From natural history to early modern science: the case of Bacon's “histories”

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FROM NATURAL HISTORY TO EARLY MODERN SCIENCE:
THE CASE OF BACON’S “HISTORIES”

DANA JALOBEANU

Francis Bacon’s natural history has been a longstanding subject of debate among the historians of early modern philosophy. Both his claim that science (i.e. natural philosophy) should be build on natural histories and the very nature of the latter have been the subject of heated debates. Recently, no less than three different contextual interpretations have been put forward by Graham Rees, Paula Findlend and Deborah Harkness. They all address the question of the specificity of Bacon’s natural history in the context of Renaissance natural history, characterizing in different manners Bacon’s transformation and appropriation of the natural historical tradition (or discipline). In my paper I address the same issue from less contextual perspective. I try to make sense of Bacon’s natural histories as the ultimate product of Bacon’s research programme. I claim that, for Bacon, natural history has a complex theoretical structure, an associated methodology and a set of norms and values associated with the professional study of nature.

Keywords: natural history, natural philosophy, research programme, Francis Bacon.

Natural history is one of Bacon’s major legacies to seventeenth century (and to the rest of us). In terms of the widespread popularity of his books, as a model for collaborative research and as the first step into the proper study of nature, Baconian natural history outshined Bacon’s natural philosophy or the discourse on scientific method. The posthumous *Sylva Sylvarum*, or *Natural history in ten centuries* went through 14 editions in English, two translations in Latin and one translation in French until the end of the seventeenth century. It was a major source of inspiration of the “new” experimental philosophy. It was emulated, continued, read as a research project or as the proper way of doing (and writing about) science². Bacon’s more topical and more carefully drafted

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1 A large number of suggested experiments or queries from Sylva constituted serious working material for the Royal Society in its first years. See THOMAS BIRCH, *History of the Royal Society*, vol. I: 45, 163, vol. II, 71, vol. IV, 46. R. A. AUSTEN, *Observations Upon Some Part of Sir Francis Bacons Natural History As it Concerns Fruit Trees, Fruits and Flowers: Especially the Fifth, Sixth and Seventh Centuries, Improving the Experiments Mentioned, to the Best Advantage*, Oxford, 1665 – it’s a book developed out of Bacon’s experiments and suggested observations in Century IV.

2 Robert Boyle, *Certain Physiological Essays*, 1669: “I must inform you that many of the particulars which we are now considering, were in my fist Design collected in order to a continuation of the Lord Verulam’s *Sylva Sylvarum* or Natural History. And that my intended
natural histories (of the winds, of dense and rare, of life and death) had a certain amount of popularity as well, enough to be translated into English and published a number of times until the end of the century. To the modern eye, such a phenomenon can easily be seen as one of the peculiarities of the early modern world. Such texts are enormous, difficult to read, full of digressions and references, quite packed with second-hand material and observations taken out of the ancient sources and, frankly speaking, quite useless.

They nevertheless imposed a new paradigm of scientific research within the Royal Society: a new stile of writing and a model of collaborative research, new methods and new values. The natural histories had also a very important pedagogical aspect. Doing natural history was seen as the first necessary step for the apprentice in the long road towards natural philosophy and the explanation of nature. Doing natural history was part of the discipline of the natural philosopher and soon became a part of the discipline of natural philosophy.

How did this happen?

Natural history was not a Baconian invention. It was a self-standing, growing corpus of knowledge at the end of the sixteenth century, a humanist discipline born out of philological, philosophical and cultural interests. It had its own community and its own rules, quite distinct from the community and rules of the philosophers.

Recent scholarship has questioned the way in which Bacon was influenced by and transformed the tradition of natural history. Paula Findlen has

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Centuries might resemble his, to which they were to be annexed, it was exquisite that such kind of Experiments and Observations as we have been newly speaking of, should make up a considerable part of them. (ROBERT BOYLE, Works, 1999, vol. II, 17)

All references to Bacon’s works will be to one of the two editions still in use as the “standard edition”, namely J. SPEDDING R. ELLIS, D. HEATH, The life and works of Francis Bacon, reprint, Thoemmes Press, 1999, quoted hereby as WFB followed by the volume number and the page, and the new edition still in print, having Graham Rees as a general editor and referred to as The Oxford Francis Bacon and quoted here as OFB followed by the volume number and page.

