

# CORE EXPERIMENTS, NATURAL HISTORIES AND THE ART OF *EXPERIENTIA LITERATA*: THE MEANING OF BACONIAN EXPERIMENTATION

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**Abstract.** Experiment, as a new form of knowledge, was a Baconian creation. It was in Bacon's project of *Great Instauration* and in Bacon's reformed natural history that experiment and experimentation ceased to be illustrations of theories and become relatively autonomous devices for the production of knowledge and for setting the mind straight in its attempts to gain knowledge. This paper explores the way in which Bacon's Latin natural history transformed experiment and experimentation in such devices. More precisely, I investigate the way in which Bacon's Latin natural histories were put together from a limited number of significant experiments listed in the *Novum Organum* under the general title "instances of special power" or "instances of the lamp." Contrary to the received view, my claim is that Bacon's natural histories are based on a limited number of 'core experiments' and are generated through a specific methodological procedure known under the name of *experientia literata*. This paper is an attempt to reconstruct the procedure of putting such natural histories together and a more in-depth exploration of their epistemological and therapeutic character.

**Keywords:** experiments, natural history, experientia literata, Francis Bacon

## The puzzling nature of Francis Bacon natural histories

Natural history is in many ways a new or at least a 'reformed' form of knowledge in the early modern period.<sup>1</sup> After an initial flourishing in the Renaissance, natural history was transformed, redefined and given a new life in Francis Bacon's project for a reformation of learning.<sup>2</sup> This, at least, is the (still) canonical story. In fact, there is something deeply puzzling about the whole category of Renaissance natural history in general and about Francis Bacon's transformation of it, more particularly. Recent works have questioned the standard story, but more research is needed in order to place Francis Bacon's natural history in a more appropriate historical context.<sup>3</sup> Equally more research is needed with respect to Bacon's own writings about natural history. It is highly relevant, I think, that most

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of the contemporary evaluation of Bacon's natural history is primarily based on the textual evidence of Bacon's *Novum Organum* and the related texts of the 1620 *Instauratio Magna*. With the notable exception of Graham Rees and a handful of others,<sup>4</sup> contemporary scholars have still devoted relatively little attention and research to the Latin natural histories and other fragments where Bacon developed specific examples of natural (and experimental) histories.

Moreover, following the very influential dichotomy proposed by Thomas Kuhn in 1977, Baconian "science" was often treated dismissively as involved in the solely cumulative and rather naïve action of collecting "vast natural or experimental histories in which were amassed the miscellaneous data that many of them [Baconian 'scientists'] thought prerequisite to the construction of scientific theory."<sup>5</sup> As a result, Baconian natural histories are still seen as large enterprises, massive collections, as diverse as possible, with a purely introductory character and no theoretical structure attached to them. If Baconian scholars tend to agree on the fact that in writing natural history Francis Bacon made a clear break with the Renaissance "emblematic tradition,"<sup>6</sup> the view that pictures Baconian natural histories as storehouses of facts and observations is largely uncontested.

One of the puzzles of Baconian natural history originates in the way Bacon uses this term in his writings. In some more introductory works, - like *Parasceve*, for example - natural history is said to be a massive collection of data and facts that the human intellect stores in the memory for the purpose of building from it a reformed natural philosophy. In some other works, and especially in the Latin natural histories, "natural history" is used to designate series of experiments guided by theoretical observations and informed by Bacon's matter theory, together with the epistemological, practical and moral consequences deriving from them. Bacon also speaks of natural histories of species, containing descriptions of individuals, and natural histories of qualities, appetites, virtues and 'most general' properties of matter, describing things like 'dense and rare' or the 'sympathies and antipathies' of things or dealing in a rather theoretical fashion with the prolongation of life.<sup>7</sup> The frequency with which natural history occurs in Bacon's writings and the prominent role ascribed by Bacon to this propaedeutic basis of the reformed natural philosophy has, so far, somehow occulted its diversity of meanings.

Even if one concentrates on the sense in which Bacon employs natural history in his late Latin writings, one still has the feeling that natural history seem to be endowed with some sort of dual nature: on the one hand, it is a set of *results* emerging from a process of observation and experimentation and containing descriptions of the individual facts and phenomena of nature. On the other hand, Bacon seems to allude sometimes to the *process* of observation and experimentation itself. Moreover, this process of experimentation is in itself not clearly defined, because natural history is said to be, on the one hand, a procedure of dissecting and anatomizing the world;<sup>8</sup> and on the other hand a corrective and self-reflecting work of the mind upon itself, an attempt to set straight the inbuilt errors. It is even claimed to be the only safe or successful road open to the human intellect.<sup>9</sup>

Secondly, there are quite a few contradictions among the various statements and rules for writing a natural history Bacon developed during his lifetime and the actual project of writing natural histories he undertook throughout the last five years of his life.<sup>10</sup> In fact, we can say that the ‘problem’ of Bacon’s natural history is further complicated by the fact that Bacon wrote at least two kinds of texts dealing with natural history. On the one hand, he has a large number of methodological texts dealing with the general plan and the rules of writing natural histories *per se*.<sup>11</sup> On the other hand, he also wrote a number of specific natural histories: of winds, of dense and rare, of life and death, etc., and planned many more. From such works we can learn that the final product of natural historical research is not just a collection of facts, observations and results but a much more complex product, containing at least the description of the experimental procedures, advice and counsels, suggestions for further experimentation, provisional explanations of causes or theoretical assumptions, words of “caution” and “advice,” questions etc. (“whatever else is relevant”).<sup>12</sup>

