it develops, is the property to activate the appetites causing motion in matter and interactions between bodies.[29] Austen used his matter theory for the same purposes as Bacon had in his projects of natural history and he also took some of its constitutive elements from Bacon, namely the theory of spirits, the relations of sympathies and antipathies, and most important, the perception of plants as an appetite of the body able to cause motion.

2. The Baconian Reception in the Hartlib Circle

Bacon's plans for his project of *Instauratio magna* and the accompanying method of experimentation were very popular in the mid-seventeenth century in a circle of correspondents spread all over Western Europe, namely the Hartlib Circle. Samuel Hartlib (c. 1600 –1662), a Polish refugee to London, was a polymath that connected via correspondence, between 1630s and 1660s, a significant number of intellectual figures of the mid seventeenth century, with interests in diverse topics such as the reformation of schools, ecclesiastical peace, or the advancement of learning. In the 1650s, the Circle's agenda came to be dominated by Baconian experimentalism, natural history and natural philosophy and Samuel Hartlib acted as a hub for scholarly communication in different fields of interest with the presumed goal of acquiring and disseminating practical and experimental knowledge. As a result, a number of Hartlibians were connected in their concerns and activities, sharing common projects

and pursuits. The case of experiments involving plants is exemplary in this sense, gardening and agricultural activities involving, most of the time, common actions. Some examples for such relations are: Gabriel Plattes and Sir Cheney Culpeper, John Beale and John Evelyn, Ralph Austen, Robert Sharrock and Robert Boyle, and, of course, Samuel Hartlib as the center of all these shared concerns.[30]

As for the reception of Baconianism in the mid-seventeenth century, there are several interpretations. Charles Webster and Hugh Trevor Roper argue that there are two types of Baconianism, one "high" and another one "low."[31] The low form is to be discovered in manifestoes and pamphlets destined to produce social change, while the high form is a methodological one, difficult to locate and varying from one author to another. Guido Giglioni criticized this division but still found Bacon to be very influential for members of the Hartlib Circle who closely followed the Baconian programme.[32] Michael Hunter claimed that the label of "Baconianism" was mainly ideological in mid-seventeenth century England and used as a weapon by the virtuosi against Thomas Hobbes.[33] This paper will argue that people connected to the Hartlib Circle took very seriously into account the task of experimentation, according attention not only to the goal of ameliorating the nature of plants, but also insisting on framing a proper method of experimentation. In doing so, they dealt with several sources and among these sources, Bacon's works are closely followed and his advice put into practice. Also interesting is the manner in which members of the Hartlib Circle read several Baconian works. Although *Sylva Sylvarum* was very popular in the Circle, other Baconian works received significant attention (such as *Novum Organum*). My claim is that the Hartlibians used *Sylva Sylvarum* as a handbook for experimental activities in the garden but when they needed structure in their attempts for finding a method, they also assumed the Baconian language and methodological divisions from the more theoretical works such as the *Advancement of Learning* and *Novum Organum*.

Therefore, in the next section of my paper I will present the case of Ralph Austen's own observations on Francis Bacon's *Sylva Sylvarum* and his particular way of appropriating both the Baconian matter theory and Bacon's method of writing experimental natural history projects. Then I will introduce the case of John Evelyn and his pursuits of compiling natural histories in the vegetal domain, focusing on the Baconian language discovered in Evelyn's late works. The last section of my paper will present the attempts of an anonymous member of the Hartlib Circle

to find an accurate method for investigating the process of vegetation. I will emphasize the Baconian elements that I have distinguished in this attempt: accurate descriptions of natural and artificial phenomena, systematical observations that led to classifications, detailed presentations of experiments with the desire to formulate causal explanations, etc.

2.1. Ralph Austen's Observations

Ralph Austen published a book entitled *Observations upon some part of S^r^ Francis Bacon's Naturall History, as it concernes fruit-trees, fruits, and flowers*, in 1658 and dedicated it to "To the honourable Robert Boyle Esq. sonne to the Lord Boyle of Corke". Apart from the dedication to Robert Boyle the book has a Letter addressed to the reader signed by Robert Sharrock, a churchman and botanist, known for *The History of the Propagation and Improvement of Vegetables by the Concurrence of Art and Nature* and for his association with Robert Boyle.[34] Austen's book of *Observations* had a second edition in 1665.[35]

The book presents several observations made by Ralph Austen upon Francis Bacon's experiments presented in *Sylva Sylvarum*, Centuries V, VI, and VII. The book's extensive title is *Observations upon some part of S^r^ Francis Bacon's Naturall History, as it concernes fruit-trees, fruits, and flowers: especially the Fifth, Sixth, and Seventh Centuries, Improving the Experiments mentioned to the best Advantage*. At a first glance, the title could suggest that this book is simply destined to produce advantage in the practical domain. But in a passage included in the Dedication to Robert Boyle Austen tells his audience that he is interested both in "Theory and Practise", showing Austen's equal interest for the two aspects of the Baconian programme. Austen sees in *Sylva Sylvarum* a list of instances that are to be continued. Bacon himself left this task to his followers. People like Austen and Sharrock were well aware that Bacon had not personally conducted all the experiments presented in *Sylva Sylvarum*, another reason why they felt encouraged to approach particular instances and correct inaccurate information.