The disciplinary status of natural history was both questioned and re-affirmed recently, according to what was considered as the major set of characteristic forming a discipline. Natural history was not part of the university curriculum in Bacon’s time (although it would start to be taught in some European universities already at the end of the sixteenth century) but it already had a number of unifying disciplinary features: a community of practitioners, a common tradition, methods and rules, a growing specialized terminology. In the meantime it was too vast in scope and definition to have a canon of texts or a specific set of problems and for obvious reasons it never had textbooks. It was encyclopaedic and philological in appearance and was often presented as non-disciplinary knowledge used mainly to satisfy the curiosity of the rich. It also had the appeal of the new, its non-specialized content make it a very good introduction into a more vast program of exploring nature, and it was a field of public and collaborative knowledge. For a number of recent discussions see PAULA FINDLEN, “Francis Bacon and the Reform of Natural History in Seventeenth Century”, in D. Kelley, History and the Disciplines, 1999; BRIAN OGILVIE, “Natural History, Ethics and Physico-Theology”, in G. Pomata, N. Siraisi, Historia: Empiricism and Erudition in Early Modern Europe, Cambridge, Cambridge University Press, 2005, 75-103; The Science of Describing: Natural History in Renaissance Europe, Chicago University Press, 2006.
described Bacon’s attempts to “discipline” natural history (to reform its purpose, get rid of its humanist traits and make it a discipline properly speaking).  

Graham Rees described Bacon’s version of natural history as a clear break with the tradition: the end of the erudite, humanist natural history, the replacement of the old reading of the book of nature with a new one (introductory, pedagogical, like a child learning the alphabet). On the other camp, Deborah Harkness went at great length to show that Bacon did not really change the tradition, but borrowed from it, sometimes in a quite illegitimate manner, putting at work in his philosophical and political program things that were already well developed in the discipline of natural history around 1600: the empirical and observational approach to nature, the collaborative aspects of the work, the emphasis on usefulness of knowledge and on setting minimal goals to it. Despite their differences, all these authors agree on the fact that Bacon not only transformed natural history but, by placing it in a different disciplinary context, used it in a completely novel fashion. He was said to have merely reduced natural history to a storehouse of materials for induction, transforming it from a self-standing discipline to a handmaid to philosophy.

In this paper I will try to offer an alternative answer. I will show that for Bacon natural history was not meant to be only a storehouse of materials for the natural philosophers but a much more complex object, containing, in fact, the major elements of a new “paradigm”. Natural history was a discipline built upon a core theory (Bacon’s theory of matter), contained an attached methodology for knowledge production, preservation and transmission. Natural history was in many ways a preparative discipline, containing norms of acquisition of knowledge but also moral and practical norms for the self-reformation and the reformation of the proposed philosophical community.

1. **What Is Natural History? The Place of the Discipline in the Tree of Knowledge**

For Bacon, natural history is an important part of the tree of knowledge, a part corresponding to one of the tree faculties of the human intellect: memory. Again and again, Bacon stresses the complete character of his division: there are only three faculties of the intellect leading to knowledge: memory, imagination.

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5 Findlen starts from the premise that natural history was not a discipline in sixteenth century and had not yet developed a strong tradition, especially in England. Bacon took the model of the humanist natural history (ancient?) and reform it so that it can play the role of a disciplinary basis for natural philosophy. Disciplining natural history meant “narrowing the enterprise, making natural history a proper “history” of nature rather than a repository of the encyclopaedic imagination; without it, the natural philosopher could not recognize the true laws of nature. It also dignified natural history by making it a nobler enterprise.” (PAULA FINDLEN, *op. cit.*, 242).
and reason, and three branches of learning corresponding accordingly: history, poesy and philosophy.

