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CICLO XXV

THE METHODS OF NATURAL INQUIRY DURING THE SIXTEENTH-CENTURY: BARTOLOMEO MARANTA AND FERRANTE IMPERATO

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Abstract

The present dissertation focuses on the examination of the methods of natural inquiry during the sixteenth-century. The historico-epistemological analysis of the different methodologies, which naturalists used to read the book of nature, shows that natural history, medicine, and alchemy were closely interconnected during the sixteenth-century. How did the naturalist thinkers justify and validate their knowledge? The present dissertation answers this question by means of two relevant historical examples of the pharmaceutical domain: Maranta's theriac and Imperato's philosophical medicine. They both show the way in which experience and authority actually interacted within the naturalistic discourse of the sixteenth-century. In other words, the dissertation shows how experience aided naturalist philosophers to interpret correctly authorities and vice versa; more importantly, it shows under which circumstances experience could dethrone authority. In this manner, one can understand how the methods of natural inquiry justify and validate the pharmaceutical agenda of the sixteenth-century.

Riassunto

La tesi in questione è incentrata sull'esame dei metodi di indagine naturale durante il XVI secolo. L'analisi storico-epistemologica delle diverse metodologie, che i naturalisti utilizzavano per la lettura del libro della natura, rivela il nesso fondamentale che la storia naturale, la medicina, e l'alchimia hanno avuto nel corso del Cinquecento. Come facevano i naturalisti a giustificare e confermare la loro conoscenza? La tesi risponde a questa domanda mediante due importanti esempi storici dell'ambito farmaceutico: la triaca di Maranta e la medicina filosofica di Imperato. Entrambi mostrano il modo in cui l'esperienza e l'autorità interagivano di fatto all'interno del discorso naturalistico del XVI secolo. In altre parole, la tesi mostra come l'esperienza aiutava i naturalisti ad interpretare correttamente le autorità e viceversa, e -ancora più importante- indica in quali circostanze l'esperienza poteva detronizzare l'autorità. In questo modo, è possibile comprendere come i metodi di indagine naturale giustificavano e convalidavano il programma farmaceutico del XVI secolo.

Prologue

This dissertation focuses in the scientific methods used by the sixteenth-century naturalists for inquiring nature, particularly within the domain of medicine. Generally, neither the historians of science nor of philosophy give a full and detailed account of the key role that medicine played in the development of scientific knowledge during the Renaissance. Usually, the discoveries in physiology and anatomy are the most emphasized. However, the scope of medicine was wider, and its essential goal was healing diseases. The elaboration of medicines was a vital medical agenda. It required not only the knowledge of simples, that is, medicinal plants, minerals, and animal parts, but also the artificial processes for actually made them. The former knowledge was provided by the natural historian and the latter by the chemist. Therefore, natural history, medicine, and chemistry were closely interconnected during the sixteenth-century. Two naturalists of the sixteenth-century, namely, Maranta and Imperato, a physician and an apothecary respectively, would constitute the two concrete historical cases for analyzing the naturalists' methods and its interaction, particularly in the interdisciplinary domain of pharmaceutics.

Historians of science have recently reevaluated the role that medicine played during the Renaissance as well as its interactions with natural philosophy from diverse points of view.[1] By doing so, they have showed the debt that modern science has with medicine. This dissertation humbly extends the new historical accounts of medicine within the doctrinal renewal of the Renaissance to the domain of pharmaceutics. Particularly, it will tackled the elaboration of compound multi-medicaments—real or

[1] For example, Mammola gives an account of the interaction between philosophy and medicine from the point of view of the status of medical knowledge (cfr. Mammola, 2012); and Rinaldi shows the importance of emphasizing the role of the theoretical debate and the practices of the transmission of medical knowledge during Renaissance form the point of view of schematisms and other diagrammatical devices (cfr. Rinaldi, 2007).

imaginary—carried on by Maranta and Imperato under the methods and the epistemological criteria endorsed by the philosophical frameworks of their time. In this manner, by means of two very concrete examples, this research contributes showing the heritage that modern science inherited from the sixteenth-century pharmaceutical and methodological approaches for inquiring nature.

The multi-medicaments that we are going to expose have been very controversial since its invention to our times: the theriac, a compound drug that virtually could cure every sort of disease; and the philosopher's stone, which was an elixir of life and rejuvenation. These drugs cannot be seen today as authentic products of a scientific inquiry. However, this was not the case during the sixteenth-century. As we will show, both multi-medicaments were completely justified by the natural knowledge of the times. Engage in an alchemical quest for the philosophers' stone cannot be regarded as an irrational and superstitious activity during the Renaissance. The Major Work surely was controversial, but according to the state of knowledge of the sixteenth-century it was feasible. We do not have to forget that during the Renaissance both the Copernican system and the Alchemical Art were heretic and persecuted by the Church. In other words, if we expect to find a scientific agenda, practice, and knowledge akin to nowadays natural science we will be disappointed. The problems that the naturalists of the sixteenth-century were trying to solve as well as their methods and criteria of truth have to be understood under their own historical context.

There was a complex interrelationship of continuities and discontinuities among natural philosophy, natural history, medicine, chemistry, hermetical philosophy, and hermetical practice during the sixteenth-century. Therefore, all the dimensions that were involved in the quest for natural knowledge and its practical applications were interacting in diverse ways among each other. The knowledge diffusion, the theoretical discourse, the erudite philosophers, the artificers, the laboratory tests by means of experimentation and its industrious applications, and so on, all them were harmonically intermingled in many ways. Consequently, rigid dichotomies cannot be applied to the sixteenth-century naturalists, who were very eclectic in the quest of natural truth. They resorted to diverse authorities, traditions, and practices according to their needs, beliefs, and their own experience as well as their judgment.

The dissertation is structured in three parts. The first part deals with the subject of sixteenth-century methods. It is composed of two chapters in which the methodological traditions inherited by the sixteenth-century naturalists are addressed as

well as the new natural methodologies that were developed by them. In addition, the relationships between medicine and natural philosophy as well as its institutional status are considered. The idea is to offer a general picture of the methodological panorama of the sixteenth-century.

The second part presents the particular case of Maranta and his theriac's recipe. It is composed of three chapters. Firstly, the theriac antidote is historically contextualized. Secondly, it is considered Maranta's methodological approach for making theriac. The problems involved in the production of theriac, and the way in which Maranta solves them are exposed by means of relevant examples. Finally, the disputes about theriac are treated, being its efficacy an issue still controverted.

The third and final part presents the alchemical framework of Imperato's *Natural History*. It is divided also in three chapters. This part is more difficult to digest from our current scientific standards. Firstly, it is considered the relationship that existed among natural magic, medicine, and natural history during the sixteenth-century. Secondly, alchemy is explained and historically contextualized. Finally, the alchemy of Imperato is exposed by means of some artificial remedies that he teaches to make; being the philosopher stone, the culmination of the natural agenda of his time.

Part I. Natural Sciences and its methods in the sixteenth century

Introduction

This part is focused on presenting and understanding the natural sciences of the sixteenth century as well as its scientific methods. A very brief semantical analysis will show that Renaissance philosophers understood differently ‘science’ and ‘method’ than nowadays. Modern science was being under construction, there was not a consensus of scientific criteria, and methodologies for inquiring nature. Furthermore, a proper definition of science itself was missing. Thus, if we expect to find during the sixteenth century a unanimous and well defined scientific methodology for natural sciences or philosophies, we will be disappointed, especially concerning the Renaissance medicine and its associated natural philosophical branches. The account of method of the natural philosophers of the sixteenth-century is unfamiliar to us. The scientific vein, which we regard as scientific according to our current criteria, was integrated within the framework of the Renaissance art colleges, “[o]ne would hardly look for a doctrine of experimentation in a treatise on grammar or rhetoric, yet these Renaissance students were naturally as much, if not more, concerned with these arts as they were with the science of astronomy, and with the methods successfully employed in their

cultivation."[1] However, a leading intellectual enterprise of the time was the search for a fruitful method for acquiring a practical and useful knowledge, and a line of thought went from the rhetorician's art of persuasion to experience.[2] Many prestigious philosophers enrolled in such a quest settling the seeds of what would become the future methods of natural sciences.

However, during the sixteenth-century, Renaissance philosophers concerned with studying natural things with the fervent desire of acquiring a practical and useful knowledge of nature also engaged and developed techniques, practices, and activities that today we could be regarded as methods of natural scientific inquiry, even if they cannot be matched with nowadays methodologies. This section also treats these sorts of practices which were carried on by the sixteenth-century naturalists. Even if it cannot be denied that these new methodologies were based in the more orthodox methodological authorities, they were innovative enough to go out of the traditional approaches of questioning nature that sixteenth-century natural philosophers have inherited form their precursors.

[1] Gilbert, 1960: p.xxi.
[2] Cfr. Randall, 1940: pp.177-178.

Chapter 1. The methodological traditions and meanings of 'method' during the sixteenth-century

1.1. Science as *ars*

The term 'science' acquired its current meaning in the nineteenth century. It was William Whewell who coined the term 'scientist' to refer to the cultivators of science, such as the mathematician, the physicist, or the naturalist.[3] Before this time scientists used to call themselves 'natural philosophers,' because they viewed themselves as cultivators of the branch of philosophy in charge of inquiring nature.

Renaissance philosophers of the sixteenth century distinguished 'science' from 'art' not by its content or subject-mater but by its degree of *certainty*: they called 'science' to the knowledge followed *necessarily* from unquestioned premises, as Aristotle preached.[4] The sixteenth-century physician Janus Cornarious (1500-1558) explains why medicine is not a science in his *Medicina, sive Medicus, Liber… De rectis medicinae studijs amplectendis* (1556):

> Se infatti […] come vuole Aristotele, abbiamo scienza (*scientia*) di tutte quelle cose che reputiamo non possano essere diverse da come sono, e se la scienza è un abito dimostrativo (*habitus demonstrativus*) o una conoscenza conveniente, ferma e immutabile secondo ragione (*cognitio congrua, & firma, & a ratione immutabilis*), certamente nella medicina non troviamo nulla di tutto ciò.[5]

Therefore, from an epistemological point of view, science represented the highest level of certainty for them. For instance, when the theory of numbers (geometry and arithmetic) or the theory of harmony (astronomy and music) was applied to the celestial appearances, the gained knowledge was regarded as 'science,' or at least "[…] as

[3] Cfr. Whewell, 1840: p.cxiii. Whewell introduced for the first time the term 'scientist' in a review of Mary Somerville's *On the Connexion of the Physical Sciences* in 1834.
[4] Cfr. Wightman, 1972: p.19.
[5] Cornarious quoted by Mammola, 2012: p.113.

approximating most closely to the true nature of 'science'."[6] Otherwise, the level of certainty would decrease; for example, when the theory of numbers or the theory of harmony was applied to the sublunary sphere. Also the science of eternal relationships of form and magnitude, i.e., mathematics, was widely applied to solve a vast and diverse scope of practical human problems that went from navigation and gunnery to astrological prognostication. The majority of mathematical books published during this period testify an eagerly cultivation of diverse mathematical applications, which were considered ancient and 'lost' arts that the philosophers of the sixteenth century were 'reviving.'[7]

From the point of view of the Aristotelian cosmology, which was the official scientific framework used by the natural philosophers during the sixteenth century, knowledge about the realm of the 'coming-to-be' and 'passing-away' had an inferior epistemological status that the one of the realm of the 'changeless heavenly spheres.' [8] Therefore, natural philosophical studies concerned with the motion, composition and transformation of singular and particular sublunary phenomena were regarded as arts rather than sciences.

In the sixteenth century, natural philosophy embraced a cluster of disciplines which today could be regarded as geology, biology, botany, zoology, chemistry, and physics. However, the scope, goals, theories and practices of sixteenth century natural philosophy cannot be perfectly matched with nowadays natural sciences even if they overlap sometimes. Furthermore, some sixteenth natural philosophy disciplines, such as botany, became autonomous by the end of the sixteenth century and others like zoology were just emerging.[9]

The study of nature during the sixteenth century involved the inquiry about among its subjects the generation and corruption of all natural objects: the animated, such as the vegetative beings (plants) and the sensitive beings (animals); and the inanimated, such as the minerals and fossils (which many natural philosophers of the period considered animated). Rational beings were the object of study of medicine, a discipline entirely autonomous but not independent of natural philosophy issues during the sixteenth century.

[6] Wightman, 1972: p.19.
[7] Cfr. Wightman, 1962: pp. 82-83.
[8] Cfr. *Ivi.* p.5; p.19; pp.80-81.
[9] Cfr. *Ivi.* p.84.

1.2. Medicine and natural philosophy

The contents of both disciplines medicine and natural philosophy overlapped during and prior to the sixteenth century without loosing their distinct identities.[10] For example, studying animals was very important from a medical point of view. Human beings got ill by ingesting poison animals or by being bitten by them. And also they were cured by the medicinal virtues of animal parts. The same goes for the study of plants: knowing their healing virtues as well as their venomous properties was an important medical issue that also was a matter of life or dead during the sixteenth century. Furthermore, the Galenian medical theory, which was the hegemonic doctrine within the university milieu of the sixteenth century, was based in herbal remedies.[11] Therefore, the degree of specialization in the knowledge about plants or 'simples,' as were called the medicaments that come directly from nature, generated the creation of the first permanent chair in 'simples' in 1533 at the university of Padua.[12] The medical interests in the healing qualities of plants have given birth to a new autonomous discipline for the centuries to come.

The close link between medicine and natural philosophy during the Renaissance has its roots in the medieval period as the meaning of 'physician' (i.e. expert on medical matters) testifies.[13] It was during the twelfth century that *physica* "[…] came to refer to both the learning and the practices associated with rational medicine."[14] Previously, for example, at the beginning of the medieval age, Isidore of Sevilla defined *physica* as "the investigation of nature" consisting in searching "the causes of heaven and the power of natural things."[15] The physicians claimed that their discipline was superior to philosophy and other disciplines because philosophy was a necessary condition to exercise it brilliantly. The humanist physician Giovanni Mainardi (1462-1536) thought that the introduction of philosophical issues to medicine detour it from its goal; physicians instead of the healing were becoming masters of argumentation.[16] However,

[10] See Bylebyl, 1990: p.16.
[11] Galen therapeutics are addressed in Cortés' *Historia Antigua de la Medicina* (Cfr. Cortés: 2007: pp.115-185).
[12] Cfr. Findlen, 1994: p.253.
[13] According to Siraisi, the physician (*physicus*) refer to "[…] someone who had advanced medical education and some acquaintance with natural philosophy (*physica*);" but in its "[…] vernacular equivalent was also used more loosely to distinguish a practitioner of general internal medicine (also called "*physica*", or physic) from a surgeon." (Siraisi, 1990: 21)
[14] Bylebyl 1990: p.16.
[15] Isidore Sevilla quoted by Bylebyl 1990: p.24.
[16] Cfr. Mammola, 2012: p.126.

Mainardi could not deny that philosophy along with all the liberal arts were a necessary condition for learning medicine:

> […] è necessario che quanti desiderano apprenderla [medicina], come ora è scritta, conoscano bene tutte le arti liberali e l'intera filosofia: e questo sebbene in sé e per sé la medicina sia da considerare un'arte e non propiamente una scienza.[17]

Medicine encompassed natural philosophy, and thus it was a superior discipline. Not all agreed in seeing medicine superior to philosophy or any other discipline. Not only natural philosophers but also intellectuals since the late medieval attacked the physician intention of crowning medicine as the queen of Arts, living philosophy and other arts just as its slaves. For example, in the XIV century, the father of humanism, Petrarca, urged to the physician: "Resta al tuo posto e non sconfinare fuori dal tuo campo."[18] Petrarca was against regarding superior medicine to rhetoric, and as he claims is the opposite way:

> Fai il tuo mestiere meccanico, ti prego, se ci riesci; cura i corpi se puoi, e altrimenti uccidi e fatti pagare la mercede del tuo delitto… Ma come potresti osare con inaudito sacrilegio di subordinare la retorica alla medicina, la padrona alla serva, un'arte liberale a un'arte meccanica?[19]

And in the sixteenth-century Zabarella agreed with Petrarca but he put forward sharper and more sophisticated arguments. Without entering in the complexity of his argumentation, Zabarella claimed that medicine was inferior to philosophy, because it was, as all physicians accepted, an art and not a science. Its aim was to cure sick people, and for achieving this goal, medicine needed to consult natural philosophy who knows the causes of diseases.[20] Therefore, Zabarella did not neglect the tight bound that existed between medicine and philosophy, he only view things from a different perspective.

The clear demarcation between art and science was an important and polemic problem which was fought from medieval times till the sixteenth-century.[21] However, the role that medicine institutionally played since the thirteenth-century shows how medicine acquired a very important status within the traditional curriculum during the late medieval and Renaissance universities of all Europe. In the sixteenth century the

[17] Mainardi quoted by Mammola, 2012: p.127.
[18] Petrarca quoted by Mammola 2012, p.25; Cfr. Garin, 2000: pp.25-31.
[19] Petrarca quoted by Garin, 2000, p.32.
[20] Cfr. Mammola, 2012: pp. 223-240.
[21] Mammola gives a scholarly and detail account of the status of medicine in his book *La ragione e l'incertezza* (2012).

role, interrelation and status of both disciplines was clearly demarcated. Philosophy formed part of the *trivium* (Grammar, Rhetoric, Philosophy), which along with the *quadrivium* (Arithmetic, Geometry, Astronomy, Music) composed the traditional curriculum imparted in the College of Arts. Medicine was studied in the College of Medicine, which along with the Colleges of Theology, and Laws (Canon and Civil), form part of the Higher Colleges in which students could continue their academic formation.[22] The institutional organization reflected the sixteenth-century's ultimate practical values: the salvation of the soul, a just law for the common good, and the human health. Institutionally medicine overcame philosophy, rhetoric, grammar, arithmetic, geometry, astronomy and music.[23] This fact had an enormous impact in the scientific culture of the sixteenth century as well as in the history of sciences, because universities, with their queen of natural philosophy, were greatly leading the development of natural knowledge.[24]

1.3. Universities and medicine

During the sixteenth century, as well as in previous centuries, medical training could be learned with different degrees of intellectualization and sophistication.[25] There was the possibility to become apprentice of some medical guild, such as the apothecary or the surgeon guilds, and eventually became a member of the guild. The guilds had the power to give formal qualifications to their candidates by examination.[26] However, the highest and more prestigious medical education was given by the universities. The university graduates of the College of Medicine not only had followed the curriculum of the College of Arts but also known Latin and Greek. Literacy, in those times, denoted social and intellectual status. Universities during the sixteenth century were leading the

[22] According to Siraisi, the specific curricula could change conforming to the university but the general picture was the same in all of them: "[…] medicine was one of three higher colleges, the others being law (canon and civil) and theology, the study of all of which, at least, in principle, followed training in liberal arts. Not all three higher faculties were present in all universities; for example, Bologna and Padua lacked theological faculties until the 1360s […]." (Siraisi, 1990: p.65)

[23] The supremacy of theology never was doubted. Instead the problem of supremacy between medicine and law was a debated problem (cfr. Mammola, 2012: pp.60-69).

[24] Rashdall gives an exhaustive account of medieval universities curricula and institutional organization in his three volumes of *The Universities of Europe in the Middle Ages* (2010). In the chapter two of the first volume he addressed in detail the role of medicine within the university from the twelfth century to Renaissance (cfr. Rashdall, 2010: pp.233-271).

[25] At the end, as Siraisi claims, all sorts of medical training shared a common medical culture (cfr. Siraisi, 1990: p.23).

[26] Cfr. Stendardo, 2001: pp.15-17.

development of scientific knowledge, and the Higher College of Medicine played an active role.

The paramount example is the University of Padua which size, importance, and fame flourished enormously during the fifteenth and sixteenth centuries. The rename of Padua's College of Medicine goes back to the thirteenth century with Pietro d'Abano, who was one of the prestigious figures of medical history. Since then, and up to Renaissance, Padua's College of Medicine was very well known for its academic excellence. Padua contested with the medical colleges of other important universities of that epoch, such as Bologna, Ferrara, Montpellier, and Paris. By the mid-fifteenth-century Padua had the greatest number of students and medical degrees.[27] And through out the sixteenth century Padua achieved the most prominent university of all Europe as the head of the scientific development of their century. Famous figures of Renaissance have studied or/and taught at Padua: Nicholas of Cusa, Giovanni Pico della Mirandola, Nicholas Copernicus, Andrea Vesalius, Gabriele Falloppio, Girolamo Fabrici d'Acquapendente, Pietro Pomponazzi, Bernardino Telesio, Jacopo Zabarella, Galileo Galilei, and many many more. Historians of science like J. H. Randall and Butterfield regarded the University of Padua as the most important cultural and scientific center of Renaissance. It was the meeting point where the ideas of all Europe collided producing all kind of innovations:

> What Paris had been in the thirteenth century, what Oxford and Paris together had been in the fourteenth, Padua became in the fifteenth: the center in which ideas from all Europe were combined into an organized and cumulative body of knowledge. […]Padua remained to the days of Galileo the leading scientific school of Europe, the stronghold of the Aristotelian qualitative physics, and the trainer even of those who were to break with it. Cusanus, Peurbach, Regiomontanus, Copernicus, as well as the Italians, all studied at Padua.[28]

The Botanic Garden and its famous Anatomical Theatre stand as clear evidence of the prominent role in the development of knowledge that the University of Padua played in the sixteenth century. Butterfield claims that Padua University is without doubt the only place which can be regarded as "the seat of the scientific revolution".[29] In addition to the works of Copernicus and Galileo, Butterfield support his thesis in the

[27] Cfr. Siraisi, 1990: pp.55-56; pp.62-64.
[28] Randall, 1940: pp.182-183, p.184.
[29] Butterfield, 1965: p.59.

fact that "the medical students and the medical university of Padua were ahead of most other people in their regard for experiment […]."[30]

In the sixteenth century, the College of Medicine of the University of Padua counted with prestigious professors of surgery, astrology, botany, and natural philosophy, and of practical and theoretical medicine.[31] The basic curriculum was based on Hippocrates and Galen treatises of medicine, such as *Aphorisms* and *Prognostics* of the former and *Ars parva* of the later; the Arabic commentators of Galen, such as *Isagoge* of Johannitius and the *Canon of Medicine* of Avicenna; and many medieval practical treatises on diagnostic through pulse and urine.[32] In addition, the eager desire to improve drugs lead not only to incorporate the herbalist knowledge of Dioscorides and Theophrastus to the college curriculum but also to extend their activities from the library to the botanic garden and the field, as we will show. Their interest were not reduced to catalogue and describe plants but also to inquiry about their generation and corruption.[33] Without doubt the development of botany during the sixteenth century came from the medical colleges, as the medical college of Padua testifies. The same happened with the case of zoology, physiology and in revolutionary degree with anatomy. After all, the physicians of the twelfth century were right subordinating philosophy to medicine, which scope, theories, and practices were wider enough to be reduced only to healing therapeutics.

1.4. 'Method' understood as compendium

Throughout the sixteenth-century compendia and epitomes appeared as excellent media to recapitulate briefly, clearly, and accurately the relevant ideas stated by the authors. They embodied the humanistic quest for innovative forms of discourse as opposed to the scholastic commentaries based on the linear discourse and focused in understanding a text by analyzing it phrase by phrase.[34] For example, Andreas Vesalius applied in a novel way the iconographic use of the schematisms, which were already extensively used as pedagogical tools due to its mnemonic virtues since medieval times, when publishing his own compendium of his *Fabrica* in 1543. He presented anatomic

[30] *Ivi.* p.92. According to Butterfield, "[t]he ancients had practised dissection, and Galen, besides dissecting animals, had studied human skeletons, and made experiments on living creatures. In fact, it as from Galen that the medical students,—in a university like that of Padua, for example—had learned to be in advance of other scientists in their general attitude to experiment." (Butterfield, 1965: p.53)
[31] Cfr. Siraisi, 1990: p.4.
[32] Cfr. *Ivi.* p.58.
[33] Cfr. Wightman, 1972: pp.84, p.148.
[34] Cfr. Rinaldi, 2008: pp.25-28.

knowledge in a descriptive and analytical way by means of tables and engravings of the body in a very innovative fashion. Instead of using engravings, tables, schematic devices, and other printing technologies of the body as a means of merely illustrating the linear narrative of the anatomical knowledge (as they were traditionally used in the scholastic books), he used them as inquisitive anatomical instruments in the formulation of anatomical problems. Vesalio's particular style of iconographic representation of anatomical knowledge introduced the demonstrative character of the figurative dimension in which anatomical data were represented.[35]

The anatomical developments that Vesalius achieved during the sixteenth-century were not laden of any mathematical form, such as the approach Galileo was using to examine the motion of bodies. Vesalio was just dissecting the human body to observe it, as Galen certainly would advise him to proceed.[36] Today, we regarded this procedure as a method of anatomical inquiring. And indeed it was, since times of Galen, nevertheless in the sixteenth century the term 'method' didn't refer to such kind of procedures. For them the meaning of 'method' was "[…] a short cut to knowledge, or a short art or *compendium*."[37] The elaboration of compendia required to be done with *methodus*. In this way the correct order of exposition or explication of a subject would be clear and easy to understand. Without doubt Vesalius used the diagrammatic apparatus of his time in a new original way, settling a new method which would be paradigmatic for addressing anatomy. The anatomic compendia of the mid-sixteenth century followed the Vesalian manner, such as the *Medicae syntaxes* of the Flemish Johann Jakob Wecker published in 1562 and reprinted thrice; the *Externarum et internarum principalium humani corporis partium tabulae* of the Dutchman Volcher Coiter published in 1572; or *De corporis humani structura et usu* of Felix Platter published in 1583.[38]

The methodological innovation of Vesalius is not so outstanding when viewing at its intellectual milieu. The tables and other synoptic devices were extensively used in

[35] Cfr. *Ivi.* p.32, p.40.
[36] Cfr. Gilbert, 1963: xiii-xix. Nutton claims that Vesalius' rediscovery of Galen's methods demolished Galen's authority: "Paradoxically, the overthrow of Galenism in the Renaissance was due precisely to the rediscovery of Galen's methods by Vesalius […]. The medical scholars of the first half of the 16th century had returned to reading Galen in the original Greek. They emphasized his superiority over his later interpreters, stressing his learning and the centrality of anatomy in his view of medicine. Vesalius, while openly contemptuous of Galen, followed his advice and methodology to produce a new anatomy of the human body." (Nutton, 2002: p.801)
[37] Gilbert, 1963: p. 60.
[38] Cfr. Rinaldi, 2008: p.113, p.119, p.131.

universities. For example, the French Loys Vasse privileged diagrammatic schematism over the traditional scholastic linear narrative when transmitting Galenian anatomical issues in a simple, clear and brief way published his anatomical tables *In anatomen corporis humani, tabulae quatuor* (1540-1541).[39] Also the natural philosophers, such as Mercati, Cesalpino, and Aldrovandi, used synoptic tables for showing briefly the order of knowledge through the relationships among the different parts of nature and of knowledge.[40]

The University of Padua, the most prominent university of the sixteenth century, was not an exception but the leading institution regarding method issues. As a matter of fact it played a key role in given birth to the modern scientific method:

> For three centuries the natural philosophers of the school of Padua, in fruitful commerce with the physicians of its medical College, devoted themselves to criticizing and expanding this conception and method [i.e., the idea of an experimentally grounded and mathematically formulated science of nature], and to grounding it firmly in the careful analysis of experience. It left their hands with a refinement and precision of statement which the seventeenth century scientists who used it did not surpass in all their careful investigation of method.[41]

According to J. H. Randall, Galileo's methodology represents the culmination of these three hundreds years of critically addressing the subject of method at the College of Medicine at Padua:

> For three hundred years, after Pietro d'Abano brought the problems to the fore, the Paduan medical teachers were driven by their texts, especially Galen, to a careful analysis of scientific procedure. […] It is possible to trace step by step in rather beautiful fashion the gradual elaboration of the Aristotelian method, in the light of the medical tradition, from its firsts discussion in Pietro d'Abano to its completed statement in the logical controversies of Zabarella, in which it reaches the form familiar in Galileo and the seventeenth-century scientist.[42]

During the three hundred years mentioned by Randall, philosophers, logicians, physicians and rhetoricians not only from Padua but from all over the European world were involved tackling the questions raised by the problem of method. They were embedded by different traditions. Even if all of them regarded valuable the problem of method, they had different conceptions of it, which usually were an eclectic selection

[39] Cfr. *Ivi.* p.64, pp.105-108.
[40] Cfr. Findlen, 1994: pp.60-61.
[41] Randall, 1940: pp.178, brackets: p.177.
[42] *Ivi.* p.184.

based on the classical authorities over method, being the most influential Aristotle and Galen.[43]

According to Gilbert, the wide range of questions to be considered under the general heading of method by the sixteenth century intellectuals were three: "how the arts and sciences were first found, how they were 'disposed' or presented, and how they were demonstrated."[44] J. H. Randall's excel exposition of the Medical College of Padua account of method falls precisely under the demonstration question; whereas Rinaldi's scholarly account of the diagrammatic apparatus used by physicians during the sixteenth-century has to do with the disposal or presentation aspect of the method. Both historiographical accounts (i.e., Randall's and Rinaldi's) focused in the extreme poles or categories of the Renaissance methodology, namely, the 'scientific method' and the 'artistic method' respectively.[45] The 'scientific method' was concerned with the "criteria of demonstrative procedure," and the 'artistic method' with "the teaching of the arts."[46] Aristotle was the father of the first methodological tradition and Socrates of the second. To understand the Renaissance methodologies and meanings of 'method,' it is necessary to survey the two different traditions and "meanings" of method inherited by the sixteenth century thinkers.

1. 5. Socrates and the tradition of artistic method: compendium

According to its etymology 'method' means 'following after' (meta- 'after' + hodos 'a traveling, way'); and, according to Gilbert, the philosophical use of 'method' was made for first time by Plato in his *Phaedrus* (265d-277c).[47] Socrates is discussing with Phaedrus "how and from whom is the truly rhetorical and persuasive art to be acquired?"[48] According to Socrates, it is the method which allows the rhetorician to acquire, usefully exercise, and eventually successfully teach his art: "he will not be able to speak by the method of art, so far as speech can be controlled by method, either for purposes of instruction or of persuasion."[49] 'What is this method?' Phaedrus asked

[43] Cfr. Gilbert, 1963: p.xiii.
[44] *Ivi.* p.xxv.
[45] The two categories are coined by Gilbert whose working hypothesis consists precisely in approaching the entire discussion over method by means of oversimplifying its complexity by settling a useful dichotomy (Cfr. Gilbert, 1963: p.xxv).
[46] Gilbert, 1963: p.xxv.
[47] Cfr. *Ivi.* p.40.
[48] *Phaedrus* 269d.
[49] *Ivi.* 277b.

Socrates,[50] and the problem of the 'artistic method' was born, because Socrates believed the same method for acquiring, exercising, and teaching rhetoric could be extrapolated to other useful arts:

> The method of the art of healing is much the same as that of rhetoric. […] In both cases you must analyze a nature, in one that of the body and in the other that of the soul, if you are to proceed in a scientific manner, not merely by practice and routine, to impart health and strength to the body by prescribing medicine and diet, or by proper discourses and training to give to the soul the desired belief and virtue.[51]

Ultimately, Socrates will answer Phaedrus' question saying that it is the "dialecticians" method, that is, the men who are "[…] able to see things that can naturally be collected into one and divided into many."[52] The dialectical method identify and divide or analyze the scattered particulars of a subject and bring them together in one idea or definition without breaking their natural links repeatedly until gaining knowledge. This procedure is exemplified by Socrates through the *Phaedrus*' passages (and other Platonic dialogues), but could be briefly read in his account of method with the rhetorician's example:

> A man must know the truth about all the particular things of which he speaks or writes, and must be able to define everything separately; then when he has defined them, he must know how to divide them by classes until further division is impossible; and in the same way he must understand the nature of the soul, must find out the class of speech adapted to each nature, and must arrange and adorn his discourse accordingly, offering to the complex soul elaborate and harmonious discourses, and simple talks to the simple soul. Until he has attained to all this, he will not be able to speak by the method of art, so far as speech can be controlled by method, either for purposes of instruction or of persuasion. This has been taught by our whole preceding discussion.[53]

The dialectical method[54] would be rigorously analyzed and discussed in the centuries to come, but Gilbert claims that essentially it would remain the same:

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[50] *Ivi.* 271c.
[51] *Ivi.* 270b.
[52] *Ivi.* 266c.
[53] *Ivi.* 277a-c.
[54] Gilbert clarifies us that in later "[…] Greek thought *method* in the singular will refer to Art, and especially to the peculiarly Greek art of dialectic and *methods* in the plural to the dialectical devices so beloved of Socrates. The methods can be applied to the "material" or subject matter of any art, and when so prosecuted result in a particular art of method. […] Only in dialectic do *method* and *methods* merge and become confused. In other arts the method is the result of the *methods* of dialectic. […] This latter identification is not made explicitly by Plato, nor by Aristotle, who retained the dialectical sense of method in the singular and virtually discarded the methods in the plural." (Gilbert, 1963: p.6)

> […] the basic pattern of division—that of determining the end of an art, then analyzing the different parts and functions with a view to evaluating their relative merits and functions in respect to that end—prevail[ed], in recognizable fashion, through many changes of detail and language.[55]

Taking Socrates' analysis as starting point, the Stoics defined the notion of an art as a "[…] set of precepts exercised together toward some end useful in life."[56] This definition of art became culturally widely known. For example, the rhetorician Lucian of Samosata (c. AD 125 – after AD 180) used it in his satirical *Parasite* when Tychiades is trying to demonstrate Simon that sponging is an art:

> Tyc. Well, what is Art? Of course you know that?
> Si. Quite well.
> Tyc. Out with it, then, as you know.
> Si. An art, as I once heard a wise man say, is a body of perceptions regularly employed for some useful purpose in human life.
> Tyc. And he was quite right.
> Si. So, if sponging has all these marks, it must be an art?[57]

The medieval thinkers inherited the Stoic conception of art as a system of precepts or rules to acquire an art,[58] but they also thought that these rules not only have to allow someone to learn an art, but to learned it fast and easily. We could say that the problem of Socrates was redefined in a extended version: 'how and from whom is the truly rhetorical and persuasive art to be acquired quick and effortlessly?' In other words, they search the system of precepts which allow them to teach in the fastest, easiest and most accurate way an art. A problem of practical importance for a physician who would need to live two or more lives to finish reading all the books concerned with his discipline. Therefore, compendia were regarded as the paramount pedagogical tools, because they save time due to their shortness. And the dialectic as an "[…] art of arts, having the way to the principles of all methods […],"[59] became the art in charge of finding the suitable method to learn an art in a brief and easy fashion for the Medieval thinkers. The Renaissance humanists made this idea the creed of their educational reform. Without acknowledging the role of medieval thinkers in the development of the subject,[60] they

[55] Gilbert, 1963: p.5.
[56] Zenon quoted by Gilbert, 1963: p.43.
[57] Lucian: 2007, p.484.
[58] Cfr. Gilbert, 1963: pp.11-12.
[59] Lambert of Auxerre quoted by Gilbert, 1963: p. 57.
[60] According to Gilbert, "[t]he Humanists of course did not realize that the same Stoic doctrine had been used in medieval dialectic: they were notoriously apt to overlook medieval antecedents for their innovations." (Gilbert, 1963: p.13)

fight scholasticism forms of knowledge transmission, such as the use of tables and engravings—already mentioned.

Therefore, during the Renaissance the concept of art (i.e., the set of rules to acquire an art) was enlarged in the concept of method: "an art is brought into method by being presented in short, easily memorized rules set forth in a clear manner so that the student may master the art in as short time as possible."[61] And method became almost synonymous of compendious, that is, the materialized result of applying the method which facilitated and hastened the mastery of an art.

1.6. Aristotle and the tradition of the scientific method: demonstration

Aristotle developed his syllogism logical theory for determining the conditions under which certain knowledge is demonstrated, not for taught a skill-art. Therefore, the logical syllogism was not addressed to solve the same problem that Socrates posited in the *Phaedrus*. Aristotle was inquiring: how do we know that a discipline has acquired true knowledge or science? And he offers his solution in the *Posterior Analytics*. Generally speaking, Aristotle claims that we know that a discipline has acquired scientific knowledge if it can be demonstrated, that is, if it has been inferred by a syllogism which premises are true, primary, immediate, better known than and prior to the conclusion.[62] Thus, the truth obtained by demonstration always will be necessary. [63]

Aristotle's detailed and virtuous account of the demonstrative knowledge would be questioned for three centuries by the members of the College of Medicine at the University of Padua. The problem of 'scientific method' (in Gilbert's sense) arouse among the physicians because they wanted to know if medicine was a science, i.e., a demonstrated knowledge or science.

According to J.R. Randall, it was precisely the famous Pietro d'Abano who first stated the problem, inheriting it to the future generations of physicians at Padua. In his *Conciliator differentiarum philosophorum, et praecipue medicorum* (1310), Pietro d'Abano distinguishes two Aristotelian uses of 'science': (1) the demonstration presented in the *Posterior Analytics* (mentioned already above); and (2) the demonstration presented in the *Physica*—demonstration *propter quid* (wherefore or

[61] Gilbert, 1963: p.66.
[62] Cfr. *An. Post.* 71b20.
[63] Cfr. *Ivi.* 73a20-25.

why) and demonstration *quid* (that) respectively.[64] The demonstration (2) obtains scientific knowledge by inferring the premises from the conclusions, or the causes from the effects, or the principles from things in a "natural way", as Aristotle explains:

> Connaissance et science se produisant, dans tous les orders de recherches dont il y a principes ou causes ou éléments, quand on à pénétré ces principles, causes ou éléments (en effet nous ne pensons avoir saisi une chose que lorsque nous avons pénétré les causes premières, les principes premieres et jusqu'aux éléments), il est donc clair que, dans la science de la nature, il faut s'efforcer de définir d'abord ce qui concerne les principes.
> Or, la marche naturelle, c'est d'aller des les plus connaissables pour nous et les plus claires pour nous à celles qui sont plus claires en soi et plus connaissables ; car ce ne sont pas les même choses qui sont connaissable pour nous et absolument. C'est pourquoi il faut procéder ainsi : partir des choses moins claires en soi, plus claires pour nous, pour aller vers les choses plus claires en soi et plus connaissables. Or, ce qui, pour nous, est d'abord manifeste et clair, ce sont les ensembles les plus mêlés ; c'est seulement ensuite que, de cette indistinction, les éléments et les principes se dégagent et se font connaître per voie d'analyse. C'est pourquoi il faut aller des choses générales aux particulières ; car le tout est plus connaissable selon la sensation, et le général est un sorte de tout : il enferme une plurité qui constitue comme ses parties.[65]

Pietro d'Abano believed that demonstration (1) was the proper scientific method for gaining scientific knowledge, even if he was totally aware that medicine used demonstration (2).[66] Physicians have to discover the causes of diseases from their symptoms. Thus, by methodologically reasons, Pietro d'Abano regarded medicine (and natural knowledge in general) with a lower scientifically status or, degree of certainty, than mathematical disciplines which proceed by demonstration (1).[67]

However, not all agreed with Pietro d'Abano's solution to the problem of 'scientific mehtod'. Among the Paduan physicians of the following century, Hugo of Siena saw the matter in a totally different way in his *Exposition Ugonis Senensis super libros Tegni Galieni* (1498). For him, the proper scientific method used by physicians or natural investigators was a combination of demonstration (1) and demonstration (2). In other words, medicine start seeking causes from effects, and then explain effects

[64] Cfr. Randall, 1940: p.185.
[65] *Phys*. 184a10-26
[66] For simplicity we will refer to the Aristotelian demonstrations as 'demonstration (1)' and 'demonstration (2)'. Trough centuries, they have been called diversely by commentators and authors. For example: demonstration *propter* and *quia* by Pietro d'Abano (cfr. Randall, 1940: p.188); or demonstration *simpliciter* and demonstration (*signorum*) by Urban the Averroist (cfr. Randall, 1940: 190). They also have been widely called "compositive" and "resolutive," names taken from Galen's doctrine of teaching medicine (cfr. Randall, 1940: p.188; Gilbert, 1963: p.7).
[67] Cfr. Randall, 1940: p.188.

through causes.[68] Therefore, Hugo of Siena vindicated medicine, claiming the existence of two scientific methods: the first consisting in demonstration (1); and the second consisting in the combination of demonstration (2) and (1). This innovative idea was not only of Hugo of Siena, in fact was in the air at the end of the fifteenth-century at the University of Padua. There were other physician proposing the combination of both Aristotelian demonstrations in just one "double procedure" as a third kind of demonstration, such as Urban the Averroist in his *Urbanus Averoysta philosophus summus … commentorum omnium Averoys super librum Aistotelis de physico audito expositor* (1492).[69]

In the following century, the idea of the double demonstration applied in medicine and natural inquires continued further development at Padua by Paulus Venetus, Achillini, Zimara, Pomponazzi, Simon Porzio, Agostino Nifo, Bernardinus Tomitanus, and finally Zabarella.[70] For example, Agostino Nifo resumes in his *Augustini Niphi philosophi Suessani expositio…de Physico auditu* (1552) the state of the problem of 'scientific method':

> Recent writers (*recentiores*) maintain that there are four kinds of knowledge. The first kind is of the effect through the senses, or observation; the second [i.e. demonstration (2)] is the discovery (*inventio*) of the cause through the effect, which is called demonstration *of sign*; the third [i.e. demonstration (2) and (1)] is knowledge of the same cause through an examination (*negotiatio*) by the intellect, from which there first comes such an increased knowledge of the cause that it is fit to serve as the middle term of a demonstration *simpliciter* [i.e. demonstration (1)]; the fourth [i.e. demonstration (1)] is a knowledge of that same effect *propter quid* [demonstration (1) or *simpliciter*], through that cause known so certainly as to be a middle term of a demonstration.[71]

Bernardinus Tomitanus, a famous professor of logic in the times, was the Paduan paladin of the *negotation* [i.e. demonstration (2) and (1)] as the method of medicine and other natural inquires.[72] His most brilliant disciple, Zabarella, guided by his ideas, distilled his own original contribution from the three hundred years of Paduan sophisticate discussions over the Aristotelian theory of demonstration in the chapter *De Methodis* of his *Opera Logica* (1578). Zabarella claims there are only two methods of

[68] Cfr. *Ivi.* p.190.
[69] Cfr. *Ivi.* pp.190-191
[70] Cfr. *Ivi.* pp.191-202.
[71] Nifo quoted by Randall, 1940: p.192.
[72] Randall claims that it was precisely Tomitanus the first in formally identifying demonstration (2) as induction or *inquisition* (cfr. Randall, 1940: pp.195-196).

scientific demonstration, namely, demonstration (1) and resolution—i.e., demonstration (2) and (1)—instead of four as it was commonly stated:

> Est hac tempestate communis omnium sententia quatuor esse methodos, demonstrativam, & resolutivam, quas diximus, & praeter has etiam definitivam, ac divisivam; […] Divisiva, ac definitive methodis refutatis duae relinquuntur […]. Quod autem ad res omes cognoscendas duae methodi sufficient, demonstrativa, & resolutiva […].[73]

However, the originality of Zabarella does not reside in his statement, as we have seen already, this statement had many supporters prior to Zabarella, but in his conception of the nature of logic.[74] Zabarella regards both, demonstration and resolution, as *instrumenta logica*[75] or logical tools that can be applied to things in order to gain true knowledge or science:

> & est instrumentum non ad significandum, sed ad scientiam comparandam inventum, praeterea omnis methodus, & omne instrumentum logicum est via, & processus ab aliquo ad aliquod, quae sint eiusdem generis, seu eiusdem ordinis, ut a re ad rem, vel a conceptu ad conceptum, vel a voce ad vocem; […] quoniam igitur methodus instrumentum est, & cuiusque instrumenti causa praecipua est ipse finis, idcirco in definitione methodi finale causam adi ecimus, que est rerum cognitio a nobis per methodum acquirenda; in hac enim consistit tota methodi natura […].[76]

Thus, Zabarella conception of resolution (i.e., demonstration (2) and (1)) as an instrumental tool which serve to gain inductively knowledge of the unknown causes through the known effects, and then deduce the known and unknown effects from the recently known causes settled down a so called 'logic of scientific discovery'. According to Randall, this transformation of "the demonstrative proof of causes into a method of discovery"[77] is the contribution of the University of Padua to modern science.

Galileo Galilei would be the heir of the Paduan's efforts. The natural principles or causes would not be anymore indemonstrable and self-evident, but "hypotheses resting upon the facts they serve to explain."[78] Galileo would add an important dimension that was missing in the Paduan analysis, namely, the quantitative

[73] Zabarella, 1578: p.156, p.174, p.177.
[74] Cfr. *Ivi.* pp.89-92; Randall, 1940: 199-202.
[75] Zabarella, 1578: p.150.
[76] *Ivi.* p.91.
[77] Randall, 1940: p.186.
[78] *Ivi.* p.201.

measurement approach to natural inquiry based on the mathematical works of the ancient Greeks, such as Archimedes, Euclid, Hero, Apollionius, Pappus and Diophantus.[79] In particular, the geometrical methods of "analysis" and "synthesis".[80] However, the Galilean mathematical approach to nature also had Pythagorean and Platonic roots:

> Alla radice di gran parte della scienza del Rinascimento resta, sottinteso, il presupposto, dal Ficino messo in chiara luce, di una corrispondenza perfetta fra mente umana e realtà attraverso la matematica, in cui si rispecchia esemplarmente il ritmo preciso con cui Dio ha creato l'universo (*numero, pondere, et mensura*). Questo sottinteso pitagorico-platonico, di una specie di armonia prestabilita fra mondo e uomo, fondata sul platonico Dio geometrizzante, è comune così a Leonardo, "omo sanza lettere", come a Galileo, nemico dei "trombetti" ripetitori dell'antico, ma dogmaticamente sicuro del fatto che Dio ha scritto l'universo in caractteri matematici.[81]

Without doubt the sixteenth-century was the crucible which gave birth to a new scientific method, and the University of Padua, particularly its College of Medicine, played a central role. This method would be further developed through the seventeenth century, until it would be eventually clearly and succinctly formulated by Isaac Newton in his *Principia* (1687).