> The Learned, and incomparable Author S^r^ Francis Bacon hath left unto men such Rules, and helps in all kinds of Learning, that they will be much wanting to themselves, if Arts, and Sciences improve not, very much above what they have been in former ages: And as the foresaid worthy Author was eminently seen in all Arts and Sciences, so his delight was especially

> (as is recorded of him) in Vegetable Philosophy, which was as it were, his darling delight, having left unto us much upon Record in his Naturall History; some part whereof referring to Fruit-trees, Fruits, and Flowers, I have, (by encouragement from himselfe) endeavoured to improve unto publique profit, according to what understanding, and experience I have therein […] I have encouragements in my labours thereabout, (both as to the Theory, and Practise) I humbly, present these following *Observations* into your hands, and am (for all your favours).[36]

In his book, Austen kept intact the order of the experiments presented by Bacon in *Sylva Sylvarum*, Centuries V, VI, and VII; he individually took the Baconian experiments and made several observations upon them. Austen not only embraced the practice of experimentation as a way to further develop Bacon's program for natural history, but he also devoted particular interest to methodological aspects. Austen assumed the task of writing natural histories expressed by Bacon in *Parasceve*,[37] that of seeking and collecting in order to construct true axioms, not just to provide immediate advantage.

The first interesting thing to be noticed is the division of experiments into experiments of fruit and of light. Not only that the same language is used, but the purpose of this division is the same both for Bacon and Austen. Experiments of light are meant to give causal explanation, to contribute to the discovery of causes, while experiments of fruit are more practical and oriented towards the production of economical outcomes. Experiments of light are complex procedures, involving measurements, weighing, while experiments of fruit are of little use for natural philosophy.

> Let it be observed also, That the *Experiments* set downe by the Author in his *Naturall History*, are of *two sorts*, as himselfe saith: *Experimenta Fructifera, & Experimenta Lucifera*: *Experiments of Light, and Discovery*, (such as serve for the *illumination* of the *understanding*, for the finding our, and discovering of Naturall things in their *Causes*, and *Effects*, that so *Axioms* may be framed more soundly, and solidly) And also *Experiments of use*, and *Profit*, in the lives of men.
> Now the *Observations upon these Experiments* tend also to the *same ends*.[38]

Apart from borrowing the experimental language, Austen re-conducts experiments with plants and, according to his own findings, he either endorses Bacon's theories or contradicts them and advances new ones.[39] Experiments belonging to the first category, the ones which

prove Bacon's theories and also complete them on the basis of Austen's evidence obtained through direct experimentation (re-conducting experiments, testing and conducting experiments that Austen knows Bacon never conducted himself, or simply recording facts derived from further experience), are designed to re-enhance Bacon's theories. The second category of experiments has the purpose to correct a number of experiments presented in *Sylva Sylvarum* and to advance new theories, notable being Austen's theories regarding sap and grafting, two aspects in which he contradicts Bacon.

Austen's observation on experiment 402 of *Sylva Sylvarum* is a good example belonging to the first category.[40] The discussion in this experiment regards the process of germination of seeds steeped into water mixed with several types of fertilizers. Austen, like Bacon shows interest in understanding the process of germination and uses the seeds as instruments of inquiry into this fundamental process of nature. Apart from the interrogation of what makes a seed develop into a mature plant, Austen uses Baconian methodological extensions and includes in his experiments plants that Bacon has not referred to (such as apricots and almonds). Apart from that, Austen also correlates a causal explanation for the effect produced by fertilizers upon the growing of the plant.

The second category groups observations that are meant to refute Bacon's theories and to propose new ones. In experiment 427 Bacon explains that sap descends during winter but Austen does not agree with this theory: "As for *the baring from the barke*, which is supposed to keepe sap from *descending towards Winter*; I say, the sap is as farre from *descending* when the barke is on, as when is off; theres no such thing in nature as *descention of sap* in any trees whatsoever."[41] Claiming that Bacon accepted the theory of the descending sap just because this was the general opinion on the matter, Austen advances a new theory, completely opposed to Bacon's, and he argues that sap ascends into the tree and is transformed into bark, leaves, fruits, etc.

Austen's observations upon Bacon's experiments in Sy*lva Sylvarum* prove not only the systematical approach to experiment and experimentation but also his determination in respect to the methodological/theoretical dimension associated with the program of natural histories. Assuming the Baconian appetitive matter theory and using methodological elements of *experientia literata* (such as variations and extensions) Austen endorses Bacon's theories by adding new information and by making causal

explanations in accordance to Bacon's previous theories or, on the contrary, rejects Bacon's theories and advances new ones.

2.2. John Evelyn's gardening literature

My second example is John's Evelyn and his project of writing natural histories in the vegetal domain. John Evelyn, an English writer, gardener and a diarist, was educated at Balliol College, Oxford and at the Middle Temple. Evelyn travelled on the continent where he attended several meetings and came in contact with other intellectuals such as Nicolas le Fèvre, Gabriel Naudé, Pierre Gassendi, Francois de La Mothe Le Vayer, Abraham Bosse. Evelyn was a member of the group that founded the Royal Society, and also a member of The Mechanical Committee and the Society's Georgical or Agricultural Committee, instituted in 1664.