Therefore, although it is clear that natural history played a central role in Bacon’s general program for the reformation of the human mind,<sup>13</sup> it always covered a rather diverse range of meanings and roles, of which some are still insufficiently explored. One common role one can find in all Bacon’s writings dealing with natural history, however, is the propaedeutic and therapeutic role of natural history, said to offer benefits and ‘cures’ for the diseased and idolatrous mind. The image Bacon uses in a number of writings is that of using natural history as a sort of primary material to be written on the “tables of the mind.” Unlike on a waxen table, the contents of the human mind cannot be erased without being replaced at the same time, with something else:

Nor, even if you wished to do so, could you rid yourself of idols by simply taking my advice without familiarizing yourself with nature. On waxen tablets you cannot write anything new until you rub out the old. With the mind it is not so; there you cannot rub out the old till you have written in the new.”<sup>14</sup>

In this way, natural history plays the role of a corrective and propaedeutic discipline destined to fill the mind, keep it safe (from the idolatrous tendencies of theorizing),<sup>15</sup> purify and educate it. What is a bit puzzling is, however, that natural history is not the only candidate to a therapy or for a medicine of the mind in Bacon’s writings. At best, natural history shared this role with other forms of moral and practical exercises destined to provide therapeutic devices against the diseases of the mind.<sup>16</sup> There is, however, a more precise and definite sense in which natural history alone came to play a very important moral and therapeutic role in Bacon’s mature writings. Such a meaning gained contour in Bacon’s experimental works and projects, from 1612 onwards and is amply illustrated in his late Latin natural histories. In these writings Bacon both elaborate a more sophisticated and more

theoretical conception of natural history and added to it supplementary epistemological, moral and therapeutic levels.<sup>17</sup>

There is something deeply puzzling in the way Bacon wrote, in the last five years of his life, his (Latin) natural and experimental histories. In many ways, in writing them, Bacon did not respect his own precepts as formulated in 1620, in *Parasceve*. The Latin natural histories are not vast masses of observations but, rather, interesting groups of phenomena discovered with the help of experimental, hands-on devices. They are not histories of species or individuals, but deal with ‘spirits’ and ‘qualities.’ They have an interesting structure and are obviously permeated by Bacon’s speculative philosophy<sup>18</sup> and matter-theory. Last but not least, they seem to stress the value of experimental work in settling the mind, in curing the idols, in preventing the diseases produced by any form of speculative philosophy.<sup>19</sup>

In this paper I will try to investigate some of the ways in which the medicine of the mind seems to be a recurrent topic and also to play an important role in Bacon’s Latin natural histories. I will first try to sketch a character of these natural histories, showing their complex and intricate nature and structure. I will show, using a couple of examples, how these natural histories were put together starting from a relatively small number of core experiments and how the process of generating a natural history was said to be guided by an art of thinking, the art of learned experience. On the same limited number of examples I will show in what way the process of experimentation and the learned experience seem to be intrinsically connected with a set of rules and practices for improving the senses, disciplining the passions, extending the limits of the intellect, in short, with a medicine of the mind.

### **The Latin natural histories**

My focus in this paper is on Bacon’s late natural histories, namely on the Latin natural histories planned to constitute part III of the *Instauratio magna* and to be published under the generic title *Historia naturalis et experimentalis*. The plan was grandiose: it comprised 6 topical natural histories to be published every six months. The first, *Historia ventorum* was published in 1622 under the generic name *Historia naturalis and experimentalis* with a general preface and a presentation of the whole project, a theoretical introduction, a set of rules for developing natural histories, and a list of the 6 planned natural histories with short introductions for each of them.<sup>20</sup> Only two volumes of the series were eventually printed until Bacon’s death, (in 1622 and 1623) but they are enough to see that they feature a natural history that is anything but a storehouse of facts. They are filled with theoretical speculations, observations regarding the process of experimentation, ideas for further experiments, reports taken from the ancients, critical discussions of Aristotle’s opinions and epistemological considerations about the role of experiments in general. The two volumes have a similar structure: they begin with a theoretical preface and a list of ‘topics of inquiry,’<sup>21</sup> followed by what Bacon calls ‘historia’ (observational reports, facts established through experiments, observational data

etc.). The history properly speaking contains also observations, commentaries, speculations, advice for further experimentation and other theoretical items.<sup>22</sup> Each volume ends with a list of provisional rules describing the whole domain under investigation. This structure is emphasized by the way the two volumes were printed: the printer used no less than 6 different characters to separate the various categories of items described above.

In addition to the two natural histories published in 1622 and 1623 Bacon left a number of manuscripts in English and Latin, various drafts and plans for part III of *Instauratio*. Some of them were published posthumously by Rawley following the structure and organization of the 1622/1623 volumes. I will discuss in what follows an example from one such posthumous natural history, published for the first time in 1658, namely *Historia densi et rari* (HDR).