1.7. Aristotles' answer to Socrates

Following Gilbert, for more easily tackle the problem of method, we have divided it into two categories, which historically were not so clearly demarcated and were overlapping when philosophers discuss over the method. Therefore, Aristotle also addresses the problem of Socrates about how to acquire rhetorical mastery in one of the six parts of his *Organon*. Aristotle's solution consists in a systematic analysis of certain particular procedure for arriving at sound conclusions when arguing and debating: the "reasoned way".[82] The Aristotelian *Topics* are precisely consecrated to provide the rules of engagement in any reasoned discussion. They are aimed to mastery the effectiveness of logical persuasion, that is, the one which persuades through logically correctness:

> Le présent traité [*Topiques*] se propose de trouver une méthode qui nous rendra capables de raisonner déductivement, en prenant appui sur des idées admises, sur

[79] Cfr. *Ivi.* pp. 204-205.
[80] Gilbert, 1963: p. 31.
[81] Garin, 2000: p. 212.
[82] Cfr. Gilbert 1963: pp.40-41.

> tous les sujets qui peuvent se présenter, comme aussi, lorsque nous aurons nous-mêmes à répondre d'une affirmation, de ne rien dire qui lui soit contraire. Il faut donc commencer par dire ce que c'est qu'un raisonnement déductif, et quelles en sont les variétés, pour faire comprende la nature de la déduction dialectique ; c'est en effet cette dernière qui est l'object des recherches du traité qu'on se propose de composer.[83]

Aristotle distinguishes dialectical arguments from demonstrations not by its logical structure or validity but in reason to the necessity of its inference in base to the character of their premises.[84] Demonstrations, as we have already mentioned above, require premises which are true and primary. In contrast, the premises of dialectical arguments consist in general accepted opinions, as we have just read. Even if the dialectical arguments do not carry an apodictic force, knowledge could be achieved by them. The rational discussions over pros and cons settled in accordance to an arrangement of procedures and rules, based on Aristotle's *Topics*, became the well-known medieval practice of *obligationes* or disputation.[85] Furthermore, the *disputatio* [disputation] was the end of the scholastic commentary exercise which started with the *lectio* [*lecture*], that is, the reading or exposition of the meaning and exegesis of a written text; then followed the *quaestio* or critical analysis of a subject that is questioned by the commentator, and finally the *disputatio* took place, that is, the rational discussion made by the intellectual community interested in the question.[86] This was the paradigm of medieval teaching, as testify the so many written *commentaria* and *quaestiones*.

Humanists reacted against the medieval established forms of teaching.[87] For example, disputations were, at their eyes, useless tournaments for victory and glory between opponents and respondents. They do not regarded the procedures and rules of reasoned discussion provided by Aristotle in his *Topics* as wrong, but believed the medieval use of them had lost its primarily objective, that is, the search of truth.[88]

Humanists, who eagerly read and study the ancient classics by reading them in Greek or Latin, were not against Aristotle.[89] They learned from Aristotle but without blindly trusting in his authority. As a mater of fact, the *Topics* formed part of their

[83] *Top.* 101a19-24.
[84] Cfr. *Ivi.* 100a-101b4.
[85] Cfr. Gilbert, 1963: p.10.
[86] Cfr. Le Goff, 1987: pp.92-95.
[87] Cfr. Perreiah, 1982: pp.6-12.
[88] Cfr. Gilbert, 1963: p.10.
[89] According to Wightman, reading in the original Greek and Latin texts constituted the *studia humanitatis* of the College of Arts, and thus its teacher was called *(h)umanista*; Wightman also thinks that this is the origin of the later term 'humanism' (cfr. Wightman, 1972: p.19).

methodology.[90] Humanists were aware of the importance of the Greek; therefore they search new ancient texts as well as new and accurate translations of the already possessed. And, every new discovery was regarded as a major achievement from the humanist point of view.[91] Humanist sought after ideas which were genuinely from the ancient authorities, such as Aristotle, not the ones amended, changed or distorted by their commentators.

According to Gilbert, the humanists introduced the Latin term 'methodus' into philosophical use during the Renaissance. Translations of Aristotle and other Greek authors have used words like *ars, via, modus, ratio,* and *processus* instead of *methodus*. For example, "Aquinas also used *ars* for *methodus,* even when he was commenting on a text that contained the Greek word in such conspicuous fashion as did the *Politics*."[92] The direct access to Greek sources showed the various senses of the term made by the Greeks. And by the sixteenth century they were ready to use the term 'methodus' in their translations instead of different circumlocutions or complicate phrases. The Ciceronian use of Latin was the paradigm of correct Latin. Cicero has translated the term 'methodus' for *ars* or *ratio*.[93] Therefore, 'methodus' was considered a barbarism for the Latin purist as Mario Nizoli (1498-1566), who still considered *methodus* as barbarous in the sixteenth century, and thus banned it from the polite and learned discussions.[94]

According to Garin, the humanists developed a new approach or method totally based on history and philology to study whatever subject from a human dimension:

> […] alle scuole dei "grammatici" avevano imparato un metodo e un modo di affrontare la realtà. Che è precisamente quell'atteggiamento "filologico" che, come aveva ben visto una storiografia oggi troppo facilmente disprezzata, costituisce appunto la nuova "filosofia", ossia il nuovo metodo di prospettarsi i problemi, che non va considerato quindi, come taluno crede, accanto allla filosofia tradizionale, come un aspetto secondario della cultura rinascimentale, ma proprio effettivo filosofare.[95]

The humanistic historico-philological methodology probed to be very reliable for studying the ancient authorities in all domains. Physicians also were trying to restore the

[90] Gilbert claims that the label "Humanist Aristotelian, while it may offend readers of history books, accurately describes many Renaissance philosophers" (Gilbert, 1963: p.36).
[91] Cfr. Debus, 1978: pp.4-6.
[92] Gilbert, 1963: p.55.
[93] Cfr. *Ivi.* p.49.
[94] Cfr. *Ivi.* p.64.
[95] Garin, 200: p.11.

ancient and pristine medical knowledge, so they adopted the humanistic methodology.[96] For instance, medical humanists, such as Girolamo Mercuriale, were masters of combining the philological and clinical approaches to analyze ancient medical texts.[97] The meticulously philological analyses of humanists were very effective. For example, in 1614, Isaac Causabon concluded that the famous Hermetic corpus has been written during the post-Christian Era rather than in the ancient Egyptian times as it was proclaimed by the hermetic philosophers.[98]

The philological analysis was very wide spread among the philosophers of the Renaissance, its goal was to avoid misunderstandings and deviations from the author's original ideas. Therefore, a philosopher who did not read authorities in their original language would have a serious handicap,[99] and worst if he did not write Latin, the scientific language of the times.

However, even if Humanists were very good philologists, the meaning they gave to *methodus* differs from the tradition of the 'artistic method' where it come from. As we have already seen above, they enrich the concept of method when conceiving it as a "short cut" to knowledge or *compendium*.[100]

The tradition of artistic method and scientific method were intermingled, philosophers used to account both without demarcating them neatly. The tradition of the scientific method or demonstration has been widely and deeply analyzed by the historians of science. The so well-known Scientific Revolution, which traditionally goes from Copernico's *De revolutionibus orbium coelestium* published in 1543 to Newton's *Principia Mathematica* published in 1687, is about the ulterior development and culmination of the critical thinking about scientific method which started at Padua. [101]

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[96] Nauert, 1998: p.438.

[97] Cfr. Siraisi, 2003: p.232-233. Among the arsenal of humanism methodologies was also rhetoric. A complete humanist was a fluent language user highly skilled in the use of analogies, metaphors, and all the tools of eloquence (cfr. Walshe, 1950: p.380).

[98] Cfr. Yates, 2002: pp.116-117.

[99] Cfr. Gilbert, 1963: p. 36.

[100] The humanist method for producing compendia was a scientific tool of natural inquiring during the sixteenth and seventeenth centuries. For example, according to Blair, Bacon's *New Organon* was arranged following the humanist method of compendia (cfr. Blair, 1992: p.550).

[101] The mathematical devices applied to mechanical problems, such as Galileo's mathematical hypothesizing to analyse the problem of motion, are not being addressed in our approach of the sixteenth-century methodology. This has been already done by many historians occupied with the Scientific Revolution. For example, *The Construction of Modern Science. Mechanisms and Mechanics* (1977) of Richard Westfall or *The Copernican Revolution. Planetary Astronomy in the Development of Western Thought* (1957) of Thomas Kuhn among many others. However, not all scientific methods during the sixteenth century involved a sophisticate mathematical approach, particularly does concerned with natural history and medicine.

The line of scientific thought that this dissertation will take is not the mathematical demonstration but the development of scientific methodologies within the domain of the natural disciplines linked with medicine, which were taught at the Colleges of Medicine, particularly in Italy.

We have focused in the theoretical discussion over the method. In the following chapter, the actual strategies of natural inquiry used in the sixteenth century would be tackled. The framework of artistic and scientific method discussion constitutes their theoretical fundament as well as the authorities over method, being Galen the most important authority in medicine. The medical sixteenth century scientific inquiry was nurtured by both methodological traditions. Physicians used the already existing procedures and criteria for inquiring nature, and also developed and put in practice new methodologies and criteria. The quantitative aspect was considered an important factor but not in the degree of sophistication that it was applied to physics.

Chapter 2. The sixteenth-century development of natural history: new attitudes toward nature and new techniques of investigation.

2.1. Galen's empiricism and the principle of authority

The humanist enterprise of reviving the original sources made possible to drastically extend and spread the knowledge of ancient medicine as never before in human history. Prior to that date, many Galen treatises were incomplete or attributed to Hippocrates, such as his anatomical and physiological treatises. His practical manual on dissection titled *On Anatomical Procedures* was translated in the late of the fifteenth century.[102] Humanist without doubt contributed to the development of medicine during the Renaissance.

Aristotle had nothing relevant to taught about diseases and their particular causes, although he was the most important influence in Galen's scientific method. Galen remained "[…] within the Aristotelian framework, supplemented by some doctrines form Plato and the Stoa, with certain emphases which seemed to be called for by the state of medical instruction in his day."[103] He developed a doctrine of teaching medicine which consisted in three methods, namely, composition, resolution, and definition. Before the problem of methodology was considered at Padua, an Arabic commentator of Galen, called Hali (*994), was the first in identifying the first two Galenian methods with the two Aristotelian methods: demonstration (1) and demonstration (2) respectively.[104] Galen was considered one of the most reliable commentators on Aristotle and also an unchallenged authority in matters of medicine and natural philosophy. However, his narrative style differs from the precision and clarity of Aristotle. Contrary to Aristotle, names make no difference for Galen so long as we understand the matters they speak of:

[102] Cfr. Siraisi, 1990: pp.70-71.
[103] Gilbert, 1963: pp.14-15.
[104] Cfr. Randall, 1940: pp.185-188.

> Whether the name is given rightly or wrongly, in a proper sense or otherwise, is to be considered at greater leisure when we already begin to have an understanding of the matters. What is successful lies in the knowledge of these matters, not in their names.[105]

The style of Galen of grasping the concepts without given importance to the words in which they are formulated made difficult to understand and determine Galen's philosophical position, because his unclear terminology makes hard to trace his line of thought from all the philosophical traditions he nurtured it. Through centuries his commentators have suffered to reconstruct his ideas and arguments, and still historians of medicine find the same difficulties.[106]

Galen's doctrine over method is based on Hippocrates, Plato, Aristotle, and Theophrastus among others. Nevertheless he did not respect blindly the opinions of Aristotle or anyone else concerning the acquisition and mastery of the principles of medicine. The only authority for him was the truth, so he exhorted his disciples to only accept the opinions which could be considered true. However, for Galen the truth criterion was not always based on experience but also in authority. The problem of determining a true history is a good example. Galen uses the term 'history' to refer to every written report of "[…] things which have been seen or of things as if they had been seen."[107] Thus, the problem of determining the truthfulness of a history can be formulated as follows: how can we judge whether a history is true or not? Galen offers three criteria to solve the problem. Firstly, the empiricist criterion: if we have perceived by ourselves the reported things (or very similar ones), then the history is true.[108] However, the criterion is useless if we want to learn new things or things that we cannot experience. In that case, Galen appeals to the agreement criterion, that is, if all reliable authors agree on a subject, then we can believe it as true and trust it in practical life.[109] Thirdly and finally, he appeals to the classical authority criterion, that is, the expertise and moral character of the author to take an opinion as truth.[110] As we can see, even if Galen claims truth as the supreme court of knowledge, the ways of truth are not merely

[105] Galen, 2006: p.184.
[106] Cfr. Gilbert, 1963: p.45.
[107] Galen, 1985: p.35.
[108] Cfr. Galen, 1985: p.35.
[109] Cfr. *Idem.*
[110] Cfr. *Ivi.* p.35, pp.34-36.

experience or agreement but also authority. And this would be a hallmark, not only of the medieval period but of the sixteenth century as well.

Galen's as a searcher of truth adopted several philosophical traditions of his time but the fundament of his teaching was the same that its origin: experience. Medical knowledge was not based on rational consequence or "indication", as he called it, but in "the knowledge of something which is based on one's own perception."[111] The physician had to acquire "learned experience" to become and expert, that is, the moment when the physician practice was "[…] guided by the similarity with things which already have been found out by experience."[112] According to Galen, the similarity of experience could fall under four differentiations of theorems: "the knowledge of those things which have become apparent so often that […] they always have turned out this way, or only for the most part, or half of the time, or rarely."[113] However, indications are not banned from Galen's approach to medical matters. The transition from a known perception to another similar can be made by experience or by logic. The logical transition "[…] arrives at knowledge based on the nature of the thing by means of indication [i.e. rational consequence]."[114] In other words, logical transition does not rely on what is naturally known by experience but in the *plausibility* "that something similar should have similar effects, lack similar things, or be similarly affected […]."[115] For example, if someone shows very similar symptoms of a known disease, it would be plausible to conclude that the same remedy is needed. Galen utilizes logic as a heuristic tool which "promises the discovery of what is possible" and therefore it has to be "tested by practical experience."[116]

We can see in this brief example of Galen's methodology the role that reason and experience play in medical inquiry and practice. Both are useful; medicine is not a one-sided rationalism or empiricism as claimed respectively the two medical schools of the time.[117] Nevertheless, we cannot concluded that for Galen experience was the ultimate tribunal of truthfulness, because curiously he does not advice to proceed in the same fashion in the case of history agreement or history authority, which "can already

[111] *Ivi.* pp.24-25.
[112] *Ivi.* p.24.
[113] *Ivi.* pp.24-25.
[114] *Ivi.* p.37.
[115] *Idem.*
[116] Cfr. *Idem.*
[117] Cfr. Gilbert, 1963: p.20.

be trusted prior to the experience" if the authors are "trustworthy."[118] This statement can sound odd nowadays; we have a historiographical prejudice against the principle of authority. Medicine was a very wide and difficult subject and the physician cannot test by himself all an every one of the statements of the medical knowledge, such as prognostications, therapies, remedies, recipes an so on, so it was very rational to take for granted what a trustworthy physician have said. In many cases he faced unknown diseases and has to appeal to history or logic or both. Even physicians of today, as well as patients, proceed under the principle of authority. The important question is not why the physicians of the sixteenth century had as an epistemological criterion the principle of authority, but under which circumstances it would be doubted and revised. And also is important to examine under which circumstances Renaissance natural philosophers followed it blindly. The principle of authority has been challenged since old times; it is not an exclusive feature of the thinkers of the sixteenth century. Furthermore, during the sixteenth century, the most trustworthy and reliable authorities continued to be Aristotle in philosophy, Galen in medicine, Ptolemy in astronomy, Euclid in geometry, Dioscorides and Pliny in natural history, and Theophrastus in botany. And at the same time, these personages were the most challenged.

2.2. Medicine and natural history

The use that Galen makes of the term 'history' is not strange. Medicine and history were closed related since Greek times.[119] During the sixteenth century, medicine and history also were affine disciplines. From the point of view of the intellectuals of the sixteenth century, both medicine and history assembled a collection of empirical particulars and inquired into their causes.[120] For example, Machiavelli exhorts the politicians of their time to learn from history as the physician does:

> […] *quanto io veggio nelle differentie che tra i Cittadini civilmente nascono, ò nelle malatie nelle quali gli huomini incorrono, essersi sempre ricorso a quelli giudicy, ò a quelli rimedy che da gli antichi sono stati giudicati ò ordinati. Perché le leggi civili non sono altro che sententie date da gli antichi Iureconsulti, lequali ridotte in ordine a presenti nostri Iureconsulti giudicare insegnano; ne anchora la medicina è altro che esperientia fatta da gli antichi medici, sopra laquale fondano i Medici presenti li loro giudici*, Non dimeno nello ordinare le Republiche, nel manternere gli stati, nel governare i regni, nell'ordinare la militia, & amministrar la

[118] Galen, 1985: p.37.
[119] Cfr. Cortés, 2007: pp.24-31.
[120] Cfr. Siraisi, 2000: p.2.

> guerra, & nel giudicare i sudditi, nello accrescere lo Imperio, non si trova ne Principe, ne Republica, ne Capitani, ne Cittadini, che à gli essempi de gli antichi ricorra. Il che mi persuado che nasca […] dal non havere vera cognitione delle Historie […].[121]

Medicine and history *practical purposes* or *usefulness* resided in the same methodology: recourse to the past experience and base one's judgment on it. Therefore, the criteria for determining the truthfulness or falsity of histories were so relevant, such as the ones formulated by Galen.

They both the analysis of causes and the recollection of particulars were intrinsic features of the Galenic medicine. The twofold nature of medicine, that is, its theoretical and practical features, made difficult to catalogue it as a *scientia* or as an *ars*. From its theoretical aspect, such as the analysis of principles, certain knowledge or *scientia* could be achieved in Aristotelian sense. On the contrary, its practical component, aimed to facts, such as individual patients, illnesses, remedies, and so on, made medicine an *ars*.[122] For this reason, is not surprising that Physicians discussed the problem of method for tree centuries, as we have already seen.

The history of animals and plants as found in the books of Aristotle, Theophrastus, Dioscorides and Pliny would share the same methodology that practical medicine, that is, the storing up past data for present practical purposes. Furthermore, Medicine would not only be the paramount instance of history understanding, as in Machiavelli's *Discourses*, but also its goal of recovering of conserving human health would turn to be the noblest practical goal. Therefore all natural knowledge was headed towards it.

2.3. Museums and collections: direct observation.

During the sixteenth century, natural history suffered a radical transformation. Natural historians, physicians among them, developed new attitudes toward nature and also innovative techniques of investigation, which went beyond the methodological traditions (i.e., the artistic and scientific traditions already seen above) even if they were based on them.[123] In this case, the development of natural histories rather than be the result of theoretical discussions, resulted from the practical necessities of each

[121] Machiavelli, 1537: pp.xviii-xvix, *emphasis added*.
[122] Cfr. Siraisi, 2000: p.12; Mammola (2012) gives a full and detail account of this problem in his book *La ragione e l'incertezza* (2012).
[123] Cfr. Findlen, 1994: p.1.

discipline. In particular, the eager desire of systematically gathering all natural specimens with the intention of learning about nature through experiencing it. Eventually, this collecting activity culminated with the apparition of museums.

Museums of the sixteenth century were not museums in a modern sense, that is, they were not aimed to the public in general. The collections of specimens were not displayed with the pedagogical intention of teaching and diffusing science to the neophyte public. On the contrary, the museums of the sixteenth century were more similar to the ancient Museum of Alexandria. They were meeting points for learning and discussing about diseases, plants, minerals, animals, fossils, and other natural issues of that period.[124] Because of the encyclopaedic tendencies embraced by the sixteenth-century naturalists, diverse discursive and practical activities were carried on inside museums. The concept of museum was extensive. It could be seen as a *studio, cabinet, archivio, galleria, theatrum* and even as a *microcosmo*. [125] This later concept of museum is not surprising, because the mainly purpose of colleting was to fetch all and each relevant samples of nature into the walls of one space: the museum.[126] Therefore, museums were *locus amoenus* ['amenable places'] for undertaking a wide variety of natural studies, such as dissection, by naturalists with different qualifications.[127] For example, Federico Cesi, the founder of the most important and prestigious scientific community of the time, required an encyclopaedic approach to natural inquiry: "la confluenza di uomini 'di diverse inclinazioni nelle scienze e professioni' in vista di una ricerca integrata […]."[128]

Naturalists investigated nature in the museum, that is, in an artificial microcosm composed by many and different kinds of collected specimens. The museum's collection, rather than be beautifully displayed in vitrines for entertaining, was the first source for experiencing nature and acquiring knowledge by direct observation.[129] Sixteenth-century museums could be seen as laboratories of nature, that is, places where nature was not only examined and manipulated, by means of artificial procedures, such as dissection or distillation, with the aim of acquiring knowledge, but also for transforming it, such as in the case of the manufacture of medicines and other

[124] Stendardo, 2001: p.15.
[125] Cfr. Findlen, 1994: p.191.
[126] Cfr. *Ivi.* p.1.
[127] Cfr. *Ivi.* p.191.
[128] Cesi quoted by Battistini, p.9.
[129] Without doubt many nobles and scholars visited museums only to satisfy their curiosity. But naturalists went to examine specimens that help them in their researches, such as Mattioli who wrote his Natural History entirely based in the collection of Aldrovandi's museum (cfr. Findlen, 1994: p.24).

commodities.[130] Therefore, in museums naturalists were becoming aware that knowledge is power, because they unveil the mysteries and secrets of nature unknown to them, and then, if possible, employed them in a useful way: "In the museum, the unknown became knowable, and the known showable."[131]

However, the observations of the sixteenth-century were based on the sensory organs of naturalists themselves rather than on the instruments they used. The naturalists of this period were highly trained and sharp observers. Observation did not reduce to the sense of sight; all five senses were included in the direct observation of specimens during the sixteenth-century. Natural historians needed also to touch, smell, and taste many of their specimens to know their properties. Therefore museums of the sixteenth-century were closely related to experience.

2.4. Collections and experience: the sensory philosophers

The naturalists gained experience when they saw, touched, smelled, tasted and heard some particularly object which compose the collection of a museum. In other words, the primarily goal of a museum's collection was to furnish naturalists who visited them with a wide and diverse range of particular sensory experiences. Through these experiences, naturalists would acquire knowledge. Therefore, museums were places for experiencing nature. The experimental practices of the sixteenth naturalists often involved artefacts (such as furnaces or dissecting tools) but their fundament resided in the acute sensory organs of naturalists themselves. For example, Aldrovandi was proud of seen with his own eyes and touch with his own hands all the natural objects he have accumulated in his little world of nature.[132] As Findlen claims, the sharpening of sensory organs played a key role in the sixteenth-century naturalist quest for knowledge:

> Through sharpened faculties such as Falloppia's ocular sensibilities, Anguillara's acute sense of smell, and Aldrovandi's discriminating palate, Renaissance naturalists refined their histories of nature in a manner sanctioned by classical authorities. "I call this sensory [philosophy] the mother of universal philosophy, from which it derived its origins," explained Aldrovandi, paraphrasing Aristotle. "If this particular is taken away, the universal does not remain, since memories are born from sensory experiences, and universals from memories…for there is nothing in the intellect that is not first in the senses." Through his collecting of

[130] Cfr. Findlen, 1994: pp.153-154.
[131] *Ivi.* p.156.
[132] Cfr. *Ivi.* pp.156-7.

> experience, Aldrovandi became known as "a true sensory Philosopher." Nature, as he and his contemporaries learned, could be read as easily through sensory data as through the pages of a book. This was the experience that naturalists most coveted, as they translated textual images into experiential practices.[133]

Trough a sharply sensory inspection of collections, not only reduced to sight, naturalists discovered and made evident many differences between things.[134] In other words, sixteenth-century naturalists were acquiring a very particular sort of knowledge at museums, namely, the knowledge of particulars.[135] And for sixteenth-century naturalists, the guarantee of scientific knowledge was experience as proclaimed the famous French surgeon Ambroise Paré (c.1510/20-1590): "science sans expérience, n'apporte pas grande assecurance."[136] Therefore, concerning matters of natural history, experience was fundamental. More and more sixteenth-century naturalists started to give experience a prominent role as a scientific criterion along with reason and authority. For example, Paré claimed that he would prove "par experience, authorité, et raison" that unicorns horns are not effective against venoms.[137]

2.5. Experience as truth criteria

Experience as a truth criterion is not an innovation of the sixteenth-century naturalists and physicians. As we have already seen above, Galen proclaimed it as touchstone to ponder the truth of theories or 'histories' as he called them. However, sixteenth-century philosophers regarded it as sufficient evidence for proving something. For instance, the physician Paré claims that the faculty of remedies for producing effects is something "conneuë par seule expérience."[138] And also the sixteenth-century natural philosopher Benedetto Varchi regards convenient to ask experience rather than authority when dealing with practical problems:

> […] molte volte un lapidario […] non conoscerà un vetro finto, e falso da un Diamante buono, e vero, se non viene alla sperienza, et alla prova; e'l simile dico de' metalli, et altre cose […]. E sebbene il costume dei filosofi moderni è di creder sempre, e non provar mai tutto quello, que si trova scritto ne' buoni autori, e

[133] *Ivi.* p.206.
[134] They were following Aristotle (cfr. *Metaph.* 980a21). However, the sixteenth-century naturalist incorporated equally all senses for distinguishing things.
[135] Cfr. *Metaph.* 981a10-20.
[136] Paré, 1841: p.649.
[137] *Ivi.* p.505.
[138] *Ivi.* p.527.

> massimamente in Aristotle, non è però, che non fusse e più sicuro e più diletevole fare altramenti, e discedere qualche volta alla sperienza in alcune cose […].[139]

The alchemist Paracelsus was more categorical than both Varchi and Paré together. He demanded the experimental credentials to any kind of natural knowledge:

> If you, in like manner, have learnt anything from the light of Aristotle, or from us, or from the rules of Serapio, come forth, and bring that knowledge experimentally to light. Preserve now the right of the Schools, as becomes a lover of honor and a doctor. But if you know nothing and can do nothing, why you despise me as though I were an irrational Helvetian cow, and inveigh against me as a wandering vagabond? Art is a second Nature and a universe of its own, as experience witnesses, and demonstrates against you and your idols.[140]

But no one better as the genius Leonardo Da Vinci to demolish authority as truth criteria:

> Chi disputa allegando l'autorità, non adopera lo 'ngeno, ma piuttosto la memoria. Fuggi li precetti di quelli speculatori che le lore ragioni non sono confermate dalla isperienzia. […] in tali discorsi mentali [i discorsi scientifici che principiano e finiscono nella mente] non accade sperienza, senza la quale nulla dà di sé certezza.[141]

During the sixteenth-century, the term 'experience' referred to "[…] a wide range of activities in scientific discourse."[142] For example, experience could refer to: a way of attaining knowledge; a type of knowledge; a repeated natural phenomena; a specific description of a particular natural phenomena; a fact already tried and probed, such as an antidote; a physical demonstration of the occurrence of certain phenomena under certain circumstances; a test of a phenomena; a type of proof which involved artificial objects; a guide for discovery; and a criteria of truth.[143] Therefore, the term 'experience' "[…] conveniently summarized a multitude of different practices unified by a certain engagement with objects […]."[144]

Naturalist did not only raise the epistemological status of experience, as the sensory knowledge of particulars, but also its methodological status as a scientific

[139] Varchi, 1827: p.24, p.34.
[140] Paracelsus, 2007: pp.44-45.
[141] Da Vinci quoted by Garin, 2000: p.213.
[142] Findlen, 1994: p.203.
[143] Cfr. *Ivi.* pp.200-208.
[144] *Ivi.* p.204.

activity: to experience or experimenting. By means only of "fare expérience"[145] or experimenting Renaissance naturalists learn nature's behaviour. For instance, Paré relates the "experiment" that the French king of Clermont at Aubergine carried on with the Bezahar (a stone supposedly with medicinal virtues against venoms). All the tested prisoners died, "[e]t ainsi la Pierre d'Espagne [i.e. Bezahar], comme l'expérience le monstra, n'eut aucune vertu."[146] Experimenting, "faire expérience" or "fare sperienza" was not only a common activity in which naturalist engaged, but the paramount activity of naturalists. By practicing it, they were spreading and developing the experimental culture of their time and contributing to settle some of the bases for the future experimental philosophy. Sixteenth-century is full of examples which instead of be complex and extraordinary are very simple and ordinary, such as Aldrovandi's experiment in which he took part at Verona in Calzolari's museum in 1572:

> We experimented [*habbiam' fatto esperienza*] in his house, placing it [asbestos] in the flame of a burning candle. It lit up as if in flames, so the everyone thought that it had turned to ashes. Nonetheless, once cooled, its substance and appearance remained the same as they were before […].[147]

This sort of examples is far from being called 'scientific experiments' in nowadays sense.[148] In general, sixteenth-century naturalists involved in collection rather than trying to test general hypotheses in a Galilean manner were as Della Porta "[…] attempting to imitate nature in order to produce utilitarian knowledge, and to correct and amplify the written tradition."[149] And many times, repeated experiences were needed to understand a observed natural phenomena. However, they show the important role of sensory evidence and its related activities for the sixteenth-century naturalists. Natural history gradually was becoming a more experiential discipline rather than textual, and consequently experience was gradually replacing authority from the scientific tribunal of truth while the sixteenth century was passing by.

Museums could be seen as scientific places of knowledge production from experience. Men of science of that time were concerned in discovering knowledge by experiencing it directly through the specimens they stored up in their museums, rather than reading about it or deducing it by means of scientific syllogisms. The Linceans

[145] Paré, 1841: p.531.
[146] *Ivi.* p.342.
[147] Aldrovandi quoted by Findlen, 1994: p. 224.
[148] Cfr. Guillaumin, 2005: p.241.
[149] Eamon, 1996: p.221.

erased from their botanical list Aristotle and Theophrastus as authorities.[150] Many anatomical expositions of the second half of the sixteenth-century completely relinquished to Galen's authority; instead they were entirely based on Vesalius, such as Wecker's *Medicae syntaxes* (1562), Coiter's *Externarum et internarum principalium humani corporis partium tabulae* (1572) and Platter's *De corpis humani structura et usu* (1583).[151] But nobody exceeded the iconoclastic Paracelsus against classical authorities, who on june 24th of 1527 at the University of Basel publicly burned Avicenna's *Canon of Medicine*, that is, the more used volume as medical textbook during the sixteenth-century.[152] However, during the sixteenth-century, not all naturalists dethroned classical authorities. On the contrary, according to Findlen, there were still many, such as the famous Aldrovandi, who "[…] emblematized the revitalization of Aristotelian natural philosophy and Plinian natural history […]."[153] But all sixteenth-century naturalists, such as Aldrovandi, Girolamo Cardano, Girolamo Fracostoro, G. B. della Porta, Andrea Cesalpino, Bernardino Telesio, and a huge so on, whatever their intellectual inclinations were united by a shared belief: grounding and generating natural knowledge from experience. They all would make Leonardo da Vinci's words their slogan: "La sapienza è figliola della sperienza."[154] Naturalists were convinced that possessing nature would give them experience, and experience knowledge and, thus, they challenged or supported one another based on their way of "experiencing" nature. They believed that "the naturalists who claimed the greatest level of "experience" subsequently came to possess the highest degree of knowledge."[155]

2.6. Reading the novelties of Nature

The wide variety of activities related with experience used and developed by the naturalists were forms of deciphering and understanding book of nature's language as well as the secrets hidden in its written pages. Reading the great and "truly named universal book of the world,"[156] as proclaimed Federico Cesi, would eventually destroy and dethrone classical authorities during the following centuries. The Linceans leaded by their famous paladin, Galileo, conceived the book of nature as the only textbook or

[150] Cfr. Findlen, 1994: p.75.
[151] Cfr. Rinaldi, 2007: p.113-131.
[152] Cfr. Pagel, 1958: pp. 20-21.
[153] Findlen, 1994: pp.4-5.
[154] Da Vinci quoted by Garin, 2000: p. 213.
[155] Findlen, 1994: p.157.
[156] Cesi quoted by Findlen, 1994: pp.56-57.

canon of knowledge; nevertheless, in the sixteenth-century still was a wide belief that the book of nature amplified the books of authorities, which were compatible and contained in it.[157]

Many naturalists of the sixteenth-century followed ancient authorities in some respects and not in others, as Vesalius did. He claimed that he was not rejecting Galen but returning "[…] to something older and more accurate, the practice of dissection as it had once been conducted at Alexandria in the days of *Herophilus*, *Andreas*, and *Marinus*."[158] Vesalius dissented and relinquished Galen's authority by correcting him, but he still respected him. Vesalius even detected Galen's anatomical source of error, namely, his dissections were carried on monkeys otherwise he would not haven committed such mistakes.[159] Castiglioni defines Vesalius attitude toward classical authorities in the following terms:

> Vesalio is the master who feels the link between himself and his forerunners, between himself and his followers; who realizes his debt to the first an is conscious of his power over the second. His work is deeply studied, conceived and complete in the smallest details and this explains his marvellous success.
> For the first time in history a surgeon expounds anatomical doctrines, enriching it with beautiful pictures in order to justify the fact that he does not faithfully follow those masters whom he quotes with great respect on every page of his book. He mentions all the ancients without exception, at the same time he dissents. His work undermines Galen's authority, especially in the method: it constitutes from now onwards the foundation of anatomical teaching and of medical speculation according to the new method.[160]

We could say then that naturalists of the sixteenth century oscillated from those who completely rejected classical authorities as many of the Linceans or Paracelsus, and those who thought that experiencing was the ulterior development of classical authorities, such as Aldrovandi; and between these extremes there was a wide range of naturalists who, openly or stealthily (even unconsciously), accepted and/or rejected

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[157] Cfr. Findlen, 1994: p.56-57. Findlen claims that paradoxically this attitude towards the ancient authorities, which motivated a vast number of natural researches, also caused the extinction of the whole: "Ultimately the value placed upon the experience of the senses would result in its uncoupling from this traditional philosophical framework. But at this point, naturalists perceived their museums to be a tangible sign of their commitment to the ancient study of nature. In the sixteenth century, this entailed little more than subsuming everything collected within a proper philosophical framework, as determined by the traditional classification of the sciences. […] Aristotelian naturalists designated the museum as a site of critical synthesis. With hindsight, it is easy for us to predict their failure. At the time, they had the weight of more than 2000 years of authority on their side." (Findlen, 1994: p.5)
[158] Cfr. Nutton, 1997: p.159.
[159] Barón, 1970: pp.101-102.
[160] Castiglioni, 1979: p.48.

partially the doctrines inherited from the classical authorities, such as Vesalius.[161] Surely, the middle attitude was the more diffused. These naturalists were not trying to be revolutionaries cutting their vinculums with the ancient authorities. On the contrary, they understood their activities to be the emendation, expansion and fulfilment of the scientific programs settled by the classical authorities; thus, for the vast majority of sixteenth-century naturalist, "[…] experience did not compete with authority but rather complemented and enhanced it."[162] The achievement of this goal "was unwavering in the belief that erudition combined with experience was the most credible form of knowledge."[163] They were trying to accesses directly to the natural subjects treated by the ancient authorities, and in doing so they were damaging the statements of authorities rather than supporting them. Experience in many cases contradicted the dogmas created by the authorities; when this happened, naturalists usually did not relinquish and abandon all Aristotle's doctrines, rather they corrected him or modified their own position according to the evidence and research circumstances. In fact, the naturalists of the sixteenth century were discovering too many novelties which were unknown and, for this reason, never tackled by classical authorities. Thus, experience was playing the primary role in the sixteenth-century enterprises for discovering and expanding natural knowledge through the accumulation of new objects and facts. For some naturalist, such as Aldrovandi, the discovery of a new fact signified that it had to be catalogued and understood under the framework of Aristotle. In this way his natural activities were basically a labour of upgrading Aristotle's philosophy.[164] As we have seen, not all naturalists saw themselves as upgrading Arsitotle's philosophy by providing descriptions and explanations of the specimens unknown to Aristotle. However, also is true that in the absence of a theory for explaining the new occurrences, naturalists recurred to modify Aristotle's philosophy. Therefore, the discovery of novelties generally made them develop explanations, which were new versions or adaptations of traditional philosophical theories applied to the new particular cases. For example, gunpowder which was one of the three discoveries immortalized by Francis Bacon in his *Novum Organum* (1620):

[161] For example, the tables and schematisms promulgated and used by the anti-Aristotelian Federico Cesi "[…] reinforce the viewpoint that taxonomy was fundamentally an Aristotelian exercise, even if its practitioners refused to acknowledge the connection. Cesi had liberated himself from the past with the tools of ancient philosophy and the techniques of Renaissance natural history." (Findlen, 1994: p.75)
[162] Findlen, 1994: p.4.
[163] *Ivi.* p.36.
[164] Cfr. *Ivi.* p.215.

> Again, it is well to observe the force and virtue and consequences of discoveries, and these are to be seen nowhere more conspicuously than in those three which were unknown to the ancients, and of which the origin, though recent, *is obscure and inglorious*; namely, printing, gunpowder, and the magnet.[165]

Sixteenth-century naturalist have to offer some sort of explanation of how gunpowder worked and why. Instead of creating a new framework, it was easy to work under a known philosophical framework. This is precisely the case of Vanoccio Biringuccio (1480-1539) who published in 1540 what is considered the first book on metallurgy: *De la Pirothechnia* or "*art du feu"* as the French version of 1572 defines it in the cover.[166] Biringuccio primary objective was not teaching metallurgy *per se*, but with a very define and precise practical purpose; as it was characteristic of all the arts during the period. As an attentive reading show, he was teaching all the procedures and techniques of metallurgy for making and using cannons for protecting his kingdom against aggressors (as well as adding some lighting to royal nocturnal and special events). Although his noble intentions, Biringuccio have had felt remorse, because he suspected who was the gunpowder's inventor:

> […] tellement qu'on trouvera cette invention [la poudre] en la bien considérant, beaucoup plus nuisante que tout poison et venin, et plus pernicieuse que la propre foudre du ciel : Comme celle [le canon] qui est encore plus dangereuse que n'est toute autre arme de fer... . [Pour cette raison] […] qu'on dit le diable en avoir été premier inventeur […].[167]

Biringuccio offers a very brief theoretical explanation of the most destructive power of his time. He formulates his theory under the Aristotelian lines of the four elements and its transformation. Aristotle claimed that all things are composed of four elements: water, earth, air, and fire. Each element has two manifested qualities which are antagonist: The water is cold and moist; the earth is cold and dry; the air is hot and moist; and the fire is hot and dry. According to Aristotle, each element could be transformed into another if one or both of its manifested qualities are modified. Thus, to transform the fire into air, one must extinguish its dryness and bring to be moistness.[168] With these principles Aristotle explains in his *Metheorology* natural phenomena which go from water evaporation to thunders.

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[165] Bacon, 1863: aphorism 129, *cursives mine*.
[166] Cfr. Biringuccio, 1572: frontcover.
[167] *Ivi.* p.158.
[168] Cfr. Aristotle *Meteor.*, II, 3-4, 356b-363a.

Birunguccio formulates his theory under the mentioned Aristotelian framework. According to him, the gunpowder has a destructive power because the qualities of the elements which compose are antagonist, particularly the hot and the moist. These two qualities fight against each other making that the gunpowder transforms into a very strong wind:

> Laquelle [la poudre] est composée des quatre forces élémentales, et étant en la plus grande partie de sa plus grande sécheresse, jetant le feu au milieu du soufre, vient à se multiplier d'air et de feu, faisant avec l'humidité mêlée avec la terre subtile une vapeur grosse et enflambée : tellement que la nature d'un chacun élément combattant avec l'autre, ce convertit en humeur et en grande ventosité à cause du chault et humide.[169]

Natural philosophy discovery of novelties during the sixteenth-century was expanding the knowledge pushing and challenging the limits of the traditional frameworks, although almost all naturalists of this century "[…] still committed to the preservation of ancient views of nature."[170] And the desire of collected all them along with the already known natural things in one space, called museum, was developing natural history and also the philosophical traditions and worldviews we are inheritors.

2.7. Objects and scientific travelling

During the sixteenth-century, collecting natural objects or the eager desire of possessing nature was also cultivated by the social and educated elite of Europe; the possession of objects gave them knowledge and through their display, they "[…] symbolically acquired the honour and reputation that all men of learning cultivated."[171]

Ideas were gathered in books and natural objects in museums, experience started to be a new sign of erudition and culture.[172] For the naturalists each object they kept in their museums could be a multiple source of data and knowledge. For example, a curious animal, such an armadillo, while living their habits and movements could be observed; dead, its generation could be understood, its skeletal structure articulated, and eventually it could be preserved for all to see at the museum.[173] Therefore, objects were a multi-valuable source of acquiring experience and knowledge, and thus collecting them was vital for the naturalists of the sixteenth-century.

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[169] Biringuccio, 1572: p.157.
[170] Findlen, 1994: p.5.
[171] *Ivi.* p.3.
[172] Cfr. *Ivi.* p.35.
[173] Cfr. *Ivi.* pp.211-12.

Collecting increased curiosity and the desire of travelling. Naturalists were eager of knowing more new natural things as well as cultures. During the sixteenth century, travelling for scientific purposes had become a well established scientific activity or method. During the sixteenth-century there were not only adventurers and explores who went on around the world—like Columbus—but also more and more academics, intellectuals and professors of natural history started to travel with the purpose of acquiring knowledge through experience. Aldrovandi liked to say: "If reading gives so much utility to scholars, travel gives them ten times more."[174] The exploration of nature by means of travelling signified learn directly form the first museum of all, namely, nature itself.[175] And "[…] nature […] is not silent but speaks to us everywhere and teaches the observant man many things if she finds him attentive and receptive […]",[176] as Erasmus of Rotterdam says through the words of Eusebius in *The Godly Feast* (1522). The attentive and receptive naturalist did not have necessary to enrol in an expedition to the new world for attending nature lectures. Nature taught everywhere outside from their studio, university or museum. Even a local voyage to the mountains or fields of the region was fruitful enough to an observant naturalist eager of knowledge. Furthermore, many naturalists sometimes preferred to know perfectly well their local environment than imperfectly the entire nature. Thus, they become specialists on the natural history of their regions. In this manner, natural history for many naturalists was becoming an investigation of specific nature instead of a study of nature as a whole: it consist in the knowledge of singular and particular things of specific regions of the earth.[177]

Whether a naturalist could afford travelling around the world gathering extraordinary specimens or conform himself only with knowing the common specimens of his region, he always tried to incorporated scientific travels to his activities, because he considered them essential to natural research. "Nature provided [him] with the perspective that [he] lacked as long as [he] stayed at home."[178] Always would be better to observe the specimen in the field, before start their analysis in the museum. However, the big collections housed in the famous museums of the sixteenth-century naturalist were the result of a collective activity through a huge network of travellers of all type of

[174] Aldrovandi quoted by Findlen, 1994: p.155.
[175] Cfr. Findlen, 1994: p.155.
[176] Erasmus, 1997: p.175.
[177] Cfr. Findlen, 1994: pp.164-65.
[178] *Ivi.* p.158.

qualifications interested in natural history. The ultimate goal of establishing natural history networks for collecting was to assemble the encyclopaedia of nature within their museums.[179]

2.8. Museums and scientific networks: public knowledge

Museums, where collections were housed, were multifunctional places. Knowledge was possible not only by the direct observation of specimens but through the human interactions among the naturalists, collectors, philosophers travellers, traders and all people that assisted and give life to museums.[180] The conception of knowledge as consensual and public enterprise was highly acknowledged and valued by the naturalists of the sixteenth-century. During the sixteenth century, not only experience and objects but also the scientific community play a vital role in the assessment of truth. And museums were the physical spaces where scientific communities meet and realized their activities.

Naturalists of the sixteenth-century organized their discipline both around the objects themselves and around the discussions about them. The objects were the anchorage which allowed different disciplines, such as medicine, natural history and natural philosophy, to interact among them. Thus, the museums represented a nature microcosm which could be studied by the intersection of diverse disciplinary points of view. However, sixteenth-century naturalists were aware that natural knowledge was not only generated by the interdisciplinary interaction of scholarly individuals but also by a wide number of unlettered people who exercised different crafts and activities, such as the butchers, fishermen, apothecaries, herbalists, barbers, goldsmiths, gardeners, hunters, street vendors, birdcatchers, distillers, glassmakers, metal workers and so on who empirically understood very well the commodities they exchanged or produced. Therefore, they were valuable sources of practical knowledge or know-how to the naturalists.[181] For example, Aldrovandi explains how he proceeded to acquired knowledge and gather specimens from his scientific trips:

> For the obtainment of my object, I was in the habit of going into the country for months during the summer and autumn, north for relaxation, like others; for at these times I employed all my influence, as well as money, to induce the country-people to bring me such insects, whether winged or creeping, as they could procure

[179] Cfr. *Ivi.* p.35.
[180] Cfr. *Ivi.* p.8.
[181] Cfr. *Ivi.* pp.170-175.