Evelyn's attempts in the field of natural history start at the beginning of the 1650s, when, partially inspired by the atmosphere around Samuel Hartlib and other members of the Hartlib Circle, he decided to start a project of an all-encompassing History of Trades.[42] However, Evelyn's activities in the 1650s and early 1660s are not such a strong proof that can connect him and his endeavours to Francis Bacon and his method of experimentation. Michael Hunter claims that it was the French tradition that influenced Evelyn in this stage rather than Bacon.[43] I would say that the Baconian atmosphere of the Hartlib Circle affected him to a degree but the Baconian influence is largely felt in his writings on gardens and trees (such as *Sylva* and *Elysium*) rather than in the project of the history of trades. In the 1650s, Evelyn commenced another interesting project, *Elysium Britannicum*, which began as a history of the trade of gardening but Evelyn became so captivated by the complexities of this subject that he continued working on it for several years and ultimately never published it.[44] In an interesting manner, *Elysium* shares a combination of experimental and speculative approaches. For instance, interpretations of the Genesis and theories on elements and celestial influences (present mostly in the first Book) are combined with chapters on the great diversity of species that can be grown from various combinations of soil types and amounts of water. Apart from this project of natural history of the trade of gardening, Evelyn also compiled a natural history of forest trees, *Sylva*. *Sylva* was pretty popular; it had several editions (1664, 1670, 1679, 1706).[45] The book contains several chapters, half of them dedicated to specific types of forest trees (from oaks and elms, to myrtle and acacia). There are also

chapters dedicated to certain activities regarding the cultivation of trees (such as pruning or curing trees infirmities). The exposition ends with encouragements for further experimental activities related to the subject under discussion. This might be interpreted as Evelyn's own reading of the advice given by Bacon in the *Parasceve or Preparative to a Natural History* in regard to the compilation of the History of Arts.[46] Similarities between the uses that Bacon attributes to natural history and Evelyn's are easy to identify. Therefore, the task of encouraging further inquiry is a condition that is present in both authors. The demand to accurately describe the experiment so it can be of use for other people is something that is mentioned by both authors. Also, for Bacon as well as for Evelyn it is of utmost importance to intersperse old and new observations and to inquire into received opinions. But even more evident is the methodological language that Evelyn engages with. He claims that the truth of nature is to be accessed by "induction," which is able to direct the experiment and the experimenter to the general rules of nature. The role of experiments, Evelyn says is that, by "induction," to access the truth and to formulate general rules regarding the natural world. The experiments, according to Evelyn, whether of fruit or light, record information accessible by senses and induction will select from a wide range only those experiments able to advance the establishment of "Axioms, General Rules and Maximes".[47]

> They are not hasty in *concluding* from a *single*, or *incompetent* number of *Experiments*, to pronounce the *Ecstatic Heureca*, and offer *Hecatombs*; but, after the most diligent *Scrutiny*, and by degrees, and wary *Inductions honestly* and *faithfully* made, to *record* the *Truth*, and event of *Tryals*, and transmit them to *Posterity*. They resort not immediately to *general Propositions*, upon every *specious appearance*; but stay for *Light*, and Information from *Particulars*, and make Report *de Facto*, and as *Sense* informs them. They reject no *Sect* of *Philosophers*, no *Mechanic* Helps, *except* no *Persons* of Men; but chearfully embracing *all*, cull out of *all*, and alone *retain* what abides the *Test*; that from a plentiful and well furnish'd *Magazine* of true *Experiments*, they may in time advance to solemn and established *Axiomes*, *General Rules* and *Maximes*; and a *Structure* may indeed lift up its head, such as may stand the shock of *Time*, and render a solid accompt of the *Phænomena*, and *Effects* of *Nature*, the *Aspectable Works of God*, and their *Combinations*; so as by *Causes* and *Effects*, *certain* and *useful* Consequences may be deduced.[48]

Evelyn moved from the narrative natural history of the *Elysium*, inferior in Bacon's eyes to the superior and "the proper preparative for the founding of philosophy" that is to be discovered in the last two editions of *Sylva* published throughout his life (1679 and 1706).[49] In *Sylva* Evelyn's intention was to put together a Baconian methodologically-framed project of natural history. From a collection of experiments, using the method of induction, Evelyn tries to select information about nature that will constitute the basis for general rules and axioms.

If in the 1650s and in the early 1660s Evelyn concentrated on compiling projects of natural history focused on commonplacing and collecting facts about nature, in the years after his association with the Royal Society his interest shifted, paying more attention to methodological aspects. If his efforts in the 1650s and early 1660s cannot connect him to the Baconian type of natural history, his natural history of forest trees shows a more sophisticated Evelyn, an experimentalist that wished to reveal the general rules and axioms of nature in a inductive, Baconian fashion.

2.3. A Method for a perfect Inquiry upon the whole subject of vegetation

The third source I propose to discuss is an anonymous, undated letter addressed to Samuel Hartlib.[50] In this letter the author proposes a method for "a perfect Inquiry upon the whole subject of vegetation". Although not mentioned, the letter's real purpose is to present a project of natural history for the study of vegetation, divided into three major parts: "The Physicall part and of the Inquiry about Vegetation," "The Oeconomicall part," and "the Medicinall and Anatomicall part." The first part ("the Physicall"), is the more consistent one and it presents the method proposed by the anonymous writer for the study of vegetation. The first step of the method requires the systematical collection of all the phenomena the author can remember from his observations on vegetation. Besides the natural phenomena, the author proposes to collect the artificial phenomena that can improve or alter plants (in respect to their colour, taste, figure, time of ripening, time of germination, etc.). Another thing that is worthy of mention is that all these observations and phenomena are meant to form "the substrata … which being laid" will help to settle "what Principles we should thinke meete to assert in Nature to be the true causes of vegetation." When talking about the causes of vegetation, the anonymous writer questions other previous theories such as Aristotelianism, Paracelsianism,

Cartesianism, magnetic attraction, favouring a more empirical method, based on accurate observations and experimentation.