An interesting aspect of Bacon's Latin natural histories is that they were put together, in the last 5 years of his life, from much older material. In some cases, parts of what got into the Latin natural histories were developed in the first years of the seventeenth-century. A number of extant manuscripts contain most of the experiments and some of the theoretical considerations that, repacked, will figure prominently in Bacon's *History of winds*, *History of life and death*, or *History of dense and rare*. Comparing them with the published versions of the Latin natural histories shows that Bacon was seriously interested in putting older experiments and results into a new form and structure. Each Latin natural history contains a natural history properly speaking, i.e. experiments and empirical observations, and a number of more theoretical additions called observations (*observationes*), directions (*mandata*), connexions, speculations, or incentives to practice (*vellicationes de practica*). Each of the published natural histories ends with a list of what Bacon calls provisional rules (*cannones mobiles*) which seem to be axioms of different degrees of generality.

Another interesting characteristic of these natural histories is that they seem to have been put together from a relatively limited number of experiments from which Bacon generates, through experimental variation, new cases, observations and 'facts.' In fact, one can identify in the Latin natural histories a number of experiments from which facts and results are so generated. I will call such experiments 'core experiments' and, in what follows, I will analyze three such examples, discussing the procedure Bacon employs for deriving from them other facts, experiments and results.

### **Core experiments in *Historia densi et rari***

One can see the bulk of Bacon's posthumous HDR as being basically generated from two core experiments.

#### Core experiment 1: Weighting bodies and drawing the table of densities

The first experiment is one that Bacon already devised in the first decade of the seventeenth century and incorporated into what at that time was a natural

philosophical treatise destined to unveil the structure and schematisms of matter.<sup>23</sup> It involves constructing a cube of gold weighting one ounce, and two identical cubical recipients of silver that can contain the cube of gold. Then, the cube of silver filled with the ounce of gold is weighted against the empty recipient, with the help of a balance. Subsequently, the empty silver recipient is filled with all sorts of substances. The relative weight at equal volume translates into relative densities. After repeating the weighting process with all substances that he could lay his hands on, from quicksilver to ‘common earth’ and from milk to fir wood, Bacon draws the resulting experimental fact: a long list of relative densities called “A table of the Coition and Expansion of Matter in Relation to Space in Tangible Bodies with a computation of the proportion in different bodies.”

In its published version, HDR begins with this table – presented as the experimental “fact.” This is followed by a description of the experimental procedure and a list of advice for those wanting to try the experiment themselves. Some advice is explicitly formulated in terms of instructions. Others explain the limits of experiment and formulate questions for further investigation.

The table and the whole experiment are said to be provisional, compiled “many years ago” and being therefore in need of refinement. In this way, the reader is encouraged to try it for himself, replicate, and move a step forward in the process of experimentation. When it comes to the results of the experiment, they are set down in a list of 7 observations. It is a very heterogeneous list, containing more than one category of results. The very first observation, for example, states that the experiment is important because, by showing that there is a finite variation of densities in nature (the found ratio is 32:1), it can give us *hope* that we will eventually find a place in this table for all the known substances in the universe. On the other hand, the table is provisional and unfinished and we should not assume that the “wrestling match” with nature is over. The second use of the table is to “dispel fantasies and dreams;”<sup>24</sup> one such fantasy being the Aristotelian theory of the four elements. But the experiment is said also to be able to refute common opinions (for example the common opinion that hard bodies are especially dense), or to refute common expectations (many things in the table are other than one might suppose) or to restrain and correct (*cobibenda* & *corrigenenda*) common assumptions of regularity and order in nature. The third use of the table is what we would today consider the main result of the experiment, namely the fact that we can establish quantitative approximate laws of relative densities (the maximum variation of densities on Earth is 32:1) or empirical classifications.

From these first results, Bacon moves forward to establish new questions and possibilities of varying the experiment in such a way that it is possible for the experimenter to answer them even if no final theory has been reached so far. For example, the experimenter can see that there is a gap in the table of densities between metals and stones. What is the significance of this gap? Even if a theoretical answer cannot be formulated at this stage of research, Bacon suggests that one can devise experiments constructed to inquire into the possible answers to such a

question. A similar approach is taken for another question: the table of densities is clearly open-ended at its 'light' end: how many substances lighter than fir wood can one find? The answer is obviously not a theoretical one but it is left to the experimenter to try further substances whose densities can be measured in such a way. Most of the questions thus formulated are questions that will be eventually settled by further experimentation and not by the formulation of a theory. Moreover, some of the above questions have a moral or therapeutic character; the very results of the experimentation, the questions formulated and the further experiments suggested can function as an efficient treatment against idols and diseases of the distempered mind.

After the list of observations, Bacon draws a table of what he calls incentives to practice (*vellicationes de practica*) which are extensions of the initial experiment into different uncharted territories. One such interesting extension is to see whether we can use the table to identify the relative quantities of substances in a mixture. Another extension would be to see whether on the basis of this table it is possible to make gold. As a principle, there is no reason why some substances cannot be transformed into another, by mixture. However, this is not the way to produce gold. Can a less dense metal take all the properties of gold but not the additional weight/density? Is there any other process in nature, besides mixture, that can increase the weight? Here a "new" experiment is divided which is, in fact, just a variation of the old experiment, namely to weight the same substance in different states: reduced to powder, dissolved into various things etc., inquiring into what Bacon calls "the opening of bodies." A new table is issued followed by new observations, advice and incentives to practice.