> in the fields or underground, and in the rivers and ponds. When any were brought to me, I made inquiries about its name, habit, locality, etc. I often, too, wandered over the marshes and mountains, accompanied by my draughtsman and amanuenses, he carrying his pencil, and they their notebooks. The former took a drawing if expedient, the latter noted down to my dictation what occurred to me, and in this way we collected a vast variety of specimens.[182]

In this way, the search for natural knowledge did not reduce to the environment of the museum, but also shops, hospitals, pharmacies, markets, and other physical spaces within the city walls which were excellent places for achieving experience and knowledge. However, the knowledge obtained in this form was not official, until some naturalist recognized as such.[183] Furthermore, the official knowledge or natural knowledge that the naturalist achieved was the result of the wide variety of activities he carried on, such as excursions to the field, visits to the marketplace, exchange of specimens and ideas, and the examination of specimens at the museum.[184]

Moreover, collecting was not a unique activity of naturalists; also the professional guilds of physicians and apothecaries practiced it. The institutional established scholarly social ranks and status, and not only the theoretical frameworks, started to be demolished by the collecting activities. For example, Francesco Anguillara who was in charge of the botanic garden of Padua from 1546 to 1561 was a man of experience rather than scholarly literacy.[185] And paradoxically, the most famous Italian naturalist of the sixteenth-century, who "[…] founded and managed a botanical garden, went on field trips, started a museum, exchanged specimens with colleagues, and engaged talented artist to portray the thins he was investigating,"[186] rather to be a man of experience was a scholarly philologist looking forward to subsided his handicapped experience. This naturalist was precisely Aldrovandi, who lacked from Anguillara qualifications and vice versa. Anguillara rather to be a scholarly philologist, was a man "who possessed theory as well as practice, and has experienced many things."[187] This two personages made a field trip together to Monte Baldo in 1554 along with Calzolari,

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[182] Aldrovandi quoted by Findlen, 1994: pp.169-70.
[183] Aaccording to Findlen, the information derived from the illiterate people from the marketplace and other places "[…] did not count as knowledge until some recognized form of authority confirmed it. While the primary location of experimental life was the *studio*, the process of acquiring the artefacts and information that formed the museum knew no such bounds. Stepping outside of the museum and into the piazza, collectors accumulated their data through an intricate and fruitful juxtaposition of reading, travel, and observation that constituted the "experimental life" of early modern history." (Findlen, 1994: p.179)
[184] Cfr. Findlen, 1994: pp.157-158.
[185] Cfr. *Ivi.* p.181.
[186] Settle, 1978: p.622.
[187] Anguillara quoted by Findlen, 1994: p.202.

a man who claimed that "one cannot know simples by reading books, unless this reading is accompanied by direct observation."[188] Due to their different and diametrical opposed formations, Aldrovandi and Anguillara could not settle an endurable scientific relationship. Aldrovandi knew everything about natural history but he could not "[…] venture[…] out into the fields with a simple sack and a single companion."[189] He needed his assistants to do all the manual work for him. And Anguillara did not have the vast culture and mastery of authors as Aldrovandi. For this reason, Anguillara was considered ignorant by Mattioli, Aldrovandi's right arm.[190]

Also the Latin literacy regarded as the scientific language at the times was being displaced by its vulgar versions due to the heterogeneity of the people involved in the investigation of nature during the sixteenth-century. Therefore, within the domain of natural history Latin was not sufficient for learning. Reading in their original language the descriptions of Theophrastus and Dioscorides was as important as known the names in which natural things were called and identified by the vernacular communities of speakers involved with them.[191] Something as ordinary as buying a simple without knowing its vernacular name or description could be a difficult task. There were many apothecaries, surgeons, chemist, and so on who did not knew any Latin or Greek but were virtuosi in their crafts. Therefore, the literature on natural history subjects was many times traduced or directly written in vernacular languages or dialects.

The wide range of activities that naturalists of the sixteenth century carried on within the variety of heterogeneous physical spaces were broadening the scientific culture and community of its century. Furthermore, the museum was not the only place where intellectuals meet and gather to discuss natural knowledge. Also pharmacies, marketplaces, courts, piazzas, ports, academies, libraries and virtually any place could become a place where scientific activities took place. Summarizing, as Findlen claims, the new attitude of sixteenth-century naturalists towards nature, experience and knowledge were reshaping natural history as a discipline as well as a scientific community:

> The new visibility of natural history was as much an act of cultural production as intellectual orchestration or institutional resolution; the centrality of collecting to

[188] Calzolari quoted by Findlen, 1994: p.156.
[189] Findlen, 1994: p.170.
[190] Cfr. *Ivi.* p. 181.
[191] Cfr. *Ivi.* p. 171.

> the reformulation of this discipline had much to do with its ability to rearrange the boundaries of the scientific community.[192]

Naturalists have taken awareness that studying nature required the collective participation of a wide range of people with different qualifications that were virtuosi in different activities. These people were also a valuable knowledge source of experience for the naturalists. For example, Bartolomeo Maranta was convinced that it was impossible to mastery the knowledge of simples "[…] without seeing different places and talking to diverse men [who are] experts in their profession."[193] Many times it was necessary to employ these experts. For instance, Aldrovandi used to employ Tagliacozzi, a surgeon, for dissecting the special specimens he had in his museum.[194] And "[…] Della Porta learned metallurgy, as he learned other crafts, by observing artisans at work and by experimenting on his own."[195] Furthermore, Della Porta settled correspondence with both scholarly men and craftsmen with the objective of continue learning from them after he have met them in his voyages:

> […] as I travelled through France, Italy, and Spain, I consulted with all libraries, learned men, and artificers, that if they knew anything that was curious, I might understand such truths as they had proved by their long experience.[196]

In addition to the virtuosi just mentioned in Della Porta's quotation, we have to emphasize the communicative and cooperative dimensions of natural history. It was virtually impossible to cultivate and develop the discipline by oneself, it was necessary the constant exchange of ideas, specimens and artefacts among the members of wide network of virtuosi in different domains. Moreover, natural history involved the public as well as the private dimensions in the quest for knowledge.[197] In the one hand, they knew natural knowledge acquisition was only possible interacting with a huge scientific network. In the other hand, in the privacy of their museums, they experience and test by themselves (or with a small group of collaborators) the information and specimens gathered through their network, as Della Porta continue explaining:

[192] *Ivi.* p.10.
[193] Maranta quoted by Findlen, 1994: p.175.
[194] Cfr. Findlen, 1994: pp.211-213.
[195] Eamon, 1996: p.220.
[196] Della Porta, 1957: p.xiii.
[197] Cfr. Findlen, 1994: pp.102-107.

> Those places and men, […] I wrote letters to, frequently earnestly desiring them to furnish me with those secrets, which they esteemed rare; […] by earnest study and constant experience, I did both night and day endeavored to know whether what I heard or read, was true or false, that I might leave nothing unassayed […].[198]

Without a doubt, collecting was deeply transforming and rearranging not only the public boundaries of natural history but also the private activities of the sixteenth-century naturalists.

2.9. Natural history institutions and illustrations

Collecting, travelling, experiencing and other activities cultivated by the naturalists of the sixteenth-century were transforming the scientific culture of their time. The institutional transformation at universities testifies the rearrangement that naturalism occasioned in the scientific culture and communities of the sixteenth-century. The necessity of teaching natural history to physicians not only originated the creation of the chair in natural history but also the foundation of botanical gardens and anatomical theatres. The paramount example of the sixteenth-century is the University of Padua. It invested money for developing a new pedagogical infrastructure which reflected the new way to "organize and interpret their world."[199]

The first botanical gardens were founded at Pisa (1544) and Padua (1545) for training physicians, recollecting and experiencing simples, inquiring nature's medicinal features and manufacturing remedies. Naturalists taught to their disciples the importance of travelling for observing and collecting, so they them to learn and gather directly at the field. The prestigious lecturer Luca Ghini, who held the first chair in botany at Pisa and Bologna, introduced the field trips as part of his course. Soon he was followed:

> In imitation of Ghini, Aldrovandi frequently took his students on summer excursions, while students of Anguillara in Padua made pilgrimages to Mattioli in Goritia to learn from the acknowledged master of Dioscorides.[…] The growth of herbaria at the hands of such scholars as Aldrovandi and Cesalpino gives testimony to the facility with which these techniques spread; Aldrovandi had more than 14, 500 specimens and 2, 000 illustrations of plants by 1570.[200]

[198] Della Porta, 1957: p.xiii-xiv.
[199] Findlen, 2006: p.7.
[200] Findlen, 1994: p.166.

This new proposal was an excellent pedagogical tool. It also helped to enlarge the collector's collection and contributed to the development of the illustration and depiction of specimens. Thus the naturalists did not only observed and collected the natural objects but also elaborated detailed visual records or entrusted some virtuoso to do it for them.[201] Images become a central element of the sixteenth-century herbariums, catalogues and printed materials. Usually the authorities relied in discursive descriptions without making any use of quality and detailed images. In his *Miscellanea di animali e piante depinte*, Aldrovandi recognize the epistemological power of image at the time he complains about the lack of images in the authorities:

> By the means of these pictures, together with the histories, scholars gain full knowledge of what [the plants and animals] were according to the ancients. And one cannot imagine anything more useful; if the ancients had drawn and painted all of the things which they described, one would not find so many doubts and endless errors among writers.[202]

As it can be seen, during the sixteenth-century the image acquired a vital role. It was easier to identify unambiguously objects by reading and seeing them through woodcuts and engravings which realistically and accurately depicted specimens. Furthermore, drawings and illustrations were also useful as "an active organizational tool […],"[203] as Aldrovandi's *Index insectorum* (1593) testifies. For example, insects are catalogued according to their printed visual features (e.g., type, size, form); this cataloguing technique gave an "[…] infinitely variable and adaptable system of classification."[204] Therefore, illustrating techniques were highly developed in the Renaissance, such as adding colour. Teaching by means of displaying images of objects or the objects themselves to an audience was definitely a hallmark of the naturalist of the sixteenth-century.

Natural knowledge consisted not only in the exterior aspects of natural things but also in knowing their interior structure and functions. Dissection was the technique that revealed the hidden secrets inside the bodies. Aldrovandi claimed that "who wishes to judge […] natural things, beyond theory, must have practice, not only in the description of the exterior parts, but also in the particular anatomy of plants and

[201] Cfr. *Ivi.* pp.167-9.
[202] Aldrovandi quoted by Findlen, 1994: p.69.
[203] Neri, 2011: p.44.
[204] *Ivi.* p.44.

animals."[205] And their contemporary colleges totally agreed. Anatomical demonstrations were carried on not only in the anatomical theatres, but also in the botanic gardens, and in the museums.

The first permanent anatomical theatre was founded in 1594 at the University of Padua by the anatomist Girolamo Fabrici, a teacher of Harvey.[206] Spectators were not only students that learn by observing but also notable witnesses, such as other naturalists or some authority of the city, who validated the practices and its epistemological results.[207]

Image played a revolutionary role within the domain of anatomy during the sixteenth-century. According to Massimo Rinaldi, it was precisely at the University of Padua that a new iconographic innovation occurred with the publication of Vesalio's *Epitome* in 1543. Andrea Vesalio was fully aware of the fashion of printing fraudulent compendia, so he decided to work on his own compendium: in this way he would produce an exact and simple approach to the issues he treated in his *Fabrica*, preventing someone else from doing it deceitfully. Vesalio presents anatomic knowledge in a descriptive and analytical way by means of tables and engravings of the body. The Vesalian typographical approach demonstrated the important role of visualization in the organization and transmission of anatomical knowledge and its superiority over the scholastic perspective. However, Vesalio not only showed that compendia and epitomes were better pedagogical instruments since they acted as introductions and guides for acquiring knowledge, due to its summarizing virtues, but he was also innovative in the way in which anatomy had to be presented and transmitted to the reader. He was not only using engravings of the body as a means of illustrating anatomical knowledge, as they were traditionally depicted in what is called the *corpo-museo*: Vesalio's substitution of the anatomical linear narrative with its particular style of iconographic representation made it easier and more accurate to approach anatomical subjects. Vesalio was introducing the demonstrative character of the figurative dimension in which anatomical data were represented.[208] He used tables, schematic devices, and other printing technologies as inquisitive anatomical instruments. In this manner, Vesalio

[205] Aldrovandi quoted by Findlen, 1994: p.211.
[206] Cfr. Windelspecht, 2002: pp.23-25; Klestinec, 2007: p.439, note 18.
[207] Cfr. Findlen, 1994: pp.208-210.
[208] Cfr. Rinaldi, 2007: p.40.

transformed the notion of *corpo-museo* into the *corpo-laboratorio*, i.e., the use of anatomical tables in the formulation of anatomical problems.[209]

The training by means of experiencing nature within determinate physical spaces had become an important aspect of the teaching of *materia medica* during the sixteenth century. In few decades, collecting was generating new places for both knowledge transmission and its production. And also collecting was given a epistemological status to the illustrations, which at the end were the observations that the naturalist made by means of anatomical dissections, a field trip, or in any another way.

2.10. Natural history, medicine and wonders.

The close relation that medicine share with natural history was emphasized and a hallmark of the sixteenth-century scientific culture, a period in which medicine was the queen of natural inquires. Both Dioscorides and Galen have defined natural history as "[…] the study of objects useful in medicine."[210] Natural history was studied for the use and betterment of mankind, being the human health the noblest and ultimate goal. Therefore, the eventual goal of collecting, observing, describing, classifying and understanding natural objects was to learn something useful in relationship with the medicinal properties of natural objects.

Naturalists collected and studied all kind of natural beings in their museums: from ordinary plants and animals to extraordinary or curious ones, such as unicorns. For example, in 1572 the Italian naturalist Ulysses Aldrovandi (1522-1605), the owner at Rome of the biggest and most important museum of all Europe during the sixteenth-century, was entrusted with the body of a fearsome dragon which was captured near Bologna.[211] The city habitants and authorities wanted to know if the dragon was indeed of natural occurrence. After dissecting it in his museum in front of a Bolognian commission, Aldrovandi diagnosis proof that the dragon was a natural curiosity rich in anatomical meaning.[212] Few years later Aldrovandi published his *Draconology*, a treatise on dragons based in all specimens of dragons and serpents he expertly known, being the dragon of Bologna the most significant.[213] Naturalists, by means of their

[209] Cfr. *Ivi.* p.32.
[210] Findlen, 1994: p.3.
[211] Cfr. *Ivi.* p.17.
[212] Cfr. *Ivi.* p.23.
[213] Cfr. *Ivi.* p.18. Findlen tell us that the attitude of exposing natural curiosities or wonders that impress an audience would be a hallmark of the transformation that museums would suffer during the seventeenth century (cfr. Findlen, 1994: p.44).

analysis procedures and explanations, were trying to demystify the metaphysical implications that natural phenomena used to have during the sixteenth-century. Therefore, the final results of Aldrovandi's diagnosis would never conclude that the dragon was a divine sign or a miracle.

2.11. Medicine: collecting and innovative catalogues

The inventories were further developed by the sixteenth century collectors. Their eager desire of keeping evidence of their housed specimens made them manufacture very well designed catalogues which not only enlisted the specimens of the collection but also contextualized them by providing their information and depiction. Catologues served to diffuse knowledge as well as to preserve its memory. They do not only record quantitatevely the collection but offered an interpretation of it as a whole by systematically arranging and cataloguing each of its specimens under the state of knowledge of the times according to the author. The descriptions made by an author's catalogue usually served many functions:

> First, they recounted the circumstances by which an object entered a museum, often heroic tales of great deeds—the capture of the 1572 dragon […]—distant conquests, and signal visits of important patrons. Second, they situated an object historically, philologically, and comparatively. Collectors always wished to know the etymology of a name and the circumstances of its production; in this fashion, an artefact was located within a literary as well as scientific canon, defined as much by Ovid and Horace as by Aristotle and Pliny. The addition of a new artifact predictably occasioned speculation on its ability to maintain or dismantle long-standing interpretations of its scientific and medicinal properties. Finally collectors could not resist comparing an object to others of its kind. Preferably in museums of equivalent or greater stature. Putting their latest acquisition to the test, they asked, 'Is it bigger, better, stronger, nobler, or—best of all—incomparable?' This is a sample of the different methods by which collectors interrogated each object that came into their possession.[214]

The creation of catalogues in this sense was an innovation of the Renaissance collectors and antiquaries. The most important intellectual object that could be produced from a whole collection housed in a museum was precisely its catalogue.[215]

Museums housed objects and catalogues were their textual representations. Pliny wrote his *Natural History* with the firm intention of treating "all those things which the Greeks include in the Encyclopedia […]" or general education, and many more "[…]

[214] Findlen, 1994: pp.36-37.
[215] Cfr. *Ivi.* p.36.

which were either not known to [his] predecessors, or which have been lately discovered". [216] He describe 20, 000 topics about the nature of things and life that are worthy of attention.[217] No naturalist of the sixteenth-century or before was able to surpass Pliny's enterprise. Aldrovandi the greates collector of the sixteenth-century in 1577 "[…] possessed about 13, 000 things; in 1595, 18, 000; at the turn of the century, approximately 20, 000."[218] However, all sixteenth-century naturalists followed Pliny's desire of treating about all the topics of nature and life (the ones alredy known and the just recently known) in their catalogues. And as Pliny, they were interested in describing *all* the singular and particular things of nature in detail and precision.

The sixteenth-century naturalist dedicated much fatigue and time to the elaboration of their catalogues. For the owner of a museum, the publication of its catalogue was their main goal, the cuspide of their collecting efforts. The publication of a catalogue will convey him a higher status and social prestige even if he did not write it.[219] Something that usually happened due to the dimensions of the collections. For example, Giovan Battista Olivi's catalogue titled *De reconditis et praecipuis collectaneis ab honestissimo, et solertissimo Francisco Calceolari Veronensi in Musaeo adservatis* (Verona 1584) was based on his pharmaceutical research at Calzolari's Museum. Olivi studied Calzori's simples, rare spices, nature curiosities (e.g. a unicorn's horn), antidotes and artefacts; the catalogue not only described a part of Calzori's collection, but also was useful for the trading of simples.[220] Therefore, Museums were also spaces for buying and selling items, especially naturalists trade with the simples which compose remedies.

We can understand the trading of simples that took place in museums only if we take in account the strong bound between medicine and natural history. Medicine was intrinsically related to sixteenth-century museums. Sixteenth-century naturalists were aiming to use nature for the benefit of humanity. Their ultimate goal was human health, and consequently the use of simples for the production of better medicines was their most important task.[221] This attitude was characteristic of the naturalists of the sixteenth century, such as Aldrovandi and Calzolari, whose collecting was aimed to find the uses of nature for the benefit humanity. The medicinal uses of nature are a key topic of

[216] Pliny, 1938: dedication: p.8, p.10.
[217] Cfr. *Ivi.* pp.8-10.
[218] Findlen, 1994, p.63.
[219] Cfr. *Ivi.* p.37.
[220] Cfr. *Ivi.* pp.37-38.
[221] Cfr. *Ivi.* p.44.

natural history, which was refereed as *materia medica* by physicians, such as Galen, Dioscorides, and Avicena.[222] Eleven books of the thirty three that composed Pliny's natural history are addressed to medical issues. For example, which parts of cultivated plants are proper for food and medicine; which garlands and medicines are made from plants; which medicines are made from wine and cultivated trees; which medicines are made from forest trees; which medicines are made from wild plants; which medicines are made from certain plants for diseases and new disease; which are other plants and medicines; which medicines are procured from man and large animals; which medicines are made from other animals and which are the medical authors; which medicines cured certain parts of the body; and which medicines are from aquatic animals.[223] As it can be seen, the thirty percent dedicate to medicine in Pliny's *Natural History* also is in its majority dedicated to the making of medicines from nature. At the end, all the activities of naturalists, such as travels, collecting, dissecting, distilling, exchanging and so on were in great degree focus in finding the medical uses of nature for the benefit of humankind. And this pursuit did not only benefit humanity but also the economy of the apothecaries, and naturalists that produce, and trade medicines. After all, the business of medicine seems to have been very profitable in the sixteenth-century. Both manufacturing remedies and curing patients were two branches of the same medical discipline medicine. They were usually carried on by two different professionals: the chemist or pharmacist and the physician. And the problem of clearly demarcated by defining their practices, knowledge, responsibilities and boundaries has been a fundamental problematic in the history of pharmacy.[224] In that time the pharmacist knowledge, skills and responsibilities were very different to our days. They become cleared defined, as we know them today, during the nineteenth-century when pharmacy was divided in pharmacology, pharmacognosy, pharmaceutical chemistry and pharmaceutics.[225] The pharmacist of the sixteenth-century not only studied the virtues and natural origins of drugs, analyzed and synthesized chemically drugs (i.e., *spagyria*), and manufactured medicines, but also he had extended roles, such as diagnosing minor conditions, prescribing medicines, and giving health advice.[226]

[222] Cfr. *Ivi.* p.154.
[223] Cfr. Pliny, 1938: dedication: p.14
[224] Cfr. Anderson, 2005: p.4.
[225] Cfr. *Idem.*
[226] Cfr. *Ivi.* p.3.

Part II. Bartolome Maranta: the making of theriac

Introduction

In this section we will exemplified with a study case how the methods used by the naturalists of the sixteenth century actually interacted among them in the domain of pharmaceuticals. We will analyze the scientific agenda that presented the production of a drug to the apothecaries of the sixteenth-century. There is not better example than the theriac: the paramount antidote of the times. And thus, the scientific problems that its elaboration presented were of capital importance to the sixteenth-century community of naturalists, physicians, and apothecaries. In Italy, as in the rest of Europe, there were many prestigious naturalists that engage in this practical scientific quest. There is a very interesting approach on the subject made by Bartolomeo Maranta, a famous physician of the University of Salerno; and Ferrante Imperato, a collector and apothecary from Naples. In other words, both scholarly and experience summed forces to solve the scientific demands of their time. The book of Maranta *Della Theriaca et del Mithridato* (1572) resumes this fascinating and fruitful approach, and thus it consists in a suitable historical record for analyzing the interaction of the natural methods used in the sixteenth-century.[1]

[1] Maranta was considered an expert in theriac matters beyond his century. For example, in 1724, the Spanish apothecary Domingo Guillen mentions Maranta's name within the list of the most excel theriac makers of all times (cfr. Guillen, 1724: pp.9-10).

Maranta's book will guide us through each step of the preparation of theriac. We will expose their recipe for making theriac, emphasizing the methodology he applies to solve the practico-pharmaceutical problems which arose when making medicines. Our approach is based in the problematic of making theriac rather than in the exhaustive description of the ingredients and laboratory process that were used in its elaboration. Therefore, only some selected ingredients and processes will be mentioned to illustrate our account.

Chapter 3. A royal antidote: the theriac

3.1. Pharmacy: the link between natural history and medicine during the sixteenth-century

The long tradition in natural history inherited by the sixteenth-century naturalists, as we have already seen, believed that main goal of studying nature was to render it useful to mankind. And according to the authorities in natural history, such as Dioscorides, Theoprahstus, and Pliny, the most useful knowledge natural history could give to mankind was precisely the medical knowledge to recover and maintain human health. In some way, all the innovative activities carried on by the sixteenth-century naturalists were headed to develop medicine. Not only the prescription but the making of antidotes was a *fundamental* part of medicine. Mattioli told the importance of natural history studies on simples to the Queen of Poland, Catherine:

> Onde meritatamente, & senza dubbio veruno si puo affermare, che questa gloriosa scienza di Medicina, ne sia stata insiememente creata, & insegnata da Iddio solo, & che però meritamente sia chiamta divina; & spetialmente quella parte, che comprende l'historia, le facultà, & la dottrina dei semplici medicamenti, come primordio del tutto.[2]

For Mattioli, as for many naturalists, the fundament of medicine, and eventually of human health, resided in the knowledge of simples. The knowledge of simples was practical rather than theoretical. As we have mentioned already, experiencing the simples through the five senses was more important than knowing the etymology of their names. And the preparation and application of composed natural medicines involved a wide variety of practical knowledge since times of Dioscorides, who taught in his *De material medica* all what was needed to become skilful in making medicines:

[2] Mattioli, 1563: dedication to Queen Catherine.

> Necessariam quidem esse doctinam de medicamentis, omnibus est manifestum, ut quae toti sit arti coniuncta omnibusque eius partibus praesentissimum exhibeat auxilium. Quin et ars ipsa e praeparationibus, mixturis experimentisque quae in morbis instituuntur, augmenta capere potest, plurimum ad id conferente singulorum medicamentorum cognitione.[3]

The making of medicines was tightly linked with biology (botany and zoology) as well as chemistry. The bound was not theoretical but very practical. The elaboration of medicines could require harvesting some plants, hunting a particular animal, and eventually their artificial manipulation through laboratory procedures, such as distillation. Moreover, many chemical remedies only could be produced artificially at a chemical laboratory. Chemistry was an essential "craft applied to medicine."[4] Giuseppe Donzelli, the philosopher, physician, and chemist from Naples, explains the necessity of beginning his *Teatro farmaceutico dogmatico, espagirico* (1681) with the chemical discourse a century later of the sixteenth-century:

> Era d'assoluta necessità, che il presente Discorso Chimico, fosse collocato nel primo luogo di questo Teatro, […] che per lungo tempo ha tenuto in contrasto l'animo mio, se potesse convenirmi il publicar un ben corretto Antidotario, con aggiungervi anche il vero modo di comporre i medicamenti Chimici; conciosia cosa che è tanta oggidì nel Mondo la malignità d'alcuni, che pazzamente oppugnando quello, che non conoscono, mossi da cieco furore, aguzzano, quasi in ogni congresso la lingua, e i denti contro questo nobilissimo Magisterio, e prendendone l'occasione della cieca ignoranza di qualche prosontuoso Empirico, aggravano di scorni tutta la Professione […]. Pietro Andrea Matthioli dice chiaramente, che non solo non può essere buon Medico, ma ne anche mediocre, chi non è istrutto dall'arte Chimica, perche senza la guida di essa, camina dietro à scorta fallace, e cieca […].[5]

The pharmaceutical branch of medicine had being the duty of apothecaries and chemists for centuries. However, as we have already mentioned, during the sixteenth-century the study of simples was introduced into the curriculum of Colleges of Medicine. The idea is perfectly captured in the words of Aldrovandi, a pioneer in natural history lectures:

> […] [the physician] cannot be an expert, as Galen testifies, unless he really knows the true instruments of his profession, that is, the pharmaceutical aspect of

[3] Dioscorides, 1829: p.5.
[4] Wightman, 1962: p.81. As Wightman claims, chemistry as we know today "[…] was virtually non-existent." (Wightman, 1962: pp.80-81) In the final part of the dissertation we will develop exhaustively this issue.
[5] Donzelli, 1704: dedication.

> medicines, as simples as well as compounds […]. We cannot compose a medicine without first knowing the simples.[6]

Physicians felt the necessity to learn *materia medica* in a scholarly way; in part due to the proliferation of quacks who were in the medical business, but also to the errors and bad training of many apothecaries. There were a lot of simples misused as substitutes and also a great quantity of fakes. The men immersed in the medical knowledge felt the necessity to correct these mistakes. For example, Quatramio was convinced that the utilisation of wrong simples in medical recipes had to be stopped. Only genuine simples and its right substitutes must be used. Otherwise, the theriac will become ineffective. This made him wrote a treatise on the royal antidotes:

> [...] mi pareva essere obligatissimo à far tale dechiaratione, vedendo tale abuso, nel pigliar tanti falsi semplici, & adoprar tanti varij succidanei, per li veri, che tutti si trovanno, & con facilità si posson far venire, come nel Trattato si fà noto il modo [...].[7]

Many orthodox physicians were also convinced that theoretico-medical knowledge was more important than the practico-pharmaceutical knowledge. Instead of learning humbly from the apothecaries, they wanted to teach them. This generated a war over the social status of the pharmacist as well as the epistemological credentials of their practices. The pharmacists of the sixteenth-century in some way threatened physicians, because they not only studied the virtues and natural origins of drugs, analyzed and synthesized chemically drugs (spagyria), and manufactured medicines, but diagnosed diseases, prescribed medicines, and gave health advice.[8] Therefore, the battle between physicians and apothecaries went far beyond of the academic domain. And, it was a very important problem. As we will see below, Maranta valued equally the epistemological and social status of these two disciplines. Nevertheless, Maranta's attitude was not the official one. For example, the physician from Padua Marcus Oddus undervalued pharmacy, even if he believed that it was intrinsically necessary to medicine.[9]

Despite their differences, physicians and pharmacists regarded the study of nature "as a medically necessary knowledge."[10] Collecting was a very valued activity. In

[6] Aldrovandi quoted by Findlen, 1994: pp.246-7.
[7] Quatramio, 1597: p.5.
[8] Cfr. Anderson, 2005: p.3.
[9] Cfr. Oddus, 1577: Chapters 1-5.
[10] Findlen, 1994: p.246.

addition to medical knowledge and experience, it provided apothecaries with the simples for making medicines and with "an infinite number of rare things for the apothecary's profession."[11] Collecting was not only a mandatory activity for the medical business of selling drugs, but also for confronting and comparing simples to determine their medical properties, genuineness, and utility. Botanical gardens as well as museums fulfilled this important task. Many natural historians, who owned a museum, such as Calzolari or Imperato, were also drug-sellers. The simples and antidotes displayed in their museums "[…] reinforced the authoritative nature of the medicines [they] sold to costumers."[12] As we have already mentioned, the catalogue of Giovanni Battista Olivi's titled *De reconditis et pracipuis collectaneis ab honestissimo, et solertissimo Francisco Calceolari Veronensi in Musaeo adservatis* (Verona, 1584) described the *materia medica* displayed at Calzolari's Museum in Verona. Not only the simples and antidotes, but the very devices of distillation triggered Olivi's admiration on Calzalori's pharmaceutical knowledge. Olivi's catalogue focuses in Calzolari's pharmaceutical knowledge, mainly in his antidotes, and particularly one occupies the central position: the theriac.[13]

According to Findlen, Calzolari cured Olivi's son by giving him theriac.[14] But this was not the reason that motivated Olivi's description of Calzolari's theriac. In fact, the theriac was the more important item within the whole collection housed in Calzolari's museum.[15] Theriac by itself was one of the most famous medicines, along with mithridatium, since ancient times. The theriac has been regarded as the most perfect and effective antidote of all antidotes by the great majority of naturalists, physicians, and pharmacists from ancient times till the sixteenth-century. And the theriac in Calzolari's Museum was very special. It was regarded by many as the best theriac produced in the sixteenth-century. This was a great achievement from the pharmaceutical point of view. For this reason, Calzolari's Museum displayed theriac as its highlight. It showed the skilfulness of Calzolari's as apothecary; and it also represented a huge progress of natural history towards its main goal: the study of nature for the benefit of mankind. In the sixteenth-century, there was not any remedy which could be more beneficial for humankind than the theriac antidote.

[11] Imperato quoted by Findlen, 1966: p.246.
[12] Findlen, 1994: p.246.
[13] Cfr. *Ivi.* pp.37-44.
[14] Cfr. *Ivi.* p.40.
[15] Cfr. *Ivi.* pp.279-280.

3.2. Theriac: the universal medicine

What was an antidote and what sort of antidote exactly was the theriac? According to Maranta, the physicians of their time used 'antidote' in an extensive way to refer to all the compound remedies which were drunk to "correggere malii del corpo, che nascono per le cause intrinseche."[16] However, the original use of 'antidote' was only to those drinkable compounds against venoms,[17] such as the famous hemlock which Socrates drunk as death sentence. The theriac bore as an antidote against all kinds of venoms. It consists in a compound of around 64 ingredients (that go from diverse types of plants to viper meat) divided in six "compartments" which, very roughly speaking, are distilled or crush for eventually being combined with wine and honey.[18] Theriac both protected and cured from the venom of all poisonous beasts, such as snakes, spiders, scorpions, rats or mad dogs.[19] Bitten by a venomous animal or poisoned by a criminal, it was enough to take a theriac's dosage equivalent to the amount of a walnut with some wine to stop the action of the venom. The same dosage, as a prophylactic, was prescribed before an imminent danger of poisoning.[20]

However, the theriac was not an 'antidote' in an original sense but in a very extensive way. It was good for a wide range of illnesses, both of the body and of the soul. According to Maranta, one of the most relevant medicinal virtues of the theriac was its capability of heating all the body parts draining from the sicken body all the noxious substances:

> Preserva ancora il corpo, percio che induce à i corpi un ottimo temperamento, & conserva in essi la sanità, & ciò perche consuma gli humori disutili, risclada i membri raffredati: & fortificando la virtù naturale, fa che possa agevolmente essercitare le sue attioni; cosa chiara essendo, che quando la natura è forte; all'hora si smaltisce bene il cibo: il fegato guarisca bene, & l'una e l'altra colera manda fuori del sangue: onde il cuore ricevendo il sangue puro & senza feccia, lo fa poi attissimo à notrire bene tutto il corpo; & le vene si riempieno di sangue purificato, onde si prolonga la vita. Manda fuori con moderanza tutti gli escrementi non solo

[16] Maranta 1572: p.7.
[17] Cfr. *Idem.*
[18] Usually antidotes against venoms were more simple compounds. For example, Apolludorus' "all-heal" for all sorts of venoms consisted in crushing "[…] the root [of great centaury] when dry or still green in a mortar, mix in a cotyle [1/2 pint] of wine, and drink." (Watson, 1966: p.14) Cornelius Celsus prescribed it mixed with other things against the venom of the haemorrhois: "[…] polygermander with rue, or trefoil, and wildmint and juice of all-heal along with vinegar." (Watson, 1966: p.17)
[19] Cfr. Maranta 1572: pp.5-6; p.163.
[20] Cfr. *Ivi.* p.164.

> quelli, che sono reliquie del cibo, ma ancora i più sottili, per la urina, per sudore, & per la traspiratione, che si fa da i pori del corpo insensibilmente [...].[21]

As Maranta explains, theriac consumed or dissolved the corrupted humors of the body restoring its optimum temperament or health again. Thanks to its purifying virtues by means of heating, Theriac was a very effective remedy against putrefying diseases. For instance, according to Maranta, it preserved from pests, such as the Ethiopian pest which Galen combated; and it diminished leprosy and sometimes even healed it.[22] The purifying virtues of theriac also made it an excellent purgation therapy. It did not only purge the stomach, but also the stones from kidneys and bladder.[23] Theriac purged from the body virtually any obstruction. For example, a theriac's high dosage could be used as curettage therapy when a dead fetus was risking its mother life, because it caused women's menstruation.[24] Theriac also was efficacious against the mental illnesses. For example, it burned and expelled all the excess of black bile which according to their medical framework caused melancholy.[25]

Another medicinal virtue of theriac—which acted along with its heating virtue—was its capacity to induce sleep. In this manner, people were freed from pain and stress. It was enough to give the right dosage of opium according to the age of the patient and its ailment. This relaxing virtues made it an efficacious against flu, cough, blood spitting, and even mental illness, such as the choleric temperament, because theriac put patients into a calmly sleep.[26]

Maranta's list of illnesses which were cured by drinking theriac is really huge. Theriac de-wormed the intestines; it healed any sort of congestions; it healed from headaches and vertigo; it helped old people to see and hear better; it healed asthma; it restored strength and avoided fainting; it reestablished the natural appetite; it was efficacious against abdominal colic and other stomach pains; it vanished bad smells from the body; it was good for the spleen; it healed rheumatism and all the pains in the bone conjunctures; it healed all the fevers; it made slim fat people; it maintained perfectly functioning the five senses as well as the mind faculties; and Maranta continues given many more examples.[27] Summarizing, the theriac was virtually

[21] *Ivi.* p.163.
[22] *Idem.*
[23] Cfr. *Ivi.* p.167.
[24] Cfr. *Idem.*
[25] Cfr. *Ivi.* pp.164-166.
[26] Cfr. *Ivi.* p.165.
[27] Cfr. *Ivi.* pp.163-168.

efficacious against every known disease, and even it had sometimes successfully cured terminal illnesses:

> Dirassi dunque questo Antidoto essere buono per ogni affetto, il quale sia stato indarno tentato di gaurirsi con gli altri rimedij; percioche per gravissimo che sia & quasi senza speranza di guarirsi, è avenuto spesso, che fuori di ogni credenza, sia stato superato della Theriaca: potendosi dire che, alle volte non la sanità, ma la vita habbia data all'infermo: & la sua operatione si è chiamata piùtosto un risuscitare, che un rimediare.[28]

Without doubt the theriac was a magnificent remedy in the sixteenth-century. It was good for the body and for the soul. Theriac made them both to operate perfectly. It healed the sick people and preserved the health of the healthy people.[29] Definetely, theriac did worth its value in gold. Surely, it was a good inversion for a pilgrim who would want to conserve his health and strength and be protected against almost all diseases. Theriac would keep pilgrims as well as any traveler because it heats the body keeping it safe from the corrupted waters and airs.[30]

According to Maranta, the theriac was a multi-medicament which not only heals the sick body from all maladies, but it also "*prolonga* la vita."[31] Theriac was not an elixir of eternal life, but it was a *quasi* universal medicine. And it was officially justified by the pharmaceutical knowledge of the sixteenth-century.

3.2.1. Renaissance's official theory of antidotes

During the sixteenth-century, the most eminent official authority in pharmaceuticals was Galen. Almost all Renaissance's apothecaries had converted Galen's framework of elaborating drugs in their pharmaceutical canon.

According to the Galenean theory for making medicines, there are four natural qualities or innate powers: two active qualities, heating and chilling; and two passive properties, drying and moistening.[32] Plants, animal parts, minerals, and all material substances necessarily manifest a couple pair between an active quality and a passive one. Therefore, the four natural qualities can co-exist coupled in an individual simple in one of the following four ways: heating-drying, heating-moistening, chilling-drying, chilling-moistening. Therefore, a simple presents necessarily one of the mentioned

[28] *Ivi.* p.169.
[29] Cfr. *Ivi.* p.163.
[30] Cfr. *Idem.*
[31] *Idem.*
[32] Cfr. Totelin, 2004: p.16.

combinations of qualities. Furthermore, there are fourth degrees of potency or intensity in which each quality can separately manifest: "(1) fairly perceptible; (2) definitely perceptible; (3) strong; (4) burning."[33] Consequently, the heating quality could predominate over its paired partner due to their higher degree of potency. However, the four natural qualities mentioned are not the only existing qualities in nature, but they are the more fundamental. Nature is full of different and diverse manifest qualities as well as occult ones. As Maranta clearly mentions when talking about the fermentation effects over both types of qualities:

> Un'altra cosa è anco da notarsi, che havendo quasi tutti i semplici della Theriaca due considerationi; l'una in quanto alle manifeste, & apparenti qualità con lequali oprano: come è riscladare, raffredare, provocare l'orina, nettare, costrignere, & altre simili, che chiaramente paiono venire da quelle qualità che à i sensi nostri si dimostrano; l'altra inquanto à quelle virtù, lequali vengono d'occolta, & indicibile proprietà; come è il guarire il morso dello Scorpione, della vipera, del cane rabbioso. Hora la fermentatione se bene riguarda la una & l'altra; nondimeno, molto meno attende alla prima, che non fa alla seconda: & molto più mantiene incorrotte le occolte proprietà, che non le manifeste. Percioche bisognando tempo à farsi l'unione; le apparenti proprietà restano assai domate: non già le occolte: lequali oprano, non perche naschino dal caldo, ò dal freddo, ò dalla apertione, ò dalla costrittione: ma per altra cagione à i medici, & à i filosofi nascosta: & perciò manco detrimento ne viene a i semplici per la fermentatione nelle indicibili proprietà; che non è nelle palese. Ne aviene à quelle, come à queste: percioche, perche un semplice sia buono per lo morso dell'Aspide, non si troverà un'altro semplice, che di occolta proprietà se gli opponga se non fusse istesso veneno: ne perche sia qualche altro semplice buono per lo Ceraste, ò per la Diapsa, ò per altro animale fiero; perciò verrà a scemare la occolta qualità del primo. Dunque è chiaro che la fermentatione molto piu favorisce la occolta, che non la manifiesta proprietà de i semplici.[34]

Therefore, simples have additional sensorial qualities, which can be determined by the respective trained sense. For example, the sweetness, bitterness, astringency, or sharpness of a simple can be easily determined by the sense of taste, but its degree of potency would require an acute and well trained taste. However, for determining the manifest qualities, the apothecary had to select the appropriate sensory organ to test the simple, because he could be deceived if he chose a wrong sense. For example, the sense of sight is not enough to determining the chilling properties of a simple, because there are many white things, and they are not precisely as chilling as the snow. Recurring to the five trained senses was the safer policy for an apothecary of the sixteenth-century

[33] Watson, 1966: p.72.
[34] Maranta, 1572: p.153.

when making drugs.[35] On the contrary, occult qualities by definition cannot be directly detected by the sensory organs, so they had to be inferred from experience.

Taking in account the qualities of simples, the Galenian apothecaries sought to counteract the symptoms of diseases with the opposed effects that simples produced over people.[36] For instance, a hot fever could be counteracted with cold water. The manufacturing of drugs was a more sophisticated and complex process than our example. Firstly, it consisted in diligently determining the qualities and degrees of a disease; secondly, in searching the simples with opposed qualities and degrees; and finally, in proceeding to artificially elaborate a compound drug with the purpose of eventually equilibrate the harmful qualities with the medicinal ones. If the drug worked successfully, then the natural balance of the humors of the body (i.e. blood, phlegm, black bile, yellow bile) would be restored.[37] In other words, a drug appropriately produced would restore the health to sick person. Therefore, from the point of view of Galen's theory of antidotes, the medicinal efficacy of antidotes and drugs was explained by "the principle of healing by contraries."[38]

Generally speaking, almost all diseases were harmful due to their chilling active quality as well as "[…] ogni veneno per la maggiore parte amazza co'l freddo."[39] Consequently, when making a compound drug, the apothecary added up as many heating-drying simples as needed to counteract the chilling-moistening effects of a disease or poison. In this manner, the balance of the body humors could be restored.[40] However, the theriac was not an ordinary antidote; it was not created to heal a specific disease or act against any particular venom. It was a multi-medicament designed to cure all diseases and protect against all venoms. Therefore, it was composed with simples of diverse qualities and degrees, for example:

> […] cinnamon is in the third order of heating and within that order is the most drying; frankincense is in the second order of heating and the first of drying, and is slightly astringent; cepa (onion) is in the fourth order of heating; acacia is in the third order of drying, and in the second of chilling when washed, when unwashed in the first; wild rue is in the fourth order of both heating and drying, and is sharp and bitter; poppy (opium) is of the fourth order of chilling; […] crocus is slightly astringent, in the second order of heating and the first of drying; galbanum is on the

[35] Cfr. Watson, 1966: p.72.
[36] Cfr. *Ivi.* pp.58-59.
[37] Cfr. *Ivi.* p.74.
[38] Cfr. *Idem*.
[39] Maranta, 1572: p.153.
[40] Cfr. Totelin, 2004, p.16.

> border-line between the second and third order of heating and between the first and second of drying; terebinth (turpentine resin) is astringent, of the second order of both heating and drying, but the dried 'fruit' is almost of the third order of drying; chamaedrys is bitter and somewhat sharp, of the third order of both heating and drying, but its heating power is greater than its drying power; petroselinum is sharp and bitter, of the third order of heating and drying; absinthium is more astringent and less hot than abrotonon, which is of the third order of heating and drying. As for animals, viper's flesh […] is drying, strongly diaphoretic, and moderately heating; castoreum, […] heats and dries. Being very fluid it penetrates further into the body and heats and dries more effectively than other drying and heating substances; it can be used internally or externally. […] All earths and minerals chill. Chalcitis (roasted copper) dries, is sharp and astringent. Bitumen from the Dead Sea is in the second order of both heating and drying.[41]

As we can see, Theriac contains a few chilling simples, and some like the poppy are of fourth degree! As Totelin points out, if the majority of the diseases are chilling, it seems paradoxical to put many simples which manifest a chilling quality in high degree.[42] However, Galen thought otherwise. He admits that poppy-juice can be fatal if it is drunk alone, but if it is mixed with other simples in a compound, it becomes helpful to the sick.[43] Moreover, he explains why multi-medicament compounds require contrary simples, rather than similar:

> If simple drugs alone could cure all maladies, compound ones would never be needed. The case is quite different. Often when we wish to heat the body to a certain point, we have no simple drug to do that effectively, for the healing drug must correspond to the condition which has to be healed. If the condition be cold in the fourth order, clearly the drug that is to heal it must be in the fourth order of heating. Should no such [suitable] drug be available, if we have two, one of the fifth order and the other of the third order, and mix them, we get a mean, a drug of the fourth order. […] Moreover, some simple drugs cannot be used unmixed for certain purposes—for example, in plasters. Therefore the inventors of plasters deliberately restored to roasting metals with oil, dissolving what could be dissolved, and adding herbs bruised and sieved. Again, in other morbid conditions we use a single natural drug, but mix with it some other in order to blunt its excessive strength or to mitigate its harshness of taste. […] The need for compound drugs is greatest in the case of diseases requiring contrary forces simultaneously […]; for instance, both thinning and thickening of the humours. The most useful and finest drugs themselves posses or contain contrary forces. And this compounding is necessary when we wish to have a single medicament efficacious against many venomous creatures or many deadly poisons. Hence the antidote called Theriake and, besides it, Mithridatium and many others.[44]

Based on Galen, Maranta gives the following and detailed explanation to the

[41] Watson, 1966: pp.73-74.
[42] Cfr. Totelin, 2004: p.16.
[43] Cfr. Watson, 1966: p.76.
[44] Galen quoted by Watson, 1966: pp.75-76.

problem of chilling simples as components of Theriac:

> Ne potrà farne difficoltà il vedere noi, che nella Theriaca entrino ancora de i semplici freddi i quali si opporanno à i caldi, si che impediscano la loro operatione manifesta; & cosi facciano il corpo non molto traspirabile: percioche si risponde […] che quando non ancora è fatta la fermentatione del composto; mettendosi in uso la sua giusta dosi, primieramente, & per buona pezza inanzi si riducono nell'atto della loro operatione i semplici di natura caldi: & dapoi per notabile intervallo i freddi: & aviene alle volte che quando i caldi hanno finita la loro operatione & che non resta più in loro parte dellla virtù, cominciano à dimostrasi in attto i freddi: i quali non havendo contrasto da i caldi gia suaniti; fanno segnalata alteratione nel corpo: il che si vede nelle Opiate compositioni, lequali quando di fresco fatte si adoprano, ancora che habbiano molti semplici caldissimi, sempre mostrano più evidenti le qualità fredde, & stupefattive; che non le calide: essendo il caldo (come dicono i filosofi) più attivo, & di più celere operatione. & in tali composti non oprano altro, che aprendo le vie far luogo all'Opio, che da per se pegrissimo essendo diffilcilmente si distribuisce pe'l corpo: Dunque quando la Theriaca si adopera fresca, la prima cosa che fà, mette in opera tutti i semplici caldi, & fà traspirare il veneno per ogni buco ò picciolo ò grande che sia nel corpo. Dapoi a lento passo venendo i semplici freddi; giovano a ottundere il veneno con la loro occolta proprietà. […] [Nel composto fresco] i semplici freddi non si oppongono a i calidi, quando il composto è fresco, & non fermentato: ma traspira il corpo per l'operatione de'caldi, come se i freddi non vi fussero: & ciò aviene perche non è ancora fra i caldi, e i freddi fatta la attione, & reattione; per laquale vengono à indebolire alquanto le loro qualità.[45]

Therefore, as Maranta explains, the contrary forces act one after another and not contemporary according to the maturity of the antidote, being the fermentation the key process. Eventually, when theriac fermentation process finished, the chilling simples would not oppose anymore to the heating ones. They would become beneficial to human health, rendering the Theriac its universal medicinal virtues.