<table>
<thead>
<tr>
<th>DISCIPLINE</th>
<th>OBJECT</th>
<th>CORRESPONDING FACULTY</th>
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<tbody>
<tr>
<td>Natural history</td>
<td>EXPERIENCE i.e.</td>
<td>Memory</td>
</tr>
<tr>
<td></td>
<td>Individuals/species</td>
<td></td>
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<tr>
<td></td>
<td>- individuals as members of a species</td>
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<tr>
<td></td>
<td>- distinct individuals (monsters)</td>
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<tr>
<td>Poesy</td>
<td>Individuals</td>
<td>Imagination</td>
</tr>
<tr>
<td></td>
<td>- invented in the imitation of the individuals of history</td>
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<tr>
<td></td>
<td>- exceeds the measure of nature</td>
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<tr>
<td>Philosophy</td>
<td>SCIENTIA</td>
<td>Reason</td>
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<td>Universals (&quot;philosophy discards individuals&quot;)</td>
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<tr>
<td></td>
<td>Abstract notions derived from the impressions</td>
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<td>Composition and division of abstract notions</td>
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<td></td>
<td>“according to the law of nature and fact”</td>
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<td></td>
<td>(WFB, IV, 292)</td>
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<tr>
<td></td>
<td>Arts and sciences (WFB, V, 504) – whatever was digested by the mind into general notions</td>
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Natural history is, therefore, a natural introduction to natural philosophy, simply because this is how the intellect works: memory being the storehouse of materials for the workings of reason.

That these things are so, may be easily seen by observing the commencements of the intellectual process. The sense, which is the door of the intellect, is affected by individuals only. The images of those individuals – that is the impressions which they make on the sense – fix themselves in the memory, and pass into the first instance entire as it were, just as they come. These human mind proceeds to review and ruminate; and thereupon either simply rehearses them, or makes fanciful imitations of them, or analyses and classifies them. Wherefore from these three fountains, Memory, Imagination, and Reason, flow these three emanations, History, Poesy, and Philosophy; and there can be no others. For I consider history and experience to be the same thing, as also philosophy and the sciences. (WFB, IV, 292-293)

There is a subsequent theory of knowledge at work here: the images of individuals received by the sense and fixed in the memory and then compounded by the imagination or reason:

Then the mind recalls and reviews them, and (which is its proper office) compounds and divides the parts of which they consist. For the several individuals have something in common one with another, and again something different and manifold. Now this composition and division is either according to the pleasure of the mind, or according to the nature of things as it exists in fact. If it be according to the pleasure of the mind, and these parts are arbitrarily
transposed into the likeness of some individual, it is the work of the imagination; which not being bound by any law and necessity of nature or matter, may join things which are never found together in nature and separate things which in nature are never found apart… If on the other hand these same parts of individuals are compounded and divided according to the evidence of things, and as they really show themselves in nature, or at least appear to each man’s comprehension to show themselves, this is the office of reason… (WFB, 503-504).

In this context, (natural) history is the first step to knowledge and, in the same time, a discipline and way of training of the mind:

History is properly concerned with individuals; the impressions whereof are the first and most ancient guests of the human mind, and areas the primary material of knowledge. With these individuals and this material the human mind perpetually exercises itself, and sometimes sports. For all knowledge is the exercise and work of the mind, so poesy may be regarded as its sport. In philosophy the mind is bound to things; in poesy is released from that bond, and wanders forth, and feigns what it pleases. (WFB, V, 503)

Natural history can be further divided according to its scope/end, into a sort of narrative natural history, a storehouse of curiosities and facts that can be used in itself, as a source of knowledge, or what he calls an inductive natural history, the “primary matter”, or the “solid and eternal basis” of natural philosophy:

<table>
<thead>
<tr>
<th>Narrative natural history</th>
<th>Used for the knowledge of the things themselves</th>
<th>Extant – but full of fables</th>
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<tbody>
<tr>
<td>Inductive natural history</td>
<td>The primary matter of philosophy, The nursing mother of philosophy (WFB, IV, 298)</td>
<td>wanting</td>
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<tr>
<td></td>
<td>The noblest end of natural history (WFB, V, 507) – a solid and eternal basis of the true and active philosophy</td>
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The second type of natural history is, of course, what Bacon needs to construct; without it the natural philosophy would be impossible:

Now the noblest end of natural history is this; to be the stuff and matter of true and lawful induction; and to draw forth from the sense enough to inform the intellect. For that other kind which aim either to please by the agreeableness of the narrative, or to help by the use of experiments, and is pursued for the sake of such pleasure or such profit, is an inferior thing, and in its very kind of less value, than that which is qualified to be a proper preparative for the building up of philosophy. For this is that natural history which constitutes a solid and eternal basis of true and active philosophy; this it is which gives the first spark to the pure and real light of nature; and whose genius being neglected and not propitiated, has caused us to be visited most unhappily by that host of spectres and kingdom of shadows which we see fitting about among the philosophies, afflicting them with utter bareness with respect to works. (WFB, V, 507-8)

However, a narrative natural history is, we are told, also important, although, arguably, less “noble” than the “stuff and matter of true induction”. It
is important because, if collected properly, offers a good training of the mind. It is also important because we need to correct the extant natural histories, full of fables and fancies, more like “a treasure house of eloquence rather than a solid narrative of facts” (WFB, V, 508).