All this process of experimentation is significant on more than one level. On the one hand, it has a complex and rich theoretical structure.<sup>25</sup> On the other hand, the generation of new experiments, facts and discoveries is said to work by experimentation itself: one can generate new experiments and facts just by varying in a certain way the experimental procedure.

#### Core experiment 2: The bladder experiment

There is another interesting "core experiment" in *HDR*, also figuring in the early manuscript of *Phenomena universi*. It involves attaching a bladder to a glass phial by means of special glue (made according to Bacon's own recipe). The vial is filled with water and put on fire until the water boils and the bladder inflates. Then, Bacon tries to find out how much of the water transforms into vapors or spirits and carefully observes the process of phase transition from liquid to vapors for a number of substances including: water, wine, vinegar and various 'spirits.' Again, the experiment is repeated, conditions are varied and various observations and incentives to practice are recorded for future investigation.

The two experiments are connected, of course, at the theoretical level, by Bacon's matter theory. For Bacon, everything in the universe is either tangible or

pneumatic.<sup>26</sup> Tangible bodies are heavy and dense according to the quantity of spirits they contain, enclosed in their pores. Pneumatic bodies (spirits) are rare, and both the density and the rarity can be measured, calculated and set into tables, i.e transformed into a natural history. It is important to stress, however, that matter theory is implicit and not explicit in *HDR* and the other natural histories. There is no theory of matter separate from natural history and the relation between theory and experiment is not inductive or hypothetico-deductive. Experiments are not confirming or refuting the matter theory. Presuppositions about the nature of tangibles and pneumatics are core-presuppositions, implicit in Bacon's research programme.<sup>27</sup> For our purpose here, however, suffice it to say that the two core experiments reconstructed here are clearly part of a more complex procedure of experimentation where the methodology of varying experiments, asking questions and devising new experiments to extend the field of the initial one prove Bacon's interest in an art of experimentation that goes beyond the simple fact-gathering procedure.

Moreover, there is a connection between the two core experiments at the methodological level: the very idea of continuing the table of densities "all the way up" and the questions regarding the nature and source of density can carry us one step further, to the experiment trying to see whether we can totally transform a tangible body into a pneumatic one. The second experiment is seen as the methodological development of the first one.

Last but not least, this string of experiments has important epistemological and moral outcomes. They provide a specific preparation of the mind for the difficulties encountered in this particular road of natural historical investigation.

#### Core experiment 3 from the *History of Winds*: the tower experiment

This particular structure of extending the field of experimentation is not confined to *HDR*. In *Historia Ventorum (HV)*, Bacon's first published Latin natural history, we have a similar example of an experiment that is multiplied and complicated by variation of experimental conditions and serves to extend the field of investigation. It is less spectacular than the table of densities, but not uninteresting for that matter. It is Bacon's example of producing an artificial wind.

In a high tower, we are told, a tower without windows, we light a central fire – using a brazier with hot coals, as smoke free as possible. At a certain distance from the fire we hand a thread having in the lower part a cross of feathers. What happens is that the feathers will oscillate in the turbulence created by the hot air ascending in the tower. Then, Bacon says, we pierce a hole in the wall of the tower and we observe the bouts of heat getting out intermittently.<sup>28</sup> We have created a wind through the dilatation of the air. A wind is, in Bacon's view, the motion of vapors or spirits originating in water and moving in the air in the direction where the surrounding air is least resistant. What happens again is a process of transformation: tangible matter becomes spiritual and new spirit is added in the air.

Since there is no void anywhere in the world, such a process creates a sort of swelling and a necessary motion of the vapors and the surrounding air.

The tower experiment is taken up again, a couple of times in the HV and the conditions of the experiment are varied. Bacon replaces the brazier first with a boiling kettle, so that hot vapors are released in the enclosed tower. What happens is that the feathers are moved “more weakly and lazily.” He then uses both the brazier with burning coals and the kettle to produce both a current of hot air and a lot of vapors and, of course, the motion of the feathers is more pronounced: “such as is was sometimes rotated upwards as if by a tiny whirlwind, since the water supplied an abundance of vapor which the brazier was ready to dissipate.”<sup>29</sup>

By creating an artificial wind and varying the experiment in such a way, Bacon claims to have proven that “the main cause provoking wind motion is the overburdening of the air with added air made of vapour.”<sup>30</sup> He claims to have proven that winds are not a particular substance or a quality of the air, but simply motions of vapors originating in waters (rivers, seas and clouds) and moved around according to the varying degree of density of the surrounding air. He also claims that turbulences like the one described are not motions of one wind, but the result of meeting winds coming from different directions. Again, the experiment refutes received opinions, establishes some new and unexpected facts and leaves room for further experimentation, providing thus help for the mind in its way to knowledge. In a similar vein as the experiments quoted above, the tower experiment offers equally provisional results and requires further experimentation.