3.3. The origins of theriac: Mithridates and Andromachus

Since ancient times venomous creatures have menaced mankind. Farmers, peasants, travellers, soldiers in campaign, and virtually anybody in the field could be easily bitten by a snake, or stung by a scorpion, dying quickly. However, there was a more evil danger menacing the life of people than lurked venomous creatures: poisoning. Not only important people like Kings and Emperors were afraid of been poisoned but also any ordinary person fear to be poisoned by an enemy. Always was possible to hire for a suitable fee a criminal disposed to murder stealthy and effectively.[46]

[45] Maranta, 1572: pp.154-155.
[46] Cfr. Watson, 1966: pp.81-87.

Nero used to get rid of his opponents by poisoning them. He had his own personal poisoner, a woman called Lucasta.[47] And like him, many powerful leaders applied the same policy through centuries. A banquet always could be the last for some guest or the very host. Kings and Queens knew they were in constant danger. The punishments for murdering by means of poison were severe. For instance, criminal poisoners were boiled to death at London from 1531 until 1542.[48]

The development of antidotes against venoms constituted a significant practical problem that physicians and apothecaries have to solve since antiquity till Renaissance. The theriac antidote was precisely a convenient solution to this problem. Theriac's legendary origins go back in time to the Kingdom of Pontus in Asia Minor and its King, Mithridates VI (114-63 B. C.), who was attempting to develop an antidote against all venoms due to the common threat of being killed by drinking poison. Pliny describes Mithridates as:

> […] an especially diligent student of medicine, and collected detailed knowledge from all his subjects, who comprised a great part of the world, leaving among his private possessions a bookcase of these treatise (comentationum) with specimens (exemplaria) and the properties of each.[49]

The Mithridates King along with Crateva, his personal physician,[50] vehemently researched, worked, and tested many compounds and recipes. According to Maranta, the Mithridates King was questioning himself if it was "[…] possible à ritrovarsi una cosa fatta per arte, laquale non come cosa humana, ma più tosto come divina, potesse à tutti i mali del mondo sempre con vittoria opporsi."[51] Mithridates's efforts were crowned with one electuary which gave him fame and glory for hundreds of centuries: the mithridatium antidote. It was a fusion of all his successful recipes against venoms into one compound antidote, which protect him to all venoms at once. A daily dose of it made him immune to venoms.[52] As the legend tells, when Pompeius vanquished him, Mithridates tried to commit suicide by drinking poison but he failed, and had to ask one of his friends to kill him with his sword. Galen tells us the tragic end of Mithridates:

[47] Cfr. *Ivi.* p.82.
[48] Cfr. *Ivi.* p.115.
[49] Pliny quoted by Totelin, 2004: p.3.
[50] Cfr. Cappelletti, 2002: p.15.
[51] Maranta, 1572: Proem; p.2.
[52] Cfr. Watson, 1966: pp.34-35.

> They said that Mitrhidates himself, the great warrior, having taken not Theriac—as it did not exist yet—but another much-mixed antidote, the one that is named by his name, […] could not die after having taken poison […] whilst his daughters, who wanted, by filial love, to follow him in death, died quickly after drinking the same poison. Then as Mithridates was slow to die, the poison being ineffective because he was used to drinking antidotes, he called Bistokos, one of his friends and ordered him to cut his throat and to accomplish with the sword the work of the poison.[53]

The royal booty of Roman victory included all Mithridates's treatises on pharmacology and antidotes. According to Pliny, "[t]his great victory therefore was a benefice to life as it was to the State."[54] The Romans were in possession of the mithridatium recipe, and they quickly Romanized it. The Roman version of the mitrhidatium would be precisely the theriac, and its inventor was Neron's personal physician, namely, Andromachus the Older. Therefore, the role of the King Mitrhidates as well as of Andromachus is crucial. However, Maranta also acknowledges the role Pompeius played in the process of inventing the Theriac:

> Ma tutto ciò io ho al mio proponimento aggiorno per dimostrare, che si il Mithridato non fusse stato, non sarebbe venuto all'animo di Andromaco componere la Theriaca, & perciò, à Mithridate Re come à primo autore, & à Pompeio comè primo, & autentico divulgatore del Mithridato Antidoto tocca anco gran parte della lode, che per la Theriaca Andromaco si acquistò.[55]

Andromachus the Older expanded mitridatium's recipe creating a new antidote. He conserved almost the majority of simples which composed the mitrhidatium, such as the opium, but added around one dozen of new simples, such as Lemnian earth, roasted copper, and bitumen. Andromachus more essential modification to Mitrhidatium antidote was the substitution of a septtentrional African lizard, called skink, for the viper which was easily found in the heart of the Roman Empire.[56] A new antidote was born: the theriac—from the Greek *theriakós*, signifying wild or poisonous beasts.[57] Theriac was like the mithridatium, namely, an antidote against venoms, but it was thought to be more powerful. The theriac medicinal effective virtues did not only reside in the quality of their ingredients, but in their quantity, because it could benefice all

[53] Galen quoted by Totelin, 2004: p.6.
[54] Pliny quoted by Totelin, 2004: p.3.
[55] Maranta, 1572: p.184.
[56] Cfr. *Ivi.* p.6; Berman, 1970: p.5; Watson, 1966: pp.53-54; Cappelletti, 2002: pp.15-16.
[57] Cfr. Maranta, 1572: 6; Parojcic, 2003: p.28.

kinds of human complexions, thus becoming a sort of universal antidote, that is, it was against all venoms and effective in all human beings, surpassing the mitrhidatium. As Maranta said:

> [...] questo Antidoto provedere à così strani casi, acciò chi fusse ò per morsicatura di fiera, o per veneno in pericolo certisimo di vita, havesse con che discacciarlo subito & al sicuro. Ma perche le nature & complesioni de gli huomini sono tanto diverse, che molti rimedii semplici giovano manifestamente a uno, che à un' altro non fanno util veruno, anzi alle volte nuocono, volsero con la moltitudine de medicamenti provedere à tutte le nature, & prorprietà de corpi humani, acciò se con un contraveneno à qualque particolar complesione non puo giovarsi, si giovi con l'altro, o con molti altri. [...] Et per questa cagione la Theriaca è singolar contraveneno à tutti i veneni e à tutte le nature, & complesioni de gli huomini, che se averrà per aventura, che à qualcuno non giovi, s'ha da imputare solo alla mala compositione di essa, fatta per ignoranza, ò stracuragine de'Medico o de gli Speciali.[58]

Precisely, each simple that composed the theriac served to restore and maintain the health of each particular organ and function of the human body. Consequently, the combination of all them in one compound cured from any disease and preserved the human health entirely, as Galen claimed in his books *On Theriac to Piso*, *On Theriac to Pamphilus*, and *On Antidotes*.[59] In this manner, Galen popularized the theriac becoming his greatest diffuser.[60] Galen believed in the superiority of the theriac with respect to mitrhidatium, as can be read in his story of Mitrhidates death (quoted above). He publicly prepared it in Rome.[61] And not only Galen, many other medical authorities were proud of the healing virtues of the theriac. The use of theriac was widespread. Therefore, after Andromachus the Older invented the theriac antidote, it was highly valued among the European and Arabian communities of physicians. The popular medical treatises recommended theriac against the bites of poisonus beasts. For example, the *Al-Rhama* prescribes:

> I. antidoto contro tutti i veleni: 10 dracme di aglio sbucciato, 10 foglie di acacia, 10 di foglie di fico, 5 di ammoniaca, 5 di terra d'Armenia; il tutto debe essere pestato in polvere fine e eimpastato con miele; II. Antidoto costituito da aglio e miele, da prendere ogni giorno a digiuno; III. Contro il morso della vipera: salasso, cauterizzazione, legatura a monte, medicazione con aglio e sale per impedire la diffusione del veleno, assunzione di succo di limone e aceto; IV. Contro il veleno dello scorpione: *sadab* (Ruta graveolens) verde pestata con aceto e saliva con

[58] Maranta, 1572: p.8.
[59] Cfr. Findlen, 1994: pp.241-2.
[60] Cfr. Parojcic, 2003: p.29.
[61] Cfr. Berman, 1970: p. 5.

> psyllium; V. assunzione di un impasto di miele, burro, trementina di Chio […]; X. trattamento contra scorpioni, serpenti e tarantole: incisione e medicamento con pepe e miele; XI. impiego della teriaca, eccellente contro tutti i veleni. [62]

Thus, theriac was a very famous antidote that became an antidote of international consume during almost two thousand years. For example, Berman affirms that in France the theriac persisted as an official drug till 1908; year in which it entirely disappeared from the medical compendiums.[63]

3.4. The protomedic and theriac's public production

The theriac was an expensive remedy. Many of their simples came form Africa, Asia and the oriental Mediterranean. During the Renaissance, the Republic of Venice held a privileged position with respect to the commerce of simples as well as theriac itself. The Venetian Republic made a high quality theriac and profited of its commerce.[64] Trading Theriac was a very good business, because it was expensive due to their exotic ingredients. Theriac was a standard remedy of elite medical practice, and thus widely consumed by the wealthy people.[65] The poor people who could not afford to pay such a high-priced remedy could buy the "special theriac", attributed to Mesue, commonly used for cattle and composed of four ingredients.[66]

The quantity of charlatans that frequently sold counterfeited or adulterated theriac put in risk not only the health of the people but the richness of the business.[67] Therefore, the production of theriac was under strict regulation and public supervision. The public production of theriac was first regulated by statutes at Venice in 1298. Then Bologna in 1377, Milan in 1389 and other Italian city states adopted the same policies for the production of the theriac.[68] Since then, the apothecary who wished to elaborate theriac could not do it privately. For example, the approximately 40 pharmacies that existed during the Renaissance in Venice were required to present their theriac recipe to

[62] *Al-Rhama* quoted by Canova, 1991: p.234, *emphasis added*.
[63] Cfr. Berman 1970: p.11.
[64] Cfr. Cappelletti, 2002: p.20; p.44.
[65] Cfr. Findlen, 1994: pp.242-243.
[66] Cfr. Berman, 1970: p.6.
[67] Cfr. Bernhard, 1893: pp.83-104.
[68] Cfr. Capelletti, 2002: p.29. Similar statues were proposed in other kingdoms to regulate the theriac production (cfr. Berman, 1970: 5-7; Bernhard, 1893: pp.146-149).

the authorities for approval.[69] After the certification of the College of Medicine, the theriac had to be publicly manufactured by the surveillance of the city magistrates and physicians. For three days before its production, all the ingredients had to be display in a city square for public inspection. As clearly testify the statute for preparing Theriac of Verona in 1586:

> Che alcuno non presume nè ardisca di componer teriaca né mithridatio ovvero altro medicamento di quelli che l'Ecc.mo Collegio de' medici sarà terminato, se prima non haverà messo fuori per giorni tre tutti gl'ingredienti quali possino esser visti a beneplacito di ciascuno che vorrà vederli, et doppo passati li tre giorni non possi componer detto antidoto se gli ingredienti non saranno stati approbati per il Collegio delli Ecc.mi medici sotto pena di ducati dieci oltra la prohibitione di poter veder esso antidoto il quale senza quest'ordine fosse stato composto, la qual pena sia applicata all'offitio che farà l'inquisitione o inventione. Captum de allotis 46 pro, 2 contra.[70]

These public settings were public ceremonies in which all the city was involved. They were celebrated every year in June.[71] After exhibiting the ingredients to public inspection for three consecutive days, and the benediction of the highest ecclesiastical authority of the city, the *triacanti* (i.e. theriacmakers) started the preparation of the coveted antidote under strict surveillance.[72] All the simples have to be skilfully and accurately weighed and mixed in the presence of physicians, magistrates, and protomedics for their approbation.[73] Eventually, the theriac produced in this manner could be sold, because it was legally guaranteed.

Knowing the ingredients and procedures involved in the production of such an important remedy was part of the formation of any apothecary apprentice. In fact, the guilds of apothecaries evaluated the skills of their apprentices by means of complex recipes such as theriac, mitrhidatum, "Hiera composta" of Niccolò Salernitano, or "Olio Mastichino" of Mesue.[74] If apprentices were capable of identifying the simples of these antidotes and know the artificial procedures of its production, they were accepted as apothecary members of the guild. Therefore, it was not necessary to learn the pharmaceutical art in the university, it was sufficient to:

[69] Cfr.Capelletti, 2002: p.30.
[70] "Statuto degli Speziali di Verona" quoted by Capelletti, 2002: pp.70-80.
[71] Cfr. Findlen, 1994: p.242.
[72] Cfr. Watson, 1966: p.105.
[73] Cfr. Capelletti, 2002: pp.31-36.
[74] Stendardo, 2001: p.16.

> […] svolgere un regolare apprendistato presso una bottega già affermata, cui seguiva un esame di ammissione all'Arte, […] nel cui contesto il Protomedico chiedeva al candidato dove e con chi avesse studiato e fatto pratica e se lo interrogava sulle Prammatiche riguardanti la farmacia […]. Condizione essenziale per l'immatricolazione all'Arte era anche una posizione economicamente agiata, per evitare che l'attività di speziale fosse svolta a fini di lucro e per salvaguardare l'autonomia professionale e il buon nome della categoria.[75]

The so called protomedics also had exhaustive control over the pharmacies of their apothecary guild. They were chosen among the most prestigious members of the guild to make regular but unexpected visits to the city pharmacies to check out the quality of the ingredients used in the remedies as well as the correct production of the drugs. This prominent chemists, or protomedics, represented the most excel and expert pharmacists of the guild to whom the control of the drug production was entrusted by the guild themselves or by some ruler. The "Protomedicato" as a control institution was first created at the kingdom of Sicily in 1397.[76] These personalities along with the physicians were often called to certify and approve the public production of theriac. Many times the protomedic was neither a member of the guild nor of the College of Medicine of the kingdom, but an outsider of both places who was invited to judge and certify impartially the correct procedures in the fabrication of medicines. That was precisely the role that Aldrovandi, the famous collector, played at Bologna in 1575, and his rejection to approve the theriac generated one of the most famous controversies about theriac production, as we will see below. However, not all protomedics were alien to the apothecary guild. For example, in the sixteenth century at Naples the "Corporazione dell'Arte degli Speziali," founded the previous century, was in charge of this duty. It was composed of eight prestigious and respected protomedics or "speziali" who were selected by the members of the guild to warranty the right production of remedies in the Kingdom.[77] Protomedics also checked biannually the theriac stored and sold by the apothecaries attesting its authenticity.[78]

Apothecary guilds due to their social importance and monetary power occupied a high status within the Renaissance society. Therefore, the apothecary guilds knew they need to carry out a strict surveillance of their remedies to protect their interest and business as well as the health of their costumers. However, apothecaries could not

[75] *Ivi.* pp.15-16.

[76] Cfr. Findlen, 1994: p.264.
[77] Cfr. Stendardo, 2001: pp.15-17.
[78] Cfr. Findlen, 1994: p.267.

remain entirely autonomous for too long. After the mid-sixteenth century, the College of Physicians started gradually to have inherence along with the *protomedicato* over the apothecary guild activity. In this way, if an apothecary wanted to open a pharmacy, the approval of the Medical College was also mandatory. All antidotes and compound remedies had to be made following the standardized recipes proposed by the College of Physicians. Furthermore, apothecary apprentices were also examined by physicians. According to Findlen, the examinations were not merely about the knowledge of simples, artificial procedures of drug production and basic literacy (including etymology and classification); but also an ideological imposition of the hierarchical superiority of the physician over the pharmacist.[79] For example, the fourth statute of the Guild of Apothecaries in Modena stated: "I will treat Physicians with due reverence."[80]

Statues for regulating theriac production have been created for protecting public health by avoiding low quality falsifications of theriac. However, statues did not only monopolize theriac's production; they also fomented its trade by warranting theriac's quasi-perfection. There were many cities which produced it around the world, such as Venice, Byzantium, and Cairo. These cities competed for being regarded as the best quality theriac producers.[81] Without doubt theriac was a very profitable business during the sixteenth-century. Some cities, like Cairo, even kept secret its theriac recipe only for economical reasons, because they were afraid of losing its international markets in Italy, Germany, Poland, and England.[82] The many maladies which daily menace humanity as well as the unexpected catastrophes were theriac's best advertisement. When cities were stricken by plague, theriac was more demanded, and consequently more expensive due to its shortage.[83] Even crime contributed to theriac's trade. Almost every member of the higher social circles wanted to have a box of theriac bottles. Kings, Popes, and other powerful leaders inverted money hiring and equipping pharmacists who could produce theriac for them.[84]

[79] Cfr. *Ivi.* pp.265-266.
[80] Statute of Modena quoted by Findlen, 1994: p.256.
[81] Cfr. Watson, 1966: pp.102-103.
[82] Cfr. *Ivi.* p.108.
[83] Cfr. *Ivi.* p.109.
[84] Cfr. *Ivi.* pp.103-104; p.112.

Chapter 4. Maranta's methodology for making theriac

4.1. Maranta's book on theriac and the problem of the apothecary's status

Maranta dedicates its book *Della Theriaca et mithridato* to "Ferrante Imperato spetiale, et semplicista eccelentissimo, et uno de gli otto in Napoli."[85] Ferrante Imperato was precisely one of the eight protomedics who composed the already mentioned "Corporazione dell'Arte degli Speziali" at Naples in the sixteenth-century. Therefore, Imperato was a prominent and respected apothecary in Naples. He was interested in teaching and diffusing the correct way to produce theriac not only to the people of Naples but to the whole kingdom of Naples and other kingdoms for the benefit of mankind.[86] With this noble aim, Imperato asked Maranta, a prestigious physician from the College of Medicine of the University of Salerno, to write a book about the correct way of making the theriac and mithridatium.[87]

Maranta's *Della Theriaca et mithridato* was mainly addressed to those apothecaries who generally lacked of Latin and Greek literacy as well as of a sound scholarly formation in medicine. Therefore, the book was written in Italian rather than Latin. Also Maranta's narrative style is brief and simple. He does not engage into theoretical and philosophical arguments. Instead, the book pretends to be very practical:

> & il nostro intento fu solo di insegnare, come si possa questo Antidoto preparare artificiosamente [...]: & il dire delle sue proprietà non fa à questo proposito […]: & non ad altro fine io ho voluto stendere il mio ragionamento in ogni particolare, forse più di quello, che per la intelligenza bastava; se non per essere chiarissimo, & per farmi bene intendere da gli Speciali; [...]. Et volendo io delle facotà di questo antidoto ragionare nel medessimo modo: oltre che farei lunghisssimo: non farei cosa che à gli Speciali troppo grata fusse; non s'impacciando essi del medicare: che se Galeno lasciò di parlarne nel primo de gli antidoti, dove tutto ciò che à questa compositione si appartiene insegnò diffusamente; & pur scriveva à i Medici più che a gli Speciali: Tanto più io potrei lasciare di parlarne. Ma percioche lasciando in tutto di ragionarne, potrei dare occassione à i calumniatori di oppormi, che io

[85] Maranta, 1572: dedication.
[86] Cfr. *Ivi.* dedication and proem.
[87] Cfr. *Ivi.* dedication.

> habbia fatto questo discorso imperfetto: perche inquanto à Galeno, egli forse non ne parlò ne i libri degli Antidoti, perche altrove ne haveva detto à sufficienza, cioè nel libro à Pisone, & nel libro à Panfiliano: per turare à costoro la bocca, voglio ragionarne, però semplicemente riferendo quel tanto, che Galeno, Aetio, e Paulo ne dicono, non intromettendomi in dichiarationi delle cose per aventura [..].[88]

As it can be read, Maranta is interested in clearly explaining Galen's pharmaceutical knowledge to apothecaries. He is sensible to his audience needs, and thus he detours from the style used in the orthodox books on the subject. Maranta, as he says, would not try to emulate Galen discourse; rather he develops his on style, which pretends to fill Galen's gaps from a practical point of view. He would underline the frequent errors that most apothecaries committe when preparing this sort of antidotes; and he would emend them by determining the genuine simples, substitutes, proportions and the correct ways of mixing them to obtain both royal antidotes.

It was not only Ferrante Imperato but also Gianantonio Pisano, another protomedic, who encouraged the publication of Maranta's book.[89] Maranta states very clearly, that all what he writes about both royal antidotes has been based entirely in experience. However, he clearly acknowledges Ferrante Imperato as the artifice of all laboratory procedures. Therefore, it is very likely that Maranta had witnessed the processes of theriac production in Imperato's Museum:

> [...] come potrei, M. Ferrante mio, ne al Signor Pisano, ne à qual si vogli altro far dono di quest'opera, essendo appresso di me dubbio se mia, ò più tosto vostra dire si debba? Percioche, qualcosa altra hò io in questo libro posta, se non quel tanto che ho osservato e veduto mentre voi l'uno e l'altro Antido composto havete? Dove mi accorgo molto bene, che nel ridurre à fine questi due discosi fra voi e me, è stata quella differenza, che si vede essere fra l'Architetto, & il Muratore, e quanto quello di questo è più nobile, tanto di me voi, in essi miglior parte havete. Di maniera, che mettendo io questo libro in luce sotto il mio nome, ho tema che gravarei talmente la mia conscienza, che mi sarebbe forza al fine farvene, come di cosa rubbata, restitutione. [...] niuna strada migliore mi s'offerisce se non quest'una, Di indrizzarlo à voi stesso, si come faccio, dedicandovelo, non già come cosa mia, ma come vostra, facendovene prima Padrone, e poi Protettore, per l'obligo che ciascuno hà nel difendere le propie cose. Ne perciò faremo esclusi dal patrocino del Signor Protomedico […].[90]

We can conclude that Maranta is not the only author of the book. Ferrante Imperato has been a co-author but no precisely in writing the very book. He gave the

[88] *Ivi.* pp.161-162.
[89] Cfr. *Ivi.* dedication.
[90] *Idem.*

instruments, ingredients, and did all the practical work implied in the production of theriac, which eventually would be the content of the book. Moreover, there are at least another two relevant issues that can be read in Maranta's dedication, which show the epistemological as well as social significance of Maranta's book.

Maranta from the very beginning of his book shows that he was clearly aligned with the new activities and attitudes of the natural historians which were emerging in the sixteenth-century. Firstly, Maranta emphasizes the importance of "experience". He is clearly stating that he is not writing about what others have already written without any kind of experimentation. Precisely, thanks to Imperato, he has experience through his five senses the nature of the simples, and the complexity of the artificial procedures for making theriac. Very likely Maranta did not experience all the simples, instruments, and procedures for making theriac, but Imperato surely did it. Therefore, the book is not only based in the medical erudition about medical authorities, but also in the experience of nature. Maranta and Imperato represent respectively both faces of knowledge, that is, it's the theoretical face and its practical face. We will follow with attention the way in which interact both faces to justify and validate knowledge through the whole book. Therefore, we would have an historical example of the way in which theory and practice interacted within the naturalistic discourse of the sixteenth-century.

Secondly, the words of Maranta to Imperato point directly to the problem of the demarcation between the physician and the pharmacist. As we have already mentioned in the first section, the demarcation between pharmacy and medicine has been a fundamental problematic in the history of pharmacy not only theoretically but socially—salaries and social recognition were always at the stake. Defined boundaries between their professions did not exist.[91] During Renaissance the pharmacists' knowledge, skills, and responsibilities were very different to our days. They become cleared defined, as we know them today, during the nineteenth-century when pharmacy was divided in pharmacology, pharmacognosy, pharmaceutical chemistry and pharmaceutics. The activities of the Renaissance's pharmacists did not reduce to study the virtues and natural origins of drugs, analyze and synthesize chemically drugs (i.e. spagyria), and manufactured medicines; they also had extended roles, such as diagnosing minor conditions, prescribing medicines, and giving health advice.[92] Therefore, there was a struggle between pharmacists and physicians for epistemological

[91] Cfr. Anderson, 2005: pp.4-5.
[92] Cfr. *Ivi.* p.3.

superiority which affected directly in their social status, which not only meant more money but also power over the medical policy of the kingdom. Thus the problem of defining the professional scope between pharmacists and physicians was a hot issue in the sixteenth-century. For example, the professor of Padua's prestigious College of Medicine, Marcus Oddus, who was the holder of the extraordinary lectures on theoretical medicine at the hospital of San Francesco,[93] devotes five chapters of the twenty seven which compose his *Meditatione doctissime in teriaca et mithridaticam* (1576) to give his solution to the demarcation problem.[94]

The dedication of Maranta clearly distinguishes the physician and the pharmacist as the architect and the mason. However, he differs from the orthodox view when he does not consider architecture (i.e. medicine) superior to the art of masonry (i.e. pharmacy). He recognises the autonomy of pharmacy as a craft by acknowledging Imperato's work. Natural knowledge, as the natural historians of the sixteenth-century were starting to think, was obtained by the interaction of many subjects with different qualities. Teaching about antidotes required necessarily the practical knowledge that the pharmacists possessed and which the physicians in general lacked. Therefore, Maranta's very book embodied the new attitudes toward natural knowledge. The book is written in Italian instead of Latin, which was the scientific language of the time; the book contents are based on experience rather than only in which authorities have said; and it is written by a physician and a pharmacist with different expertises and qualifications, but none is better than the other. Anybody seriously involved in natural history was aware of the importance that research networks had. Natural inquiry required virtuosi with different knowledge and qualifications. In other words, knowledge was regarded as a public enterprise. In some degree, as we have show in the previous section, these conclusions came from experience rather than scholarly thinking alone.

Maranta's point of view was not shared by every physician. For instance, Marcus Oddus gives an orthodox account of the problem in question. He bases his plea in the so well known medical and philosophical authorities. Medical authorities, such as Galen and Dioscorides:

> […] justified the subordination of apothecaries to physicians through the argument that medicine, as a philosophical discipline, was the highest art and its practitioners

[93] Cfr. Bertolaso, 1960: p.26.
[94] Cfr. Oddus, 1576: pp.2-12. Mammola's book *La Ragione e l'incertezza* (2012) analyses this problematic from medieval till modern times.

> the most skilled healers. Philosophy, wrote Galen, was the means to truth, and only physicians could claim to know philosophy by virtue of their education. According to the classical model, apothecaries were simply "makers of remedies" (*pharmakopolai*), while physicians determined what those remedies would be.[95]

Oddus was a sixteenth-century paladin of this authoritative thesis. Summarizing, Oddus regards medicine as if it were a walking man. Its right leg represents the theoretical knowledge of medicine; and his left leg the practical knowledge of the apothecaries. According to Oddus, both legs are necessary to walk. One leg would not be sufficient to move the human body.[96] Medicine metaphorically speaking could not walk without one of his legs. Therefore, for Oddus the theoretical knowledge of medicine is as necessary as the practical knowledge of the apothecary. Maranta would agree with the Paduan lecturer. In fact, the medical community of the sixteenth-century would entirely agree with the authority of Dioscorides:

> Necessariam quidem esse doctrinam de medicamentis, omnibus est manifestum, ut quae toti sit arti coniuncta omnibusque eius partibus praesentissimum exhibeat auxilium. Quin et ars ipsa e praeparationibus, mixturis exterimentisque quae in morbis instintuuntur, augmenta capere potest, plurimum ad id conferente singulorum medicamentorum cognitione. Praeterea vero et familiarem vulgatamque complectemur materiem, quo scriptio evadat omnibus numeris absoluta.[97]

However, Oddus's argument has not ended yet. According to Oddus, even if both sorts of knowledge are necessary to heal sick people, they do not have the same epistemological status. The knowledge of the pharmacists is subordinate to the theoretical knowledge of the physician. He claims that the physician knows the causes of diseases; and thus he is the one who knows what kind of antidote the pharmacist should prepare. Therefore, the practical knowledge of making drugs is dependent on the theoretical knowledge of medicine. Oddus appeals to another analogy to claim the epistemological superiority of theoretical knowledge over the practical knowledge. He regards the relation between the physician and the pharmacist identical to the one between the general and his soldiers.[98] Both are concerned with war; nevertheless, their goals are different. The general, who knows the entire warfare strategy, is concerned with wining the war. His soldiers are concerned with following successfully his orders. Soldiers without general would be totally lost. They could even cause the death of their

[95] Findlen, 1994: pp.251-2.
[96] Cfr. Oddus, 1576: pp.4-5.
[97] Dioscorides, 1829: p.5.
[98] Cfr. Oddus, 1576: pp.9-10.

comrades. The same applies to the pharmacist, who without the physician knowledge, could kill his patients by giving them wrong remedies. Therefore, knowing how to make rightly any drug is necessary to the discipline of medicine, but not sufficient to restore health, the goal of the physician:

> nam licet medicus, & pharmacopola medicamentorum materiam pertractent, scopus tamen pharmacopole ab eo medici varius esta, atque distinctus: quandoquidem pharmacopolae is tantum est, medicamenta quaelibet recte conficere […], at medici alter est scopus, nimirum ut contrarijs actionibus morbis officiat, ac sanitatem introducat.[99]

Maranta valued equally the epistemological and social status of these two disciplines. He conceived them as two diverse but autonomous disciplines, which were them both necessary to medicine. Maranta acknowledges the importance of the apothecary and recognizes his own domain of expertise. The very book shows Maranta's attitude. He could not be able to write it without the practical knowledge of the co-author. Many naturalists of the sixteenth-century, such as Aldrovandi, shared these ideas. However, not all sixteenth-century naturalists hold the same opinion. For example, Fallopia, who held the lectureship in simples at Ferrara, Pisa and finally in Padua, and who was interested in teaching the physicians to supervise apothecaries in the preparation of medicines, severely criticized Aldrovandi:

> I do not wish to imply that you [Aldrovandi] will be simply an herbalist. […] However, it displeases me that you have made this transition—not because I dislike the profession, which you know that I still perform unworthily, but because I liked the first one better. *It seems to me to be the more worthy one in every respect*, and I will embrace you as a true and faithful friend if you return to [medicine] at the first opportunity that you can do so with honour, leaving the other to whoever wishes it. Thus, I am able to leave my [duties in *materia medica*] and those in anatomy to attend only to medicine, as I would and will do voluntarily when the occasion arises.[100]

Like Fallopia, almost the majority of physician held prejudices against the apothecaries. They had been instructed to do so for centuries. Marcus Oddus was not an exception inside the prestigious College of Medicine of Padua. Contrary to Maranta, Oddus undervalued pharmacy, even if he believed that it was intrinsically necessary to medicine. The fact that Oddus wrote in Latin instead of Italian, as Maranta did, was a sign of scholarly discrimination. Latin was the scientific language of Renaissance, and thus also a scientific criterion which paradoxically the most interested audience

[99] *Ivi.* p. 9.
[100] Fallopia quoted by Findlen, 1994: p.255, *emphasis added*.

concerning theriac's production did not meet. However, both physicians and apothecaries were active members of the same scientific culture.

4.2. The problems concerning theriac production and Maranta's theriac recipe

The theriac was a very complex compound drug elaborated with herbs, minerals, and animal parts. According to the apothecaries of the sixteenth-century, the only way to combat effectively all sorts of venoms against a wide range of poisonous beasts (which range from different kind of snakes—such as the asp—scorpions, to mad dogs and rats) was to mix all the contra-venoms in one unique compound drug.[101] Therefore, the artificial elaboration of a compound drug capable of healing an infinite number of diseases, and effective against all poisons, would necessary require a vast quantity of simples all properly mixed in the right proportion into one unique compound, as Galen reasoned.[102] In this fashion, the use of around 64 simples was entirely justified when making theriac. Precisely, the theriac represented the most advanced technological achievement according to the medical framework of the sixteenth-century.

The process of making theriac was very important. Each simple had been carefully selected for healing a specific part of the body. Thus, it had to be made in the right order, respecting determinate procedures and proportions. And the whole processes of production had to be strictly followed. Precisely, all these issues were prescribed by the correct recipe for making theriac. The correct theriac recipe was the original recipe, the one which Andromachus the Older had written.

However, Andromachus' recipe presents some difficulties. It is written in verse, so it is not an exhaustive and systematic recipe. Andromachus does not describe meticulously the artificial processes implied in its production. He does not give any accurate measures and proportions in which the simples have to be mixed. Therefore, the Andromachus recipe is ambiguous and it could be read in diverse ways. The problem of correctly interpreting Adromacus' recipe becomes even harder through centuries. The identification of the simples which are referred in it becomes a huge challenge in which not only a mastery of botanical and historical knowledge are required but also a mastery of Greek, Latin, and in some cases even Arab. Only by a mastery of the philological analysis, the naturalist was able to track over time and cultures the accurate reference of the simple names used by Andromachus. Therefore, it

[101] Cfr. Maranta 1572: p.8.
[102] Cfr. *Ivi.* pp.8-9.

is not surprising that theriac's recipe had generated a wide sort of polemics since Galen times until Renaissance.

The main problems concerning theriac production that the sixteenth-century apothecaries had to solve were the same that had to be faced in the production of any compound drug, but highly more complex. Firstly, there was the problem of identifying simples. It consisted in locating with precision the simples referred by the names used in a recipe. In the case of theriac, it was vital to accurately identify all the ingredients. The enterprise required more than trained sensory organs, it was a semantic problem and also required reading the *auctores* in medicine and natural philosophy, such as Pliny the Elder, in the search of hints to locate the changes of both name and reference through time. The apothecary, who enrolled in this quest, needed philological abilities and the mastery of Greek and Latin besides the practical knowledge of his Art. Usually, the majority of apothecaries lack of scholarly and literacy competences. Therefore, the problem of identifying theriac's ingredients was a big challenge. Indeed, the apothecary had to infer the properties of the original ingredient according to the qualities, and their degrees, given by the *auctores*. This was also a hermeneutic task. The descriptions given by authorities were not always detailed and thus ambiguous.

Secondly, there was the problem of substitution. Determining the best substitution, that is, to determine a simple that could replace the original simple due to its similarity with the original, was a common empirical problem that the apothecary faced in his art. The question of the substitutions frequently generated quarrels between apothecaries. However, in the case of theriac substitution became a highly controversial matter. For example, the apothecary frequently had to select the best substitute for an original simple that was very difficult to found or even worst: unknown and thus impossible to obtain. Furthermore, the question of substitutions was not only controversial in an empirical level but also in a conceptual one.[103] It also entailed methodology issues at a normative level, that is, to settle rules of substitution that guarantee the efficacy of the antidotes. Maranta, as we will see below, gave an account of this problem, which applies to any antidote, theriac included. The problem of

[103] In his book *Progress and its problems* (1977), Larry Laudan regards science fundamentally as a problem-solving activity, and thus gives a useful taxonomy of scientific problems (cfr. Laudan, 1977: pp.11-14). Laudan considers there are two categories of scientific problems: the empirical and the conceptual problems. According to Laudan, every time scientists ask how and why certain observed phenomena occur, they are posing an empirical problem (cfr. Laudan, 1977: pp. 14-17). The second type of scientific problems are higher order questions about the well-foundedness of the theories that are offer as solutions to empirical problems (cfr. Laudan, 1977: pp.45-48).

substitution involved also another problem, namely, the problem of natural versus artificial. In other words, the sixteenth-century communities of naturalists asked whether it was possible to artificially elaborate substitutes without altering the efficacy of the antidotes. Therefore, the problem of substitution implied at least the problem of normativity and the problem of artificiality.

Thirdly, and finally, there were the practical problems of making any drug. Determining the correct proportions as well as laboratory procedures to which the simples were submitted to produce an antidote also were very important. We do not have to forget that Andromachus' recipe is written in verse, so there are not references to any proportions in it at all. Andromachus neither explains carefully the elaboration steps of the process; he just mentions them. He takes for granted that apothecaries perfectly know the laboratory techniques and procedures he refers. Therefore, Andromachus omits the many practical problems that aroused when the theriac is being produced. Technical difficulties appear when boiling, distilling, crushing, grinding, and mixing simples. Maranta gives an account of these problems for the particular case of theriac production. Through some relevant examples we will expose Maranta's solution to each of them underlining the scientific methodologies he utilized. He accepted the new methods developed by the naturalists of the sixteenth-century but at the same time utilized the orthodox methodologies. Maranta respected Galen's authority but he did not blindly follow him. Maranta, along with Vesalius and many sixteenth-century naturalists, was disposed to correct Galen's mistakes without losing respect to his medical doctrine:

> Hò voluto anco molti luoghi di Galeno indurui quasi di parola in parola, in quelle cose, che non havevano bisogno di espositione per intenderle : persuadedomi che cosi più acconciamente si dicessero : come all'incontro molti luighi da Galeno detti oscuramente, io con aggiontione di parole ho proposo finhe chiari per ciascuno paruti mi sono. Et ho anco arditamente dalle determinationi di Galeno in poche cose deviato non perche io habbia di mia natura (come molti hanno) l'animo pronto al contradire a i nostri maestri, ma per eccitare i belle ingegni à nuove speculationi lasciandosi sempre libero il giudicio di ciascuno in approvarle, o in lasciarle. Ove se io harò fatto qualche frutto di giovamento al mondo, mi farà molto caro & quado ciò no sia, pigline ciascuna la mia buona & pronta voluntà; laquale è stata sempre di fare cosa che a gli uomini di utile & di homore fusse.[104]

Therefore, even if Maranta do not blindly follow Galen, it is also true that his account of theriac production is based on the one exposed by Galen.

[104] Maranta, 1572: proem, pp. 3-4.

4.2.1. The problem of identification

Recognizing simples was a key ability for producing remedies. In the mid-sixteenth-century, both apothecary apprentices and physicians were train to identify medical simples. The former learn practically to identify simples helping their apothecary master in the pharmacy; the latter did it assisting to their *materia medica* lecture at the university. As we have already seen, during this period the knowledge of simples—highly valued and developed by naturalists—became regarded as vital to the physician instruction and was incorporated to the medical curricula. The classification of simples emphasizing their medical utility only was possible after their identification. Therefore, identification was a fundamental activity. It was the most important goal of the people who work with simples, such as apothecaries and collectors. Identification not only resided in trained sensory organs, but also in a scholarly knowledge of the authorities. Frequently, simples had regional names; therefore, identification also consisted in matching the regional names with the names authorities have given them. Consequently, as Findlen states "[…] identifying a specimen was not simply a matter of experience but also authority."[105]

Imperato and Maranta represent experience and authority respectively. However, Maranta avoids technical language and theoretical arguments. Instead, he focuses in the art of the apothecaries utilising clear and brief explications in the apothecary jargon. He claims that:

> [...] l'intentione mia fu di rationare più con la turba de gli Speciali, che co i medici; io mi sono sforzato di essere chiarisimo nelle cose, & nelle parole. Onde perciò hò lasciato di parlare di alcune cose che à proposito essendo, richiedevano sollevatione di mente, & solo fra quelle mi sono raggirato, che à me sono parse essere per la capacità degli Speciali: avegna che quando io per l'Imperato solo havesi ciò fatto, senza dubbio di ogni cosa, per gravisima che fusse, harei potuto trascorrere; già che non solo in Napoli, & nel Regno nostro, ma in tutte le Città celebri della Italia è chiaro, quanto sia il valore de l'ingegno suo: mi sono anco per istessa cagione dilatato nelle parole, di proprio intento, allargandomi dove poteva per aventura essere più breve: percioche in simili casi è molto più prezzata la chiarezza, che non la brevità; laquale bene spesso à i dotti, non che a i mediocri ingegni, suole partorire oscurità & periciò cessino quì i detrattori di biansmare questo mio honesto proposito.[106]

Consequently, Maranta would not engage in complex theoretical arguments to solve the problems concerning theriac production. Rather, he would be very pragmatic. He

[105] Findlen, 1994: p.248.
[106] Maranta, 1572: p.3.

always procures that his audience understand his solutions to theriac's production problems. Our purpose is not to give a detail account of Maranta inspection of each one of the 64 simples composing the Theriac. Instead, we will exemplify the methods and justifications of his exposition through some relevant examples that show Maranta's methodological approach.

4.2.1.1. Maranta identifying the "Folio"

Is the simple called "folio" the same to the one named "malabathro"? Neither Galen nor Dioscorides explicitly affirm it. Therefore, the matter cannot be solved so easily. Maranta is against the common opinion that "folio" and "malabathro" refer to the same simple, because of they similar appearance. He thinks they are names of different simples. His suspicion comes from a passage of Dioscorides where he seems to use two simples—leaves of "folio" and "malbathro"—for perfuming the viper. However, the passage cannot be put forward as a proof. Maranta has to find evidence which supports his suspicion elsewhere.[107] He could try to find some evidence in another authority. Not only Galen, but Damocrates, Aetius and other physicians also engaged in solving the same problems. Thus, there were many distinct versions of theriac's original recipe. However, Maranta decides to solve the question appealing to experience guided by the sensory data provided in the descriptions of the authorities. The specific criteria or sensory organ which would function as Maranta's touchstone for this particular case would be the taste. Armed with an acute taste, Maranta would claim that the "folio" rather than be the Indian leaves of "malabatrho" corresponds to the leaves of "cassia:"

> […] il gusto ha da essere il vero giudice di questa difficoltà. Et volendo Dioscoride che il Malabathro habbia odore & sapore dello Spigo Nardo, & dicendo Galeno che ha parimente similissima facotlà co'l Nardo, nel 7. & 8. libro de i semplici; anzi in tanto il Malabathro è simile al nardo, che alcuni (come vuole Diosc.) per questo solo si pensorono, che questa sua foglia fusse della pianta del nardo Indico, & non trovandosi (se vorremo confessare il vero) in quelle frondi trinervi che vanno à torno sotto nome di Folio Indio ne sapore ne odore di Nardo; Non so come mi possa pesuadere tal frondi essere del vero Malabathro. Percio che […] le frondi della cassia di simile figura con quella del Malabathro dirò, che queste che quì ne vengono, siano della cassia, come ne fa fede il suo sapore al sapore della canella del tutto simile.[108]

"Malabathro" tastes akin to "Nardo" and "Folio" does not. Therefore, they are not names of the same simple. The sense of sight leads to mistakenly assume that "folio"

[107] Cfr. *Ivi.* p.87.
[108] *Ivi.* pp.88-9.

and “malabathro” are synonymous terms, because the leaves of one and the other are similar. Maranta even adduces a counterexample that he directly observed and tasted (i.e. that he experienced or experimented):

> Messere Ferrante Imperato mi ha mostrato due sorti di quelle frondi dette volgarmente Folio Indio: l'una ha il sapore di Cannella come si è detto; l'altra un altro sapore, se bene aromatico molto diverso. Ma nella figura sono similissime. Ne puo dirsi questa altra forte essere del Malabathro, perciò che non è in este sapore nardino. & io credo che sia di qualche specie di Canella delle manco vigorose.[109]

Experience shows that there are leaves very similar but with different tastes. Consequently, they have to be identified by tasting them. Therefore, Maranta shows us that identifying is not only a matter of appealing to experience without any discrimination of sensory input. On the contrary, experience is the right judge when it is correctly used. The guide in this case is given by the authorities. Therefore, as we can see, Maranta is cautiously moving through nature aided with the authorities’ knowledge. By a careful reading of authorities, Maranta selects the correct experiential criteria to inquire nature. Maranta scientific methodology in this case involves both experience and authority. However, one could write about tastes without actually experiencing them. Maranta is clearly stating that he directly experience or tasted the simples in question and we supposed he did it at the Museum of Ferrante Imperato.

This dual methodology is applied by Maranta to each and every simple that composed Andromachus’ recipe. The philological approach was also an essential weapon of analysis within his methodological arsenal. He detected translation mistakes. For example, concerning Damocrates’ theriac recipe, he claims that it has been wrongly understand “racemi dell’Amomo” instead of the right translation “Amomo racemoso”:

> E Damocrate nella sua Theriaca piglia i racemi dell'Amomo: Ma Andromaco dice l'Amomo racemoso & non i racemi , il che è differente. potendosi intendere de’ surculi, i quali per segno della lora bontà havessero i semi ò le sue attacate. perche nel greco dice [*Botruoentos*] & il latino racemiferi.[110]

Experience aided naturalists to interpret correctly authorities. In fact, it seems that they thought that authorities always speak supported by experience, for this reason they were authorities. However, experience not always was congruent with authorities. In this

[109] *Ivi.* p.89.
[110] *Ivi.* p.95.

case, one could save an author's anomaly by suggesting a wrong copy. Therefore, it was possible to "correct" the authority. Also was possible to correct an authority statement when it plainly contradicted experience.

4.2.2. Maranta's substitution rules

Maranta believed that the use of substitutes for making drugs diminishes the healing power of the compound remedies. There was anything better than genuine simples, the ones prescribed by the recipe. However, for different reasons, the apothecaries have to introduce some substitutes. The theriac was a paramount example of the problem of substitutions. Many of its simples were imported and thus hard to acquire. And many others had not been re-discovered yet. Therefore, apothecaries had to find the better substitutes of the original ones, which in many cases they did not ever have seen but only read descriptions about them. The less the number of substitutes was used in a compound drug, better and powerful it was. For example, Maranta tell us that in 1577, after three years of gathering simples over all his network, Imperato managed to make a theriac with only ten substitutes. Imperato did not give up and eventually he could reduce the number of substitutes to less than six.[111] Precisely, Calzolari's Theriac was appraised as the best theriac of the sixteenth-century because, as Mattioli stated, "[…] it was made with fewer substitutes than any other made in our time."[112] Indeed, Calzolari's theriac contained only three substitutes,[113] and for the same reason Mattioli did not marvel that it "works wonders".[114]

Maranta believed that it was not only the use of substitutes but also their over use and bad qualities the cause of its decreased miraculous efficacy: "percioche l'havere à ogni medicina i sustituti, fa l'huomo poltrone in non cercare veri. donde ne nasce, che la Theriaca non viene à esser perfetta […]."[115] According to him, it is true that the substitutes share many similarities with the original simples, but they also differ in some respects and properties from them. Any over use of substitutes made by apothecaries would corrupt an antidote from its very beginning, and eventually they would obtain something different to the drug prescribed in the recipe. Apothecaries had the bad habit of excessively use substitutes, because they were cheaper, and within reach. Therefore,

[111] Cfr. *Ivi.* p.35.
[112] Mattioli quoted by Findlen, 1994: p.276.
[113] Cfr. Capelletti, 2002: p.36.
[114] Mattioli quoted by Findlen, 1994: p.276.
[115] Maranta 1572: p.33.

for warranting the efficacy of any antidote, it had to be made using original simples.[116] However, Maranta is completely aware that it is not always possible to follow that methodological rule. In the practical craft under many circumstances the pharmacist would have to introduce a substitute, such as when he run out of a specific simple or it was not easy to get. And there were special antidotes, such as theriac, that relied on substitution.