For I well know that a natural history is extant, large in its bulk, pleasing in its variety, curious often in its diligence; but yet weed of its fables, antiquities, quotations, idle controversies, philology and ornaments (which are more fitted for the table talk and the noctes of learned men than for the instauration of philosophy), and it will shrink into a small compass. Certainly it is very different from that kind of history which I have in view. (WFB, IV, 299)

In most of his later writings Bacon complains that he is forced to gather raw materials for the construction of his *Instauratio magna* instead of being in charge of designing the building. However, he explains that he is obliged to do so; otherwise, people will continue to gather natural histories in the “old way”, wandering hopelessly away from the true design. He stresses once and again that there is a new kind of natural history he has in mind. And no advance in natural philosophy can ever be made without this new kind of natural history.

Natural history is no mere storehouse of facts. On the contrary, it is a complex object, a wide-ranging discipline “of the scale of the universe”. Its structure and composition should follow the very states/condition in which Nature can exist: free, constrained, or “wandering away” from its regular course. The results are long lists of natural histories divided in three kinds: histories of generations (nature free), histories of pretergenerations or monsters (nature driven out of her course), and mechanical and experimental histories (nature subject to constraints).

However, all these natural histories should not be treated separately; there are interconnected, constituting a methodological unity.

Bacon claims that natural histories should present the intellect with “bare facts”, simple reports, no pleasant stories, no superstitions, simple language and no philological references. Taking such claims for good, numerous authors have considered that we have here a fair break with the humanist discipline of natural history. In fact, things are a bit more nuanced, as usual. Bacon’s natural history has many humanist features: it is largely based on second-hand reports.

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6 “But the main point of the whole accusation against natural history is that men have gone astray not only in the work, but in its very plan. For the natural history which is in existence seems to have been composed either for the usefulness of the experiments themselves, or for the agreeableness of their narratives, and to have been made for their own sake, not so as to furnish the makings of philosophy and the sciences and as it were breast-feed them” (OFB VI, 5).

7 “Perhaps others too will be moved by my example, especially when they have fully appreciated what I am up to. For in a good and solidly constructed *Natural history* lie the keys both to knowledge and to works” (OFB, XII, 5).

8 See for example *Parasceve*. OfB XIII. See also GRAHAM REES introduction to OFB XIII and his claim that Bacon’s natural history is: “the end of erudition”.
from the ancients, interspersed with personal observations and experiments. It is not more selective or critical than Pliny, an author whom Bacon praises for initiating the genre. The difference lies somewhere else: the kind of natural history advocated here permanently seen as the very first step of a longer and continuous route to knowledge leading from the observation of bare facts to formulating queries and hypotheses, to the testing or imagining tests for the latter and then to the next stage, the inductive way into natural philosophy. The same gradual ascent is clear in the very division of natural history by subject of study: the study of nature should follow the constitution and order of the world. The *history of generations* begins with a history of the ether or the celestial zone, continues with a history of meteors and the regions of the air (including things like comets), follows a history of the earth and sea and then the history of the “elements” (great masses of connatural bodies) and “species”. There is also a kind of intermediate natural history advocated by Bacon as the medium term between natural history properly speaking and natural philosophy. It is the natural history of qualities or virtues: dense, rare, light, heavy, hot, cold etc., or a history of motions (*Descriptio Globi Intellectualis*, WFB V, 510).

So much for the plan: little was completed from this long list. However, from the little that was completed, we can see a number of very interesting features of the “new” natural history, most of them linking this new discipline closely together with Bacon’s projected natural philosophy.