### **The art of learned experiments and generating a natural history out of a core experiment**

A natural history is constructed, I claim, from such core experiments, through what Bacon calls the art of the *literate experience* (*experientia literata*). The literate experience is one of the late additions in Bacon’s program. It is developed in *De Augmentis scientiarum*, 1623 and seems to be a response, at least in part, to Bacon’s concerns over the true method of discovery.<sup>31</sup> By contrast with all his predecessors who stumbled upon new discoveries by pure chance, Bacon proposes a special ‘help’ (instrument) to solve the problem: one of the arts of thinking, called the Art of Indication (*Ars Indicii*). This art had two parts: the learned/literate experience (*experientia literata*) and the ‘Interpretation of Nature or the New Organon.’ *De Augmentis Scientiarum* is silent as to the form of *interpretatio naturae* and the *Novum Organum* gives us a mere hint as to what Bacon had in mind. By contrast, the learned experience is described more fully.<sup>32</sup> It is an instrument through which the human intellect can proceed from one experiment to another, as if ‘led by the hand’ in the dark. With Bacon’s favorite term, the learned experience is a sort of hunt: the Hunt of Pan. Unlike the *interpretation of nature*, the learned experience proceeds from experiments and ends in other experiments; the provisional rules and hypotheses developed between two experimental stages do not rise to the status of axioms or laws/forms.<sup>33</sup> The major object of this art of indication seems to be to find and

describe ways of experiments (what Bacon also calls ‘methods of experimenting’ or ‘modos experimentandi’) and ways in which one can proceed from a set of given experiments to generate new experiments by variation, translation, inversion etc. Through such a procedure, the experimenter not only extends his field of research and the store-house of facts but also generates knowledge about the experimental procedure. The learned experience is essentially a communitarian enterprise: in practising it, the experimenter enters a larger community and shares his practices, hypotheses and questions with all the others practitioners of the literate experience.<sup>34</sup>

Literate experience is, in Bacon’s view, the instrument our mind has for the purpose of building natural histories. And, as I hope I have proved by way of example, at least in part Bacon’s Latin natural histories exemplify precepts or methods of the learned experience. They are topical natural histories, constructed around exemplar experiments or particular fruitful topics of experimentation “most weighty in respect of use, handiest on account of the abundance of experiments ... or ... the ones which present the widest range by way of example.”<sup>35</sup> Such exemplars are set “as light for the present and stimulus for future inquiry.”<sup>36</sup> What are these exemplars? At least in some cases, they are what Bacon calls *Instances of Special Powers*, labour-saving devices and other favourite ‘helps’ for the intellect and the senses, as exemplified at length in the second book of *Novum Organum*.<sup>37</sup> They are, Bacon claims, good devices for starting the natural historical inquiry. The instances of special powers as exemplified in *Novum Organum* will provide, according to Bacon, good topical natural histories *because* they are different from ordinary experimentation:

we should put together a collection of them, as a kind of particular history, right from the start because they work on what enters the intellect, and *put right the corrupt complexion of that very faculty*, which simply cannot avoid being tainted and stained, and then perverted and twisted by the daily invasion of ordinary experience.<sup>38</sup>

Some such instances offer especially fitted exemplars for building up natural histories because they “stir and raise the intellect to investigate and discover.”<sup>39</sup> The core experiments, therefore, have an interesting commerce with the mind. They are an important part of the process of disciplining the mind and extending its powers that act like a form of ‘medicining’ the mind. Such instances with potentially therapeutic effects are, therefore, at the very core Baconian natural histories.

The large part of the second book of *Novum Organum* containing the Instances of Special Powers is among the least read of Bacon’s writings.<sup>40</sup> It is a very complicated and intricate discussion and a thorough analysis of it is beyond the scope of my paper. For what concerns us here suffice it to say that there are at least two classes of such instances: those providing ‘helps’ for the intellect on the road leading to the investigation of forms and those providing ‘helps’ for the senses in

the development of the art of experimentation. The latter class is called *Instances of the Lamp*. They are devices for extending the natural powers of the senses, i.e. instruments and experiments that can render visible the invisible ‘objects’ and processes of nature.<sup>41</sup> A particular class of the Instances of the Lamp is what Bacon calls *Summonizing Instances*: experiments able to reduce the imperceptible to the perceptible. There are many examples of experiments grouped under this category that constitute core experiments for the Latin natural histories. Two we have seen already: they are the experiment leading to the table of densities and the bladder experiment. A last example will bring into our discussion the third of Bacon’s Latin natural histories to which I have not referred so far, namely *Historia vitae et mortis* (HVM) (1623).

### **Instances of the Lamp and the learned experience: how to generate a natural history**

HVM is in many ways the trickiest of the natural and experimental histories, in that it contains very little ‘experimentation’ properly speaking. Also, most of the items of Bacon’s own list of how to write a natural history are absent. Experimental set-ups are not described, experimental conditions are not specified and there are very few experiments according to any modern meaning of the term. Instead, it contains long lists of factual observations relating to possible reasons for achieving a long life (including, for example, observations of what kind of philosophy seems to be conducive to a long life), improbable recipes of medicines for the prolongation of life etc. What I would like to show in what follows, on the basis of an example from HVM, is that one can find in this natural history the same use of the *experientia literata* as in the previous examples.