Maranta underlined that substitution was not an arbitrary procedure. He believed there were clear norms for making drugs, which stated, for example, how many simples could be substituted in a recipe. Therefore, Maranta engaged in the task of single out a set of rules to be followed for carry out appropriate substitutions without altering (or at least in a minimum degree) the resultant antidote.

According to Maranta, there are two ways of procedure when making substitutions, namely, the improper and the proper.[117] The first one consists in substituting an original simple for another which also heals the disease to which the original is prescribed.[118] Therefore, the first substitution procedure demands that both simples, original and substitute, share only the same healing virtue. Other properties, such as taste, are irrelevant. For example, Maranta tells us that "Aloe" distillated in some wine is prescribed to cure ear pain. According to the improper substitution criteria, "Aloe" cures ear pain (i.e. a chilling disease), because it is hot and dry; therefore, the apothecary can replace it with any hot simple, such as the "Chalciti", "Nitro", "Aristolochia", and so on. However, Maranta claims that even if all simples mentioned share the heating quality, they own it in different degrees; and even worst they also manifest different virtues and faculties from each other. For instance, he explains us that if "Aloe" is replaced only taking in account its heating quality, the resulting electuary would harm instead of cure:

> [...] Perioche ancora che per la esiccatione, e per la detersione , che fanno; gioveno à consumare & nettare gli humori grossi & tenaci; & dissolveno il vento grosso che sta intorno all'orecchie; non dimeno per essere l'Aloe calda nel primo grado, & secca nel terzo; il Chalciti calda forse nel quarto grado, perche rode la carne; non ben si portebbe un'altra infermità l'un per 'altro pigliare: oltre che nella sustanza sono deversi, e nel Sapore. E ne doviamo ricordare di quel che di sopra è detto da noi, di quanta importanza sia metter una medicina arida in vece d'una molle ne'medicamenti composti famosi.[119]

[116] Cfr. *Ivi.* p.34.
[117] Cfr. *Ivi.* p.42.
[118] Cfr. *Ivi.* p.36.
[119] *Idem.*

Therefore, Maranta concludes, it is not appropriate to follow the first procedure of substitution; for this reason, he refers to it as the improper substitution procedure.[120]

The proper procedure of substitution assures that the substitution match perfectly in every feature. In other words, both simples, the genuine and the substitute, can be interchanged in any recipe without altering the antidote as a whole. Therefore, the criterion does not reduce to a similarity concerning their medicinal virtues but in all respects as possible. While more properties the substitute shares with the genuine simple, the better the substitution would be. And the procedure of searching the better substitution possible is precisely the second way of procedure for making substitutions. Both Maranta and Imperato regarded it as the correct one, because it assured that:

> […] la sustitutione sia vera, e perfetta: & il primo scopo è, che le due medicine a vicenda si possano à ogni male & à ogni compositione mettere reciprocamente & indifferntemente; e che non sia cosa veruna nell'una che no si trovi nell'altra: prima siano confromi nel grado delle prime qualità, apresso nella sustanza overa essenza delle parti; cioè che se l'una faà di parti sottili, sia ancora l'altra: se una farà liquefattibile, l'altra cosi parimente sia; e più habbiano conformità nell'odore, e nel sapore, e nello occolte proprietà, & in somma in tutte le qualità.[121]

Theoretically speaking one can agree completely with the argumentation of Maranta, but practically it sounds troublesome. If simples shared all their qualities in all respects, they would be identical, and thus they would not be regarded as distinct. However, this is not a problem, because the simples can be artificially altered to match in degree and faculty as Maranta claims: "[…] e se per aventura l'uno fusse più potente dell'altro, aiutisi il difetto dell'uno con la maggiore ò minor quantià, ò con qualche altro ragionevole artificio."[122]

Ones Maranta has theoretically exposed the proper substitution procedure, he exemplifies it. According to him, the best substitution possible is the one which is made between simples of the same kind, because there is little variety between them. For example, the "Nardo Montano" can substitute the "Nardo Celtico," because they are of the same kind. They roots are substantially almost identical and they manifest a very similar taste and smell. In other words, simples of the same kind are almost identical. When simples of the same kind do not match in every respect, as in the case of substituting "Casia" for "Cinnamomo" which differ between them only in potency (but

[120] Cfr. *Ivi.* p.36; p.42.
[121] *Ivi.* p.38.
[122] *Idem.*

look the same, taste the same, smell the same, and also share a similar substance) the apothecary has just to double the weight of "Casia" to equated the potency of "Cinnamomo" or vice versa.[123]

In the case of a complex antidote like theriac, which has a great number of ingredients, all substitutions must be *perfect*, that is, of the same nature and consistency, to assure the efficacy of the antidote. Therefore, the pharmacist is compelled to use only the second procedure of substitution. If he do otherwise, not only the nature and consistency of the simples replacing the original ones would be compromised, but the whole antidote's nature and consistency would decompose. The reason, as Maranta explains us, is because:

> […] se il succedaneo no si farà di cosa, della medesima consistenza, e della medesima natura, si viene à guastar la proportione tra le cose triturabili, e quelle che si dissolveno ò liquefanno: tra le cose di crassa essentia, e quelle che hanno le loro parti sottili, e penetranti: & cosi discorrendo nelle proportioni pigliate dall'altre considerationi. Donde ne viene à deteriorare non poco la massa di tutto l'antidoto, risultandone ò piu liquida, ò più solida di quel, che si converrebbe, oltre l'altre particolarità, onde può peggiorare; e dal troppo humido ne nasce la putrefattione, come dal troppo secco lo svanimento di tutto l'antidoto [...].[124]

For this reason, it is very important to *properly* replace the original simples without making any mistakes. The pharmacists must proceed with diligence when replacing simples in a complex and sophisticate antidote as theriac, which ingredients are highly numbered and not easy to get, and which elaboration requires knowledge, skill, time and effort (as well as money), to certify the perfection of its medicinal virtues.

Maranta's proposal for carry out proper substitutions was not his invention or innovation. In fact, he tells us that Galen himself followed this rule even if he did not explicitly mention it. According to him, an attentive reading of Galen is the only requirement. Therefore, after reasoning in base to experience, he justifies his substitution procedure claiming that it was the very Galen who used it:

> La onde quando noi troviamo in Galeno, che una medicina si mette per un'altra, dovemo ben mirare, se in una sola infirmità la sustituisce; ò pure generalmente à ogni cosa: il che per non havere alcuni considerato; ò si ha burlato di Galeno, che metta una cosa per unaltra, le quali sono tra loro diverse in qualità; overo non considerando piu che tanto, hanno sustituito generale preso che s'è posto per un male particolare solo; overo per somiglianza di una facoltà sola, che fa à proposito

[123] Cfr. *Idem.*
[124] *Ivi.* p.40.

> male, ancora che tra loro ve ne siano parecchie non solo diverse ma contrarie […].[125]

Maranta denounces that many apothecaries misread Galen.[126] They generalize the particular procedures of Galen, replacing in any antidote one simple by another, because Galen has done it. Nevertheless, they forget that Galen did it for a particular antidote, and thus Galen's particular substitution cannot be universally applied. The only general rule is to match substitutes and genuine simples in every respect; if it is not followed we would not have a substitute similar in degree and quality to the original one. Maranta points out many examples of mistaken substitutions that are carry out among his contemporaries due to misunderstanding Galen's real substitution procedure:

> Come han fatto quelli che per vedere in Galeno sustituise per lo Cardamomo, il doppio del Senape; hanno poi loro in ogni cosa messolo, dove non potevano havere il Cardamomo: Non s'avendo che Galeno [...] mettendo una compostione di Asclepiade alla tosse, dove entra il Cardamomo; soggiunse se farà l'inverno, & l'ammalato sia senza febre, si può mettere per lo Cardamomo il Senape dopio; ma non gia che lo desse [Galeno] per regola generale.[127]

However, Maranta acknowledges the limitations of Galen's real procedure of substitution. He knows that a replaced simple, even if selected of the same kind and artificially transformed to match the original (as the substitution rule dictates), cannot be regarded as identical to the original one. Always it would be an almost imperceptible difference between the original simple and its substitution. However, this subtle difference would not cause the putrefaction of the resulting antidote.[128] Consequently, Maranta emphasizes one more time that the substitution rule for achieving an almost perfect substitution states that substitutes ought to be similar in kind, quality, nature, consistence, essence and degree:

> [...] che inquanto alla parte del semplice, no si harà à fare molta difficoltà, purche si pigli il simile nelle qualità, & nella essenza: & basta che convenghino nel genere. & perche mi facci bene intendere; se bene il succedaneo è sempre migliore, quando in vece di una radice si piglia un'altra radice; ò di un seme un'altro seme, & cosi delle altre parti; nondimeno purche nella essenza convenghino, cioè che in vece di un semlice arido e triturabile se ne pigli un'altro etiandio atto à ridursi in polve, & non in vece di un triturabile un'altro liquefattibile: Et di piu che il sustituto habbia le istesse virtu del principale, tanto nelle prime, come nelle seconde, & terze qualità, la sustitione è buona: percio che questo non sconcia la mediocrità della

[125] *Ivi.* p.37.
[126] Cfr. *Ivi.* pp.37-38.
[127] *Ivi.* p.37.
[128] Cfr. *Ivi.* p.41.

> consistenza di tutta la massa, ne sminuisce la virtu; & qualità, di tutto il composto.[129]

Ones Maranta has demonstrated by experience (examples and counterexamples), reason, and authority the proper substitution rules, he is ready to solve the practical problems of substitution that the production of theriac encounters. Following the proper substitution procedure, that is, substituting original simples with simples that match in every feature, the resulting theriac would be as efficacious as Andromachus Theriac.

4.2.2.1. The proper substitution of malabathrum in theriac according to Maranta

When making theriac, the prescribed malabathrum is usually substituted by the "spigo nardo," because the "spigo nardo" possesses similar features, faculties, and medicinal virtues than the malabathrum.[130] The "spigo nardo" have the same taste and smell of the "malabathrum" as well as other features. However, Maranta claims that even if the "spigo nardo" is very similar to "malabathrum", it is not its proper substitute. Maranta explains that the difference between them resides in their potency. The malabathrum is more powerful than the "spigo nardo". All malabathrum virtues operate in a higher degree.[131] Therefore, the substitution cannot be a proper one because they are not similar in degree.

According to Maranta, who is following the classical authorities, such as Dioscorides and Galen, malabathrum is hot and dry in second degree. So we can infer that the "spigo nardo" is hot and dry in first degree, Maranta does not explicitly say it. It also seems that this difference of degree is perceived by the senses, that is, that malabathrum smells and tastes stronger than "spigo nardo". However, Maranta does not appeal to experience in this case, and follows authorities to state that Dioscorides said that: "il Malabathro, se ben ha le virtù dello spigo, opera nondimeno più valorosamente in tuttel le sue virtù, & in specie allo stomaco, & al provocar dell'orina […]."[132] Therefore, the higher potency of Malabathrum is determined by an attentive reading of authorities.

Ones Maranta has shown the dissimilarity in degree of the "spigo nardo" with respect to malabathrum, he has also prove that it is not a proper substitute for malabathrum. However, it does not mean that "spigo nardo" has to be through away. On

[129] *Idem.*
[130] Cfr. *Ivi.* p.90.
[131] Cfr. *Idem.*
[132] *Ivi.* p.89.

the contrary, it can be transform very easily in a perfect match from the artifice's point of view. Transforming "spigo nardo" into a suitable substitute of malabathrum involves any serious practical problem; it is enough to double it. In other words, it has to double the amount of "spigo nardo" in relation to the amount of the original simple prescribed by the recipe.[133]

Therefore, it is not the "spigo nardo" but the doubled "spigo nardo" the proper substitution of malabathrum. However, Maranta claims that not only the doubled "spigo nardo" is a proper substitution. There can be many more and better ones. For example, the "nardo silvestre" (also called "phu") or the "nardo celtico," because they both are hot and dry in second degree as the malabathrum.[134] Here Maranta does not appeal to experience but to Galen authority again. For instance, with respect to the "nardo celtico" he justifies it as a proper substitution claiming:

> il quale [il nardo celtico] egli [Galeno] medesimamente dice essere più potente in provocare l'orina, & più utile allo stomaco, & Galeno afferma essere alquanto più caldo: Donde si coglie il celtico essere caldo e secco nel secondo grado.[135]

Therefore the "nardo celtico" is a perfect match for malabathrum, and it does not require any artificial intervention; so it is also a better option than "spigo nardo" due to its nature.

4.2.2.2. Artificial transformations for substituting in Theriac

The artificial manipulations on simples were not always as easy as in the case of the "spigo nardo". There were some substitutions that imply sophisticated and complicated laboratory processes that seem almost miraculous. Theriac's pastils of hedychorum were originally made with "opocalpaso".[136] Precisely, the "opocalpaso" was inexistent or still undiscoreved in 1572 when Maranta wrote his book. Therefore apothecaries had necessary to find a proper substitute based on the descriptions provided by the authorities. The problem of correctly elaborate the pastils of hedychorum could be solved by the introduction of an artificial "opocalpaso". The search of the most similar simple to eventually artificially transform into "opobalsamo" was not so hard. The authorities had already said that "mihrra" could be transformated into "opocalpaso":

[133] Cfr. *Ivi.* pp.90-1.
[134] Cfr. *Ivi.* p.90.
[135] *Idem.*
[136] Cfr. *Ivi.* p.91.

> […] dice Galeno all'undecimo capo del primo libro de gli Antidoti, che la Mirrha si trasforma nell Opocalpaso, pigliandone non solo la figura, ma ancora la qualità sua venenosa: perche Dioscoride del sugo del Carpaso (che così egli lo chiama, & non Opocalpaso come Galeno) ne parla tra i veneni nel sesto libro. Et perche molti havevano veduto questa sorte di Mirrha giovare mirabilmente al mali de gli occhi, credendose, che per di dentro fusse anco cosi efficace; cagionarono la morte à molti, che la pigliarono.[137]

This was a perfect solution, because it assured the effectiveness of the antidote as a whole. However, it also implied sophisticate and complex laboratory procedures. Here enters Imperato's art and Museum. Maranta says that:

> Questa transformatione dunque della Mirrha in Opocalpaso mi mostrò l'Imperato, non l'havendo io prima veduta. Et se bene non havemo noi il vero Opocalpaso, co'l quale ne potessimo fare il paragone, tutta volta vedendo nella Mirrha alcune glebe molto diverse, & di odore, & di sapore dal suo propio; non senza ragione si giudicava essere la trasformata in Opocalpaso percioche, se bene nel colore, e nella sustanza dà mostra di una eccelentisima Mirrha, havendo per di dentro certe venette bianche simili alle onghie, nondimeno che bene la considera, non la dirà essere più Mirrha: perche ha certi come punti rossigni & lustri: & parendo Mirrha, & non essendo, si conchiudeva essere il fugo del Capaso fatto cosi per trasformatione dalla Mirrha.[138]

The transformation of "mirrha" into "opocalpaso" was not the only one mentioned by Galen. For example, it was also possible to transform the "Galbano" into "Sagapeno"; and the "Cassia" into "Cinnamomo".[139] Maranta has more to say over this "meravigliosi mutationi" in which "una specie si tramuta in un altra."[140] We will retake this subject in the following part of the dissertation. For the moment, it is important to emphasize that Maranta is not only reading attentively authorities, but he is also carry on the experiments which are described by their reasoning. Therefore, both authority and experience are functioning together as a method for inquiring nature as well as manipulating it. Particularly, Maranta is questioning about which are the proper substitutions for theriac original simples; many of the correct answers to his questions demand artificial procedures.

4.2.3. The proportions of theriac according to Maranta

Since antiquity apothecaries have differed from one another in their manner of elaborating theriac. Identifying the real ingredients and finding proper substitutes of

[137] *Ivi.* p.92.
[138] *Ivi.* pp.92-93.
[139] Cfr. *Ivi.* p.93.
[140] *Idem.*

them were not the only problems that theriac elaboration presented. From the very beginning was the problem of proportions: not each and every proportion which involves the production of theriac is explicitly and clearly stated in the 174 lines of Andromachus's poem. Furthermore, the few quantities given by Andromachus differ in its many different versions. Starting with the version of his son, Andromachus the younger, who restated the poem of his father in prose, and who differs from his father. For example, he assigned 18 drachms more to the 6 drachmas amount attributed to long pepper by his father.[141] The same happens with Galen's version of theriac which "[…] non risponde del tutto ne à quella del padre, ne à quella del figlioulo […]."[142] The copyists frequently committed errors. Pliny complains that even prescriptions were wrongly copied; for these reason Galen recommended to write numbers in full for avoiding confusions and errors.[143] However, for some physicians and apothecaries "[t]he metrical form not only aided the memory but was in some measure a safeguard against fraudulent alterations."[144] In other words, for some physicians and apothecaries Andromachus poem was a sort of code that only could be decoded by the people who knew the art of making medicines. The problem was that not all apothecaries interpreted the poem in the same way, and thus proportions differ from one apothecary's recipe to another. The question was to determine the correct proportions for making the theriac antidote.

Maranta is determined to find the correct proportion, emending in this way all the previous erroneous proposals and mistakes. For achieving this goal, he would decipher the way in which Andromachus introduces proportions in his poem ones and for all. In doing this, he is aware that his recipe would be different from the already given:

> Ma havendo io fatto la ricetta mia variata da quanti n'han ragionato, & antichi, e moderni, in alcune cose trasponendo il cinquefoglio, & il Sagapeno di un peso in un altro: ne potendo mostrar ciò aver fatto con ragione, se tacesse questo artificio [usato da Andromaco introno alla proportione de'semplice di questa compositione]: perche col parlarne si concieranno alcune scorettioni, che correno per tutto in questa ricetta; mi son disposto di trattarne. [...].[145]

[141] Cfr. Watson, 1966: p.45.
[142] Maranta, 1572: p.22.
[143] Cfr. Watson, 1966: pp.45-46.
[144] *Ivi.* p.7.
[145] Maranta, 1572: p.17.

Consequently, Maranta firstly would decipher Andromachus' "artificio" for determining theriac's proportions. Ones Andromachus' device is clearly understood, it will be possible to determine whatsoever theriac proportion.

4.2.3.1. Deciphering Andromachus' device for determining theriac's proportions

Maranta starts emphasizing that he would give an easy and comprehensible account of the subject. In this superficial manner he expects apothecaries, who do not have the education of physicians, can understand clearly his explanation.[146] He knows very well the audience to which his book is addressed. And thus, he is trying to eliminate all unnecessary scholastic discourse which only would difficult to grasp his point.

According to Maranta, proportions are not arbitrary settled by Andromachus. If we read attentively Andromachus's recipe, Maranta argues, we will find that the number of simples as well as its weight is proportionally determined. He claims that Andromachus follow the quaternary proportion: "[…] [Andromaco] andò con la proportione del quaternario, il quale numero hora lo prende semplice, hora al doppio: & hora radoppia il doppio, quadruplicando il quaternario, & hora tripla il doppio."[147] He underlines that pastils or troches of viper and hedychorum (which are already compounds) count each one as one simple when applying this rule of proportions. Maranta explains that it is like this, because he is taking the nature and operation of the compounds as wholes, and not of each of its parts.[148]

Once Maranta had decoded Andromachus' poem, he has the tool to determine the original theriac proportions; and following the same rule, he can also determine the number of simples that go in each of the six compartments established by Andromachus. The first compartment has 2 simples, the second doubles the number in the first compartment, that is, 4, and Maranta continues:

> Il terzo spartimento hà otto semplici, che è il doppio del secondo. Il quarto ha sedeci medicamenti, che è il doppio de gli otto, & il quadruplo de quattro. Il quinto n'ha ventiquattro, che è il triplo de gli otto, & il sescuplo de'quattro. Il sesto & ultimo ne ha otto. Vedesi chiaramente che con questa intentione divise Andromaco i pesi ponendoli con debita proportione in quanto al numero de' semplici.[149]

[146] Cfr. *Idem.*
[147] *Idem.*
[148] Cfr. *Ivi.* p.18.
[149] *Idem.*

At this point, it is not clear why the last compartment has eight simples instead of forty-eight. The reason seems to be that in other case the total sum of simples would not be 62. It is important to underline that honey and wine were not counted as simples. They were taken for granted, because they were used in the production of every electuary. Therefore, the whole quantity of simples numbers 62, when 8 simples are added in the last compartment. However, Maranta's rule of proportion seems a little tricky.[150] Definitely, Maranta was not a mathematical genius as Galileo, but he managed to decode the metrical form of the poem of Andromachus finding a mathematical device for determining the proportions involved in theriac's production. This was an innovative achievement within pharmaceuticals. Philology and mathematics collide to give pharmaceutical fruits. The problem is that reality do not corresponds one hundred percent with the ideal world of mathematics:

> Ma noi truoviamo questa proportione variata in due partimenti; percioche l'ultimo ha sette semplici, e il quarto n'ha dicesette: la onde si può arditamente dire, che sia trasposto un semplice da un partimento à un'altro: & che quell'uno che è soverchio a i sedici, si debbia metter i sette, si che questi tornino otto, e quelli sedeci: e così la proportione verrà à essere osservata. Questa mutattione se si debbia far'ò nò, importa molto à saperlo: percioche ne verrà à esser l'Antidoto è più perfetto, ò manco; secondo che si farà ò la migliore ò la peggiore elettione.[151]

As we have read, anomalies appear. A new problem has to be solved. Maranta is very confident that his proportion's rule is correct; consequently, it is Andromachus' recipe the one that has to be amended. The problem resides in determine which simple of the fourth compartment had to be transferred into the sixth compartment. Which simple would be transferred from one compartment to another? Maranta thinks that any transference has to be done gradually, that is, one simple always moves one

[150] It seems odd that the last number of simples is not assigned by "la proportione del quaternario" (Maranta, 1572: p.18) already mentioned. However it seems that for Maranta it reassures its theory; because the only possible number to sum the 62 is 8, a number divisible by 4 which has been already justified by his rule of proportions. Moreover, Maranta's calculations seem tricky, because if his rule of proportions orders to double a number and then triple it, then the progression would be: 2, 4, 6, 12, 24, 48. However, Maranta progression is: 2, 4, 8, 16, 24, 8. He seems to double every number until he arrives to eight, then he doubles, and then triples it. Then he stops of applying his calculations and chooses to put a number divisible by fourth (to adjust to "la proportione del quaternario" we suppose) in the six compartment for summing the total of 62. Here the point is not very clear. When Andrea Cuna explains Maranta's rule of proportions, he does it with the decreasing progression: 48, 24, 12, 6, 4, 2, that is, our first progression (cfr. Cuna: p.75). Unfortunately, Cuna does go deeper into the subject and gives no further light for understanding Maranta's mathematical decodification of Andromachus' rule of proportions.

[151] Maranta, 1572: p.18.

compartment up or down, if the quaternary proportions are respected.[152] In this manner, the quaternary proportion of simples rules any change:

> […] la mente di Andromacho fù di moltiplicare il quaternario nel modo detto: in modo che se noi vedremo qualche semplice che manchi da questa proportione, ò con essere soverchio, ò manco: potremo giudicarlo per trasposto da una partita di peso à un'altra: e potremo pigliare sicurtà di metterlo al luogo, che giudicaremo che sia il suo.[153]

According to Maranta, the first simple of the list, which composes any compartment, can be transferred to a lower compartment; and the last simple of the list can be transferred to a higher compartment. Therefore, he chooses to move the last simple of the fifth compartment, namely, the "sagapeno", to the sixth compartment; and the last of the fourth compartment, namely, "quinquefolii", to the fifth compartment. In this manner, the simples are rightly disposed according to the quaternary proportion.[154]

4.2.3.2. The weight of the wine

The quaternary proportion has to be respected along all the process of making theriac. However, determining the quantity of drachmas of each singular simple one by one following the quaternary proportion presents a methodological difficulty: in *praxis*, the proportions of simples cannot be determined with accurately precision, because it is difficult to match the ideal mathematical calculations with the real quantities when making the theriac. Maranta is aware that proportions in the real practice cannot be perfect:

> Et bisogna avertire bene in questo, che nelle compositioni di molti semplici, ancora che s'usi ogni avertenza intorno tante sorti di proportioni che vi si considerano; non possano però riuscire tutte puntualmente, che non vi manchi qualcosa; della quale noi non ne havemo à turbare, ne perciò tenere l'Antidoto per men buono: percioche è cosa impossibile à poterle accertare tutte à misura giusta; ma si fa quel che piu si puo ottenere dall'arte: laquale se bene sempre tiene la mira alla iddea, per grande che sia la diligenza dell'artefice, non puo fuggire alcuni difettuzzi, i quali non dal mancamento dell'arte, o dell'artefice, ma dalla natura delle cose nascono.[155]

[152] Cfr. *Ivi.* 20.
[153] *Ivi.* p.18.
[154] Cfr. *Ivi.* pp.20-21.
[155] *Ivi.* p.27.

Therefore, Maranta's rule of proportions face some methodological limitations which gone even beyond the skillfulness of the artifice: occult properties. They always tamper the accurate measures, so it is normal to expect some variations when making theriac. Therefore, he recommends to proceeded in the following way:

> Et però se in queste nostre osservanze nascesse qualche dubbio, non dovemo per un lieve scropolo, lasciare le molte ragioni chiare, e reali. Ma parte aiutati dalla ragione e parte dalla sperienza, dovemo da per noi nelle occasioni adoperare lo arbitrio in aggiungnere, e levare alcune cose: percioche assai deve parere à un medico quando delle diece cose che egli per aventura cerca da un semplice, ne ottiene otto, ò nove [...] & ne bastará che non sieno nelle cose d'importanza. Et cio che habbiamo detto de i semplici; dovemo applicare anco a tutte le considerationi universale del composto; come per caso nel nostro proposito l'intento d'Andromaco fu di fare tutta la massa della Theriaca di sedeci libre: se riuscisse in mezza libra di più, o manco, non per questo l'antidoto deteriorerà. Così anco è difficil cosa havere tutte le circonstanze in tutte le proportioni [...].[156]

In fact, this is a very practical methodological rule, which gave the artificer freedom to move and proceed according to its knowledge and own experience for solving all sort of daily difficulties when making theriac. This methodological rule applied to the whole process of production. Therefore, the wise and experience judgment of the apothecary was the ultimate tribunal for resolving any practical dilemma. For example, the precise weight of each compartment, fixed by the quaternary proportion, could not be always one hundred percent accurate in *praxis*.[157] Moreover, in the case of wine the quaternary proportion had to be entirely omitted. According to Maranta, the reason is simple:

> […] non sempre i dissolubili si trovano di una consistenza: ma certe volte perche sono più spesi, richiedeno piu vino, & certe altre meno: perche si trovano piu teneri & molli: & è difficile l'accertare la misura giusta à peso determinato.[158]

Therefore, the exact quantity of wine used in making theriac was determined by the "discretione di un buono artifice".[159] Imperato, for instance, used to equal the amount of wine with the total weight of the simples that will be dissolved; therefore, for him one pound of wine was enough for making theriac.[160] On the contrary, Andromachus the younger utilized always a precise and invariable amount of wine: "oncie quaranta &

[156] *Ivi.* pp.27-28.
[157] According to Maranta's quaternary proportion, the first compartment must weight a half pound, the last compartment a sixth part of a pound, and the rest compartments a pound each (Cfr. Maranta, 1572: p.18; pp.25-26).
[158] Maranta, 1572: p.15.
[159] *Ivi.* p.14.
[160] Cfr. *Idem.*

libre tre, & un terzo".[161] Both procedures are correct according to Maranta.[162] They both depend on the apothecary's way of making theriac; therefore, for Maranta, the amount of wine could be more or less according to the apothecary's production habits.

4.2.4. Making the theriac according to Maranta

Almost all apothecaries differed from on another in the way of making theriac. For this reason, rulers aided by their respective Colleges of Medicine regulated its elaboration. This measure certified the quality of theriac production. In this manner, the consumers would not buy poor quality theriac made by inexpert apothecaries or quacks.

Roughly speaking, the theriac consists in a mix of 64 ingredients (that go from diverse types of plants to viper meat) which are distilled or crush for eventually being combined with wine and honey. However, the preparation and manufacture of theriac was a very intricate and laborious procedure. It also distinguished for being a very lengthy process. Not any druggist could carry out such a technological enterprise. Besides knowledge and skill, an apothecary would require a special workshop equipped with sophisticated scales and other laboratory apparatuses as well as some assistance and the approval of the competent authorities.[163]

The preparation of theriac started with the gathering of all simples, especially of vipers. These venomous creatures had to be mature females and not be pregnant; and the period of the year to find such specimens was before the beginning of summer, particularly in May.[164] After hunting and gathering the theriac's simples, it was mandatory they were displayed for public inspection during three days. In this manner everybody could examine them. At the fourth day started the theriac elaboration by means of pounding, mixing, heating, and stirring of ingredients. These processes lasted at least forty days and sometimes even two months.[165] After these two months, theriac was not ready yet. According to Galen, it needed to maturate for twelve years to acquire its maximum medicinal potency or virility.[166] In fact, Maranta, as any other apothecary, conceived theriac's process of maturation as the life of a human being. Theriac as well as humans would have four periods: "la pueritia, il vigore, la vecchiezza, [e] la

[161] *Idem.*
[162] Cfr. *Ivi.* pp.14-15.
[163] Cfr. Watson, 1966: p.82.
[164] Cfr. Maranta, 1572: 44-45.
[165] Cfr. Watson, 1966: p.49.
[166] Cfr. Maranta, 1572: p.142; Watson, 1966: pp.49-50.

decrepità".[167] During its infancy, theriac has not reached still its perfection, so it is not advisable to prescribe it except in an emergency case.[168] After its infancy, theriac has achieved his maximum potency, which starts to decrease with the passing years till it arrives to its decrepity at the age of fifty years, becoming hardly effective.[169]

4.2.4.1. The problem of theriac's maturity

Determining accurately the duration of theriac's fourth periods of life constitutes a difficult problem. However, the key problem consists in determine how much time takes the complete process of theriac's maturation, because then it can be useful. According to Galen, it takes twelve years, but Maranta thinks he is *wrong*. Maranta does not support his claim in another authority, which in this case would be Aetius who said that theriac maturates in twelve months.[170] Evidently, there is a big difference of time, which maybe has been generated by an intransigent copyist. In this case, there is only one criterion to appeal: experience. Maranta appeals to the common experience of physicians and apothecaries who prescribed theriac with good results after it had reach one year. Therefore, the medical practice contradicts Galen statement, showing that he is wrong:

> [...] l'uso commune ne mostra il contrario: percioche per ordinario niuno tratiene à servirsi della Theriaca più di uno anno doppo fatta: & alcuni anco la vendono doppo sei mesi: & molto tedioso obligo sarebbe di chi volesse fare uno Antidoto per tenerlo sepolto dodeci anni prima, che lo metta in operatione [...]: onde parrà che il testo di Aetio sia più corretto: & ciò non solo si congettura da quel che habbiamo detto; ma ancora, che essendo questo autori di molti anni più vicino alla età nostra, che Galeno non è; senza dubio è stato manco esposto alla ingiuria de'tempi: & ha conserato la sua prima, & originale compositione più incorrotta: & di questo parere io sono: & cosi hò sempre consegliato à gli Speciali, che co'l mio intervento hanno fatto la Theriaca.[171]

This quotation is revealing, because even if Maranta follows Galen as an authority, as many examples in this section testify, it is clear he does not blindly follow him. Furthermore, he thinks Galen's version of theriac is worst than other versions made in more recent times! Maranta seems to share the same heresy of Aldrovandi, who said: "I am of the opinion, as I have said at other times, that today one can make a more perfect

[167] Maranta 1572: p.145.
[168] Cfr. *Ivi.* p.146.
[169] Cfr. Watson, 1966: pp.49-50.
[170] Cfr. Maranta, 1572: pp.146-147.
[171] *Ivi.* pp.147-148.

theriac than was made in the time of Galen."[172] In other words, for them ancient recipes could be upgraded and transformed in even better medicaments.[173] This position was outrageous for the orthodox physician and apothecaries, such us Marcus Oddus, who thought medical progress consisted in restoring drugs to its ancient purity and virility.[174] Anyway, it is clear that Maranta's faith in Galen is not as strong to resist experience's dictum. In fact, Maranta appeals to an Imperato experiment in the matter:

> […] & l'Imperato nello spacio di dodeci anni ò poco più, l'ha fatta tre volte: antecipando sempre di uno anno il principio della seguente, con la fine della passata: acciò, subito finita di vendersi la precedente, si potesse mettere mano alla nuova […].[175]

Maranta does not only refute Galen appealing to the medicine practice of his contemporaries and the experiment of Imperato. In addition, he gives the following reasoning. He argues that if theriac infancy last twelve years, it would be very long and disproportionate. And surely this is not the case, as it can be corroborated by experiencing the animal kingdom:

> […] vedendosi ne gli animali, iquali se faranno di quelli, che in un'anno finiscono la tenerezza della persona; la loro vecchiaia e poi ne' diece, ò dodeci anni: & le due altre mezzane età sono fra quella e questa; come aviene de'cavalli & de cani [...].[176]

Maranta, based in both reason and experience, feels free to conclude against Galen's authority. However, he takes some precautions:

> Ond'io conchiudo, che possono gli Speciaii cominciare à vendere la Theriaca doppo uno anno, facendo però avertiti i compratori della età dell'Antidoto acciò fattone consapevoli i Medici, possano servirsene canonicamente.[177]

4.2.4.2. The selection of the simples

The apothecary has to be very selective with the quality of the ingredients he will use when making theriac. The seeds, roots, leaves, minerals and animal parts not only have to be exactly identified or properly substituted, they have to be of the best quality—or

[172] Aldrovadi quoted by Findlen, 1994: p.280.
[173] For example, Mattioli invented the "scorpion's oil" which was a compound antidote of more than a hundred of ingredients. Mattioli had mixed together theriac, mithridatium, and some exotic ingredients, such as oriental pearls, and emerald splinters. (Berman, 1970: 9)
[174] Cfr. Oddus, 1577: dedication.
[175] Maranta, 1572: p.147.
[176] *Ivi.* p.148.
[177] *Idem.*

as Maranta say "nella loro perfettione".[178] A royal antidote as theriac deserves it. On the contrary, the resulting theriac would be of low quality and low potency or, even worst, it would be wasted. Therefore, Maranta gives a detailed account of each simple. He explains where to find it; how to know if it is of good quality; and how to collect it rightly. A relevant example of selection would be a simple that is very common and accessible as the honey. The selection of it is relatively easy but requires trained sensory organs. Acute senses played a capital role in selecting the best quality simples as is exemplified by honey.

Maranta points out there are essential and accidental features as criteria to select the best quality honey. The more important would be its essential features, because accidental ones can be also presented by an imperfect honey, as Galen affirms.[179] Maranta claims there are two the essential features of a perfect honey, and he also gives a way to recognize them:

> […] l'ottimo dunque deve essere dolcisimo, & acutisimo: percioche per sua natura il mele hà questi due sapori: iquali quanto più sono potenti, tanto più danno indicio di sua perfettione: & chi harà gustata la Sapa harà trovato in essa una dolcezza obtusa, & sola senza una certa vellicatione & leggiera puntura di lingua. Ma nel mele vi è anco questo, cioè la acutie; laquale se farà potente; dà indicio dela bontà di esso. Questi sono i principali segni, & gli essentiali.[180]

However, Maranta remarks that honey has to taste strongly sweet but without tasting too much to the plant from where it has been gathered. Otherwise, it means, as Galen affirms, that the bees had badly transmute it, and thus it could be more difficult to digest.[181] Therefore, it is necessary a well trained and experienced sensory organs to detect these sensory subtleties.

Maranta continues giving the accidental features which also help to locate a good quality honey. If we follow them, probably we will not obtain a perfect honey, but neither a bad honey. The accidental features in the case of honey are four. Firstly, its color, it has to be a little red. Secondly, its smell, it has to be good and soft. Thirdly, its substance or consistence, it has to be homogeneous, not too thick nor liquid; it also has to be strong, that means that it would fluently fall rather than fall in parts when taken with the tip of the fingers, and the remaining honey in the fingers would return quickly

[178] *Ivi.* p.78.
[179] Cfr. *Ivi.* p.135.
[180] *Ivi.* p.134.
[181] Cfr. *Ivi.* pp.140-141.

to unify. And finally, its durability, the honey consistence and properties have to remain the same for long periods of time. Maranta agrees with Galen that these properties have to last two years at minimum.[182]

According to Maranta, generally the honey that is collected in springtime matches these characteristics perfectly, then follows the one collected in summer, then that of autumn, being the worst of all the one collected in winter due to their low qualities. Also matters the kind of plants from which bees have gathered the honey. For instance, Maranta remarks that "thimo," "serpillo", "thimbra" and "rosmarino" and other similar plants would produce and excellent honey, because they are plants with perfumed fruits good for the stomach and for the whole body. Maranta also recommends to the Neapolitans the honey of the Mont Gargano, because it is full of the mentioned plants. And lastly, but not less important, it also matter the skillfulness of the farmer in his art.[183]

4.2.4.3. Dissolving and crushing: the fundamental procedures for making theriac

Every ingredient composing the theriac had to be crushed till it became a very subtly powder; or dissolved till it became a homogenous syrup or juice without any particles in it. Many ingredients required first to be dissolved, and then crushed or vice versa. Eventually, all ingredients would be dissolved into a drinkable antidote.

The theriac antidote would be perfectly manufactured, if it fulfills the following conditions: firstly, an homogeneous consistence, it has to be not too solid, not too liquid; secondly, a good an unique smell, it does not have to present any kind of stinky smell, and no particular smell of any of its components has to prevail over the others; thirdly, it has to taste a little bitter, but not too much, an acid taste would indicate a bad fermentation as well as an strong bitterness.[184]

All humid simples, such as liquids, gums, juices, tears, had to be dissolved with wine. In fact, wine and honey were the two base elements with which all antidotes were prepared. Therefore, a good wine was always required when making drugs, that is, one potent, strong and with "buona schiena;" one which takes too many years to turn into

[182] Cfr. *Ivi.* pp.134-135; p.142.
[183] Cfr. *Ivi.* pp.134-138.
[184] Cfr. *Ivi.* p.145.

vinegar.[185] The Falernian was the paramount selection, but it was enough any good wine. For example, Galen used the "Surrentino".[186]

Not all things were easily dissolved in wine by means of only mixing them with it. Many require laboratory procedures. Generally, simples were dissolved with the famous Mary bath.[187]

All dry simples could be combined with honey, when needed, before being diligently crushed in huge mortars with big pestles along with all the rest of not humid ingredients. Seeds, roots, fruits, leaves, herbs, mushrooms and minerals had to be perfectly crushed. Thus, the crushing procedure was iterated as many times as necessary to obtain a very thin and subtle powder.[188] Maranta who is interested in prescribing normative rules to the preparation of theriac, gives the following methodological procedure as criterion to verify the optimum degree of thinness or subtleness. The criterion is not taken by any authority, but from its apothecary friend and co-author, Imperato himself:

> In somma tutte le cose humide si dissolano in vino, & le secche si riducano in polve sotilissima, & si tenghino in due vasi appartatamente: avertendo di passare le cose humide per pannolino stretto; perche restino fuora tutte le immonditie, che nelle lagrime, & nelle gomme, & ne' sughi si sogliono trovare: overo si possono passare per tamigio: il qual modo hà in uso di fare messer Ferrante Imperato & manco scapita: perche il panno sempre resta bagnato del liquore.[189]

Ones each ingredient has been correctly crushed or/and dissolved until it become a subtle and unified substance, then each one has to be labeled and stored in a particular vase. The next step consists in mixing all the simples following a determinate order.[190] All the simples which belong to a compartment must be combined together; so they are crushed and dissolved again. Then they are again stored and labeled in a vase. The same process applies to the six compartments. Finally, the six compartments have to be mixed following the same procedures.

However, the process described is more complex in reality; it has been oversimplified for commodity. There are some very particular instructions along the briefly described process. For example, some ingredients had to ferment under the sun

[185] Cfr. *Ivi.* p.128.
[186] *Idem.*
[187] Cfr. *Ivi.* p.56.
[188] Cfr. *Ivi.* p.14; p.56.
[189] *Ivi.* pp. 55-56.
[190] Cfr. *Ivi.* p.57.

for some days before they could be mixed or after mixed. Eventually, after the whole mixing process has finished, the resulting theriac was enclosed in a crystal vessel and each five days, during a period of forty days, was directly exposed to the Sun.[191]

4.2.4.4. Different ways of preparing theriac: the problem of crushing as example

There have been many ways of preparing the theriac. However, they can be reduced to two different ways. The first way is the one prescribed by Galen. The second one is the one followed by Aetius. Both are rooted in Andromachus the Older and his son. Maranta would judge wise to follow Galen in some things and Aetius in other things. Therefore, he innovated a new hybrid or eclectic way to prepare theriac.[192]

Galen dissolves in wine only the juices, tears, and the seeds that cannot be crushed. Instead, Aetius also liquefy many dry simples in addition to Galen's list. This difference generates a different amount of wine in each case. Aetius proceeds to gradually crush the simples one by one, sometimes aided also with wine. Instead, Galen crushes together as many simples as practicable as possible (according to the dimensions of his mortar for example) without any wine.[193] Therefore, Galen is capable of exactly determining an amount of wine for preparing the theriac, as Andromachus the younger did. Fact that is almost impossible for Aetius who is adding wine as required, as Andromachus the Older used to do.

Maranta regards both procedures as correct. Furthermore, this fact explains why the old Andromachus did not prescribed an exact amount of wine, and his son did:

> D'onde di facile si potrebbe cogliere, che Andromaco il vecchio si servisse nel preparare questo Antidoto non solo del modo scritto da Galeno; ma tenesse anco per buono quello, che scrive Aetio, et che perciò non determinasse la quantità del vino: perche determinandola, si sarebbe astretto alla preparationi di un modo solo [...]. Et all'incontro Andromaco il giovane il preparasse solo nel modo scritto da Galeno & perciò poteva più arditamente determinare la proportione del vino.[194]

With respect to crush gradually or not the simples, Maranta thinks it is better to proceed gradually. He does not believe that proceed as Galen is entirely wrong, but he thinks that crushing gradually the simples assures its artificial reduction to the tiniest dimension possible. In this manner, they would be capable of mixing one with each

[191] Cfr. *Ivi.* p.58.
[192] Cfr. *Ivi.* pp.62-4.
[193] Cfr. *Ivi.* pp.64-5.
[194] *Ivi.* p.65.

other in a harmonious unity that eventually would be capable to reach all the parts of the human body restoring its health.[195] In addition, Maranta thinks that when simples are gradually crushed, the artificer can control better to not destroying their properties by over-crushing them. This frequently happens because the consistency and hardness of the simples is different. For example, seeds require more time and force than leaves or flowers. Therefore, Maranta reasons, if we crush them together we risk destroying the leaves while crushing the seeds.[196] Even Galen himself, Maranta tell us, needed wine to lose the stick patch of simples mass in the bottom of his mortar after finishing his procedure.[197] This did not happen to a diligent artificer who gradually crushed his simples. Therefore, Maranta regards Aetius crushing procedure better than Galen's one. However, Galen's method is useful only when crushing minerals; in that case, it could be more comfortable and it would save time.[198] In any other case, according to Maranta, following Galen's crushing procedure is wrong, because it violates the methodological rule that apothecaries followed when crushing, namely, that the simples of the same kind must be crushed together. In other words, seeds with seeds, roots with roots, and so on.[199] Maranta again is humbly correcting the most important authority of medicine of his time.

Therefore, Maranta's way of preparing the theriac consists in crushing everything excepting the dissolvable juices, tears, and seeds, as Galen used to do; but contrary to Galen, he gradually crushes each simple, as Aetius did. This would be the correct way of crushing the simples when making theriac. However, Maranta acknowledges this general procedure not as his, but as Imperato's innovation:

> […] & se bene io ho sempre ammirato l'ingegno, & l'acutezza di quell'huomo [Imperato], in questo mi ha dato tanto da marauigliare, che non saprei esprimerlo. Et non per altro io determinai di indrizzare à lui questo discorso, se non perche buona parte degli auerimenti, che in esso ho posto, sono cauati dall'osservanza sua, mentre faceva, hora la Theriaca, hora il Mithridato, hora altra famosa compositione.[200]

Fermentation was the final step of theriac's production. Its maturity depended

[195] Cfr. *Ivi.* p.66.
[196] Cfr. *Ivi.* pp.66-67.
[197] Cfr. *Ivi.* p.70.
[198] Cfr. *Ivi.* pp.68-69.
[199] *Ivi.* p.71.
[200] Cfr. *Idem.*

entirely on it. Therefore, ones the artificer had finished mixing all theriac's simples into a unified and homogenous mass, the fermentation process started. All the amount of theriac obtained must be fermented as whole in a same vessel. On the contrary, the fermentation would not be as powerful, and thus the theriac antidote would be weak. Therefore, the artificer had to be very cautious of not losing any gram of theriac's mass during its whole fermentation process, which took around one year.[201] Finally, the theriac was ready to be bottled and sold.

[201] Cfr. *Ivi.* p.158.

Chapter 5. Controversial issues on theriac through history

5.1. Controversies on Theriac

During the almost two millennia of producing Theriac, medical communities debated always about its correct recipe.[202] Since antiquity many forcefully discussions about the genuine ingredients, the most adapt substitutes, and the correct proportions took place. The sixteenth-century was not an exception. Their goal was reviving theriac into its original and pristine form, that is, the one given by its inventor. They search for the real simples, the ones prescribed by Andromachus the Older was their primary target in their scientific agenda concerning *Theriac*. Their motivation was so strong that they inherited it to the apothecaries of the following century. For example, the French Louis de la Gryve in his *La thériaque au Roy* (1619) suggested replacing all theriac original simples with indigenous simples of the Lyons region. His proposal was seen as a heresy and challenged to the point that he was forced to retract.[203] Naively one expects to find this sort of disputes totally based in an epistemological point of view. The investigation of nature was developing during the sixteenth-century. New activities, such as, collecting, travelling, experiencing, and so on, were among the new scientific arsenal to gain nature's knowledge, as exposed in part one. However, the controversies about theriac also were heavy laden of social and economical factors. In other words, behind the naturalistic framework of controversies were hidden strong monetary interests as well as the search of fame and prestige.