> Or whether without all these, by a plaine, direct, Analyticall Consideration & Examination of all & every particular body, concurring to Vegetation.[51]

The application of this analytical method should reveal the main causes of vegetation and the factors that can influence it: the seed, water ("the prime Materiall cause"), salt, earth, and warmth. Also, apart from the principal causes of vegetation one has to consider: "air (both simply and attended with the Accidents of Lightning, Thunder, Meteors, Blasting), dews (and how they differ from rain), the Operations & influence of the Sun, the Influence & operation of the Moone, and the Operations & Influence of the other Coelestial bodyes."[52]

Inquiring and studying all these causes can help the user of the method to improve his knowledge regarding what is in the power of man and what is not and what art and industry can do to improve the condition of plants. Out of this general knowledge, further inquiry will be encouraged and more experiments will be able both to advance knowledge of the true causes of things and to derive material advantage.[53] Apart from these, another Baconian feature is the desire to use all the knowledge coming from experiments to advance "Generall Aphorismes or Conclusions in Nature."[54]

"The Oeconomicall" part is subdivided into four divisions, mainly having to do with the material advancement that experiments can yield. "The Medicinall and Anatomicall" part remains undeveloped in this letter, but the author announces his intention to distribute it into several classes and to connect it with the historical description of vegetables (for the fulfilment of the project of natural history).

Interesting for this letter is that it considers the Baconian project for writing natural histories in a different fashion than other members of the Hartlib Circle (such as Austen and Evelyn) had done. If Austen assumed the task of writing a systematic natural history and Evelyn moved from the narrative type to the superior type of natural history, this letter proposes a different perspective. It starts with the superior type of natural history, the preparative for natural philosophy, emphasizing the need for method and systematization, leaving to second place the material advancement entailed by experimentation. The real purpose of a natural history is the finding of a method that can provide conclusions and general axioms. This method

proposes the systematic study of all the factors that can generate and affect vegetation and to move from particular observations and experiments to general rules and axioms. Likewise, this anonymous and undated letter presents a project of natural history that exhibits elements of Baconian provenance: division and subdivision, a method based on accurate description of natural and artificial phenomena, systematic observation and classification, a desire to move from particular observations to causes and to formulate general aphorisms and conclusions.

In this section I have tried to show that, although, naturalists associated with the Hartlib Circle mixed several traditions in their experimental attempts and projects of compiling natural histories, still, the Baconian influence can be discovered as a bond connecting their efforts. Also, in terms of the sources used, these naturalists did not restrict their interests to just one Baconian work. Although *Sylva Sylvarum* was a very influential book for the first and the second generation of Baconians, in their search for method, the Hartlibians also appealed to other more theoretical Baconian works such as *Parasceve, Descriptio globi intelectualis, De augmentis scientiarum, Historia naturalis et experimentalis*.

3. Conclusion

This paper suggests that the study of plants in mid-seventeenth century England became a discipline whose unity was given by the system of practices described in Bacon's project of natural and experimental history. Experimenters of mid-seventeenth century England treated plants as instruments of inquiry into the fundamental processes of nature such as vegetation, fermentation, germination and this instrumental approach allowed them to study these processes in the inner laboratory of plants. Apart from the use of plants as instruments of knowledge, the other common element was the interest in method. English naturalists of the mid-seventeenth century appropriated the Baconian method of experimentation and they used elements of the Baconian *literate experience* (*experientia literata*) such as extension, variation in a particular experimental scenario, that allowed them to go from particulars to formulating the general rules and axioms of nature. The study of plants in mid-seventeenth century England was a practice-based discipline that connected people with different theoretical commitments but with the same experimental and methodological interests.

NOTES

1 Meier Reeds, K., *Botany in Medieval and Renaissance Universities*, Garland, New York and London, 1991, 3. For a general treatment of plants in the Middle Ages, see Paravicini Bagliani, A., *Le monde végétal. Médecine, botanique, symbolique*, Edizioni Del Galluzzo, Florence, 2009.

2 Bellorini, C., *The World of Plants in Renaissance Tuscany: Medicine and Botany*, Routledge, New York, 2016; Laroche, R., *Medical Authority and Englishwomen's Herbal Texts, 1550-1650*, Ashgate, Farnham, 2009.

3 Khun, T., *The Copernican Revolution. Planetary Astronomy in the Development of Western Thought*, Harvard University Press, Cambridge Mass., 229-278.

4 Chang, H., "Beyond Case-Studies: History as Philosophy" in *Reintegrating History and Philosophy of Science*, ed. Seymour Mauskopf and Tad Schmaltz, Boston Studies in the Philosophy of Science 263, Springer, Dordrecht, 2011, 109-124; Soler, L., Lynch, M., Zwart, S.D. and Israel-Jost, V., "Epistemic activities and systems of practice: Units of analysis in philosophy of science after the practice turn," in *Science after the practice turn in the philosophy, history, and social studies of science*, ed. Soler, L., Lynch, M., Zwart, S.D. and Israel-Jost, V., Routledge, New York and London, 2014, 75-87.