In fact, a thorough reading of HVM shows that there are a good number of experiments present at the origin of Bacon’s long lists of ‘facts.’ One such experiment is taken from Bacon’s own list of the instances of the lamp, the subclass of *summoning instances*, i.e. experiments making visible the presence of spirits in tangible bodies. This experiment involves the phenomenon of desiccation. HVM gives a list of observations relating to this phenomenon, namely keeping fruits in various conditions and observing the way they behave when spirit leaves and desiccation appears. Again, desiccation is seen as an effect of the fact that the living spirit leaves the body.<sup>42</sup> As a result the body becomes porous, wrinkled etc. The list in HVM is tedious: it merely states various conditions one can create for keeping fruits over a long interval. In fact, what we have here is an abridgement of an experiment we can find in *Sylva Sylvarum* on the maturation of fruits. Bacon claims he has done the experiment and describes nicely the experimental procedure: take a number of apples and place them in various conditions, sealed in boxes, buried under ashes or buried in flour, hanging in smoke, in water, sealed in wax etc. To these, HVM adds conservatories of snow, and develops one of the suggestions of the corresponding experiment in *Sylva*. There, the experiment ended with the

suggestion to inject the skin of the apples with wine, liquours and other substances (quicksilver) just to see what happens.

What do we get from this variation of experiment? The long list ends with what Bacon calls “major observations.” Again, the experiments are said to have different kinds of results. They refute the received opinion which makes dryness a fundamental quality of nature. They show that desiccation is a universal process due to maturation and is equivalent with a loss of living spirit (the very presence of smell is, for Bacon, a proof that the spirit leaves the body). Through the loss of spirit the fruits become lighter, dryer, wrinkled etc. However, the process can be delayed by keeping them out of the air, in such cold so that the internal spirit is condensed and cooled, covered with moist or oily substances so that the pores being covered the spirit is kept in etc. All this is of course just a preliminary experiment for moving a step forward, through the art of literate experience, and to extend the domain of inquiry from inanimate bodies to animals and then to humans. The true purpose of studying the ways in which the living spirit is leaving the body is the prolongation of life. Meanwhile, the study itself is said to have the same benefits for the human mind as we have seen in the previous instances: extending the powers of the senses and intellect, offering negative results/instances beneficial for keeping the mind in check, expelling the prejudices, ‘phantasms’ and idols etc.

### **Conclusion**

In conclusion, Bacon’s late natural histories are complex objects interacting in many ways with a discipline or a medicine of the mind. Natural history is a corpus of provisional knowledge constructed around, or on the basis of special prerogative instances that are said to extend the powers of the mind, provides helps for the senses and the intellect or settle the mind. From such core experiments, the learned experience or the “*Hunt of Pan*,” a practical art, is used to generate further provisional knowledge useful both for the discipline of judgement and for practical applications. One can say, therefore, that natural history offers the materials for natural philosophy not in the sense in which timber offers materials for building a house, but rather as the letters and rules of grammar offer the basic materials for the construction of words in a language. The process of construction does not simply take place by mere addition; more complex forms of generation are at play. In order to disentangle the precise way in which *experientia literata* generates natural history, more detailed and contextual explorations are needed. For the moment, however, it is enough to point to the complexities and intricacies of the process. Moreover, it would be important to point out that natural histories so generated have important pedagogical and therapeutic consequences; they can be used for the building up of a sound mind and a good, disciplined and temperate community of researchers.