5.1.1. Calzolari's controversy

Calzolari was a very prestigious apothecary, known beyond Verona's frontiers. His theriac was prized as the best theriac ever made since Galen time. He accomplished the incredible task of manufacturing it with the less quantity of substitutes possible.

[202] Cfr. McVaugh, 1972; Martínez, 1724; Vidal, 1727.
[203] Cfr. Berman, 1970: pp.6-7.

Consequently, his theriac was made almost in its totality with genuine simples. Mattioli recovered his faith in reviving the original theriac when heard about Calzolari's successful results, and praised him:

> The fame of Calzolari's 1561 and 1566 theriac was due to its remarkable proximity to the Galenic compound. While the first theriac contained six substitutes, fewer than any made previously, the second reduced the number to three. By collecting and comparing specimens, Calzolari uncovered samples of such elusive ingredients as *balsamo, amomo, costo, folio, aspalatho, terra lemnia, marmo,* and *calamo aromatico*—the very materials whose whereabouts had confounded the medical community two decades earlier when Mattioli wondered if a true theriac could ever be made. To publicize his success in restoring ancient medicine, Calzolari devoted an entire room of his museum to theriac ingredients to underscore to purity of the compound visitors could buy in the shop below.[204]

Aldrovandi, the most learned authority in the subject during the Renaissance, have given advice and approval to the first version of Calzolari's theriac recipe; and the College of Medicine of Verona as well as Mattioli, the famous naturalist, had legitimated the second and final version of Calzolari's recipe.[205] However, Calzolari's recipe was criticized in 1566 by Ercolano Scalcina. According to Scalcina, the procedures in which Calzolari made theriac were incorrect. Furthermore, he claimed that the ancient simples recently rediscovered, such as *apio, orobio,* and *scilla* which Calzolari use in its theriac were false.[206] The first impression is that under the dispute would be a sound theoretical argument, because legitimating an antidote consisted in public experiments in which experts on the subject gave their written authentication at the end of the experiment. These written statements were more reliable according to the number and prestigious personages that integrate the evaluation committee. These public certifications were the criteria that naturalists of the sixteenth century have developed to confirm the truth of their knowledge.[207] Therefore, the attack on Calzolari's recipe meant also an attack to the accepted knowledge of the time. In fact, Scalcina precisely claimed that Calzolari's theriac had been approved due to the academic connections and privileged social status of Calzolari.[208]

A close examination shows that Calzolari controversy is not a scientific controversy in any sense. Ercolano Scalcina was an apothecary apprentice who had

[204] Cfr. Findlen, 1994: p.274.
[205] Cfr. *Ivi.* p.273.
[206] Cfr. *Idem.*
[207] Cfr. *Ivi.* p.274.
[208] Cfr. *Idem.*

been rejected by the very Calzolari to take any part in his activities, such as expeditions.[209] Scalcina took revenge trying to damage the reputation of Calzolari. Paradoxically, he gave him more publicity and diffusion, because Calzolari asked all the authorities he knew testimonials against the calumnies of Scalcina. It did not take too long to Calzolari to collect testimonials of prestigious physicians, apothecaries, and naturalists that confirm the legitimacy of his recipe as well as the honour of his person.[210] As consequence, Calzolari's theriac trade increased.[211] Surely Scalcina regretted all the rest of his life about his actions; because as Findlen tells us, he had ended his apothecary career before even finish it:

> Scalcina, unable to secure a permanent position in any pharmacy and forced to wander from city to city, embodied the sort of ambulatory practitioner that respectable and honourable members of the medical profession most despised. If he did not already belong to this category when he contested Calzolari's theriac, his attempts to discredit one of the most famous apothecaries in Italy sealed his fate.[212]

5.1.2. Aldrovandi's controversy

The most important controversy concerning theriac was the one in which the most prestigious naturalist of the sixteenth-century engaged. It took place in Bologna from 1575 to 1577.[213] Aldrovandi along with other members of the College of Physicians of Bologna was part of the certification committee. Inspecting the viper troches on june 11th of 1575, Aldrovandi noted that many errors have been committed. For instance, the vipers instead of being killed in April, when the Sun is in the house of Taurus, as Galen recommends, have been recently killed and they were too fresh. Some vipers were pregnant and, even worst, many of the them were males. All vipers were too salty specimens, because all of them come from Ravenna; and thus every person who drinks the antidote would felt too thirsty.[214] Therefore, Aldrovandi refused to certify as authentic the theriac made in Bologna that year. However, few members of the committee agree with Aldrovandi, the majority sided with the apothecaries and authorities of Bologna. They accused Aldrovandi of delaying the production and sale of the antidote, and of undermining the credibility of the College of Physicians. Therefore,

[209] Cfr. *Idem.*
[210] Cfr. *Idem.*
[211] Cfr. *Ivi.* pp.276-277.
[212] *Ivi.* p.276.
[213] Cfr. *Ivi.* p.278.
[214] Cfr. *Ivi.* p.282.

they wanted to punish Aldrovandi by removing him from his protomedic position.[215] Aldrovandi was interfering with the profitable business that theriac represented; but not only money was in dispute, but also pride and fame.

Aldrovandi, as Calzolari had previously done, also gathered testimonials of naturalists to support his judgment. Prestigious protomedics from all Italy, such as Calzolari, Cardano, Mercurial, Pisano, Donati and many more, supported Aldrovandi's judgment. For example, according to Pisano, the *protomedico* in Naples, Imperato also agreed with Aldrovandi's judgement:

> You will hear from Ferrante Imperato, from who I received one of your most learned letters, that I have procured the opinions of our College so that it would be more authoritative, confirming the correctness of your judgment of the time to collect the Vipers and that those Troches were badly made […].[216]

The naturalist community of the sixteenth-century not only supported Aldrovandi, but also respected him even more as honourable men. However, the controversy left the scientific arena in second plane and become a political controversy. By fortune, Aldrovandi ties with political power also were very strong. He was the consultant naturalist of the Pope Gregory XIII. After some time, the Pope and the senate intervened. Trading the theriac produced at Bologna in 1575 was finally prohibited.[217] Aldrovandi had won over "[…] the Scalcians who walked the streets of Bologna."[218]

5.1.3. The Medical College of Padua versus the Naturalist Network of Naples

Maranta and Imperato's recipe and way of manufacturing theriac exposed in *Della Theriaca et del Mithridato* (1572) was attacked by Marcus Oddus and other two prominent members of the prestigious *Patavinorum Medicorum Collegio*, namely, Iunio Paolo Crasso, who was a lecturer of speculative and practical medicine as well as a very erudite professor of Latin and Greek; and Bernardino Taurisanus, who not only was learned professor of philosophy and medicine but also in herbolary.[219] The medics of the Medical College of Padua enrolled in the enterprise of identifying each ingredient regarding theriac's recipe as well as their proper substitutions among other fundamental and interesting problems concerning theriac production, such as the problem of

[215] Cfr. *Idem.*
[216] Pisano quoted by Findlen, 1994: p.283.
[217] Cfr. Findlen, 194: p.283.
[218] Aldrovandi quoted by Findlen, 1994: p.283.
[219] Cfr. Oddus, 1577, dedication.

proportions. The fruitful result of their research was the book *Meditatione doctissime in teriaca et mithridaticam* (1576), which, according to them, provided humanity with the true way of manufacturing theriac, the one which gives back theriac all its virtues and effectiveness making it of good use again.[220]

Generally speaking, these experts of the Medical College of Padua concluded that the lost of Theriac's strength was because theriac antidotes had been being manufactured without paying attention to the genuine ingredients nor proper substitutes, such as the case of Maranta's theriac recipe. For instance, the opium, the napum, the tears of acacia, the pieces of viper, the wine, and the honey are some of the key issues within Oddus' argument against Maranta; also the problems of distribution, proportion and number of ingredients in each partition of the Theriac's recipe are attacked by Oddus, being the fourth, fifth, and sixth compartments the more controversial.[221] In addition, Oddus fights Maranta regarding the origin of the antidote's name, and also the status of pharmacists, which we have already mentioned above. Summarizing, Oddus concluded in their *Meditatione doctissime in teriaca et mithridaticam* (1576) that Maranta's method for producing theriac was false.

Maranta died the year after publishing Della *Theriaca et del Mithridato*. He never knew about Oddus' criticism. However, Imperato along with many friends and colleagues of Maranta immediately reacted to Oddus' accusations made in 1577. The collective defence was in charge of Nicola Antonio Stigliola's *Theriace et Mithridatia Stelliolae Nolani libellus* (1577).[222]

Pondering the dispute between the Medical College of Padua versus the Naturalist Network of Imperato goes beyond the objectives of this research. However, it seems that the antipathy Oddus professed to Maranta comes from his non-orthodox approach. Maranta not only addressed to apothecaries in Italian, but he also gave them an account of the subject without using scholarly arguments and technical terms; and he even defies and corrects Galen! Moreover, it also seems very likely that Oddus was protecting the economic interests of the Paduan and Venetian apothecaries when rejecting Maranta's recipe, particularly its substitution proposals. Nevertheless, prove these statements as well as reconstruct, analyze, and evaluate the arguments of both sides would be the subject of another dissertation. Still, there is an issue between

[220] Cfr. *Idem.*
[221] Cfr. *Ivi.* pp.25-77.
[222] Cfr. Cuna, 1996: p.74.

Maranta and Oddus that concern us, because it has to do directly with the explanatory power and pragmatic effectiveness of theories: the rules for determining correct proportions for making theriac.

Oddus considers that in matters of proportions the artificers have to appeal to the theory of musical harmony, because proportions are clearly settle by it since Pythagoras. Oddus did not find so suspicious the mathematical calculations of Maranta, instead he considers that the quaternary rule of proportions is insufficient to determine all theriac proportions, because not all music harmonies, as stated by Pythagoras, manifest the quaternary proportion mentioned by Maranta; therefore Maranta's approach is false:

> Cum igitur hoc ita sit, nemini quidem dubium esse potestq si Maranta compositi consonantiam interius, uti primus Pythagoras suavem fabrorum concentum perpendisset, non tantum hanc quaternariam, sed & alias consonantias in antidoto reperijsset: cum enim Pythagoras ille (ut clarissimus autor Boethius testatur) divino quoda[m] numine fabrorum pulsantes malleos exaudisset, sonorumque ferientium varietatem inter sese expendisset, quae non ex hominum lacertis, sed malleorum in equali pondere proveniebat, ponderatis malleis, quoru[m] exempli grati ut duodecim pendebat, alius ut novem, tertius ut octo, & quartus ut sex, hanc inter se servare proportionem eos animad vertit; q[ua] duo quidem pondere dupli erat, malleus nempe ut duodecim, & alter ut sex ponderum, qui sibi secundum diapason consonantiam respondebant; qui erò ut novem, cum malleo ut duodecim, aut ut sex sexquitertio pondere coniungebatur, diatessaron consonantia comprehendebatur, ad quam etiam melodiam adiungebatur malleus ut octo cum malleo ut sex secundum epitritam, seu tertiam proportionem, at primus ut duodecim ad malleum ut octo, & alter ut novem ad alterum ut sex sexquialtera proportione consonantiam permiscebant, novem verò ad octo sesqui octava resonabat tonum: sic & Maranta divini Andromachi antidotum arte admodum conflatam, ut de ea scribens Galenus omnibus numeris absolutissimam praedicet, penitus perscrutari, ac cum Pythagora saepius malleos commutare, & personantes simplices medicinas examinare debebat: invenisset namque quartam hanc sectionem, quae decem & octo reverà simplicibus constat (ut inferius ostendemus) cum quinta ex vigintiquatuor epitritam, seu tertiam, it octo ad sex servare proportionem; primam verò cum secunda diapente, sicut secundam relatam ad tertiam duplam; ac postremam, quae ex solis tantùm septe componitur , ad tertiam sexquioctavam; ad primam verò, si tres scillae portiones separatim accipiantur, duplam, ut uberius cunde scilliticis pastillis agemus, inferius ostendemus. Itaque si ex dictis Marantae conclusio falsa est, fundamenta quoque & rationes corruant neesse est.[223]

Once Oddus has refuted Maranta's device for determining proportions, he proceed to determine the quantity and weight of each simple that composed the theriac as well as the weight of the whole antidote. The interesting point is that Oddus results differ very lightly of Maranta's results. At the end, the final sum of simples' weights of

[223] Cfr. Oddus, 1577: pp.35-36.

each recipe varies only ten drachms.[224] The missing drachms in Maranta's theriac really made a difference in the power strength of theriac's strength and potency? It seems that if Calzolari's using only three substitutes against the six substitutes used in other theriac versions made a more powerful theriac, then a difference of ten drachmas of the overall theriac's ingredients would have some consequences with respect to its efficacy. However, Quatramio claims in his *Tractatus per Utilis Atq. Necessarius ad Theriacam, Mitridaticam Q. Antidotum componendam* (1597) that there is not a significant difference:

> […] non è il mancamento di diece dramme di manco delle specie, & dire che sia composto con il numero quaternario, ò Harmonia Musicale, di Severin Boetio, che non nuoce, ne giova al composto, tale dicerire: come nuoceno al composto, di esser doventato di altra diversa qualità, da quella che è la mente del compositore, perche non può fare li effetti che faria controquelli veleni morsure de Serpenti & tanti vary morbi [...].[225]

Quality matters, not quantity. Therefore, both the quaternary proportion and the theory of music can achieve the same goal.[226] In other words, we have an interesting case of theory underdeterminacy.

The controversies of Calzolari, Aldrovandi, and Maranta show that restoring theriac pristine strength and potency was regarded as an issue of extreme importance during the sixteenth-century. The scientific communities of naturalists, physicians, and apothecaries of the time were disputing a significant scientific agenda based on traditional and scholarly procedures, the humanistic philological approaches, and the new naturalistic methodologies that were emerging during the sixteenth century. In addition, within the pharmaceutical domain mathematical models for making accurate measurements were under development. However, they still did not have the

[224] Cfr. *Ivi.* pp.64-65; Maranta, 1572: pp.172-175.
[225] Quatramio, 1597: pp.41-42.
[226] Quatramio claims that theriac antidotes, such as the ones proposed by both Maranta and Oddus, still are defective, because they still are using some erroneous substitutes; however he regards Maranta's theriac as one of the best, and thus better than Oddus' theriac (cfr. Quatramio, 1597: p.5; pp.13-14, pp.19-20; pp.41-42). Quatramio pharmaceutical agenda not only consists in amending the errors that apoticharies still commited by the end of the sixteenth-century, but also in proposing the construction of a botanic garden *ex professo* for theriac's genuine ingrendients: "[...] vedendo che se comprano oggi di tanti semplici falsi, per li veri, per caresti di chi li cognosca in Italia: per vedere tanto avare le Republiche de buone, & gran Città, che per dove sono li study, & colegy de Medici, le Città doveriano fare che vi fosse un giardino di semplici, con il suo perito Semplicista, & questo vogli che mi basti quanto à questa partita [...]." (Quatramio, 1597: p.67)

technological sophistication for making drugs following strict measures, as Maranta exemplifies.

However, remains an important question concerning theriac. How it is possible that sixteenth-century naturalists, physicians, and apothecaries—who started to defied authorities through experiencing nature in novel ways—believed in theriac's universal medicinal virtues and efficacy? Why did they believe that theriac actually would cure every disease, if it was made according to the ancients?

5.2. On theriac's efficacy

How do we know that certain theriac is perfect? We have mentioned above some sensory conditions that a perfect theriac must satisfy from a manufacturing point of view. However, the question is about its potency against venoms, poisons, and other ailments. The efficacy of the antidote is the only criterion to know for sure whether a produced theriac is perfect from a therapeutically point of view. According to Maranta, theriac's efficacy can be tested in at least three distinct manners. A perfect theriac would pass any of them, and imperfect theriac would hardly pass them, but a false theriac surely would fail to pass all of them.

The first test goes back to its legendary and royal origins. It was the one applied by the King Mithridates in its vehement research for antidotes against venoms and poisons. The theriac was tried out on criminals condemned to die.[227] After they have drunk the poison, the theriac was taken, and its efficacy could be quickly corroborated.[228] This was the favorite test of kings and emperors, such as Neron, whose apothecaries always tested theriac with prisoners condemned to death. However, not all apothecaries had access to this sort of prisoners, so Maranta propones to tested theriac's efficacy in chickens instead of men: "[...] noi ne potremo fare il saggio ne i galli; facendogli mordere da i serpenti venenosi: & doppo dargli à bere la Theriaca [...]."[229]

The second efficacy test consisted in giving theriac to someone, and immediately after give him a soluble purgative or vice versa. In either case, if the theriac was perfect, then it would interrupt completely the action of the purgative.[230]

The third and final test, was designed by Aetius, and consisted in giving a little dosage of opium to a testing subject, such as chicken, dog, or dove. Then the

[227] Cfr. Watson, 1966: p.34.
[228] Cfr. Maranta, 1572: p.144.
[229] *Idem.*
[230] Cfr. *Ivi.* pp.144-145.

corresponding dosage of theriac was given to the subject. If the theriac was perfect, then the testing subject would not present the opium effects, like sleepiness.[231]

Theriac effectiveness also could be testified by ordinary life experiences. People who used to drink it as protection to venoms when was bitten by some venomous creature would not die, if they had been drinking a perfect theriac. For example, Galen tells Piso that "[t]here is no recorded instance […] of its failure to save anyone bitten by a venomous animal if he drank it right away, or anyone who had taken it as a precaution and was bitten soon thereafter."[232] Galen claims he himself have tested theriac on wild cocks and "[…] found it completely effective."[233]

Nevertheless, in the sixteenth-century theriac has lost his effectiveness. Definitively, theriac had not anymore the amazing medicinal potency that authorities attributed to it. For example, at the last decade of the sixteenth century, in 1592, Prospero Alpino said:

> Infatti quale medico si fiderà oggi di curare con la sola teriaca o con il mitridato i morsicati da vipere, aspidi e scorpioni egiziani, o da qualsiasi altro serpente? O chi, confidando in questi antidoti, oserà inerire impunemente dell'aconito o del napello od altro veleno? Perché dunque la teriaca confezionata dai nostri, sia pure con la maggior diligenza, manca totalmente di quelle grandi doti?[234]

It is totally outstanding nowadays to understand how if evidently theriac was not as efficacious as authorities have said it was, it still was considered as the paramount antidote not only during the sixteenth-century but for almost two thousand years. As Alpino's quotation from his *Le piante dell'Egitto, il Balsamo* (1592) testifies, there was no doubt that sixteenth century naturalists were completely aware about theric's inefficacy. However, this fact did not lead the naturalists, physicians, and apothecaries working on theriac to questioning the antidote itself, nor the ancient theories on drugs and sickness given by authorities. The reason was simple. They believed in the testimonies of authorities, why did they would doubt them, if its entire knowledge was supported in their doctrine? Basically, the great amount of false simples and improper substitutions which contained the versions of their century explained the manifest inefficacy of theriac. Therefore, in the sixteenth-century, both the ancient efficacy of

[231] Cfr. *Ivi.* p.145.
[232] Galen quoted by Watson, 1966: p.74.
[233] *Idem.*
[234] Alpino, 2009: p.152.

theriac and its actual inefficacy were justified by the doctrines and testimonies of authorities. Prospero Alpino proves it, when he answers his own questions:

> Solo perché l'antidoto necessita di tutti i molti ingredienti con cui veniva preparato in antico. E fra questi occupano il posto principale l'opobalsamo, il carpobalsamo e lo xilobalsamo, in luogo dei quali i nostri faramacisti sostituiscono altre sostanze. Per questo molti dicono che la teriaca egiziana è assai più efficace: perché nella sua composizione rientrano le dette droghe vere e preparata di fresco. (Alpino, 2009: 152)

Therefore, they could not demand the efficacy which authorities had spoken about. Testing theriac did not constitute evidence against theriac nor any medicinal theories involved in it. Their scientific agenda rather to explore the medicinal virtues and limitations of their theriac versions was to restore theriac's purity and perfection. Generally speaking, this was the main goal of sixteenth-century naturalists, apothecaries, and physicians. For example, the prestigious College of Padua commissioned Marco Oddus, Iunio Paulo Crassus, and Taurisan Bernardinum for this quest:

> Verum posteaquam antidotus utraque in publicum vagari caepit, non solum regiae nobilitatis, & autoritatis eis multum detractum est, sed & praestantia, & bonitas est abolita: […] Quod quidem ut primum celeberrimum Collegium Patavinum tres ex suis doctoribus, nempe Iunio Paulum Crassum, Bernardinum Taurisanum, & me pariter delegit, quibus provinciam hanc mandavit, [...] candorem pro viribus restitueremus.[235]

Engaging in this scientific enterprise implies solving the variety of problems that Maranta's book exemplifies. The naturalists' agenda concerning theriac was clearly settled and delimited. The diverse accounts and methodologies vary a little bit. The philological approach is mandatory. The interpretation of authorities as well as the role of experience is disputed. But in the end the whole enterprise is incrusted in the framework of authorities. For instance, "[t]he Mantuan physician Filippo Costa praised Imperato for making a medicine, following the guidelines outlined in Maranta's *On Theriac and Mithridatum*, that differs from the rules of Mesue and conforms to those of Galen'."[236] However, it is no possible not asking if theriac had actually medicinal virtues. Surely naturalists, apothecaries, and physicians of different centuries, such as

[235] Oddus, 1577: dedication.
[236] Findlen, 1994: p.251, Costa quoted.

Maranta and Imperato, have tested it with some results. Maybe they not found the miraculous efficacy described by authorities, but they saw some medicinal properties in it. If not, how could be explained theriac's sovereignty of two thousand years? Precisely, this would be the last problem treated in this chapter.

5.3. The medicinal virtues of theriac

Andromachus, Damocrates, Galen, Aetius, and a huge list of pharmacists-physicians till arrive to Maranta and Imperato have experienced by themselves theriac's medicinal virtues in some degree of efficacy. Even if in the sixteenth-century the therapeutic efficacy was rather low with respect to the high efficacy described by the ancients, theriac still was used along with other remedies to combat all sorts of human ailments. Furthermore, they thought worthy to engage in the monumental enterprise which represented the restoring theriac's total efficacy. At least, we can assume that theriac have had some minimum medicinal virtues, and thus the scientific community had faith in restoring it. After all, according to the official state of natural knowledge in the sixteenth century, it was not only theoretically possible to elaborate a multi-medicament capable to cure virtually any disease and to counteract again any poison; it was a fact, as testifies the theriac. For them, the royal antidotes were "[…] poly-pharmaceutical remedies in which any single ingredient […] had a role to play. […] They were convinced that by multiplying expensive, exotic ingredients in a drug, they would eventually create a universal remedy."[237] At least, the idea of manufacturing multi-medicaments was not an outraged one, it still prevails today.

It is possible that the miraculous efficacy was exaggerated by the narrative style of authorities generating a placebo effect. Not likely, it would be very strange that for two thousand years the people, who took theriac, felt well just because they blindly believed in the word of authorities. Furthermore, many people who took it did not know medicine and could be skeptic about its results. It seems more probable, that the theriac efficacy had been always low. In other words, it was not the panacea that many authorities said, but it had some multi-healing properties.

From ancient times, there were some physicians who doubted about the miraculous efficacy ascribed by its contemporaries to theriac. For example, Watson claims that Erasistratus was contemptuous of theriac; and that Celsus stated that "[…]

[237] Totelin, 2004: p.15.

antidotes are seldom needed, but are sometimes important because they succour the gravest cases such as bodily injuries, and are chiefly beneficial for venomous bites and poisonings."[238] Another significant example of scepticism is the famous naturalist from antiquity, Pliny, who thinks "theriac […] is made up of countless ingredients, although Nature has provided as many remedies, each of them adequate."[239] Therefore, there is some evidence that theriac efficacy was not miraculous, or at least not for everybody.

The more impressive case is Galen himself. He was the greatest diffuser of theriac, and thus one of its paladins. He even tried to baptized as "Galene" [i.e. Tranquillity], but this name was not fortunate enough.[240] However, he did not always prescribe it. Why he did not do it? It is not always clear, historians of medicine try to explain the fact, but at least it count as historical evidence against the miraculous efficacy of theriac, as its advertising campaign had been showing. For example, one winter Galen objected the theriac prescription to Eudemus, an old patient with disorder of digestion, alluding that "[…] it is hard to digest and therefore ill suited to a disordered digestion. It could bring on a crudeness of the humours, especially at the beginning of winter."[241] Therefore, theriac miraculous efficacy at least demanded some particular conditions which went beyond its perfection. Watson comments that Galen also did not prescribe it to the emperor Marcus Aurelius, when he was his personal physician. The emperor was suffering of abdominal disturbances with feverishness for eating cold food. Galen instead of prescribing him theriac, which by the way the emperor used to take in little dosages as prophylactic, prescribed him to drink wine sprinkled with pepper.[242] The paradoxical point, which Watson emphasizes, is that in the chapter fifteenth of his book *Theriake*, Galen affirms that theriac cures disordered stomachs.[243] Again, we can conclude, that after all theriac's efficacy was not as miraculous as it was advertised.

In the sixteenth century, there were also some naturalists, physicians, and apothecaries contemptuous of theriac. For instance, Fioravanti was worried not because theriac could produce a lethal stomach indigestion due to its hard digestion, but by the so many noxious simples that composed it:

[238] Celsus quoted by Watson, 1966: p.90.
[239] Pliny quoted by Watson, 1966: p.90.
[240] Cfr. Watson, 1966: p.45.
[241] Galen quoted by Watson, 1966: p.65.
[242] Cfr. Watson, 1966: pp.66-67.
[243] Cfr. *Ivi.* p.67.

> Truly I am amazed upon seeing the composition of Theriac, […] considering how so many things are put into it, one contrary to the other… Similarly there are things put into Mithridatum that would kill people instantly, if [the simples] were given to them alone.[244]

The effectiveness of theriac not only has been doubted by naturalists, physicians, and apothecaries for centuries. There were also many diseases that defeated theriac. For instance, Gentile da Foligno in fourteenth-century explains that theriac was good against the victims of the plague due to its occult virtue of drying up putridity.[245] However, theriac was totally ineffective against the Black Death as Gentile da Foligno's death in 1348 proved it; yet in the following centuries it was still regarded as efficacious against plagues. For example, in the seventeenth century some physicians still prescribed it with this intention.[246]

At this point, it is possible to conclude that theriac was not good for stomach disorders or against plagues; but all theriac's multi-healing virtues were ineffective? It is possible that Galen along with other authorities lied; and all patients, who used it, were deluded, because theriac does not have any medicinal virtues? Surely it was not the case. One of the simples which compose the theriac was the opium, from which actual morphine comes. Therefore, at least theriac functioned as an efficient pain-killer due to its powerful analgesic and soporific effects.[247] Galen carefully adjusted the opium content in the theriac that Marcus Aurelius drink daily so he could sleep at night the days which was under stress.[248] In fact, Maranta claims that "[…] lo opio è il più importante medicamento, che entri nella Theriaca."[249] However, he also claims that it can be harmful, for example if it is drunk when theriac's fermentation process has not ended.[250] A theriac with a very high dose of opium could be lethal.[251] For mitigating opium's harmful effects, which were caused due to its fourth degree chilling quality, it has to be weakened by adding hot simples, as Maranta explains:

> Onde Galeno spesso dice l'Opio doversi domare da i semplici caldi: & in specie si gli è dato per adversario il Castorio, & in molte compositioni, come nel Filoneio

[244] Fioravanti quoted by Findlen, 1994: p.268.
[245] Cfr. Watson, 1966: p.96.
[246] Cfr. *Idem.*
[247] Cfr. *Ivi.* p.88. Opium is a very effective analgesic; even today it is used in combination with saffron for that purpose (cfr. Totelin, 2005: p. 14.).
[248] The myth of Marcus Aurelius addiction to opium has its origins in his daily ingestions of theriac with its dosages of opium according to his needs (cfr. Totelin, 2005: p. 14).
[249] Maranta, 1572: p.97.
[250] Cfr. *Ivi.* pp.151-153.
[251] Cfr. Watson, 1966: pp.138-139.

> Tarsense l'Eursorbio, & tutti i correttivi, che gli antidoti solutivi si mettono, fanno qusto istesso effetto, questa attione & reattione che si fa fra i semplici di contraria virtù, tanto viene più gagliarda; quanto più lungo è il tempo in chi si fà; onde ongi composto più intera conserva la virtù de i suoi semplici nel principio della sua compositione, che non fa nel progesso, quando è lontano dal suo (per cosi dire) nascimiento.[252]

Adjusting the opium dosage was a diligent operation which requires a well trained and skillful apothecary. Maranta says that the quantity of opium has to be always proportional to the "parte sessantesima quarta" of the total theriac's dosage that is taken.[253] Definitely, opium medicinal effects were strong and therefore efficacious when not harmful. Quacks were willing to prescribe it; but skilful physicians were more cautious. For example, due to the opium content, Maranta thinks that rather to drink it daily, it is safer to drink it only when needed due to opium harmful effects.[254] In fact, this was the main medical argument to regulate and control theriac's production.

Through centuries physicians have claimed diverse opinions about theriac medicinal value. For example, some physicians thought that theriac effectiveness was reduced only to opium's medicinal virtues. In the eighteenth-century Herbenden believed that the great quantity of hot simples for "tame" (in Maranta's jargon) the opium have the only purpose of decreasing its dangerous effects.[255] However, also many other simples that compose the theriac are beneficial and have healing properties. More recently, Capelletti and Maggioni single out some medical properties of theriac, for example:

> […] un piccolo contributo all'azione sedative nervina poteva derivare anche dalla valeriana […]. La presenza di oppio, che modera la peristalsi intestinale, associate a droghe astringenti come Rosacee o Lamiacee e tannini (*Rosa, Potentilla,* dittamo cretico, marrubio cretico, polio montano cretico, camepite) spiega l'attività antidiarroica; alla scilla vengono riconosciute proprietà diuretiche; genzina, mirra, costo, zenzero, anice, cardamomo e altre piante dotate di attività eupeptica e stomachica figurano tra i suoi ingredienti. Numerose sono anche le droghe dotate di forte attività antibatterica, come pepe lungo, pepe nero, i vari balsami e gli olii esenziali di varie Lamiacee (scordio cretico, dittamo cretico, marrubio cretico, stecade, calaminta montana, camepite, camedrio cretico) che possono giustificare tutta una serie di altre indicazione terapeutiche di queste celebre elletuario.[256]

[252] Maranta, 1572: pp.152-153.
[253] Cfr. *Ivi.* pp.159-160.
[254] Cfr. *Ivi.* p.150.
[255] Cfr. Watson, 1966: pp.138-139.
[256] Capelletti, 2002: p.41.

Therefore, theriac really was a multi-medicament but not a universal panacea. It did not cured all the maladies that authorities attributed it, but definitively it was good to certain illnesses without been as efficacious as described by authorities, except to those cases in which opium was rightly prescribed and dosage. However, is also true that theriac had many bad secondary effects which ranged from frequent and not so harmful, to occasional but lethal. Theriac's production as well as its prescription and dosage were the three variables which determinate a patients fate.

5.4. Theriac's decay

The following centuries, the production of theriac slowly lost the impetus of the sixteenth-century for producing the original theriac of Andromachus. Indeed, by the end of the eighteenth-century and during the early-nineteenth-century, the number of ingredients had been dramatically reduced and its formula changed; the only feature in common with theriac was probably its name.[257] Precisely, during these centuries theriac begins to be omitted from the pharmacopoeias. By the early-nineteenth-century, the only official compendia in which the entry "Theriac of Andromachus" appeared were Spain, France and the Kingdom of Sardinia.[258]

Rather than theriac ineffectiveness, it was its harmfulness the cause of its suppression from the medical history.[259] For instance, in 1818, the French physicians Armand Trouseau and Herman Pidoux stated in the first national pharmacopea of their country:

> The virtues of this bizarre assembly of different substances have been singularly exaggerated,' but they cautioned that theriac was valuable in a number of diseases and that its unique effect in certain cases could not be attributable to opium alone.[260]

Therefore, theriac has some medicinal effectiveness as a whole; however it is also true that it could be very harmful, almost lethal, if it was wrongly manufactured or dosed, particularly due to the opium. The production of theriac was so complex, lengthy, and diverse that it was very difficult to control rightly its quality. Consequently, it was

[257] Cfr. Berman, 1970: p.8; p.11.
[258] Cfr. *Ivi.* p.8.
[259] Cfr. *Ivi.* pp.8-9.
[260] *Ivi.* p.10.

dismissed.[261] The medical and pharmaceutical knowledge were under development; and thus newer, better, and simpler drugs were being made. Drugs were more easily manufactured, and thus a better business. Therefore, the long reign of theriac at last had come to its end.

[261] Cfr. *Ivi.* pp.10-11.

Part III. Ferrante Imperato: natural history and alchemy

Introduction

We have seen how during the sixteenth-century natural history was closely related with medicine. Nature was studied for the benefit of humankind, and there was no more sublime goal than human health. In this third and final part we will see how natural history was also related with the magical thinking during the Renaissance. We have not made so far allusion to the magical ties of natural history; nevertheless, they existed and they cannot be omitted. The particular case of Ferrante Imperato, a prestigious apothecary, collector, and naturalist of Naples would show that medicine and natural history were essentially connected by means of alchemy during the sixteenth century.

There are still today certain prejudices against magical thinking and alchemy due to the strong influence that the positivist historiographical view of science. Therefore, we will give a general account of Renaissance's magical framework and the role of alchemy within it. As we will see the scope of magic was very wide. And in the particular case of alchemy, there were also different types of understanding and applying it. In this manner, we will put our subject in a comprehensive and less impartial historical context.

Finally, we will expose the alchemy of Ferrante Imperato, who is not usually labelled as an alchemist. As we will see, the methods are the same methods use for

inquiring nature during the sixteenth-century. The authority criteria still is used. The alchemical authorities are iconoclasts rather than traditional. Paracelsus would be one of Imperato's authorities in spagyria and alchemy. However, as in the case of Maranta, experience would be the ultimate natural criteria for any type of knowledge. Also Imperato would use the new methods developed by natural historians, such as the public construction of knowledge by means of communities of scientists. For Imperato, the application of artificial processes would not be headed only for obtaining knowledge but for actually manipulating nature.

6. Science's shared history: magic and natural history

6.1. Medicine and magic

Medicine and magic in ancient times were tightly linked. The Babylonian hepatoscopy and its surgeons; the Egyptian physiological ideas, diseases, treatments, and medics; the pre-Hippocrates Greek medicine presented in the Homeric texts (i.e. the Demeter Hymn, the cult to Aesculapius, and the Eleusinian Mysteries); the Indian ayurvedic diagnosis and treatments; the Chinese yin-yang ideas, acupuncture, moxibustion and pharmacopea; and the rest of ancient medical traditions dispersed all over the planet believed that natural and supernatural forces were directly responsible for the occurrence of human diseases, and thus, magical concepts and treatments became indispensable for the restoration of health along with the particular therapeutics developed by each culture.[1]

For instance, the millenary and pre-Hispanic medical traditions from Meso-America, such as the nahoas—who were entirely free from the influence of Western or Eastern medical traditions—thought that diseases appeared when the equilibrium between heat and cold in the body was broken.[2] For example, the heart was the solar organ *par excellence*, so its nature was to be hot, and its coldness could only mean death. Any alteration in the natural temperature of the heart would not only be the cause of cardiac diseases, but also of mental illnesses since the nahoas believed that the "*teyolía*"–the state of mind which defines the identity of human beings–resided in the heart.[3] In order to cure illnesses the nahoas relied upon the effectiveness of medicinal plants. In the case of heart diseases, they used to concoct an infusion of "*yolloxóchitl*" (i.e., a kind of magnolia, curiously in the form of a heart) for its tonic-cardiac effects.[4] However, nahoas' therapeutics is not only restricted to herbalist wisdom: these medics also performed very delicate surgeries in which magical elements also were included.

[1] Cfr. Cortés, 2007: pp.67-110.
[2] Cfr. *Ivi.* pp.263-265.
[3] Cfr. *Ivi.* pp.261-262.
[4] Cfr. *Ivi.* pp.271-272.

The unbalance within the human body could emerge from diverse factors. Not only hot-natured gods, or cold-natured underworld entities could provoke diseases, but these could also manifest themselves through the powers of sorcerers or "*tlacatecótl*" (i.e. owl-men) who were able to induce any kind of diseases (the efficacy of their spells depending on the "*tonalli*" or vital force of the victims).[5]

The Greco-Roman medical corpuses, such as the doctrines of Hippocrates and Galen, explain disease appealing to concrete natural agents which were regarded as the cause of an unbalance of humors or diseases.[6] However, they could not detached completely from religion. In other words, even if it is true that Greeks developed a rational medical approach; it is also true that they could not vanished the thousands of centuries of magic thinking about medicine through ancient human history.

Nowadays, there is no better magical vestige to prove the essential connexion once linked medicine and magical thinking that the very symbol of medical discipline, namely, the caduceus. This short rod entwined by two snakes and topped by a pair of wings was the magic rod of the Greek god Hermes—known as Mercury by the Romans—who was the messenger of the gods and also was regarded as a physician. Friedlander claims in his book *The Golden Wand of Medicine* (1992) that since medieval times to nowadays Hermes has been wrongly identified with the Egyptian god Thoth, with the Greek demigod Aesculapius, and with the Egyptian magician Hermes Trismegistus.[7] For example,

> Since the main concern of this essay has to do with medicine, it is appropriate to examine how authors of medical histories have differentiated one Hermes from another. Again, it is found that the various Hermes are often equated. […] In Sprengel's 1815 medical history, Tauut (i.e., Thoth), Mercury, Trismegistus, and the Hermes who authored books for the "school of Plato magicians" (i.e. Hermetic Hermes) all seemed to be the same individual. Berdoe's 1893 history of medicine managed to confuse Traditional Hermes, Thoth (whom he equated with Hermes Trimegistus), and Aesculapius.[8]

However, the many embodiments (or "confusions") of the God Hermes referred for many centuries to the same knowledge, i.e., the divine knowledge of healing. Since Greek times the god Hermes was related to medicine. And he did not always appeal to

[5] Cfr. *Ivi.* pp.259-261.
[6] Cfr. *Ivi.* pp.115-180.
[7] Cfr. Friedlander, 1992: pp.5-10.
[8] *Ivi.* p.159. Friedlander also gives a detailed historical account of how the caduceus became the symbol of medicine (cfr. Friedlander, 1992: pp.83-109).

spells to heal people. For example, Hermes appealing to his knowledge on *materia medica* gave Odysseus a simple which will protect him against the witch Circe:

> Take this herb which is one of great virtue and keep it about you when you go to Circe's house; it will be a talisman to you against every kind of mischief. And I will tell you the witchcraft that Circe will try to practice on you. She will mix a drink for you, and she will drug the meal with which she makes it, but she will not be able to charm you, for the virtue of the herb that I shall give you will prevent her spells from working. I will tell you all about it. When Circe strikes you with her wand, draw your sword and spring upon her as though you were going to kill her. She will then be frightened, and will desire you to go to bed with her; on this you must point-blank refuse her, for you want her to set your companions free, and to take god care also of yourself, but you must make her swear solemnly by all the blessed gods that she will plot no further mischief against you, or else when she has got you naked she will unman you and make you fit for nothing.[9]

Accordingly to Friedlander, the herb in question was not a mythological herb. It was called *moly*, namely, a plant with black root and a milk white flower which supposedly prevented impotency.[10] And Anguillara said in 1561 that the moly described by Theopharstus "[…] si può ancora vedere in Padova nel giardino dell'Ecellentissimo dottore di medicina M. Bernardino Trivisano nobile Padovano."[11]

Berdoe's book *The Healing Art. A popular history of medicine in all ages and all countries* (1893) mentions also some other interesting relations between the god Hermes and medicine which he found in previous works of historians of medicine. In particular, the relationship between Thoth (who was identified with the god Hermes by almost everybody during the Renaissance) with the making of medicines:

> The Aesculapius of the Egyptians was Imhotep; he was the god of the sciences […]. Thoth or Tauut was similar to Imhotep; he was the god of letters, and, as the deity of wisdom, he aids Horus against Set, the representative of physical evil. By many writers he is considered to be the Egyptian Aesculapius. He has some evident relationship to the Greek Hermes. 'Thoth,' says Dr. Bass […] 'is supposed to have been the author of the oldest Egyptian medical works, whose contents were first engraved upon pillars of stone. Subsequently collected into the book *Ambre* or *Embre* (a title based upon the initial words of this book, viz. […] "Here begins the book of the preparation of drugs for all parts of the human body"), they formed a part of the so-called "Hermetic Books," from whose prescriptions no physician might deviate, unless he was willing to expose himself to punishment in case the patient died.[12]

[9] Homer quoted by Friedlander, 1992: pp.34-35.
[10] Cfr. Friedlander, 1992: pp.34-35.
[11] Anguillara, 1561: p.90.
[12] Berdoe, 1893: p.58.

Berdoe shows that there was an interesting connexion between medicine and hermetical philosophy. As we will see, during the Renaissance, the bridge between magical thinking and medicine was precisely the occult sciences of the famous magician Hermes Trismegistus. And this link was not only peculiar to medicine, but to all natural knowledge.

Today occult sciences are totally disaccredited. They are considered pseudo-sciences. Mario Bunge explains us that pseudo-sciences posit entities that are inaccessible to the empirical testing; consequently it is impossible to verify their hypotheses. Another feature of pseudo-sciences is that they don't change their principles when their predictions fail; therefore they reject all sort of criticism. Moreover, pseudo-sciences principles are incompatible with the current accepted theories by our existing scientific communities, so they don't have any type of interrelation with sciences. Bunge summarizes saying that pseudo-sciences are a bunch of nonsense theories that are sold as if they were science.[13] There is absolutely no doubt that occult sciences cannot be considered scientific disciplines today. However, as we have read, occult sciences and medicine were interrelated in the past. Therefore, it would be interesting to understand the role that magical thinking played in the quest of genuine natural knowledge during the sixteenth-century.

6.2. The view of magic inherited by the Renaissance

Today, when we think in magic, we commonly think in the illusionists which are called magicians. If we conceive magic in any other sense, it would have derogative connotations; unless we do it in a literary fashion or within any other fictional context. But what was magic according to the Hellenistic and medieval magical tradition? This magical doctrine claimed that all the things that composed the universe are closely correlated. Furthermore, things not only had manifest qualities which could be detected directly and immediately by the five senses, but also they were embodied of occult virtues or forces with often have marvelous properties which its causes could not be inferred only by reasoning. In this way, the magician, who knew the occult properties of things, knew the complex system of both sympathetic and antipathetic interrelationships among things in the universe, that is, the relationships "[…] of love and hatred, friendship or repugnance, discord or concord which exists between them."[14] This kind

[13] Cfr. Bunge, 2001.
[14] Thorndike, 1929: p.84.

of knowledge conferred powerful skills to their holders. Magicians not only had the ability to predict future occurrences, but also to control them by means of properly operating over the influences things have over each other.[15] Thus, a magician could claim, for instance, that if someone is in possession of earth from the soil of the African city of Ismuc, serpents will not approach to him, because this earth have the occult and marvelous property of rejecting serpents.[16] Other instances of incredible working antipathies in nature are the following: quieting mad elephants by showing them a ram; paralyzing vipers by touching them with a leaf from a beech tree; taming wild bulls by means of tying them to a fig tree.[17] As we can see, occult virtues not only act by direct contact but also by distance. Many magical practices were based upon this principle, such as carrying amulets, pronouncing incantations, or making wax images. For example, occult virtues were operating in the lion seal which the magician Arnau de Villanueva supposedly cure the Pope Bonifacio VIII (1235-1303).[18] The magical principle of occult virtues acting by distance gave the magician the possibility of extending his "magical powers" to unimaginable limits. Magicians were very convinced of its efficacy. It was said that Nectanebo, a famous magician, could sink the enemy ships simply by submerging wax images of them.[19]

According to Thorndike, the word "magic" comes from the *Magi* or wise men of Persia and Babylon; but it is also possibly to locate their very etymological roots in a word of a previous culture, namely, the Sumerian word *imga* or *unga*, which means 'deep' or 'profound'.[20] The word *magus* could mean: trickster, one who deceives and its magic art has not truth; wizard or sorcerer, one who performs *maleficiums* and its art is aided by demons to be used in the most disreputable sense; and wise man, like a Greek philosopher or a Persian priests who worshiped gods and aided by them could produce marvels of nature.[21] Moreover, Thorndike affirms, that through his historical research he has find that the word magic could be applied particularly to an operative art, certain doctrines and, more general, to a way of looking the world.[22]

The scope of magic was very wide. Many arts were considered as magical tokens even if they were diverse from each other. Magic domain was composed of

[15] Cfr. *Ivi.* p.542.
[16] Cfr. *Ivi.* p.183.
[17] Cfr. *Ivi.* p.213.
[18] Cfr. Marshall, 2001: p.348.
[19] Cfr. Thorndike, 1929: p.350.
[20] Cfr. *Ivi.* p.164.
[21] Cfr. *Ivi.* pp.234-6; p.288; p.318, pp.553-4.
[22] Cfr. *Ivi.* p.4.

witchcraft and necromancy (both seen as criminal and diabolical enterprises which were lead by demons), divination, astrology, natural sciences, such as botany and pharmacy (both regarded akin to magic), and useful arts such as mining metals, manufacturing armor and weapons, and even "writing with ink and paper" as states *The book of Enoch*.[23] In addition, there were the thaumaturgies, that is, magicians who create illusions by means of mechanical devices or artifacts; for example, they produced automatons like mechanical birds that sing by means of driving air through pipes.[24]

Thorndike, based on his historical analysis of magic, proposes the following conception of magic in his *History of Magic and Experimental Science* (1929):

> Magic appears, in our period at least [i.e. during Hellenistic, Medieval times], as a way of looking at the world which is reflected in a human art or group of arts employing varied rites, often fantastic, to work a great variety of marvelous results, which offer man a release from his physical, social, and intellectual limitations […] by operations supposed to be efficacious here in the world of external reality. […] The *sine qua non* seems to be a human operator, materials, rites, and an aim that borders on the impossible, either in itself, such as predicting the future or curing incurable diseases or becoming invisible, or in relation to the apparently inadequate means employed.[25]

Magic was a worldview which sought to transcend the human limitations by means of operating efficaciously over the nature to obtain marvelous results through a wide variety of methods. And this notion of magic was inherited and further developed during the Renaissance.