### 2. Natural History As a Discipline

Before moving forward it is worth having a brief look of natural history as a discipline before Bacon. At the time Bacon confiscated it for the purpose of his own Instauratio magna, natural history was already a well established corpus of knowledge in early modern Europe, having its own practitioners, a well established tradition, methods of exploration and specialized language. In many ways too vast to be a discipline properly speaking, in the second part of the sixteenth century, it developed, however, a serious disciplinary outlook. Although claiming ancient sources, it was mainly a humanist discipline, an invention of the sixteenth century’s humanist preoccupations with inventing traditions. As so many other humanist disciplines, was “forged in the library, with the bibliographic tools of the scholar”. It mainly arouse from humanist debates over the accuracy of the ancient sources. However, it gradually developed into a “new” discipline, based on facts. For such a change to be

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9 Ogilvie, 2006.

possible, a whole set of new techniques and beliefs had to replace the traditional framework and especially the belief that no real knowledge can follow the study of particulars. Brian Ogilvie describes in his recent book the shift of attitude taking place in the 16th century and promoting the attentive study of the world in an altered epistemological framework attaching value to individual facts. What happened was the gradual evolving of a science of describing. The humanist naturalists had a purpose of establishing a catalogue of nature to complete and correct the ancient natural histories. In the process, they eventually created a new discipline: developing new habits of observation, a new vocabulary, a new “sensibility, or *habitus*” i.e. not merely a set of methods or techniques; it involved a long process of self-discipline that, if successful, produced an experienced naturalist whose judgment would be accepted by his peers”\(^\text{11}\). As its “mother” history, natural history had a strongly developed moral side. The study of nature was both the study of Creation and a way of disciplining the mind (senses, memory, intellect) in its dealings with nature.

Therefore, natural history has begun as a philological discipline, evolved into a mixed discipline based on comparisons of book descriptions with specimens of the real world to eventually develop into a thorough and detailed study of nature. It was much of a self-contained discipline, with a different tradition and different practices than those associated with natural philosophy. Unlike natural philosophy, natural history did not require specialized knowledge to participate; it addressed the curiosity of the learned or the curiosity of the wealthy. It was much of an outside discipline, developed independently of the school learning. For both these reasons it appealed to a public situated outside the traditional “professional” circles\(^\text{12}\). It did no provide knowledge properly speaking but was rather addressing the curiosity and inquisitiveness of any interested mind. And it also provided a preliminary kind of cognitive and moral training, a pleasant and worthy way of learning and working, of putting one’s mind in accord to the beautiful design of nature.

3. Bacon’s Transformation of Natural History. Natural History and Natural Philosophy

In Bacon’s general scheme, however, natural history has a much more ambitious task to play. First of all, it is not self-sufficient, but mere introductive into the larger field of natural philosophy. Second, it is a discipline of the philosophers or those aspiring to knowledge. It aims at training the memory but

\(^\text{11}\) Ogilvie, 2006, 140.

equally well it aims at educating the mind. More important, however, it is the structure and composition at play in Bacon’s natural history.

**The Theoretical Structure Behind Natural History**

One of Bacon’s numerous methodological texts, *Descriptio globi intellectualis*, begins with the partition of knowledge only to transform into a description of what natural history should be and ends with a long description of the way one can gather together a natural history of the heavens. Bacon advocates a history of celestial zone that contains “bare facts”, separated from all dogmas of astronomy and in fact beginning anew with “naked observations”. Bacon emphasize that he is not interested in astronomy (reduced to the ability of calculus and prediction) but in philosophy:

> such a philosophy that inform the human understanding, not only of the motion of the heavenly bodies and the period of that motion, but likewise of their substance, various qualities, powers and influences, according to natural traditions; and again such as may discover and explain in the motion itself, not what is accordant with the phenomena, but what is found in nature herself, and is actually and really true. (WFB, V, 511)

A history of phenomena (of the heavens) should therefore be kept pure and simple, not “tinctured with the dogma” (WFB, V, 512). Instead, it should organise under the common headings and under the same umbrella, phenomena previously belonging to separate sciences: astronomy (mixed mathematics), physics, alchemy. Bacon insists there is no ontological separation between the sublunary and the celestial world (WFB, V, 512).