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## References

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- <sup>2</sup> Rees, G., Introduction to Bacon, F., *The Oxford Francis Bacon XII, The Instauration magna Part III: Historia naturalis et experimentalis: Historia ventorum and Historia vitae et mortis*, ed. G. Rees, M. Wakley (Oxford: Clarendon Press, 2007) (hereafter OFB XII); Findlen, P., "Francis Bacon and the Reform of Natural History in the Seventeenth Century", in *History and the Disciplines: The Reclassification of Knowledge in Early Modern Europe*, ed. D. R. Kelley (Rochester: University of Rochester Press, 1997), 239-260; Daston, L., "Baconian Facts, Academic Civility and the Prehistory of Objectivity", *Annals of scholarship* 8 (1991).
- <sup>3</sup> A number of recent works have emphasized that one should rather speak about renaissance natural histories; a diversity of contexts and sometimes genres extending from cosmography to medicine and from anatomy to mixed mathematics. See for example Pomata, G., & Siraisi, N. *Historia: Empiricism and Erudition in Early Modern Europe*, (Cambridge, Massachusetts: MIT Press, 2005) and Harkness, D., *The Jewell House: Elizabethan London and the Scientific Revolution*, (New Haven: Yale University Press, 2007). For a reconfiguration of natural history and Francis Bacon's role in it see the forthcoming Corneanu, S., Giglioni, G., and Jalobeanu D., *Francis Bacon and the Reconfiguration of Early Modern Thought*, special issue of *Early Science and Medicine* (2012).
- <sup>4</sup> Anstey, P., "Francis Bacon and the Classification of Natural History", in S. Corneanu, G. Giglioni and D. Jalobeanu, *Francis Bacon and the transfiguration of Early Modern Natural History*, *Early Science and Medicine*, 1/2012 forthcoming; Stewart, I. G., "Res veluti per machinas conficiatur: Natural History in Francis Bacon's Reform of Natural Philosophy", in S. Corneanu, G. Giglioni and D. Jalobeanu, (2012 forthcoming).
- <sup>5</sup> Kuhn, Th., "Mathematical versus experimental traditions in the development of physical science", in Kuhn, Th., *The Essential Tension: Selected Studies in Scientific Tradition and Change* (Chicago and London: Chicago University Press, 1977), 43.
- <sup>6</sup> Ashworth, W. B., "Natural history and the emblematic world-view", in *Reappraisals of the Scientific Revolution*, eds. D. Lindberg and R. Westman (Cambridge: Cambridge University Press, 1990), 303-332.
- <sup>7</sup> Jalobeanu, D., "The Philosophy of Francis Bacon's Natural History: A Research Program", *Studii de știință și cultură* 23 (2010): 18-37 (hereafter Jalobeanu 2010a); Jalobeanu, D., "From natural history to early modern science: the case of Bacon's Histories", *Analele Universității București* 60 (2010): 23-33 (hereafter Jalobeanu 2010b); Jalobeanu, D., "Francis Bacon's natural history and the Senecan Natural Histories of Early Modern Europe", in S. Corneanu, G. Giglioni and D. Jalobeanu, (2012 forthcoming).
- <sup>8</sup> "Hoc autem perfici non potest, nisi facta Mundi dissectione at que Anatomia diligentissima." Bacon, F., *Novum Organum* I, 124, *The Oxford Francis Bacon XI*, ed. G. Rees & M. Wakley (Oxford: Clarendon Press, 2004), 186 (hereafter OFB XI).
- <sup>9</sup> "For these things are neither examined nor described for their own sake, but in fact there is no other alternative open to the human intellect [sed nulla prorsus alia patet intellectui humano via] and the grounds of the work are left insecure without them. I am then certainly undertaking the most serious business of all and most worthy of the human mind, that nature's light, pure and quite unclouded by vain imagination (that light whose name has sometimes been mentioned thus far, while people have known nothing about the thing

itself) may be lit in this age of ours by a torch furnished and brought near by the Divine will.” Bacon, F., *Phenomena Universi, The Oxford Francis Bacon VI, Philosophical Studies c.1611-c.1619*, ed. G. Rees and M. Edwards (Oxford: Clarendon Press, 1996), 7 (hereafter OFB VI).

<sup>10</sup> Jalobeanu, D., (2012 forthcoming).

<sup>11</sup> *Phenomena universi* has an extended preface with this subject, *Parasceve* (Preparatives for writing a natural and experimental history) appended at the end of the 1620s *Instauratio Magna* (so following the *Novum Organum*), parts of *Descriptio globi intellectualis*, the preface to *Historia naturalis et experimentalis*, 1623 and *Norma historiae praesentis* from the same volume.

<sup>12</sup> *HVM*, OFB XII, 245.

<sup>13</sup> This propaedeutic and therapeutic role of natural history is prominent in *Redargutio philosophiarum*, *Temporis partus masculus* and *Cogitata et visa*, all works composed before 1610. See for example Farrington, B., *The Philosophy of Francis Bacon* (Chicago: University of Chicago Press, 1966), 108-9.

<sup>14</sup> TPM, Farrington, B., (1966), 72. The same image and sometimes the same expressions are used in *Redargutio philosophiarum*, NO etc.

<sup>15</sup> See the preface to *Historia naturalis et experimentalis*. See also Jalobeanu, D., (2010a); (2010b).

<sup>16</sup> Jalobeanu, D., “Bacon’s Brotherhood and its classical sources”, in *Philosophies of technology: Francis Bacon and his contemporaries*, ed. C. Zittel, G. Engel, R. Nanni and N. C. Karafyllis *Intersections* 11 (2008), Brill, vol I, 197-231; Jalobeanu, D., (2010c); Corneanu, S., *Regimens of the Mind: Boyle, Locke and the Early Modern Cultura Animi Tradition* (Chicago: University of Chicago Press, 2011 forthcoming).

<sup>17</sup> Jalobeanu, D., (2010b); (2010c); (2012 forthcoming).

<sup>18</sup> Rees, G., “Bacon’s Speculative Philosophy”, in *Cambridge Companion to Bacon*, ed. M. Peltonen (Cambridge: Cambridge University Press, 1996).

<sup>19</sup> Jalobeanu, D., (2010a); (2010c); (2012 forthcoming).

<sup>20</sup> History of the winds, history of dense and rare, history of gravity and levity, history of the sympathy and antipathy of things, a history of the sulfur, mercury and salt and a history of life and death. Of these, only two appeared in print according to plan: *Historia ventorum*, and *Historia vitae et mortis*. The *Historia densi et rari* appeared posthumously, published by Rawley in 1658. The others are either lost or unwritten.

<sup>21</sup> The 1620 *Parasceve* indicates that a natural history should begin with questions that will prompt and encourage further investigation. Bacon, F., *Novum Organum*, OFB XI, 467-9. In the later *Norma historiae praesentis* (1622) the beginning of a natural history is more systematic. We don’t have just questions, but “particular topics or articles of inquiry” said to function as both “light for the present and stimulus for further inquiry.” These are supplemented by questions destined to set problems in front of the reader. Bacon, F., *Norma historiae praesentis*, OFB XII, 15.