5 Bacon, F., S*ylva Sylvarum*, William Lee, London, 1626. All the references in this paper are to the 19th century edition, *The Works of Francis Bacon, Baron of Verulam Viscount of St. Alban, and Lord High Chancellor of England*, ed. Spedding, J., Elis, R.L., and Heath, D.D., 14 vols., London, 1857-1874 (facsimile reprint Stuttgart-Bad Cannstatt 1961-1963) (hereafter SEH).

6 Ralph Austen, *Observations upon some part of S^r^ Francis Bacon's Naturall History as it concerns, Fruit-trees, Fruits, and Flowers*, Hall for T. Robinson, Oxford, 1658.

7 The book was published in English in 1605 and it was followed by an enlarged edition in Latin, *De Augmentis Scientiarum*, in 1623. In 1640 Gilbert Wats published in Oxford a translation of the *De augmentis scientiarum*, called *Of the advancement and proficience of learning; or, The partitions of sciences, IX bookes. Written in Latin by the most eminent, illustrious Lord Francis Bacon. Interpreted by Gilbert Wats*).

8 Bacon, F., *Translation of De Augmentis*, SEH IV, 292; 298-299.

9 Bacon, F., *Translation of De Augmentis*, SEH IV, 413.

10 Bacon, F., *Novum Organum*, in *Oxford Francis Bacon XI*, ed. Rees, G. and Wakley, M., Oxford University Press, Oxford, 2004, aph 40, 346-359 (hereafter OFB); Also, *Sylva Sylvarum*, exp. 842, SEH II, 616; Rees, G., "Francis Bacon's Semi-Paracelsian Cosmology," in *Ambix* 22/2 (1975), 81-101 and Rees, G., "Francis Bacon's Semi-Paracelsian Cosmology and the *Great Instauration,*" in *Ambix* 22/3 (1975),163-173.

11 Rees, G., "Bacon's Philosophy: some new sources with special references to *Abecedarium novum naturae,*" in *Francis Bacon. Terminologia e fortuna nel XVII secolo*, ed. Fattori, M., Edizione Laterza Roma, 1984, 223-244; Manzo, S., *Entre el atomismo y la alquimia: la teoría de la materia en Francis Bacon*, Editorial Biblos, Buneos Aires, 2006; Doina Cristina Rusu, "From Natural History to Natural Magic: Francis Bacon's *Sylva sylvarum,*" PhD thesis, Nijmegen, 2014.

12 Rees, G., "Bacon's Philosophy," 239-40.

13 For simple motions see Bacon, F., *Novum Organum*, OFB XI, 382-417; *De augmentis scientiarum* III, chap. IV, SEH IV, 356-57; *Abecedarium novum naturae*, in *Oxford Francis Bacon XIII*, ed. Rees, G., Oxford University Press, Oxford, 2000, 190-203 (hereafter OFB XIII). For compound motions see Bacon, F., *Abecedarium novum naturae*, OFB XIII, 202-211.

14 Rees gives three meanings to "schematism": "the structure of the universe as a whole"; the "subtle, invisible events which take place in complex bodies"; and finally, the "axiological antitheses, the contrasted pairs of simple natures." Rees, G., "Bacon's Philosophy," 239-40. Manzo has argued for only two meanings: the structure of the universe and the occult structure of the particles of matter and the processes of their imperceptible motions, identifying the latter with the "appetites." Manzo, S., *Entre el atomismo*, 69.

15 Giglioni argues that natural motions result from the basic appetites of matter, the difference between the two being that appetites manifest as tendencies, while motions are "propensities through which bodies are able to feel and discriminate." See Giglioni, G., "Mastering the Appetites of Matter: Francis Bacon's *Sylva Sylvarum,*" in *The Body as Object and Instrument of Knowledge: Embodiment Empiricism in Early Modern Science*, ed. Wolfe, C.T., and Gal, O., Studies in History and Philosophy of Science, 25 (2010), 149-67, 153.

16 Bacon, F., *De augmentis scientiarum* IV, chap. III, SEH IV, 402.

17 Rees claims that vegetables, in the Baconian matter theory, are inanimate objects and possess vital spirits. Rees, G., "Bacon's Speculative Philosophy", in *The Cambridge Companion to Bacon*, ed. Peltonen, M., Cambridge University Press, Cambridge, 1996, 121–45. In my reading, plants are presented by Bacon in Century VII of *Sylva Sylvarum* as animate objects, with spirits continued and branched, apart from living creatures that, in addition to that, have their spirits enriched with cells or seats, where the spirits resides. Bacon uses the examples of intermediaries (between minerals, metals and plants, such as corals and vitriol, and between plants and animals, such as oysters) to emphasize the idea that the difference between animate and inanimate depends on the "continuity" of the spirits and on their capacity of organization. See Bacon, F., *Sylva Sylvarum*, exp. 603-604, SEH II, 529 and exp. 609, SEH II, 531.For the relation between spirits and tangible parts

of a body see Bacon, *Sylva Sylvarum*, exp. 98, SEH II, 380-2. Also *Historia densi et rari*, OFB XIII, 68-9, 136-7.