6.3. The magical thinking within the *Natural History* of Pliny

Thorndike was the first person to claim—against the hegemonic historiogrhaphical tradition of science of his time—that magic had been deeply involved in the development of science, specifically of experimental science.[26] The traditional image of magic regards magical thinking as a big obstacle to the development of science. It was constructed by both the historians and men of science during the Age of Enlightenment.

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[23] Cfr. *Ivi.* pp.344-345.
[24] Cfr. *Ivi.* p.192.
[25] *Ivi.* p.974. The borders of the impossible for the sixteenth-century naturalists as well as for the naturalists of following centuries not differ from the science of nowadays. For example the prolongation of life and renewing one's youth were within the scientific agenda of many members of the Royal Society since its foundation (cfr. Thorndike, 1953: 697-698).
[26] Thorndike's statements were made when logical positivism was dominating the scientific panorama. Thus, this kind of affirmations could not be easily digested; and even now, scientists find difficult to accept them.

In other words, reason had defeated irrationality, falsity and obscurity embodied in magical thinking.[27] In this way, magic became unvalued and repudiated. On the contrary, Thorndike findings showed for the first time that magic was not an obstacle or burden; but a very important factor that impulse the progress of science, and helped to consolidate science, as we know it nowadays. In 1929, Thorndike claimed in his *History of Magic and Experimental Science* (1929) that:

> […] magic and experimental science have been connected in their development; that magicians were perhaps the first to experiment; and that the history of both magic and experimental science can be better understood by studying them together.[28]

Thorndike supports the relation between magic and science during Hellenistic and Medieval times through an immense, extensive, and varied quantity of historical examples. One of the most relevant examples that Thorndike offers for our research is the case of the *Natural History* of Pliny written in the 77 A.D.

Pliny is not regarded as a magician either today or in his time, but as a natural philosopher. Moreover, he did not see himself as a magician; he even repudiated magic as "invalid and empty."[29] Pliny only accepted that magic "[…] has some shadows of truth, which however are due more to poisons than to magic."[30] However, when Thorndike compared all the passages of the Natural History that speak of the virtues ascribed to the things of nature, as well as to the methods employed in medicine and agriculture, with those of the magicians, he found "striking resemblances" that would made anyone to conclude that "[…] there is more magic in the Natural History which is not attributed to the magi than there is that is."[31] Furthermore, according to Thorndike, it is almost impossible in many issues to clearly demarcate a line between the marvelous properties, ceremonies, fantastic ideas, superstitious doctrines, and methods of procedure from Pliny's passages in which these magical elements are clearly not present at all.[32] In other words, in certain issues the "knowledge" of magicians and natural philosophers seems to be essentially the same. For example, for magicians, gems had marvelous virtues, which also could be acquired by those who possess them. Pliny

[27] Cfr. Lindberg, 1990: p.10.
[28] Thorndike, 1929: p.2.
[29] Pliny quoted by Thorndike, 1929: p.61.
[30] *Idem.*
[31] Thorndike, 1929: p.72.
[32] Cfr. *Idem.*

conceives these ideas as "terrible lies" or "unspeakable nonsense".[33] However, Pliny ascribed medicinal virtues rather than marvellous virtues to gems when they are worn as amulets or pulverized in beverages. He even spoke of particularly stones which had true occult virtues that made them good for fighting sorcery, discard idle fears from the mind, or cause oracular visions if place beneath one's pillow, namely, the *aniantus*, the *sideritis* and the *eumeces* respectively.[34] Magician's procedures were like rituals in which the materials utilized, the time to perform, the words uttered, and the body positions have to be sacredly respected. For example, they made use of *certain metals* to perform *certain operations*. Pliny's prescription of cutting herbs and killing animals only with iron knifes seems to be following the same principles of magical procedures.[35] Magicians also saw the universe as a complex network of sympathies and antipathies. This type of worldview was a trademark of magic. Pliny did not reject this theory; he even stated that medicine originated from it.[36] For him, this kind of relationships clearly exists among animals and maintains even after animals are death. For example, serpents flee from deer, because they tracked and extracted them from their holes; therefore serpents would flee from a person who wears a tooth of deer. Pliny even tells us that antipathies may transform into sympathies, because some parts of a death deer attract serpents.[37] Furthermore, for Pliny the antipathy of the tamarisk tree for the spleen was a good medicament for splenetic patients due to its marvelous power "[…] that pigs who drink from trough of this wood are found when slaughtered to be without spleen, and hence splenetic patients are fed from vessels of tamarisk."[38] Sympathies and antipathies were also ascribed to minerals and stones. For example, Pliny considers that both the magnet's attraction for iron and the fact that a blood of a he-goat could break an adamant extraordinary exemplified the potency of the sympathies and antipathies.[39] Another principle that Pliny's share with magic is within the scope of medicine, namely, likes cure likes, that is, that the cause of the disease is also its cure. For example, a bite of a shrew-mouse heals only by the imposition of the animal which bit. The same applies for amulets; the *ophites* are used against to snake-

[33] *Ivi.* p.80.
[34] Cfr. *Ivi.* p.81.
[35] Cfr. *Idem.*
[36] Cfr. *Ivi.* p.84.
[37] Cfr. *Idem.*
[38] Pliny quoted by Thorndike, 1929: p.85.
[39] Cfr. Thorndike, 1929: p.85.

bites due to its serpent form.[40] In the case of the theriac, Watson suggests that using viper's flesh for curing viper's bites constitutes an instance of this principle.[41]

Thorndike's give us many more specific instances of magic in Pliny's *Natural History*. He resumes his research results as follows:

> Such is the picture we derive from numerous passages in the *Natural History* of the magic art, its materials and rites, the effects it seeks to produce, and its general attitude towards nature. Besides the natural materials employed and the marvelous results sought, we have noted the frequent use of ligatures, suspensions, and amulets, the observance of astrological conditions, of certain times and numbers, rules for plucking herbs and tying knots, stress on the use of the right or left hand—in other words, on position or direction, some employment of incantations, some sacrifice and fumigation, some specimens of sympathetic magic, of the theory that "likes cure likes," and other types of magic logic.[42]

Thorndike not only exposes the magical face of one of the most important authorities in natural history, but he also shows that it is very difficult to determine what counted as magic and what did not in the domain of natural science and medicine within the context of natural history. Pliny rejected some magical assertions as ridicule and fraudulent but accepted those in which he believed even if they were very similar to the ones he relinquished. Indeed, magic and natural philosophy were so tightly intermingled that any clear distinction elaborated by historians would be too artificial.

It is not coincidence that Zambelli had entitled one of her books *L'ambigua natura della magia* (1996). It was very common that the natural philosophers or even the magicians rejected the doctrines and ideas of others saying that they were magical even if these were similar to those they praised as valuable knowledge. Magic is hard to tackle due to its ambiguous pre-modern nature. Very frequently some procedures that are considerer by someone as magical are not to another person or, even worst, for the same person in another situation. In other words, very similar procedures could be diversely catalogue: one as genuine knowledge and the other as fraudulent. For example, physicians were often charged as wizard because they could prognosticate the future course of certain maladies, something that was considered possible only due to divination rather than diagnosis. The physician authority Galen was frequently charged as wizard by his detractors, and he himself also charge of wizards and quacks those

[40] Cfr. *Ivi.* pp.86-87.
[41] Cfr. Watson, 1966: p.74.
[42] Thorndike, 1929: p.72.

physicians with which he did not agree.[43] Here we could see that to be a magician or wizard have negative connotations since times of Galen and before, and after him. Moreover, physicians justified their therapeutic procedures not only by its efficacy; or long experience, but also by the authority of the divine Galen which according to them have showed their efficacy through arduous experience.[44] However the "therapeutics" they talked about not only included antidotes, ligatures, and suspensions (enchanted or engraved), but also extravagant therapeutic procedures. For example, the physician Alexander of Tralles (525-625) prescribed against epilepsy to drink the ashes of a burned blood stained shirt of a slain gladiator in wine seven times.[45]

6.4. Natural magic: the search of nature's hidden secrets

One of the more widespread conceptions of magic conceives it as double faced activity which only differs in the intention and the kind of spiritual beings that are invocated, that is, white magic and black magic respectively.[46] It constitutes a very arduous work categorizing magic more specifically. However, for our purposes of showing the intermingled interrelation between science and magic we are going to appeal to a category coined by the very magicians, namely, "natural magic." From now on we will be referring to this type of magic when we use the word "magic."

The natural magic is a kind of white magic which searches to gain knowledge of natural forces and occult virtues to control them. Some authors, consider natural magic as an appendix of the spiritual magic, because even if it does not operates with the souls of death magicians, demons, or divine entities, it focuses in the *anima mundi*.[47] This depends of how we understand the meaning of "spirit." At least the hermetical magicians consider the *anima mundi* as a divine principle but a material one, so we see the difficulty to label magic due to its ambiguous nature.

According to Zambelli's book *White Magic, Black Magic in the European Renaissance. From Ficino, Pico, Della Porta to Trithemius, Agrippa, Bruno* (2007), during the Renaissance appears a new formulation of "natural magic" which strongly influenced its cultural context, being a topic of discussion by the end of fifteenth

[43] Cfr. *Ivi.* pp.165-6.
[44] Cfr. *Ivi.* p.583.
[45] Cfr. *Ivi.* p.581.
[46] Cfr. Figala, 2001: p.304.
[47] Cfr. Webster, 1982: p.4; p.71, note 1.

century over the cultural circles of that time.[48] This new formulation of natural magic was developed by Marsilio Ficino and Pico della Mirandola. They claimed that it is possible to operate the forces of natural world without any invocation to spirits through natural magic. In other words, there was a natural magic which was "purely natural".[49] According to them, the previous natural magic formulations were not as purely natural as they claimed to be.[50] This radical conception of natural magic appears in the *Apology* for Ficino's *De vita* in 1486:

> There are *two kinds of natural magic*. The first is practiced by those who unite themselves to demons by a specific religious rite, and, relying on their help, often contrive portents. This, however, was thoroughly rejected when the Prince of this World was cast out. *But the other kind of magic is practiced by those who seasonably subject natural materials to natural causes to be formed in a wondrous way.* Of this profession there are also two types: the first is [motivated by curiosity], the second, by necessity. The former does indeed feign useless portents for ostentation. […] This type [of magic] must be avoided as futile and dangerous to the health and the saving of the soul. Nevertheless, the necessary type, which joins medicine with astrology, must be kept. […] *Nor do I affirm here a single word about profane magic which depends upon the worship of demons, but I mention natural magic, which by natural things seeks to obtain the services of the celestial for the prosperous health of our bodies. This power, it seems, must be granted to minds which use it legitimately, as medicine and agriculture are justly granted, and all the more so as the activity which joins heavenly things to earthly is more perfect*. [51]

As it can be read, natural magic searches natural causes for natural phenomena. Its aim is to health our bodies by means of joining heavenly things to earthly ones through purely natural means without any aid of demons. Natural magic is a kind of bridge who unites heavenly things with earthy ones. In addition, Ficino claims that natural magic is as genuine form of knowledge as medicine and astrology. In that time medicine and astrology were institutionalized disciplines which were taught at universities,[52] but natural magic was missing in the curricula of all universities.

The new conception of natural magic will spread beyond the Florentine Academy, being assimilated even beyond the north of the Alps. The magician Cornelius Agrippa von Nettesheim exposes it in his book *Of the Vanity and Uncertainty of The Sciences* (1531):

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[48] Cfr. Zambelli, 2007: p.2.
[49] Cfr. *Ivi.* p.3.
[50] Cfr. *Ivi.* p.14.
[51] Ficino quoted by Zambelli, 2007: pp.23-24, *emphasis added.*
[52] Cfr. Zambelli, 2007; pp.233-234.

> Natural magic *is that which having contemplated the virtues of all natural and celestial things and carefully studied their order proceeds to make known the hidden and secret powers of nature* in such a way that inferior and superior things are joined by an interchanging application of each to each; thus incredible miracles are often accomplished no so much by art as by nature, to whom this art is a servant when working at these things. For this reason *magicians are careful explorers of nature*, only directing what nature has formerly prepared, uniting actives to passives and often succeeding in anticipating results; so that these things are popularly held to be miracles when they are really no more than anticipations of natural operations… *therefore those who believe the operations of magic to be above or against nature are mistaken because they are only derived from nature and in harmony with it.*[53]

We can see that natural magic is also a way of joining superior and inferior things by means of knowing the natural forces which interact between them. This forces are hidden or secret but can be discovered by a carefully exploration of nature. And there are not any supernatural beings involved even when its results seem miraculous, because the operations of natural magic are derived from and only the very nature. The knowledge that natural magicians have of the natural operations allow them to anticipate or predict the results of uniting active agents to passive ones. In other words, the magician applied the correct natural forces or occult virtues to the natural things which respond to them.[54] The magician primary task, as claimed by Agrippa, was precisely to discover which things have occult powers over other things.[55] In this way, the magician scrutinizes the nature attentively by means of empirical observation and experience, which many times involved proves of trial and error, to find the powers that were hidden in things. In the end, magicians were looking for the divine *signs* which God has incorporated in His creatures.[56]

The same conception of natural magic is expressed by Giovanni Battista Della Porta in his *Magia Naturalis* (1589). For him also there are two kinds of magic. In one hand, there is sorcery which has to do with foul spirits and consists in incantations and wicked curiosity. This type of magic has not truth and stands in imaginations, because of that all wise people detested.[57] On the other hand, there is magic which has to do with the highest knowledge and perfection of all natural sciences, for that reason the noblest

[53] Agrippa quoted by Henry, 1988: pp.139-140, *emphasis added*.
[54] Cfr. Webster, 1982: p.59.
[55] Cfr. Henry, 1988: p.138.
[56] Cfr. *Idem.*
[57] Cfr. Zambelli, 2007: p.29.

philosophers professed it (e.g. Pythagoras, Empedocles and Plato).[58] In his *Magia Naturalis* (1589), Della Porta defines magic as follows:

> *Magick is nothing else but the knowledge of the whole course of Nature.* For, whilst we consider the Heavens, the Stars, the Elements, how they are moved, and how they are changed, by this means we find out the hidden secrecies of living creatures, of plants, of metals, and of their generation and corruption; so that this whole science seems merely to depend upon the view of Nature…*This Art, I say, is full of much virtue, of many secret mysteries; it openeth unto us the properties and qualities of hidden things, and the knowledge of the whole course of Nature, and it teacheth us by the agreement and the disagreement of things, either so to sunder them, or else to lay them so together by the mutual and fit applying of one thing to another, as thereby we do strange works, such as the vulgar sort call miracles*, and such as men can neither well conceive, nor sufficiently admire…Wherefore, as many as come to behold Magic, must be persuaded that *the works of Magick are nothing else but the works of Nature, whose dutiful hand-maid magick is.*[59]

Della Porta's conception of magic is the same that the one of Agrippa and Ficino.[60] As we can read, magic consists in the knowledge of nature secrets in all senses. The magician can perform miracles to the eyes of vulgar people, because he knows the agreement and disagreement of things, that is, the way to control nature according to the way in which it works. Natural magic secret mysteries for realizing marvelous things consisted essentially in the Art of applying active principles to passive agents.[61] In other words, the magician carefully explored nature to discover the manifest and occult powers (i.e. active principles) that certain things have over others, that is, he sought the divine *signs* to learn the way in which earthly and celestial things were interrelated.[62] In this manner, magicians believed that all natural objects were interrelated with celestial objects through occult sympathies which were hidden in them; therefore, if a magician was capable to discover them, he would be able to control the interaction between the two in some degree, according to his knowledge and mastery of the magical Arts. For example, for capturing the power of Venus, a magician had to perfectly know which plants, stone, minerals and animals were under its influence determining practically the

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[58] Cfr. *Idem.*
[59] Della Porta quoted by Henry 1988: p.140, *emphasis added*.
[60] Zambelli shows the continuity of the new concept of 'natural magic' from 1486, year in which Ficino coined it, to 1589 with Della Porta's *Natural Magick*. This concept was strongly assimilated and in circulation during the Renaissance, especially in Italy and the regions from the north of the Alps in which German was spoken. Magicians like Ficino, Pico, Zorzi, Cardano, Bruno, Della Porta, Paulus Ricius, Augustinus, Reuchlin, Trithemius, Agrippa, Paracelsus, Thomas Erastus and Johann Weyer were well acquainted of it (cfr. Zambelli, 2007: p.7; pp.13-14.)
[61] Cfr. Webster 1982: p.59.
[62] Cfr. Henry 1989: pp.138-139.

correct astrological moments in which Venus acted in them.[63] Consequently, magicians try to determine by trial and error the effects which certain things have over another.[64] Therefore, astrology was an example of natural magic, which was officially accepted. However, there was another occult science which was more controversial, namely, alchemy. On the contrary to astrology, alchemy not only relied in discovering the occult sympathies and antipathies to profit their beneficial effects by determining the correct astrological moments in which plants, minerals, animals, and situations could be influenced by their force. Alchemy could artificially manipulate the natural interaction between active principles and passive agents. Therefore, it could carry on the same natural achievements but in an artificially fashion. Moreover, alchemy could do in less time that which nature takes years to realize.[65] Definitely, the art of generating and corrupting plants, minerals, and animals was a powerful knowledge coveted by greedy men as well as by the curious minds of the sixteenth-century thinkers.

[63] Cfr. Yates 1964: p.45.
[64] Cfr. Henry 1989: p.139.
[65] Cfr. Eliade, 1978: p.51.

Chapter 7. The occult science of Alchemy

7.1. The divine alchemy and Hermes Trismegistus

Alchemists firmly believed that the origins of their art had very ancient roots. There are many myths of alchemy origins among alchemists, but in some way all alchemists were convinced that alchemy has been given to men by God(s). In other words, the origins of alchemy were divine, and thus alchemy itself was also a divine art. Around the third century, Zosimus of Panopolis, one of the more important alchemists who's existence is proved by the historical records, claimed "[…] that the fallen angels instructed men in alchemy as well as in the other arts, and that it was the divine and sacred art of the priests and kings of Egypt, who kept it secret."[66] Around one thousand years later, the Arab alchemist Abu' l-Qasim al-Iraqui gives the following genealogy of the alchemy:

> Alchemy was revealed by God to Adam...then to his son Seth, then to Hermes, then to Noah, then to Shem, then to Ham […], then to David, then to Solomon, then to Alexander, then to *Hippocrates*, then to Pythagoras, then to Socrates, then to Aristotle, then to *Galen*, until it reached to Islam by various means, and was spread abroad among the prophets.[67]

As we can see, the idea that alchemy has a divine origin is a constant in its history. This type of divine knowledge to which alchemy belongs, among other occult sciences, which is characterized as been revealed by divine entities to very special human beings long time ago, was known as *priesca theologia* or *priesca sapientia*.[68] The holder of this ancient knowledge would posses the "knowledge of all things human and divine."[69] According to the doctrine of the *priesca sapientia*, Hermes Trismegistus was the more important magician of all times. All alchemists made reference to him and were convinced that he has lived in Egypt in the times of Moses. Nevertheless, there is not

[66] Thorndike, 1929: p.195.
[67] Abu'l-Qasim quoted by Holmyard, 1926: p.407, *emphasis added.* It is interesting to emphasize that alchemists regarded both greatest Greek medical authorities as in possession of the divine alchemical knowledge.
[68] Cfr. Cassirer, 1953: p.9.
[69] Vasoli, 1988: p.61.

any historical evidence of his existence.[70] Historians until today have not found any alchemic manuscript ascribed to him that can be dated as far back as to Moses times, but only to the Alexandrian period between the first and third centuries.[71]

One of the more important magical texts ascribed to Hermes Trismegistus was the *Corpus hermeticum*, which was translated by Ficino in 1463.[72] From this moment on, the hermetical thinking flourished in Italy and widespread to other countries of Europe. Arts and sciences were strongly infected of hermetical philosophy, not only in Florence but in the rest of European cities. For this reason, Baigent and Leigh claim that the "[…] true impulse of the Renaissance was definitively and fundamentally a magic one."[73]

The *Corpus hermeticum* is a set of various hermetic manuscripts, such as the *Poimandres* and *Asclepius*. These manuscripts are primarily consecrated with religious and philosophical doctrines very similar to Plato's philosophy concerning the soul and to the teachings of the Gnostics.[74] However, the hermetic manuscripts do not only consist in mystical theories but also in its practical operations and recipes for controlling nature, giving in this way birth to the "hermetical philosophy" and "hermetical practice" respectively.[75] The *Corpus hermeticum* treats many and diverse subjects, such as the nature of cosmos, occult virtues and properties of things, recipes for making amulets, sympathetic and antipathetic relations reigning the universe, and so forth.[76] According to Debus the *Corpus hermeticum* justifies "the goals of the natural magic", such as "the unification between nature and religion."[77]

The hermetic manuscripts do not reduce to the ones in the *Corpus Hermeticum*, there are many books and manuscripts attributed to Hermes Trismegistus which teach about diverse subjects. There are at least forty-two indispensable books of Hermes:

> Of these [42 books] ten are called "Hieratic" and deal with the laws, the gods, and the training of the priests. Ten others detail the sacrifices, prayers, processions, festivals, and other rites of Egyptian worship. Two contain hymns to the gods and

[70] Baignent claims that Hermes Trismegistus referred to the Egyptian writing god Thot-Ermes. This deity delivered the divine words to humans and revealed the secrets of his art to his neophytes in magic (cfr. Baigent, 2003: pp.39-41).
[71] Cfr. Yates, 1964: p.2; Thorndike, 1929: p.195.
[72] Cfr. Baigent, 2003: p.137.
[73] *Ivi.* p.18.
[74] Cfr. Thorndike, 1929: 290.
[75] Cfr. Yates, 1964: p.44. This dichotomy was also known as "alkimia speculativa" and "alkimia operativa et practica" (cfr. Newman, 1997: p.318).
[76] Cfr. Yates, 1964: p.3.
[77] Debus, 1965: p.6, p.13.

> rules for the king. *Six are medical, "treating of the structure of the body and of diseases and instruments and medicines and about the eyes and the last about women."* Four are astronomical or astrological, and the remaining ten deal with cosmography and geography or with the equipment of the priests and the paraphernalia of the sacred rites.[78]

However, the most important hermetical text ascribed to Hermes Trismegistus is not longer than a page. The alchemical manuscript that we are talking about is known as the *Tabula Smaragdina*:

> Il est vrai, sans mensonge, certain et très véritable :
> Ce qui est en bas est comme ce qui est en haut et ce qui est en haut est comme ce qui est en bas; par ces choses se font les miracles d'une seule chose. Et comme toutes les choses sont et proviennent d'UN, par la méditation d'UN, ainsi toutes les choses sont nées de cette chose unique par adaptation.
> Le Soleil en est le père, la Lune la mère. Le vent l'a porté dans son ventre. La terre est sa nourrice et son réceptacle. Le Père de tout, le Thélème du monde universel est ici. Sa force ou puissance reste entière si elle est convertie en terre. Tu sépareras la terre du feu, le subtil de l'épais, doucement, avec grande industrie. Il monte de la terre et descend du ciel et reçoit la force des choses supérieures et des choses inférieures. Tu auras par ce moyen la gloire du monde et toute l'obscurité s'emparera de toi.
> C'est la force, forte de toute force, car elle vaincra toute chose subtile et pénètrera toute chose solide. Ainsi, le monde a été créé. De cela sortiront d'admirables adaptations, desquelles le moyen est ici donné. C'est pourquoi j'ai été appelé Hermès Trismégiste, ayant les trois parties de la philosophie universelle.
> Ce que j'ai dit de l'Oeuvre Solaire est complet.[79]

As we can see, the *Tabula* explains how things are generated or created following the same pattern in which the universe was created; and how human beings can generate or created things in the microcosms by knowing and replicating the processes of the macrocosms. Apparently, all that is needed to accomplish "d'admirables adaptations" is stated here. However, it is difficult to clearly understand how the process of creation works and how its versions or adaptations can be carried on. If one knows that for alchemists the Sun refers to gold, then maybe we could think that the *Tabula* is in reality an encoded recipe for transmuting lead into gold by reading the ending phrase: "l'Oeuvre Solaire est complet". As a matter of fact, we could interpret the text in different ways. Basically, as historians of alchemy we could make a materialist interpretation, a mystical interpretation, or a dualist interpretation. In the first case, we would see in the *Tabula* no more than encoded encryptions of laboratory techniques and

[78] Thorndike, 1929: p.289, *emphasis added*.
[79] There are many versions of *La Tabula Smaragdina*. This French version was supposedly translated by the famous alchemist of the twentieth-century: Fulcanelli (http://www.morgane.org/willy.htm#smaradg).

procedures for knowing the structure and behavior of matter.[80] In the second case, we would interpret the *Tabula*'s enigmatic phrases as referring to our own internal process to accomplish enlightenment.[81] Finally, if we are dualist, we will claim that the *Tabula* teaches the union with divinity by means of actual laboratory techniques and processes.[82]

After seen the intrinsically relation between Hermes Trismegistus and alchemy, according to alchemists and magicians, we can understand why alchemy and hermetical philosophy are so tightly connected. There is no way to speak of alchemy without referring to hermetical thinking, at least not before the seventeenth-century. In fact, alchemy has an especial status among the occult sciences. It was regarded as the practical face of hermetic philosophy, namely, as the hermetic practical procedures to control nature.[83] Alchemy and astrology were the two most important hermetical practices. Moreover, they were essentially linked so they were also called "terrestrial astrology" and "celestial astrology."[84] However, many hermetic philosophers regarded alchemy as the "true Magick".[85]

7.2. A survey on alchemy's origins and key notions

The historical records have shown that the occidental alchemic tradition appeared in the famous city founded by Alexander the Great in 331 B.C., namely, Alexandria. This maritime city converted very soon in the most important cultural center of Antiquity during the following years. It was the meeting point of philosophies, religions, and knowledge from different cultures, such as Egyptian, Jew, Persian, Phoenician, Greek, and many more. The Museum and its famous Library founded in the third-century B.C.

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[80] This position is radically supported by Newman and Principe: "Although the Works of many alchemical writers contain (often extensive) expressions of period piety, imprecations to God, exhortations to morality, and even the occasional appearance of an angelical or spiritual messenger, *we find no indication that the vast majority of alchemists were working on anything other than material substances toward material goals*." (Newman 2001: p.398, *emphasis added*).

[81] This position can be seen in many historians of alchemy, such as Burckhardt: "La alquimia […] ofrece —con su metáfora de la conversión de los metales ordinarios en metales preciosos de plata y oro— una elocuente imagen de este proceso interior [*i.e.* la maduración espiritual del alquimista]. *En realidad, la alquimia puede ser definida como el arte de las transformaciones del alma.*" (Burckhardt, 1976: p.25, *emphasis added*)

[82] There are diverse formulations of this position, probably the more influential was the one presented by Jung in 1936: "[…] desde los tiempos más remotos la alquimia presentaba dos aspectos: por un lado, el trabajo práctico de la química en el laboratorio; pero por otro, un proceso psicológico, en parte psíquicamente consciente, en parte inconsciente, que era proyectado y visto en los procesos de transformación de la materia." (Jung, 2002: p.316)

[83] Cfr. Yates, 1964: p.44.

[84] Baigent, 2003: p.113.

[85] Haeffner, 1991: p26.

stand as clear evidence of the role in the development of knowledge that Alexandria played in that time.

Syncretism was the key note of Alexandria's cultural context. The historians of alchemy have identified the roots of the hermetical alchemical tradition in this eclectic cultural environment. Precisely, it was during the Hellenistic period of metal working that the philosophical theories of Plato, Aristotle, and other Greek philosophers, along with diverse religious views and magical worldviews, were amalgamated by metallurgy giving birth to alchemy.[86] As Berthelot claims:

> L'ALCHIMIE n'est pas sortie uniquement et sans mélange du monde égyptien. C'est après la fusion de la civilisation grecque et de la civilisation égyptienne, à Alexandrie, et au moment de leur dissolution finale, que nous voyons apparaître les premiers écrits alchimiques. On y trouve un étrange amalgame de notions d'origine diverse. A côté de descriptions et de préceptes purement empiriques, empruntés à la pratique des industries chimiques dans l'antiquité, á côté des imaginations mystiques, d'origine orientale et gnostique, que nous avons rapportées, on y rencontre tout un corps de doctrines philosophiques, issues de philosophes grecs, et qui constituent à proprement parler la théorie de la nouvelle science.[87]

Consequently, alchemy characterizes by the harmonic union of the philosophical-religious thought with the technical operations of empirical "industrial" practices. The Leyden papyrus, from around the second-century, gave excellent craftsmanship receipts in metallurgy to produce alloys who imitated the gold; and it also taught how to tincture, polish, test, and multiply it.[88] Among the receipts, also there are some in which appear the allegoric emblems of alchemy, such as the ouroboros,[89] magical alphabets and practices, and the astronomic symbols are applied to Planets as well as to metals.[90] Other examples of alchemistic manuscripts of this period are the ones coming from the Gnostic tradition, for example the "Chyropée of Cleopatra" in which we can read enigmatic alchemical phrases, like "The One is Everything" written inside an ouroboros, and see depicted the astronomical signs of the Moon, the Sun, and classical alchemical instruments, such as alembics.[91]

[86] Cfr. Silber, 1971: p.13.
[87] Berthelot, 1885: pp.247-248.
[88] Cfr. Linden, 2003: pp.46-49.
[89] It is the serpent that bites its own tail forming a circle; and it represents that the end is the beginning and the beginning the end (cfr. Berthelot, 1885: p.59).
[90] Cfr. Berthelot, 1885: pp.80-94.
[91] Cfr. *Ivi.* pp.56-76; Taylor, 1954: p.74.

7.2.1. Distillation and the vital spirit

Distillation is one of the key technical operations of practical alchemy. Herbalists and perfume makers used at least four hundred years before the apparition of Alexandria's alchemy extraction pots; however, the Alexandrian alchemists were the ones who through time developed and improve the distillation techniques and apparatus utilized by prior craftsmen and pharmacists.[92] Their interest in distillation and its mastering was directly related to their philosophical views about the universe nature. General speaking, according to their cosmogony influenced by Stoic philosophy, they thought there were two ingenerated, indestructible, and corporeal principles in the universe, one passive and other active.[93] In other words, they saw the cosmos as a living creature; and the active principle was the cause of its vitality, and it also pervaded every body in the cosmos animating it, generating it, and corrupting it.[94] We don't have to forget that for alchemists even the minerals within the mines were alive. They thought they were like *embryos* growing to its state of perfection "[…] slowly as though in obedience to some temporal rhythm other than that of vegetable and animal organisms."[95] It was the Stoic school who taught that the active principle of all things was a kind of *pneuma* or vital breathing of the universe which animated all things.[96] These ideas, which have origins in the Stoic philosophy, can be seen in manuscripts of the Renaissance alchemists, such as in Ficino's *Liber de Arte Chemica* (1518):

> For the philosophers seeing that all vegetable and animal things, as also other things, do by a certain spirit of their own multiply themselves, and that a transmutation is in this inferior world made by the air, which seemed in a long time to corrupt all particular things, and that their nature changed itself by the motions of another thing: There arose among them this question: namely why the spirit in metals could not propagate its like, since out of one scion there grew many, and out of one little grain almost innumerable grains did multiply themselves. It was at length decreed by the divine oracle, that the spirit was withheld by a grosser matter, which spirit if it were separated by a certain sublimation at the fires and being separated were preserved in its own connatural seat, it might as a seminal virtue, without any untruth, generate its like. From hence the philosophers thought to bring the light and luster of the most perfect body into the inferior bodies since they had found that they differed among themselves only according to the decoction, either greater or less, and the mercury was the first original of all metals, with which mercury extracting the metallic part of gold, they brought gold to the first nature.

[92] Cfr. Brock, 1993: pp.24-25.
[93] Cfr. Lloyd, 1973: pp.27-28. Lloyd also points out that the active principle cannot be reduced to some sort of fifth element; because it was not only a material component of things, but also the cause of its vitality, cohesiveness, and form (cfr. Lloyd, 1973: pp.27-28).
[94] Cfr. *Ivi.* pp.28-30; Brock, 1993: pp.14-15.
[95] Eliade, 1978: p.42.
[96] Cfr. Lloyd, 1973: pp.27-32.

> Which reduction indeed since it is easy and possible, it was by the philosophers concluded that a transmutation in metals is easy and possible. And when these primitive philosophers had reduced gold into the first matter, they made use of the celestial influence, that it might not be made a metal again such as it was before. Afterward they purified its nature, separating the unclean from the clean. Which being done they called that thing, the transmuting stone of the philosophers. For the making whereof several operations have been invented by several philosophers, that might be completed by art which was left by Nature; since Nature herself is always inclined toward her own perfection.[97]

The point to underline is that, since the beginnings of alchemy in Alexandria, *the active principle was conceived as a material one*, that is, like a kind of very subtle air, steam or gas. This connotation was introduced to the Latin world when the world *pneuma* was translated to *spiritus*; however now the concept become ambiguous, because *spiritus* also made reference to the divine entities as another kind of entities which were not from the corporeal world.[98] Therefore, the alchemists were trying to obtain and manipulate by means of artificial procedures the active principle, *pneuma*, *spiritus*, or *anima mundi* that animated all beings. Distillation was the primary laboratory technique employed by alchemist to extract the *pneuma* from bodies. Consequently, this technology was continually upgraded by alchemists.

7.2.2. Transmutation and its theoretical framework: The Philosopher's Stone

The ultimate goal of the alchemists was to insulate the vital *spiritus* in its purest material form. They thought that they could achieve this goal by distilling one time after another the same substance. They thought that each time they reiterate the distillation processes over and over again, they were obtaining a *spiritus* each time more subtle and more active. Eventually, they will obtain the perfect manifestation of the very active principle, known as the philosopher's stone.

The alchemist in possession of the Philosopher Stone would be capable to transmute the corrupted, impure, and imperfect bodies into pure and perfect ones. The transmutations more appreciated were the transmutation of lead into gold, and the restoration of youth and health and even reach immortality. Today, these goals are regarded as chimerical, even if desired, but they were not incompatible with the current physical theories of that time.[99] As a matter of fact, alchemist's favorable practical

[97] Ficino, 1702: pp.73-74.
[98] Cfr. Taylor, 1954: p.18; p.28.
[99] In reality, both of these goals were considered chimerical for long time. However, the possibility of the feasibility of transmutating lead into gold become justified by the chemical theories developed in the beginning of the twentieth century and, eventually, in the 1980s, the first transmutation of a bismuth

results pointed toward the feasibility of both ultimate goals. Furthermore, their feasibility was also justified by Aristotle's theory of the fourth elements and its qualities and his theory of Act and Potency. For example, in his book about *generation* and *corruption*, Aristotle states the difference between 'alteration' and 'coming-to-be' (*génération*):

> Etant donnné que le substrat est quelche chose et que l'affection dite par nature du substrat est quelque chose d'autre, et qu'il y a un changement de l'un changement de l'un comme de l'autre, il y a altération, quand, alors que le substrat subsiste et reste perceptible, il change dans ses affections, que celles-ci soient des contraires ou des intermédiares (par exemple, le corps guérit et tombe à nouveau malade tout en subsitant dans son identité, l'airain est parfois incurvé et parfois anguleux, tout en demeurant le même ; *mais, quand il y a un changement dans la totalité sans que rien de perceptible, comme substrat, ne subsiste identique à soi (lorsque par exemple de la semence dans son ensemble naît le sang, ou l0eau de l'air, ou l'air de l'eau dans son ensemble), c'est alors nécessairement la génération qui se produit, et la corruption d'autre chose*, surtout si le changement a lieu de l'imperceptible vers le perceptible, que ce soit au toucher ou à tous les sens. C'est le cas lorsque l'eau est engendrée, ou bien que'elle se corrompt en air. […] Ainsi quand le changement de la contrariété a lieu selon la quantité, on a augmentation et diminution ; selon le lieu, déplacement ; mais celui qui se produit selon l'affection et la qualitè est altération et, quand rien ne subsiste dont l'autre terme soit une affection ou, généralement, un concomitant, c'est la génération et la corruption. La matière est le substrat capable d'accueillir éminemment et proprement la génération et la corruption et, d'une certaine manière égalmente, le substrat des autres changements — tous les substrats sont en effet capables d'accueillir certaines contrariétés.[100]

Thus alchemists did not only alter bodies but also make them coming-to-be by first making them passing-away. And the manufacture of the philosopher's stone was not an exception, as we can see in the following description of its production given by Zosimos, the most important Alexandrian alchemist:

> Construis, mon ami, […], un temple monolithe, semblable à la céruse, à l'albâtre, un temple qui n'ait ni commencement ni fin, et dans l'intérieur duquel se trouve une source de l'eau la plus pure, brillante comme le soleil. C'est l'épée à la main qu'il faut chercher à y pénétrer, car l'entrée est étroite. Elle est gardée par un dragon qu'on tuer et écorcher. En réunissant les chairs et les os, il faut en faire un

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sample into one-billionth of a cent's worth of gold was realized by means of a particle accelerator (cfr. Brock, 1993: p.39). However, what alchemist did not know was that realizing transmutations is much more expensive that they ever imagine. As stated by Frederick Soddy one of Berkeley's modern alchemists: "If man ever achieves this further control over Nature, it is quite certain that the last thing he would want to do would be to turn lead or mercury into gold –*for the sake of gold*. The energy that would be liberated, if the control of these sub-atomic processes were possible as in the control of ordinary chemical changes, such as combustion, would far exceed in importance and value the gold." (Brock, 1993: p.40)

[100] *Gen et Corr.* 319b5-320a27, *emphasis added*.

> piédestal, sur lequel tu monteras pour arriver dans le temple, où tu trouveras ce que tu cherches.[101]

We could interpret the passage in the following terms. The temple is the alembic, the dragon is a metal, such as lead, that has to pass-away, that is, to lose their metallic features, and then by rearranging its parts though an artificially process one could make it coming-to-be with new properties, that is, give birth to another metal, such as gold.[102]

Returning to *On Generation and Corruption*, we can read further about Aristotle's theory of the fourth elements and their coming-to-be and passing-away. He claimed that there are four elementary qualities (i.e. hot, moist, cold, dry), and that they can be combined in six couples. But only four of them actually occur, because the contrary qualities refuse to be coupled. Thus the four possible couplings are hot with dry; moist with hot; cold with dry; and cold with moist.[103] Each one of this combination is attached to a simple body or element. Thus, Fire is hot and dry, whereas Air is hot and moist; and Water is cold and moist, while Earth is cold and dry. The more important feature of Aristotle's theory of the fourth elements is that they "[…] originate from one another, and each of them exists potentially in each, as all things do that can be resolved into a common and ultimate substrate."[104] For example, Air will result from Fire if we change one elementary quality of the pair that constitutes it, that is, when dry overcomes moist. In other words, the elements with interchangeable complementary qualities can come-to-be from each other when one of its elementary qualities pass-away and comes to be its complementary.[105] This kind of cyclical transformation is the easiest, according to Aristotle. Transformations become more complicated when they involve the change of more elementary qualities; for instance, to make Fire coming-to-be from Water, both of its elementary qualities have to pass-away.[106] But how come-to-be the many and diverse things we see, such as flesh, from the elements? Aristotle answers saying that there are differences of degree in the elementary qualities; due to this fact, a wide range of distinct combinations is possible:

> Si en effet la chair provient des deux sans être aucun des deux, ni non plus leur composition dans leur intégrité, que reste-t-il, si ce n'est de dire que ce qui provient d'eux est leur matière ? Car la corruption de l'un produit soit l'autre soit leur

[101] Zosimos quoted by Berthelot, 1885: pp.180-181.
[102] Cfr. Taylor, 1954: pp.169-170.
[103] Cfr. *Gen. et Corr.* 330a30-331a6.
[104] Linden, 2003: p.35.
[105] Cfr. *Gen. et Corr.* 331a7-332a2.
[106] Cfr. *Ivi.* 331a-332a.

> matière. N'est-ce donc pas finalment que, puisque le chaud et le froid sont susceptibles de plus et de moins, quand l'un des deux est absolument en entéléchie, l'autre sera en puissance, tandis que lorsqu'il n'est pas complètement en entéléchie mais qu'au contraire, en tant che chaud, il est froid et en tant que froid, chaud (par le fait que mélangés, le froid et le chaud corrompent leurs excès réciproques), alors on n'obtiendra ni leur matière ni l'un des deux contraires, absolument, en entéléchie, mais un intermédiaire, et en tant qu'il est en puissance plus chaud que froid ou le contraire, d'après ce rapport il est en puissance deux fois plus chaud que'il n'est froid, ou trois fois plus chaud ou plus chaud selon une autre proportion de même chaud ou oplus chaud selon une autre proportion de même type ? C'est justement une fois les contraires mélangés que les choses proviendront de ces derniers, ou plutôt des éléments, et que les éléments proviendront des ces contraires, qui sont d'une certaine façon en puissance (non pas toutefois à la façon de la matière, mais comme on a dit ; et ce qui se produit est ici un mélange, là une matière.[107]

Alchemists put Aristotle ideas into practice. They utilized them as framework to understand, manipulate and get new knowledge of the transformations they saw in the universe. Following Aristotle's framework, alchemists were making experiences to artificially produce transformations of the elements and its compounds. For example, the Aristotelian theory claims that Fire—which was dry and hot—could be transmutated into its contrary element, namely, Water, if its dryness and hotness were eliminated; therefore if one could make pass away the named qualities by technical operations, he will transmute Fire into Water.[108] However, Alchemists did not only keep realizing this sort of transmutations, but driven by their ambitions went a step further from the Aristotelian theories. They thought that if they could artificially obtain elements with only one but pure elementary quality by some technical process, then they would be able to mixed them, obtaining in this way a pure elixir, that is, the corporeal active principle which would be capable of transmutating any substance into another.

Not all alchemists interpreted Aristotle in the same way. In the pursuit of Truth, alchemists accepted Aristotle's ideas in a very eclectic way; they chose the statements that were in harmony with their own ideas as well as with the other natural philosophical theories, religious believes, metaphysical principles, and magical doctrines they professed. Other alchemists, along with Paracelsus, rejected all sort of Aristotelianism. Instead of believing that they were two precise and determined principles which rule the combination of the elements, one active and other passive, Mercury and Sulfur respectively, as the Arab alchemists called them,[109] they claimed

[107] *Ivi.* 334b5-20.
[108] Cfr. Newman, 2004: p.21.
[109] Cfr. *Ivi.* pp.280-281.

the existence of a third principle from which all the things were generated from Chaos, namely, the Salt. However, even if Paracelsians were one of the strongest alchemical parties, we cannot neglect the important role that the philosophy of Aristotle played within the history of alchemy.[110]

The ultimate alchemical goal motivated the development of alchemical knowledge, operations, and instruments. However, artificers were discovering many new phenomena and substances as well as the developing many laboratory techniques and processes seeking other more humbly goals. It is very important to underline that during the sixteenth-century alchemy was not only concern with the production of the philosopher's stone.

7.3. Alchemy as an artificial transformation of things

According to the *Trésor de la Langue Française Informatisé* alchemy is a:

> […] pratique de recherche en vogue notamment au Moyen Âge, ayant pour objet principal la composition d'élixir de la longue vie et de la panacée universelle, et la découverte de la pierre philosophale en vue de la transmutation des métaux vils en métaux précieux.[111]

This statement is not false, but it is omitting vital facts concerning the nature of alchemy. We could say that it is a half true statement or incomplete; because, as we are going to see, alchemy did not reduce only to the production of the elixir of life, the philosophers' stone and the transmutation of metals, its domain was much more vast than these three goals. The *Trésor de la Langue Française Informatisé* also claims that « [l]'alchimie a été une préparation à la chimie ».[112] This statement presupposes that alchemy and chemistry have always been two different disciplines, that is, one a pseudoscience and the other a science. This is entirely true nowadays, but is far from being true during the Renaissance.

Not only during the sixteenth-century but till eighteenth century, alchemy and chemistry were not clearly delimited or separated from each other. According to Newman and Principe, the illusion that they were was created by the historians of science. In their article "Alchemy vs. Chemistry: The Etymological Origins of a Historiographic Mistake" (1998) they give sufficient historical evidence to show that

[110] Berthelot, 1885: pp.279-280.
[111] *Le Trésor de la langue Française informatisé* : http://atilf.atilf.fr
[112] *Idem*.

historians of science have sinned of presentists too much. Believing that the current meanings of 'alchemy' and 'chemistry' were the same meanings during the Renaissance is to commit a huge historiographic mistake. By means of relevant historical records, Newman and Principe show that both terms referred to the same activity and not to different activities. Therefore, 'alchemy' and 'chemistry' were synonymous terms until the eighteenth-century when their current meanings were settled.[113] For example, the chemical text of the German Werner Rolfnik entitled *Chimia in artis formam redacta* (1661) resumes the position of professors Newman and Principe:

> Truly there is no difference between *chimia* and *alchimia*. The same art is denoted by both words. Nor are they on the right path who so distinguish *alchimia* and *chimia* from each other that the later only pertains to the artificial preparation of medicaments, while the former deals with the transmutation of metals. Both are names of the same thing […].[114]

The historico-semantical thesis of Newman and Principe shows that *artificers prepared medicaments as well as the philosopher stone; therefore, they could be indistinctly called alchemists or chemists*. And Ferrante Imperato, as we will see below, constitutes a relevant example of the sixteenth-century, which could be added to their list. The synonymous terms 'alchemy' and 'chemistry' did not only referred to the making of medicines or transmutation of metals. Artificers work in a wide and diverse range of activities:

> Chymistry [i.e. alchemy[115]] was a multi-faceted discipline that included such diverse practices as the production of mineral acids, distilling of alcoholic beverages, manufacture of dyes and perfumes, extraction and use of pharmaceuticals, and of course "chrysopoeia" and "argyropoeia," the attempt to make artificial precious metals, also known as *alchemia transmutatoria* or "transmutatory alchemy." But chymistry [i.e. alchemy] was not merely an industrial pursuit. In the previous century [XVI], the founder of "chymiatria"

[113] It is important to stress that Newman and Principe are not claiming that alchemy's bad reputation appeared at the end of the seventeenth-century. On the contrary, since its very origins there always have been detractors and, consequently, it has been frequently labeled as fraudulent, especially the part which has to do with transmutations and panaceas. What Newman and Principe are claiming is that any attempt to distinguish between alchemy and chemistry before the eighteenth century is misguided; unless it takes in account the criteria of the period under investigation. In their quoted article, Newman and Principe also explain how the equivalent meaning between 'alchemy' and 'chemy' changes through time losing its synonym relation.