<sup>22</sup> These are “mandata” or directions for experiments, what Bacon claims to be “history in embryo”; explanations of the experimental procedures; “monita”/advice and “cautions about the fallacies of things and the errors and snags which may crop up in the course of inquiring and discovering so that all specters can as far as possible be driven off as if by exorcism”; observations on the history and observations on the experiments i.e. theoretical speculations on the meaning, structure and importance of results, which Bacon claims are destined “to make the interpretation of nature readier.” Other theoretical items are “commentationes” i.e. speculations on the “interpretation of causes” and what Bacon calls “incentives to practice” which are indications and suggestions for “attention” and “memory”

addressed to the readers that might want to continue the natural historical enterprise. See Bacon, F., *Historia ventorum*, OFB XII, 15.

<sup>23</sup> Bacon, F., *Phenomena Universi*, OFB VI.

<sup>24</sup> „Nemo iatque expatietur, nemo fingat aut somniet.” Bacon, F., *Norma historiae praesentis*, OFB XII, 48.

<sup>25</sup> Jalobeanu, D., (2010a); (2010b).

<sup>26</sup> Rees, G., (2007); (1996).

<sup>27</sup> Jalobeanu, D., (2010b).

<sup>28</sup> Bacon, F., *Historia ventorum*, OFB XII, 70-1.

<sup>29</sup> Bacon, F., *Historia ventorum*, OFB XII, 83.

<sup>30</sup> Bacon, F., *Historia ventorum*, OFB XII, 83.

<sup>31</sup> Jalobeanu, D., (2010b). There are relatively few treatments in the secondary literature on Bacon’s experientia literata, most notably by Jardine, L., “*Experientia Literata* or *Novum Organum*? The Dilemma of Bacon’s Scientific Method”, in *Francis Bacon’s Legacy of Texts*, ed. W. A. Sessions (New York, 1990), 47-67; Lewis, R., “A kind of sagacity: Francis Bacon, the *Ars Memoriae* and the Pursuit of Natural Knowledge”, *Intellectual History Review* 19 (2009): 155-175 and Weeks, S., “The Role of Mechanics in Francis Bacon’s ‘Great Instauration’”, in *Philosophies of Technology: Francis Bacon and his Contemporaries*, eds. C. Zittel, G. Engel, R. Nanni and N. C. Karafyllis (Boston: Brill, 2008), 2 vols., vol.1, 133-197. See also Georgescu’s paper in this issue.

<sup>32</sup> Bacon warns the reader that his description is no more than a “shadow” of this art, so another unfinished project. Bacon, F., *De augmentis scientiarum*, in Bacon, F., *The Works of Francis Bacon* ed. by J. Spedding, R. Ellis and D. Heath (New York: Garrett Press, 1968) IV, 413; I, 623-4 (hereafter SEH).

<sup>33</sup> “None of these however extend so far as to the invention of any axiom. For all transition from experiments to axioms or from axioms to experiments belong to that other part, relating to the *New Organon*.” Bacon, F., *De augmentis scientiarum*, SEH IV, 413; SEH I, 623-4.

<sup>34</sup> “Of these things it may be said generally, that the best chance of bringing down as from heaven a shower of inventions at once useful and new, is to bring within the knowledge of one man, or a few who may sharpen one another by conference, the experiments of a number of mechanical arts; that by this translation (as I call it) of experiments the arts may mutually cherish and as it were kindle one another by mixture of rays. For though the rational method of inquiry by the *Organon* promises far greater things in the end, yet this sagacity proceeding by Learned Experience will in the meantime present mankind with a number of inventions which lie near at hand, and scatter them like the donatives that used to be thrown among the people.” Bacon, F., *De augmentis scientiarum*, SEH IV, 417; SEH I, 628-9.

<sup>35</sup> Bacon, F., *Norma historiae praesentis*, OFB XII, 15.

<sup>36</sup> Bacon, F., *Norma historiae praesentis*, OFB XII, 15.

<sup>37</sup> In *Parasceve* Bacon suggests that constructing a *History of Arts* should begin by selecting Instances with Special Powers. Bacon, F., *Novum Organum*, OFB XI, 465.

<sup>38</sup> Bacon, F., *Novum Organum*, OFB XI, 307.

<sup>39</sup> In the cases of the “Instances of Power” or “Fascies,” see Bacon, F., *Novum Organum*, OFB XI, 301.

<sup>40</sup> See the discussion in Graham Rees’ Introduction in Bacon, F., *Novum Organum*, OFB XI.

<sup>41</sup> “Of these five *Instances of the Lamp*, the first ones strengthen, enlarge and correct the immediate actions of the sense; the second reduce the imperceptible to the perceptible; the third show up the continued processes or successive stages of those events and motions which generally go unnoticed except when they finish or reach the end of a cycle; the fourth provide substitutes for the sense when it fails altogether; the fifth attract the attention and notice of the sense, and the same time limit the subtlety of things.” Bacon, F., *Novum Organum*, OFB XI, 342-3.

<sup>42</sup> This example also appears in HDR.