18 Bacon, F., *Sylva Sylvarum*, exp. 601, SEH II, 528.

19 Bacon, F., *Sylva Sylvarum*, exp. 601, SEH II, 528.

20 In opposition, inanimate bodies do not have a certain figure or a period of life, they do not have alimentation, but accretion and do not propagate themselves. Bacon, F., *Sylva Sylvarum*, exp. 602, SEH II, 528-9. See also exp. 603, SEH II, 529.

21 Bacon, F., *Sylva Sylvarum*, exp. 605, SEH II, 529.

22 Bacon, F., *Sylva Sylvarum*, exp. 601, SEH II, 528.

23 Bacon, F., *Sylva Sylvarum*, exp. 607, SEH II, 530.

24 By contrast, living creatures have local motion and are not fixed to the ground, they nourish from their upper parts (the mouth, especially), have their seminal parts located bellow, their figure is more exact, their organs are more diverse, have senses and voluntary motion. See Bacon, F., *Sylva Sylvarum*, exp. 607, SEH II, 530.

25 For a large discussion on the theory of appetites see Giglioni, G., "Mastering the Appetites of Matter".

26 See Bacon, F., *Sylva Sylvarum,* introduction to exp. 801, SEH II, 602-03. Also *De augmentis scientiarum* IV, chap. III, SEH IV, 402.

27 Giglioni, G., "How Bacon became Baconian," in *The Mechanization of Natural Philosophy*, ed. Garber, D., and Roux, S., Springer, Dordrecht, 2013, 27-54, on 44. Graham Rees argued that Francis Bacon's semi-Paracelsian cosmology had not been appropriated in the decades following Bacon's death. See Rees, G., "The Fate of Bacon's Cosmology in the Seventeenth Century," in *Ambix* 24/1(1977), 27-38; "Introduction" to Francis Bacon Philosophical Studies c. 1611-c. 1619, xxxvi-lxix, in *Oxford Francis Bacon VI*, ed. Rees, G., Oxford University Press, Oxford, 1996. Peter Anstey claims that, apart from Francis Glisson, Bacon's speculative philosophy and matter theory, including the theory of appetites and motions, had no followers. See Anstey, P., "D'Alembert, the 'Preliminary Discourse' and experimental philosophy," in *Intellectual History Review*, 24/4, 2014, 495-516: 504.

28 For Glisson see Giglioni, G., *The Genesis of Francis Glisson's Philosophy of Life*, PhD dissertation, Johns Hopkins University, 2002. For Austen see Matei, O., "Appetitive Matter and Perception in Ralph Austen's Projects of Natural History of Plants," in *Early Science and Medicine* 23/5-6, 2018, 530-549.

29 Austen, R., *A Dialogue, or Familiar Discours, and conference betweene the Husbandman, and Fruit-trees; in his Nurseries, Orchards, and Gardens, etc.*, Printed by Henn:Hall for Thomas Bowman, Oxford, 167[6], 7-8, 10, 37, 65. See also Matei, O., "Appetitive Matter and Perception."

30 For more evidence on collaboration and shared experiments in the mid seventeenth century see Jalobeanu, D. and Matei, O., *Treating plants as (al)*

chemical laboratories: a chemical natural history of vegetation in seventeenth century England, forthcoming.

31 Webster, C., *The Great Instauration*, Duckworth, London, 1975; "The Origins of the Royal Society," in *British Journal for the History of Science* 6 (1976): 106-28.; Webster, C., ed. *Samuel Hartlib and the Advancement of Learning*, Cambridge University Press, Cambridge,1970; Trevor-Roper, H. R., *Religion,the Reformation and social change and other essays*, Macmillan, London, 1967; Trevor-Roper, H. R., *The crisis of the seventeenth century : Religion, the Reformation, and social change*, Liberty Fund, Indianapolis, 1999.

32 For a criticism of this division see Giglioni, G., "How Bacon Became Baconian." See also Jalobeanu, D., *The Art of Experimental Natural History: Francis Bacon in Context*, Zeta Books, Bucharest, 2015.

33 Hunter, M., *Science and Society in Restoration England*, Cambridge University Press, Cambridge, 1981; Hunter M. and Wood, P. B.," Towards Solomon's House: Rival Strategies for reforming the Early Royal Society," in *History of Science*, 24/63, 1986, 49-97.

34 Sharrock, R., *The History of the Propagation and Improvement of Vegetables by the Concurrence of Art and Nature*, Printed by A. Lichfield, Oxford, 1660. For the relation between Sharrock and Boyle see Webster, C., "Water as the Ultimate Principle of Nature: The Background to Boyle's Sceptical Chymist," in *Ambix*, 13/2, 1966, 96-107.

35 Ralph, A., *A Treatise of Fruit-Trees…Whereunto is annexed Observations upon S^r^ F. Bacon's Natural History…The third impression, revised, with additions, etc.*, William Hall for Amos Curteyne, Oxford, 1665.

36 Austen, R., *Observations*, Dedication To the honourable Robert Boyle Esq. sonne to the Lord Boyle of Corke, A2.

37 Bacon, *Novum Organum*, OFB XI, 455-473.

38 Austen, R., *Observations*, To the Reader, A3.

39 For a complex discussion see Matei, O., "Reconstructing *Sylva Sylvarum*. Ralph Austen's *Observations* and the Use of Experiment," in *Journal of Early Modern Studies*, 6, 2017, 91-115.