For those supposed divorces between ethereal and sublunary things seem to me but figments, superstitions mixed with rashness; seeing it is most certain that very many effects, as of expansion, contraction, impression, cession, collection into masses, attraction, repulsion, assimilation, union, and the like, have place not only here with us, but also in the heights of the heaven and the depths of the earth. Nor have we any more faithful interpreters to consult, in order that the human understanding may penetrate the depths of the earth, which are never seen at all, and the heights of the heaven, which are for the most part seen untruly. (DGI, 512)

In fact, a history of the heavens is a thorough observation of the “common passions and desires of matter in both globes”(WFB, V, 512). And here we are already in the purely theoretical field of Bacon’s theory of matter: the passions and appetites/desires of matter are the hidden forces of nature responsible for the formation of all individuals in the universe. Charting those passions raises natural history far above the level of being a storehouse of facts. In fact, gathering together a thorough history of the heavens, an organised chart of the
passions and desires of matter in the celestial and terrestrial globe is already presented as a first step into discovering the secrets of nature: a complete chart of the passions and appetites will give us not only a description of the world but power over the forms of matter.

What we have here is a very good example of Bacon’s ambitious plan for a history of nature that is not a catalogue of the observed, but a thorough investigation of the (mainly) invisible processes and forces of nature. A history of the heavens is not a catalogue of the positions of stars in the sky. Instead, it is a charting of the motions and appetites that can coexist in the matter (celestial or sublunary).

However, the development of a history of the heavens is still at the level of project, one of Bacon’s published histories, *Historia Densi et rar* deploys most clearly a whole theoretical structure and an elaborated theory of matter underlying the observations and experiments. It begins with a law of general conservation of matter in the universe (OFB XIII, 39) and it is on the basis of this law of conservation that Bacon measures and classifies densities of natural objects in the hope of making a complete list (a table of all possible variations of densities/specific weights that exist in nature). An experiment is devised and performed to help the construction of the table. Equal volumes of very different substances are weighted on a balance (placed into two silver cubes, well polished and of equal weight and volume) and the result is recorded into a “table of relative densities”\(^{13}\). The table is followed by a careful explanation of the way the experiment was done and an interpretation of results. Then further experiments and trials are suggested, followed by a table of observations of epistemological and methodological character. Interestingly enough, the first of these observations concerns the uses of the devised experiment not for the factual increase of knowledge, but for the settling and training of the mind.

It does the mind a power of good to see how finite and comprehensible is the nature of things in tangible bodies. For the table gets to grips with nature as if in a wrestling match. Let no one therefore go astray or go in for fictions or dreams. In the Table we kind no being that exceeds any other in quantity of matter by a proportion of more than 32 to 1; for by so much does gold exceed fir wood. But of the entrails of the Earth we can decide nothing since they are subject neither to sense nor experiment. These, since they are both further off and in that case quite removed from the heat of the heavenly bodies, could be denser than any body known to us. (OFB, XII, 49)

The following observations raise epistemological questions: is the table complete? What kind of conclusion can we draw from that? Is there a maximum ratio of weight/density? Only for observable/terrestrial things, and even so, Bacon does not exclude that there are bodies even more dense than those subject to experiment so far, or even more dense than gold, but that have not been observed so far. A

\(^{13}\) The standard measure of weight is pure gold, “the standard of bulk to which I would relate the weights of other bodies”, XII, 45.
number of hypotheses are put forward for further experimentation: that the source of density is in the bowels of the earth, that loadstone, having a density between metal and stone is a “metallic stone” (OFB XIII, 51). A list of trials and experiments to be made are given under the name “incentive to practice”. And all this experimental chapter is followed, surprisingly, by a speculation upon the nature of matter and spirits (pneumaticals), a detailed theory of pneumatical things and further directions for the trial, hypotheses and incentives to practice.

A Baconian natural history, therefore, is far from being a mere repository of facts, a catalogue of bare observations. It is a complex and intricate object, more like a research programme, a composite writing bustling with ideas, hypotheses, lists of trials to be made, speculations, metaphysical or methodological principles to direct further investigation.

In the preface to the first volume of his Natural and experimental history (a planned 6 volumes set of histories, only 2 of which were however published during Bacon’s lifetime, the Historia densi et rari, and Historia ventorum), writing a natural history is said to have the following components:

1. history and experiments (organized or not in tables)
2. directions for future experiments
3. explanations
4. advices and cautions
5. observations
6. speculations
7. rules
8. incentives to practice

It is a complex methodological structure not unlike that of a modern research programme. In order to carry it out, a whole structured research group is necessary, a group aggregated around common values and norms, most clearly formulated by Bacon’s in his celebrated scientific utopia, the New Atlantis\(^\text{14}\).