40 See Bacon, *Sylva Sylvarum*, SEH II, 475-476 and Austen, *Observations*, 2-3.

41 See Bacon, F., *Sylva Sylvarum*, SEH II, 482 and Austen, R., *Observations*, 8-9.

42 See Hartlib, S., *Ephemerides* 1653 Part 3, [May-2 September], 28/2/62B-72A, on 28/2/66B-67A and *Ephemerides*, 1655 Part 4, [13 August-31 December], 29/5/43A-58A, on 29/5/54A, available at https://www.dhi.ac.uk/hartlib/ (hereafter HP).

43 Hunter, M., "John Evelyn in the 1650s: A Virtuoso in Quest of a Role," in *John Evelyn's "Elysium Britannicum" and European gardening*, ed. O'Malley, T. and Wolschke Bulmahm, J., Dumbarton Oaks colloquium on the history

of landscape architecture, XVII, Dumbarton Oaks Research Library and Collection, Washington DC, 1998; 79-106.

44 The book has a contemporary edition by John Ingram, Philadelphia University Press, Pennsylvania, 2001.

45 Evelyn, J., *Sylva, Or a Discourse of Forest-Trees, and the Propagation of Timber*, Jo. Martyn, London,1664). The book had three more later editions: 1670, 1679, 1706.

46 Bacon, F., *Novum Organum*, OFB XI, 465-473.

47 Bacon, F., *Novum Organum*, OFB XI, 17, 339.

48 Evelyn, J., *Sylva*, 1706, xci.

49 For a more complex interpretation of Evelyn's distinct types of natural history see Matei, O., *Merchants of light and lamps: John Evelyn's transition from natural history to the foundation of natural philosophy*, forthcoming.

50 Copy Letter in Hand H, ? To Hartlib, Undated, HP 8/22/1A-4B.

51 Copy Letter in Hand H, ? To Hartlib, Undated, HP 8/22/2B.

52 Copy Letter in Hand H, ? To Hartlib, Undated, HP 8/22/2B-3A.

53 For a similar position in Bacon see Bacon, F., *Novum Organum*, OFB XI, 465-473.

54 Copy Letter in Hand H, ? To Hartlib, Undated, HP 8/22/3A. For Bacon see Bacon, F., *Novum Organum*, OFB XI, 48-49.

Bibliography

Anstey, P., "D'Alembert, the 'Preliminary Discourse' and experimental philosophy," in *Intellectual History Review*, 24/4, 2014, 495-516.

Austen, R., *Observations upon some part of S^r Francis Bacon's Naturall History as it concerns, Fruit-trees, Fruits, and Flowers* Hall for T. Robinson, Oxford, 1658.

Austen, R., *A Treatise of Fruit-Trees…Whereunto is annexed Observations upon S^r F. Bacon's Natural History…The third impression, revised, with additions, etc.*, William Hall for Amos Curteyne, Oxford, 1665.

Austen, R., *A Dialogue, or Familiar Discours, and conference betweene the Husbandman, and Fruit-trees; in his Nurseries, Orchards, and Gardens, etc.*, Printed by Henn:Hall for Thomas Bowman, Oxford, 167[6].

Bacon, F., *Sylva Sylvarum*, William Lee, London, 1626.

Bacon, F., *Sylva Sylvarum*, in *The Works of Francis Bacon, Baron of Verulam Viscount of St. Alban, and Lord High Chancellor of England*, ed. Spedding, J., Elis, R.L., and Heath, D.D., 14 vols., London, 1857-1874 (facsimile reprint Stuttgart-Bad Cannstatt 1961-1963), vol. II.

Bacon, F., *De augmentis scientiarum*, *The Works of Francis Bacon, Baron of Verulam Viscount of St. Alban, and Lord High Chancellor of England*, ed. Spedding, J., Elis, R.L., and Heath, D.D., 14 vols., London, 1857-1874 (facsimile reprint Stuttgart-Bad Cannstatt 1961-1963), vol. IV.

Bacon, F., *Abecedarium novum naturae*, in *Oxford Francis Bacon XIII*, ed. Rees, G., Oxford University Press, Oxford, 2000.

Bacon, F., *Historia densi et rari*, in *Oxford Francis Bacon XIII*, ed. Rees, G., Oxford University Press, Oxford, 2000.

Bacon, F., *Novum Organum*, in *Oxford Francis Bacon XI*, ed. Rees, G. and Wakley, M., Oxford University Press, Oxford, 2004.

Bagliani, P., A., *Le monde végétal. Médecine, botanique, symbolique*, Edizioni Del Galluzzo, Florence, 2009.

Bellorini, C., *The World of Plants in Renaissance Tuscany: Medicine and Botany*, Routledge, New York, 2016.

Chang, H., "Beyond Case-Studies: History as Philosophy" in *Reintegrating History and Philosophy of Science*, ed. Mauskopf, S. and Schmaltz, T., Boston Studies in the Philosophy of Science 263, Springer, Dordrecht, 2011, 109-124.

Evelyn, J., *Elysium Britannicum*, ed. Ingram, J., Philadelphia University Press, Pennsylvania, 2001.

Evelyn, J., *Sylva, Or a Discourse of Forest-Trees, and the Propagation of Timber*, Jo. Martyn, London,1664; 1670; 1679; 1706.

Giglioni, G., *The Genesis of Francis Glisson's Philosophy of Life*, PhD dissertation, Johns Hopkins University, 2002.

Giglioni, G., "Mastering the Appetites of Matter: Francis Bacon's *Sylva Sylvarum*," in *The Body as Object and Instrument of Knowledge: Embodiment*

Empiricism in Early Modern Science, ed. Wolfe, C.T., and Gal, O., Studies in History and Philosophy of Science, 25, 2010.

Giglioni, G., "How Bacon became Baconian," in *The Mechanization of Natural Philosophy*, ed. Garber, D., and Roux, S., Springer, Dordrecht, 2013, 27-54.

Hartlib, S., *Ephemerides* 1653 Part 3, [May-2 September], 28/2/62B-72A, on 28/2/66B-67A and *Ephemerides*, 1655 Part 4, [13 August-31 December], 29/5/43A-58A, on 29/5/54A, available at https://www.dhi.ac.uk/hartlib/

Hunter, M., *Science and Society in Restoration England*, Cambridge University Press, Cambridge, 1981.

Hunter M. and Wood, P. B.," Towards Solomon's House: Rival Strategies for reforming the Early Royal Society," in *History of Science*, 24/63, 1986, 49-97.

Hunter, M., "John Evelyn in the 1650s: A Virtuoso in Quest of a Role," in *John Evelyn's "Elysium Britannicum" and European gardening*, ed. O'Malley, T. and Wolschke Bulmahm, J., Dumbarton Oaks colloquium on the history of landscape architecture, XVII, Dumbarton Oaks Research Library and Collection, Washington DC, 1998, 79-106.

Jalobeanu, D., *The Art of Experimental Natural History: Francis Bacon in Context*, Zeta Books, Bucharest, 2015.

Jalobeanu, D. and Matei, O., *Treating plants as (al)chemical laboratories: a chemical natural history of vegetation in seventeenth century England*, forthcoming.

Kuhn, T., *The Copernican Revolution. Planetary Astronomy in the Development of Western Thought*, Harvard University Press, Cambridge Mass.

Laroche, R., *Medical Authority and Englishwomen's Herbal Texts, 1550-1650*, Ashgate, Farnham, 2009.

Manzo, S., *Entre el atomismo y la alquimia: la teoría de la materia en Francis Bacon*, Editorial Biblos, Buneos Aires, 2006.

Matei, O., "Reconstructing *Sylva Sylvarum*. Ralph Austen's *Observations* and the Use of Experiment," in *Journal of Early Modern Studies*, 6, 2017, 91-115.

Matei, O., "Appetitive Matter and Perception in Ralph Austen's Projects of Natural History of Plants," in *Early Science and Medicine* 23/5-6, 2018, 530-549.

Matei, O., *Merchants of light and lamps: John Evelyn's transition from natural history to the foundation of natural philosophy*, forthcoming.

Meier Reeds, K., *Botany in Medieval and Renaissance Universities*, Garland, New York and London, 1991.

Sharrock, R., *The History of the Propagation and Improvement of Vegetables by the Concurrence of Art and Nature*, Printed by A. Lichfield, Oxford, 1660.

Soler, L., Lynch, M., Zwart, S.D. and Israel-Jost, V., "Epistemic activities and systems of practice: Units of analysis in philosophy of science after the practice turn," in *Science after the practice turn in the philosophy, history, and social studies of science*, ed. Soler, L., Lynch, M., Zwart, S.D. and Israel-Jost, V., Routledge, New York and London, 2014, 75-87.

Rees, G., "Francis Bacon's Semi-Paracelsian Cosmology," in *Ambix* 22/2, 1975, 81-101.

Rees, G., "Francis Bacon's Semi-Paracelsian Cosmology and the *Great Instauration,*" in *Ambix* 22/3, 1975, 163-173.

Rees, G., "The Fate of Bacon's Cosmology in the Seventeenth Century," in *Ambix* 24/1, 1977, 27-38.

Rees, G., "Bacon's Philosophy: some new sources with special references to *Abecedarium novum naturae,*" in *Francis Bacon. Terminologia e fortuna nel XVII secolo*, ed. Fattori, M., Edizione Laterza Roma, 1984, 223-244.

Rees, G., "Bacon's Speculative Philosophy", in *The Cambridge Companion to Bacon*, ed. Peltonen, M., Cambridge University Press, Cambridge, 1996, 121–45.

Rees, G., "Introduction" to Francis Bacon Philosophical Studies c. 1611-c. 1619, in *Oxford Francis Bacon VI*, ed. Rees, G., Oxford University Press, Oxford, 1996, xxxvi-lxix.

Rusu, D.C., "From Natural History to Natural Magic: Francis Bacon's *Sylva sylvarum*," PhD thesis, Nijmegen, 2014.

Trevor-Roper, H. R., *Religion, the Reformation and social change and other essays*, Macmillan, London, 1967.

Trevor-Roper, H. R., *The crisis of the seventeenth century : Religion, the Reformation, and social change*, Liberty Fund, Indianapolis, 1999.

Webster, C., "Water as the Ultimate Principle of Nature: The Background to Boyle's Sceptical Chymist," in *Ambix*, 13/2, 1966, 96-107.

Webster, C., ed. *Samuel Hartlib and the Advancement of Learning*, Cambridge University Press, Cambridge,1970.

Webster, C., *The Great Instauration*, Duckworth, London, 1975.

Webster, C., "The Origins of the Royal Society," in *British Journal for the History of Science* 6, 1976, 106-28.

Copy Letter in Hand H, ? To Hartlib, Undated, HP 8/22/1A-4B.