[114] Rolfnik quoted by Newman, 1998: p.52.

[115] Newman and Principe use the English archaic form of *chemistry*, namely, *chymistry*, to avoid misunderstandings between the use of *alchemy* and *chemistry*. They even considered more appropriated to incorporate the terms *chrysopoeia* (gold production) and *argyropoeia* (silver production) when talking of the metallic transmutations as well as to use the terms *iatrochemia* and *chemiatra* within the medical domain to stress the chymistry subdivisions and tasks (cfr. Newman, 1998: pp.41-2).

> (chymical medicine), Paracelsus, had emphasized the power of chymical techniques, such as distillation, and products, such as mineral acids, as tools of analysis. Hence chymistry [i.e. alchemy] acquired the cognomen "spagyria," which was widely interpreted in the seventeenth century to be fused from the Greek terms for "analysis" and "synthesis".[116]

The production of medicaments, perfumes, alcoholic liquors, and so on, had a key point in common: they were artificially produced. Moreover, they were not only artificially produced, but artificially modified! In other words, the artificial production of things by transforming its natural properties was the business of a natural magic branch, namely, alchemy. These procedures could not be carried on without a proper knowledge of the active principles and occult properties of things and how to manipulate them artificially. In the sixteenth-century, every time we come across with some artificial process that transforms the qualities of something, we are very likely to find a hermetic framework as background.

It is important to remember that magic played an important role within the Renaissance worldview. Every aspect of Renaissance's culture was strongly influenced by hermetical philosophy.[117] For example, architecture was an artificial art that also embodied of doctrines of cosmic harmony; and thus, it had a magical dimension. For example, Rinaldi describes the appreciation of Venice made by Luigi Groto, known as "il Cieco D'Adria," in 1558:

> Il sitio, indagato con gli strumenti del matematico e dell'astrologo, che si identificano in modo sempre più netto con quelli del medico, diventa connotativo dell'impianto urbanistico della città […]: "Mirabile è Vinegia ne gli edificii, dove l'arte vincendo se stessa, va imitando la natura, e la natura, superando se medesima, va emulando il miracolo. […] O Vinegia mirabile, promettono gli astrologi, che se noi udissimo i soavi tuoni delle sfere celesti, rimaremmo affatto colmi di dolcezza, e di maraviglia […]." Viene dunque a delinearsi una città-mondo, un microcosmo […] capace di rapresentare il termine medio nel rapporto tra macrocosmo, il mondo immutabile e simmetrico delle sfere celesti, e la più piccola unità cosmica, il corpo umano […].[118]

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[116] Newman, 2002: p.359.

[117] The hermetical principles such as the relations between microcosms and macrocosm were depicted; and the very creative act of painting was viewed as a magical operation in which the very artist attracted the cosmic forces: Botticelli's *Primavera* represents the cosmic spirit, *pneuma*, or active principle of alchemy; and the Vitruvian Man of Leonardo is a paradigmatically example of the micro-cosmos (cfr. Battistini, 2006; p.211). The richness of the Italian Renaissance is so vast, and it is so closely related to the hermetical thought that is impossible to describe it in a few paragraphs. Our briefly survey just underlines is vital importance within the history of magic. The fifth volume of the twelve volumes that compose *Il Rinascimento Italiano e l'Europa* (2008) exemplary depicts Renaissance science and shows the relation it had with occult sciences in diverse spheres of the quest of knowledge.

[118] Rinaldi, 2005 pp.64-65, Groto quotated.

A more particular architectural structures which embodied the hermetical thinking were gardens. They symbolized a new Eden in which the plants were harmonically distributed in the space; in other words, they were microcosms which reflected the perfection of the macrocosm.[119] Moreover, botanic gardens were also linked with hermetical thinking, because the processes of generation, vegetation, and corruption which shared minerals, plants, and animals composed the alchemical research agenda. In addition, alchemy also was interested in the medicinal virtues of plants, minerals and animals. Therefore, the botanic gardens could be seen as extensions of the alchemists' laboratories.[120] For the hermetical philosopher the botanic garden:

> […] trasmetteva la conoscenza diretta di Dio. Poiché ogni pianta era stata creata e Dio aveva rivelato una parte di Sé in ogni creatura, la raccolta completa delle cose create rivelava Dio nella Sua interezza. E, data la supposta relazione fra macrocosmo e microcosmo, l'uomo che conosceva meglio la natura, conosceva meglio se stesso.[121]

There is no doubt that plants inside botanical garden were artificially cultivated. A visit to the botanical garden of the University of Padua gives an idea of the architectonical disposition of a botanic garden in the sixteenth-century. Plants were disposed according to their properties one next to the other. This disposition is totally artificial. Also they were artificially cultivated. Their watering not only came from rain; and they could be fertilized or prune by will. However, it is interesting to ask if the naturalists could artificially transform the properties of the plants which they cultivate or if they just described and studied them without any further intervention that the already mentioned.

7.3.1. The artificial procedures or "methods" for transforming plants

According to Maranta's *Methodi cognoscendorum simplicium* (1559), the art of agriculture knew better than any discipline the existing differences between the urban plants and the wild plants; and thus, agriculturists could perceive the differences in texture, size, scent, taste, and form between certain plant artificially cultivated and the same plant naturally grown.[122] For example, artificial plants could be bigger and less tasty than their wild counterparts or vice versa.

[119] Cfr. Baigent, 2003: p.219.
[120] Cfr. *Ivi.* p.114.
[121] *Ivi.* pp.222-223.
[122] Cfr. Maranta, 1559: p.135.

Maranta tells us that agriculturists examined the cultivation process in every detail. They observed the meteorological factors, such as the rains, and winds as well as the cultivation and reckoning procedures to obtain the true natural form by means of sowing artificially plants.[123] The agricultures knew that each aspect of the cultivation procedure determine in some degree the final harvest. For example, with respect to the vintage of wine, Maranta tells us:

> Hinc […] vitium solo differentiam maxime numerosam esse. Quot enim genera telluris, totidem & vitium quidam esse affirmant.quae, cum secundum naturam seruntur, frugiferae prodeunt: quae praeter naturam, facile sterilescunt. Quo loco etiam dat universalia quaedam praecepta circa culturam omnium arborum, a tempore, a solo, a scrobibus, a plantis ipsis: […] a positu, quia quaedam aquilonem, quaedam orientem, quaedam meridiem spectare debent; & quod quaedam fieri debent viviradices, quaedam apud arbores ipsas, aliae exemptae; & quid faciendum, ut facilius crescant, & alia quaedam. At vero haec cultura certos limites habet, neque nimis curiosa, ac plus, quam oporteat, fieri debet. Ita enim & natura propria non minus plantae exui solent.[124]

As we can see, agriculturists knew that the same plants differ from each other for many and diverse conditions. For instance, the soil features; the time of the year; the direction in which the sown field was oriented; and so on. In other words, agriculturists had acquired a very acute empirical knowledge of the cultivation procedures; therefore, they could artificially modified the texture, size, scent, taste, and form of the plants they cultivated. They not only could cultivate red or green grapes, but they also could "[d]ocet etiam quo modo vua effici sine granis possit."[125] Therefore, agriculturists actually could artificially transform the plants by adjusting their agriculture methods towards their needs. It is increible the many things agricultures could carry on relying only in their observational data. For instance, they could thickned the roots and stalks of plants, making easy to harvest them.[126] Maranta continues giving examples of artificial transformations of size, texture, color, scent, and form which could be achieved trough the art of agriculture. He concludes that all his examples of transformations are artificial processes certified by natural authorities:

> Atque ex vite sumpto exemplo, deinde in alijs ex multorum celebrium virorum auctoritatibus secundum membrum sufficienter puto probauimus. Manifestauimus

[123] Cfr. *Ivi.* pp.135-137.
[124] *Ivi.* p.137.
[125] *Idem.*
[126] Cfr. *Ivi.* pp.138-9.

> enim quomodo ex despecto cultu plantae varient magnitudinem, colorem, saporem, tactilem qualitatem, similiter & substantiam, & alia multa, quae efficiunt, quo minus eae sint, quales cum cultu esse solent. […] *Demostravimus enim non minus in iisdem variari plantas, cum nimis superstitiose cultura administretur*.[127]

Maranta apeals to the well-known authorities of Theoprastus, Pliny, Dioscorides, and Galen; but also to many specialized and unknown authorities, such as Palladius and Columella among many others.[128]

Maranta is clearly claiming that there is nothing supernatural in the transformations he has described. Transform artificially things trying to imitate nature was a common feature of many arts and crafts. However, during the Renaissance it was convenient to be very cautiuous when talking of transmutations, because it could took anybody to face directly the inquisition tribunal.

7.4. The witches' hammer falls on alchemy

The limits of making artificial things were very controversial since the appartion of alchemy in Alexandria. However, during the Renaissance any dispute over the subject could be dangerous. Any natural hypothesis which aspired to become true had to prove that it was neither false in philosophy nor erroneous *in Fide*, but above everything that it was not a heresy.[129] A false statement was not great deal, but a heretic one would jeopardize the life of the speaker. And during the Renaissance the marvellous statements of alchemists, such as transmuting lead into gold, were considered true by the Church, but heretic.

The Arab philosophers, have already discussed if the things artificially produced were genuine or mere imitations. Both Avicenna and Averroes concluded that artificial things were not genuine, but only good imitations. Because things produced artificially could not achieve the perfection of the natural ones; thus artificial things even if seem identical to genuine things, would remain always good copies.[130] The same conclusions were reached by many scholastic philosophers, such as Albertus Magnus and his famous disciple Saint Thomas Aquinas. However, the Medieval philosophers were more interested in delimitating the power of demons which, according to them, worked by artificial means. Therefore, if alchemy the most sophisticated art—from a

[127] *Ivi.* 144-145, *emphasis added.*
[128] Cfr. *Ivi.* pp.135-146.
[129] Cfr. García, 1963: p. 48.
[130] Cfr. Newman, 2004: pp.50-51.

technological point of view—could not produce genuine things by means of transmutations, then demons either.[131]

The alchemists replied that many natural things could be obtain by artificial means, for example, the vapour obtained by boiling water was the same vapour that the one produce by the Sun when heating a puddle. Therefore, genuine things could be generated by artificial means.[132]

Eventually, Kramer and Sprenger in his *Malleus maleficarum* (1487) gave the reason to the alchemists, and started hunting them:

> For devils have no power at all save by a certain art. But an art cannot permanently produce a true form. (And a certain author says: Writers on Alchemy know that there is no hope for real transmutation.) Therefore the devils for their part, making use of the utmost of their craft, cannot bring about any permanent cure—or permanent disease. […] S. Thomas, who lays down that such an opinion is altogether contrary to the authority of the saints and is founded upon absolute infidelity. Because the authority of the Holy Scriptures says that devils have the power over the bodies and over the minds of men […]. [The truth faith] teaches us that certain angels fell from heaven and are now devils, and we are bound to acknowledge that by their very nature they can do many wonderful things which we cannot do […]. [D]evils by their art do bring evil effects through witchcraft, yet is true that without the assistance of some [natural] agent they cannot make any form.[133]

The Dominican monks had the complete approval of Pope Innocence VIII's bull against witches. Therefore, according to Zambelli, magicians coined the notion of 'natural magic' to avoid be suppressed by the witches' hammer of Inquisition.[134] It was a wise decision to entirely detached demons from magic. Thus magicians could continue practicing and cultivating relatively safely their fashionable studies in occult sciences at Florence without being prosecuted by the Inquisition, such as the countrywomen that were burned each day.[135]

Zambelli thesis is true. However, it is incomplete. The new notion of *natural magic* was not only coined so magicians could continue doing their readings, speculations and rites in a relatively safely way, but also because they were *openly diffusing* the magical knowledge; and they need to legitimize it to the eyes of the Church. For instance, Agrippa rejected the vague and mystifying language of alchemy, the one which other magicians, as Paracelsus, find necessary to the art.[136] This rebel attitude was more than merely breaking the promise of keeping the hermetical secret; it

[131] Cfr. *Idem.*
[132] Cfr. *Ivi.* pp.64-65.
[133] Kramer, 1971: p.2; p.11.
[134] Cfr. Zambelli, 2007: p.22; pp.44-45.
[135] Cfr. *Ivi.* p.45.
[136] Cfr. *Ivi.* p.123.

marks the naissance of a new attitude towards occult knowledge: many magicians shared the naturalists' public conception of knowledge.[137] Therefore, it will be show that this new shared attitude of many natural magicians had repercussions within the *natural communities of researches based in experience* as in the case of Ferrante Imperato's Naturalist Network.

[137] These rebel magicians, who could be called The Brotherhood of Natural Magicians, were trying to make accessible its magical secrets to the common people. Paolo Rossi claims that public knowledge is one characteristic of scientific thought rather than magical one, and thus he regards public knowledge as a discontinuous element with respect to the hermetical tradition: "Non si diventa maghi, né nell'ambito della magia naturale né in quello della magia demoniaca, cosí come si può diventare dottori commercialisti o professori di biologia o fisici teorici. Per una ragione molto semplice: *perché nell'universo della magia la scienza e la verità hanno una caratteristica fondamentale: non sono accessibili a tutti gli uomini né in linea di fatto né in linea di principio*." (Rossi, 1977: p.81, *emphasis added*) He is right in considering public knowledge as an essential and distinctive feature of modern science. However, not all magicians thought in the same way due to the ambiguous nature of magic. The magical thinking was suffering transformations due to the activities and interests of many of its supporters. Therefore, it is also true that there was a subtle continuity between the attitudes of many natural magicians—who also were natural philosophers, physicians, or mathematicians—and the modern conception of knowledge as a public matter. The "books of secrets" which in its majority were manuals that taught people how to do things in diverse ordinary and useful crafts—rather than hermetical manuscripts (cfr. Eamon, 1985: p.473)—reflected the widespread attitude to make public and common the personal and secret recipes. Many natural magicians shared the same attitude; and thus they were active members in the naissance and development of the first scientific communities of naturalists, such as Imperato. It cannot be dismissed that during the sixteenth-century all type of secrets (both ordinary and arcane) were disclosed by naturalists in their museums: "In the museums of Aldrovandi and his contemporaries, textbook *experimenta* and spectacular *experientia* converged under the rubric of 'secrets.' […] Secrets were no longer buried within the textbooks of physicians and natural philosophers. Through their integration with the world of scientific collecting, they had become a part of the theatrical culture of science. The Grand Duke's investment in the experimental practices of natural magic and pharmaceutical chemistry only heightened the status of such collectors as Calzolari and Imperato. As apothecaries, they possessed the skills and equipment necessary to instruct other naturalists in these arts. Calzolari proudly displayed his collection of distilling devices; Imperato cultivated a reputation as a naturalist who was assiduous in the chemical investigation of nature." (Findlen, 1994: pp.212; 224)

Chapter 8. The alchemical work of Ferrante Imperato

8.1. The scientific academies and the diffusion of natural knowledge

The big boom of hermetical thinking was not only due to Ficino's translation of the *Corpus Hermeticum*, but also to his enrolment in the foundation of the first Academy in Florence in 1459, supported first by Cosimo de' Medici and after his death by Lorenzo il Magnifico. The Florence Academy was a real center of scientific research and not only a school. Its community was not composed only by natural philosophers; among its members also were artists, medics, politicians, advocates, merchants, and priests.[138] The Florence Academy very soon started to influence its cultural context. Leonardo da Vinci, Michelangelo, and Rafael are some very famous examples.[139] More academies started to appear all over Italy. The most important scientific academy of Italy was the Lincean Academy founded by Federico Cesi in 1603.

The linxes scrutinize nature with their sharp naturalistic eyes. They natural inquires were "specialistiche e settoriali" and assumed "[…] una visione ancora inclusiva ed enciclopedica, tal da richiedere competenze multidisciplinari e un lavoro di gruppo particolarmente nutrito di interrelazioni."[140] All arts and sciences were included in the Lincean investigation of nature. The linxes exchanged ideas, specimens, and artefacts contributing in the development of natural knowledge from their particular domain of expertise. They were particularly interested in botany, zoology, medicine and chemistry. Therefore, the occult sciences could not be rejected of their scientific research. Consequently, their methods for inquiring nature were not reduced to the ones ascribed by its most famous member, namely, Galileo Galilei:

> Non che si possa prescindere dalla lezione di Galileo, se non altro per la ricezione del moderno metodo d'indagine […] consentito dal microscopio e alla nuova

[138] Cfr. Baigent, 2003: pp.128-132.
[139] Cfr. *Idem.*
[140] Battistini, 2007: p.9.

> visione degli oggetti che la nuova tecnologia ottica venne a promuovere sviluppando una sensibilità più intransigente e più analiticament geometrica. Si è però ampliata di molto la giurisdizione delle competenze alle quali la nuova episteme viene applicata, con particolare rilievo per la botanica, la zoologia, la medicina e la chimica, ossia a discipline che, pur non essendo frequentate da Galilelo, destarono l'interesse di tutti i lincei, influenzati in questo dal naturalismo rinascimentale sviluppatosi nel meridione d'Italia. *In tale prospettiva il loro consorzio no viene più ad avere come unico referente lo scienziato pisano, ma lo si fa dialogare con altre scuole e con altri gruppi di ricerca, dando conto di una più autentica varietà di modelli e di pronunce, estese a paradigmi anche molto divaricati, che spaziano dalla iatrochimica di ascendenza paracelsiana all'alchimia e all'ocultismo*.[141]

Thanks to press (invented in the mid-fifteenth-century) the encyclopedic, communicative, cooperative, and public dimensions of the Italian natural inquiry of the sixteenth-century were inherited to the European scientific academies of the next century. Venezia was the biggest editorial city of all Europe during the Renaissance.[142] It exported culture and knowledge to all Europe. In this manner, also the hermetical philosophy travel through time and space reaching the United Kingdom and influencing the Cambridge Platonists, who took at face value the Ficinian interpretation of Plato as if it were Plato himself:

> For, however, they [Cambridge Platonists] venerate him [Plato] as their patron saint in philosophy, yet their achievement is by no means the direct continuation or the mere revival of Platonic thought. Many essential phases of Platonism never enter into their purview; while, on the other hand, certain features of the thought which they eagerly pursue are so greatly modified that their original is scarcely recognizable. In these writers the teachings of Plato always appear as it were transformed through a refracting medium. It is especially that picture of the Platonic philosophy drawn by Marsilio Ficino and the Florentine Academy that seemed authentic and exemplary to the thinkers of the Cambridge School. They added no essentially new feature to this picture; nor did they have the courage and capacity for its historical criticism. Hence all stable historical demarcations vanish: the primary and the derived, the original and the tradition, are never differentiated.[143]

The example just mentioned shows us the impact through time and space that Ficino and his Academy had over the history of thought and science, because many members of the Royal Society founded in 1660 were Cambridge Platonists, such as Isaac Newton, who by the way was also an alchemist.[144]

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[141] Battistini, *Ivi.* pp.7-8, *emphasis added*.
[142] Cfr. Baigent, 2003: p.137; p.143.
[143] Cassirer, 1953: p.8.
[144] Cfr. Dobbs, 1975, 1991, 2000; Westfall, 1980; Keynes 1995.

Ferrante Imperato entirely agreed with the new attitude towards knowledge that the naturalist of the sixteenth-century professed. His *Natural History* published in 1599 summarizes the new naturalists line of thought and practice for inquiring nature. Imperato's work was reprinted twice the following century. An Italian version printed at Venice in 1672; and a Latin translation at Colonia in 1695.[145] After almost one hundred years, Imperato's *Natural History* still was a naturalistic point of reference, it was consulted and also very appreciated for the quality and variety of its scientific illustrations,[146] which as we have seen, were tools of scientific inquiry as well. The one hundred and nineteenth engravings or naturalistic tools of inquiry were still unmatched in the seventeenth-century.[147] Definitely, Ferrante Imperato contributed to the international diffusion of the naturalist knowledge and practices developed during the sixteenth-century.

Imperato was of the opinion that the empirical knowledge is public, in the sense that knowledge only could be achieve by means of a constant communication and debate among the researchers. This epistemological thesis of Imperato, which implies that knowledge is neither private, nor secretive, nor confidential, but communal, open, and unrestricted, was shared by the naturalists of Renaissance.[148] Indeed, it marks the importance of Italian Academies as *public scientific communities*. In his dedication, Imperato acknowledges all the people who helped him to learn and diffuse the knowledge of his book. He criticizes Aristotle for not giving credit to all the people who helped him to write so many books about diverse issues. For Imperato, it is absolutely impossible that a single person, like Aristotle, could write so many and diverse topics *without any help*. In other words, he claims that knowledge is produced by groups and not single individuals, and that it has to be accessible and useful to everyone. Furthermore, the great network of science to which Imperato belonged considered that knowledge is acquired by means of exchanging and discussing materials, books, natural designs, plants, fossils, minerals, ideas, and so on. The public status that Imperato concedes to knowledge is so important that is worthy to quote him entirely:

> Habbiamo oltre di ciò alla dottrina detta, aggiunte le figuration delle cose c'han certa figura, e non da altri manddate in luce: aceioche quanto per noi possibil fusse ne venisse aiutata l'intelligenza del Lettore. resta di ricordarti quel che &

[145] Cfr. Stendardo, 2001: pp.67-68.
[146] Cfr. *Ivi.* p.11.
[147] Cfr. *Ivi.* pp.75-79.
[148] Cfr. Stendardo, 2001: p.57.

> Aristotele, & altri scrittori ingenui negli loro scriti non son restati di confessare, *che le sienze humane pigliano accrecimento dal comunicar l'uno all'altro*: *dico questo, percioche io confesso, che li studii nostri, e le cose da noi trattate han fatto progresso dall'aiuto degli amici, che o sono concorsi come fautori in procurarmi la sumministration delle cose venutemi da diverse parti del mondo: o sono stati come compagni e consorti delle fatiche: à quali tutti, se nel nostro trattato è cosa alcuna di buono, si deve parte di gratia.* Tra gli fautori riconosco il primo Gio. Vicenzo Pinello Mecenate de letterati, che alla nobilità della famiglia have accompagnato le lodi della molta dottrina: per mezo di cui mi sono pervenute nelle mano molte cose forastiere procuratemi da diverse parti del mondo. nel che non solo le debbo io, ma la maggior parrte de virtuosi di Europa. Consorti nelle fatiche ho havuti trà gli usciti dalla vita presente Pietro Andrea Matthioli scrittor notissimo al mondo, con cui ho communicato molte delle mie cose, come egli stesso ne fa spessa mentione nelli suoi volumi.e Melchior guilandini huomo studiossisimo: & con chi più strettamente, che con alcuno degli detti, ho communicato, il nostro compatriota Bartolomeo Maranta Venusino, huomo di elevata dottrina, di cui sono in luce il dottissimo Methodo de medicamenti semplici, & il Trattato de Theriaca; & eravamo per aspettare molte cose di alta speculatione, se no fusse stato prevenuto da morte immatura. Tra gli viventi sono Iacomo Antonio Cortuso gentil'huomo Padovano, peritissimo nella conoscenza delle piante e loro facultà, & Ulisse Atrovandi, di cui aspettiamo molte degne opere in luce.e de forastieri Carlo Clusio scrittor nobilissimo c'ha illustrato l'età nostra della conoscenza de medicamenti peregrini; Gasparte Bauhino famosissimo Dottore appò gli Heluetii della peritia Anatomica, e della Herbaria: e molti altri diversi.è anco tra vivi miei compatrioti, Fabio Colanna nobile virtuosissimo, & accurato osservatore delle cose naturali, e Colantonio Stelliola, professore di scienze recondite, con cui ho communicato la maggior parte delle mie cose date in luce nell presente opera. Restà lettore siano buone, e mi haverai scusato in quello che ti parrà che io habbi mancato, e chi io non habbia possuto pervenirvi: sendomi in scusa la grandezza del soggeto trattato, in cui deve assai stimarsi non solo l'esservi altamente penetrato, ma anco l'haverlo mediocremente maneggiato.[149]

As it can be read, the scientific network of Imperato was very large and heterogeneous. From people who helped only in recollecting strange samples to experts in different fields. Aldrovandi, Matthioli, Maranta and many other prestigious virtuosi of their time, which are not mentioned above, were members of Imperato's research network. The number of people involved in inquiring nature was really impressive if, as Stendardo claims, we count also the indirect helpers.[150] Definitely, researching nature was a monumental enterprise that could not be carried out by a single individual.

However, Imperato is not against the authority criterion, except when it contradicts experience. Therefore, he does not reject the authority criterion, but its epistemological weight cannot surpass experience. He inquires particular subjects through reason and experience, confirming authorities' statements, correcting their mistakes or discovering new facts. Therefore, the careful exploration of nature by means

[149] Imperato, 1599: dedication, *emphasis added*.
[150] Cfr. Stendardo, 2001: pp.56-58.

of experience, reason, and philosophical doctrines was the way to extend the limits of his inherited natural knowledge. In the following terms, Imperato proclaims the methodological culture of the sixteenth-century naturalists:

> […] ma se a noi è lecito per l'investigation della vertà, contraddir ad un tanto approvato autore, e proferir quello che la sperienza stessa ci dimostra, diremo che […] nel che ancora salva la riverenza di un tanto huomo, veggiamo la sperienza contraria a quel che egli propone […]; noi non perché vogliamo contradir ad humoni di tanta authorità: ma solo per amor della verità diremo quel ce la sperienza ci mostra […]; ma perchè questa opinione falsa la riverenza di un tant'huomo par che più tosto risponda alle sue positioni, che alla sperienza delle cose in se stesse, non restaremo noi per amor della verità, dirne quanto dal senso e osservatione massime sentiamo […]; noi per l'intelligenza delle cose da essi [*gli Antichi*] dette e per la dottrina delle cose in se stessa, aggiungeremo alcune cose cha la sperienza e la ragione ci mostra.[151]

This inquiring methodology constitutes the synthesis of the naturalistic culture of Renaissance and Imperato's creed.[152] We have already seen concrete examples of this epistemological position in Maranta's proposal for making theriac; and Imperato would proceeded accordingly through the pages of his *Natural History*.

The emphasis on experience as the ultimate tribunal of knowledge started to contradict more often the doctrines of authorities; particularly, of those which did not support their statements in experience. This epistemological attitude of generating and justifying knowledge from experience was vehemently developed by the naturalists of the sixteenth-century. The natural communities of scientists of the following centuries would ascribe to it. For example, the sixteenth-century's experimental attitude embodied in Imperato's Museum and *Natural History* strongly influenced the Linceans.[153] In 1618, the famous naturalist and Lincean Fabio Colonna, who was frequently at Imperato's Museum,[154] resumes the inherited experimental attitude of inquiring nature in the following terms:

> Hora tocca à noi [lasciando di riferire, & di contradire à quanto ne han scritto gli Anticchi […] à *dimostrare le osservate proportioni, & dimensioni della corda divisa in Ottava, Suoni, & Semituoni, & minute parti di quelli; non già da supposti Methodi, ma dalla stessa Natura* cosi create, che non possono essere altrimente, ancorche l'arte volesse contrariarle. *Et però habbiamo tenuto che si debbia credere piu alla osservatione delle cose naturali, che alle cose imaginate, & supposte da un un sol principio osservato,* senza il mezzo & il fine della cosa stessa, *dalla*

[151] Imperato, 1599: p.134; p.135; p.136; p.158; pp.243-44; p.399. The selection and location of these quotations has been possible thanks to Stendardo, 2001: pp.63-64.
[152] Cfr. Stendardo, 2001: p.51.
[153] Cfr. Stendardo, 2001: pp.23-49.
[154] Cfr. *Ivi.* p.31.

> *quale si deve poi cavar regola, essendo che la cosa osservata perfettamente dà il methodo, & non il methodo farà che la cosa sia conforme il suo presupposto methodo:* non potendo la Natura delle cose mutarsi nel capriccio dell'huomo a farsi conoscere come egli pensa, ma ben dovendo l'huomo formar il suo capriccio dalla cosa natural esattamente osservata, & cavarne se può Methodo.[155]

Colonna is proclaiming the importance of experience for constructing practical rules or methods; because these only can be true and useful if they are based in the observation of natural things and not in imagined objects and suppositions. This line of natural inquiry was not an innovation of Colonna, it could be breathe in the naturalist environment of Renaissance. The link between experience and methodology for obtaining knowledge would find its more refined formulation within the experimental societies of the seventeenth-century, particularly in 1687 with the famous Newtonian dictum *hypotheses non fingo*.[156]

8.2. Imperato's *Natural History* alchemical framework

Ferrante Imperato was a "semplicista" who consecrated his life to collect the more possible pages of the book of nature to read and learn from them in his Museum. Indeed, one of his most important contributions to the development of science was his Museum in which he collected all kind of specimens with the objective of learning and experiencing. His Museum became one of the most important meeting points for learning, discussing, and developing natural knowledge during the Renaissance. Imperato's *Natural History* is precisely the catalogue of his Museum. Imperato wrote it with a clear practical goal in mind: "Il trattato dell'Istoria Naturale, studioso Lettore, composto da noi con istima di havere ad apportare alcun giovamento al publico [...]."[157] As it was thought during the Renaissance, natural history greatest benefit was its medical utility. Therefore, medicine would be not only a central issue within Imperato's *Natural History* but its justification. And the practical aspect of medicine, namely, making drugs, could not be disassociated from alchemy. However, alchemy functions as framework of the entire work, as testifies the dedication to the readers of Imperato's *Natural History*.

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[155] Colonna, 1618: p. 16, *emphasis added*.

[156] Newton resumes his methodology in his *Principia* (1687) as follows: "[…] for whatever is not deduced from phænomena is to be called a hypothesis; and hypothesis, whether metaphysical or physical, whether occult qualities or mechanical, have no place in experimental philosophy." (Newton 1995: 442-443)

[157] Imperato, 1599: dedication to the readers.

Imperato arranged his *Natural History* according to the "differenze & ordini delle cose."[158] According to him, things can be catalogued in two domains: elementary bodies and mixed bodies. Consequently, he decided to treat first the differences, qualities, and virtues of the elementary bodies: earth, water, and air:

> Perloche cominciando dalla Terra, e sue differenze, & virtù siamo indi passati all'elemento dell'Acqua, e le varie affezzioni, & impresioni che essa riceve, e dall'Acque all Aria, e sustanze in essa generate.[159]

Fire is missing, because it has a very particular status in relation with the other three elementary bodies. It is an *operational element*, that is, it does not only compose mixed things, but it actually is involved in the artificially processes utilised by the artificer for mixing them:

> Segue dopo di essi la consideratione dell'operationi naturali del caldo, e del freddo, à quali si accompagna l'artificio delle fornaci, con quali secono le occorrenti necessità, guidiamo l'operationi del fuoco.[160]

As we can appreciate, Imperato's approach is heavily guided from an operational point of view. Definitely, Imperato's *Natural History* is a practical catalogue that would benefit humankind with the useful production of things by artificially means, such as making compound-drugs. He would treat first the properties and virtues of elementary bodies; then the properties of artificial operations; and eventually he would teach to artificially generate mixed bodies and *transmute* them:

> A questo succed la consideration de corpi di prima genearione: dico de Sali e grassezze terrene, & appreso di essi la consideration delle spezie de metalli, e pietre, *con gli artificy di condurle alla loro perfettione*, e finalmente succede la consideration de vegetali, & animali terreni e marini.[161]

Precisely, as we have seen above, the transmutation of lead into gold is a particular token of alchemy's ultimate goal, namely, to transmute the imperfect bodies into perfect ones. Imperato is openly claiming not only that alchemy would be addressed inside his book, but that it has been structured from an alchemico-operational point of view.

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[158] *Idem.*
[159] *Idem.*
[160] *Idem.*
[161] *Idem. Emphasis added.*

Imperato's style of writing and exposition is clear and structured, there are not allegories, emblematic symbols, or any other form of code with the objective to hide something; or, if there is, it is not traceable at first reading. However, this fact do not means that Imperato was not involved in the hermetical tradition. In fact, many topics exposed by Imperato cannot be considered and pondered leaving aside the alchemical ideas and worldview as the general index of his *Natural History* testifies:

> -Nel primo, secondo, terzo, quarto, et quinto libro, si tratta delle terre, e lor diversi usi, e nature.
> -Nel libro sesto e settimo si tratta della acque, e sue differenze, e nascimenti.
> -Nel libro ottavo, e nono si tratta dell Elemento dell'Aria, e corpi che in esso pigliano consistenza.
> -Nel decimo, & undecimo libro si tratta de gli effetti del fuoco, e della luce nella contenenza elementare.
> -Nel libro duodecimo si tratta della generation del fuoco e varie operationi del caldo, e del freddo.
> -Nel libro decimoterzo si tratta della generation de minerali nel geno saligno.
> -Nel libro decimoquarto si fa consideratione delle spezie di grassezze.
> -Nel libro decimoquinto si considerano le sustanze appartenenti al geno metallico.
> -Nel libro ecimosesto si tratta delle vene de metalli, e sustanze che in esse si concreano.
> -Nel libro decimosettimo, decimoottavo, decimono, e vigesimo si tratta della separation del metallo dalla sua vena, e dal'un metallo dall'altro, e loro raffinamento.
> -Nel libro vigesimo primo si tratta della medicina Filosofica, così secondo l'opra maggiore, come secondo la minore.
> -Nel libro vigesimosecondo, vigesimoterzo, vigesimoquarto, vigesimoquinto, e vigesimosesto, si tratta delle pietre, e lor diverse conditioni, nascimenti, virtù, e prezzi.
> -Nel libro vigesimosettimo si tratta delle consistenze, e vegetali marini.
> -Nel libro vigesimo ottavo sono considerate alcune spetie di piante terrestri, e di Animali, non osservate da altri scrittori.[162]

The subjects treated from the tenth to the twentieth books involve alchemical fundamental notions in which Imperato's *Natural History* is based, as testifies the structure delineated by Imperato in his dedication to the readers. The twenty-first book, as we will see below, is the most relevant. For the moment, the dedication to the readers of Imperato shows that he was well aware of the alchemical processes, theories, and goals that were diffused in his time.

However, historians of science do not label Imperato as a magician. On the contrary, they used him to differentiate magicians from naturalists. For example, Findlen claims:

[162] Imperato, 1599: index.

> Despite their shared interest in collecting and distilling nature, Imperato and Della Porta typified two different trends among late Renaissance naturalists. Imperato professed to study nature *only from nature* and for the betterment of medicine, while Della Porta perceived natural history as a prelude to natural magic.[163]

Findlen says that their different methodological forms of inquiry nature were represented by the disposition of his collection within their museums. Della Porta collected precious treasuries, extravagant spectacles, and was fascinated by arcane knowledge; instead Imperato:

> He [Imperato] had no classical statues, magic lanterns, speaking tubes, distorting mirrors, or other objects of humanist erudition in his museum, and therefore possessed none of the artifacts that mediated *experientia* within the republic of letters. Imperato collected objects but did not posses "wisdom," in the humanist sense of the term, and therefore could not provide the learned conversation that initiated the sharing of secrets.[164]

Findlen even quotes Campanella to vinculate Imperato strictly to nature and disassociate him from any kind of magical enterprise within his Museum:

> Comparing Della Porta's attitude toward observation with Imperato's empiricism, Tommaso Campanella remarked, "Nonetheless the most studious Della Porta forces himself to recall this science, but only historically, without explanation; and the *studio* of Imperato can be a foundation for uncovering it." Distinguishing Imperato's active notion of *experientia* from Della Porta's more formal use of it as a philosophical category, Campanella indicated his own preference for a collector who read directly from the book of nature. While Della Porta used the objects in his possession to demonstrate historical truths, Imperato saw his museum as a space in which to create knowledge directly from artifacts rather than around them. Della Porta more closely resembled Girolamo Ruscelli, who "continually experimented on all the secrets that we could recover from printed books or from ancient and modern manuscripts" in his Accademia Segreta.[165]

And Findlen is completely right. Imperato was not any sort of initiated and scholarly magician as Della Porta. He was a man of experience. His craft was practical and so it was his approach and knowledge. He studied nature only from nature as Findlen says. However, studying nature in the sixteenth-century was an alchemy-laden activity, particularly the apothecary profession. Therefore, as Findlen claims, Imperato and Della Porta typified two different trends among late Renaissance naturalists; but they both

[163] Findlen, 1994: p.227.
[164] *Idem.*
[165] *Ivi.* pp.227-8, Campanella quoted.

also were differently immersed in magic.[166] In other words, reading the chemical, botanic, and medical chapters of the book of nature was a business of a natural magician. Imperato was an artificer in all the sense of the term, he produced artificially things, and he was very skilful. In other words, we could say that Imperato was a practical magician, and Della Prota a scholarly one. The former was interested in understand the secret ways in which nature operated to imitate it artificially; and thus observation and experimentation within its laboratory were crucial to achieve his goal. The latter was interested in the mysteries and secrets of magic from a more theoretical point of view. Magic was a complex subject. It had a very wider scope, as we have seen above. Any one interested in magic had to specialize in a specific domain. Precisely, as Imperato acknowledges, he recurred to "Stelliola" (i.e. Stigliola), a scholar who was directly in touch with Galileo,[167] for expert advice in "scienze recondite" (i.e. occult sciences).[168] The hermetic artificer was consulting the hermetic philosopher, that is, the one whose knowledge of arcane mysteries has been obtained in great degree by reading rather than by diligently working days and nights in front of a furnace.

8.3. Alchemy and natural history: Imperato's spagyrical advice

Imperato firmly believed that natural history (*chymistry*[169] included) was a useful knowledge for every one, particularly concerning medical advice. Surely, for this reason he wrote his *Natural History* in Italian instead of Latin. Consequently, he dedicated it to the reader. However, his son, Francesco Imperato, selected a more specific and noble addressee. He dedicated the *Natural History* of his father to the "illustrissimo et eccellentissimo Signore D. Giovanni di Velasco" who was "Duca di Fries, Conte D'Aro, Gran Conestabile di Castiglia, Governatore dello stato di Milano, et Capitano Generale in Italia per la Maestà Cattolica."[170] Francesco was trying to gain the protection and approval of D. Giovanni di Velasco by selling him the idea that all the kings and heroes who have knew the "secreti della natura" have achieve fame and glory, due to its

[166] For instance, Hine propounds to coin the term 'renascentist magic' to refer only to the philosophies which were influenced by the neo-Platonism worldview, particularly the ones who introduce angels, demons or any kind of spiritual entities in their explications; and leave 'renacentist naturalism' to the ones who only explain things truly by natural causes (cfr. Hine, 1986: p.170). However, in the case of alchemy such terminology is not convenient, because many alchemists mixed the Aristotle and the neo-Platonism frameworks of inquiry. For example, there were material spirits as the *anima mundi*.
[167] Cfr. Ricci, 1996: pp.36-48.
[168] Imperato, 1599: dedication to the readers.
[169] In the above sense adopted by Newman.
[170] Imperato, 1599: Francesco's dedication.

utility.[171] Reading the *Natural History* would revel to him all the secrets his father learned through the observation of both the "probabili" and the "occulte" natural properties of animals, plants, stones, and minerals.[172] This knowledge, which is acquired by the "semplicista," teaches "[…] quanto all'humana industria è stato possibile."[173] Franceso underlines in his dedication to D. Giovanni di Velasco that of all the great contributions the "semplicisti" have given to humanity, drugs for curing diverse sicknesses are their greatest contribution.[174]

Through many sections of his book, Imperato makes some references to the medical virtues of simples and gives some medical advice found by his own research as well as by other famous authorities in *materia medica*. Some very orthodox, such as Pliny or Galen, and others very unorthodox, such as Paracelsus. Indeed, Imperato's medical culture was very extensive and diverse. He summarizes the ideas of many important physicians such as Aetius, Dioscorides, Antyllus, Celsus, Diocles, Rufus, Galen, Mesuè, Oribasius, Abu'l Qasim az Zahrawi, Albucasis, Contile, Corsaliu, Dell'Orto, Fallopius, Gallus, Goebel, Handsch, and Mattioli.[175] The medical domain constitutes the best example to show the link between alchemy and natural history. The artificial methods used by the sixteenth-century alchemists, such as apothecaries, agriculturists, and so on, developed the Renaissance culture of experimentation. Eventually, they would contribute to the creation of societies promoting the philosophical knowledge by means of experimentation, such as the prestigious Royal Society. According to Robert Moray, one of his founders, its goal was to reveal all the mysteries of nature in benefit of human life.[176] The advertisement strategy of Francesco Imperato, which was the one diffuse in Renaissance, also was inherited by the future experimentation communities.

Medicine, natural history, and alchemy were disciplines closely interconnected during the sixteenth-century. The link that tied all of them was precisely human health. We will proceed to expose the very link that united these disciplines through relevant medical examples taken from Imperato's *Natural History*, emphasizing the practical methodologies and the epistemological creed of Imperato.

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[171] Cfr. *Idem.*
[172] Cfr. *Idem.*
[173] *Idem.*
[174] Cfr. *Idem.*
[175] Cfr. Stendardo, 2001: p.53.
[176] Cfr. Lomas, 2003: p.94.

8.3.1. The medicinal properties of water and the theory of impressions

In the sixth book of the *Natural History* Imperato talks about the medicinal properties of water. He gives very practical advise for using it as medicine as well as some hygienic procedures for gathering it and purifying it. His approach is based on experience, reason, and authority. As we will see, his emphasis on the manipulation of water with beneficial purposes constitutes the trademark of all books of Imperato's *Natural History*:

> [...] *cerchiamo non solo la conoscenza, ma l'uso anco delle cose*, far consideratione dell'inventione, e conducimento dell'acque; apportandovi secondo il nostro instituto, quell che da approvati Autori n'habbiamo: & aggiungendovi di più, per compita intelligenza, quel che di più ci occorra.[177]

According to Imperato's knowledge and experience, the water has a simple nature and for this reason is very useful for health.[178] He claims that the best water is the one which its taste, color, and smell are null. Our *semplicista Napolitano* claims that the cold water, which he calls "fresca", is the better for the health, because fresh water by nature tends to cool and moisten.[179] In addition, the fresh water conserves its medicinal virtues for more time. According to Imperato, relatively cold fresh water conserves better its virtues. However, if it is very cold, it has to be warmed before drinking it; because if not, it surely will produce stomach ache.[180] Imperato also regards a well known and ordinary fact as a transmutation, namely, that water can become snow by cooling it; and when doing so, its color, taste, and smell would change.[181]

There are other types of water, such as the rainy water or the sea water. Imperato thinks that the rain water is not always pure and healthy; because it is fire which raises it into the sky, and fire also can raise other metallic substances.[182] Other important features to take in account are the dimensions and the material in which water is gathered. The reason, according to Imperato, is that the recipient can give its impressions to the water and corrupt it. It is better to conserve the water in a big vase

[177] Imperato, 1559: p.215, seventh book, *emphasis added*.
[178] Cfr. *Ivi.* p.180; pp.184-187.
[179] Cfr. *Ivi.* p.180.
[180] Cfr. *Ivi.* p.181.
[181] Cfr. *Idem.*
[182] Cfr. *Ivi.* p.182.

rather than in a big tank, because with time a huge amount of gathered water corrupts due to stagnation.[183]

Imperato, due to his spagyric influences, believes that the water that comes from the limestones is considered pure and light and even healthy if it is drunk in certain amounts. It is true, affirms Imperato, that water which has a metallic smell is bad, because it is infected with other soluble substances. However, Imperato says that he is stunned by the medical virtues that Agricola gives to the arsenic sulphur. These medicinal qualities are occult. First, the "orpimento" (i.e. arsenic sulphur) has to be depleted from its corrosive qualities, and then its astringent qualities would appear:

> Ma io mi maraviglio molto, come all'orpimento dia l'Agricola conditione astringente, cosa in esso non manifiesta, lasciata la virtù sua corrosiva. Et è cosa vulgata, che l'orpimento sia l'istessa materia: onde si sollima l'arsenico veneno pernitiosissimo, oltre che la sua qualità corrosiva è da se stessa conservata. E già dall antichisima età è ricevuto nelle medicine, che dipelano il corpo.[184]

To purify any water separating the substances that are mixed in it, Imperato thinks that there is no better way to do it than to "[…] imitar con l'arte il natural dipuramento."[185] The artificially purifying operations that imitated nature were simple procedures such as dripping it; pouring it several times from on vase to another; or even collapse it with convenient sands which absorb the alien substances.[186] According to Imperato, the best way to artificially purify corrupted water is by means of boiling it, because only by this way it is possible to separate all the alien and dangerous substances which are in it.[187]

Cold fresh water is the better for health due to its medicinal virtues. However, according to Imperato, water is also important for medicine because it can acquire or get diverse and distinct impressions of medicinal virtues. Water can also acquire noxious impressions; but, from the medical point of view, it is water's capacity of receive impressions where resides the explanation of the principle operating in the medicinal beverages. The Imperato's medical theory of beverages, or infusions, is that water's null properties made it capable of receiving the impressions of things without altering them. All substances left impressions into water and those which combine better with it, or cause better impressions, are the ones which are not fatty. The best examples are the

[183] Cfr. *Ivi.* p.183.
[184] *Ivi.* p.182.
[185] Cfr. *Ivi.* p.183.
[186] Cfr. *Idem.*
[187] Cfr. *Idem.*

salty substances which have to be drunk accordingly to the medical virtues that one is after. Therefore, *minerals* are very important form a medicinal point of view:

> Diciamo dunque l'aqua, quanto a se stessa, esser di semplicissima natura: e mentre tale sia, esser ottima all'uso della sanità: ma infarsi di altre qualità estranee, e dalla conmunicanza delle minere per quali passa, o da gli vasi, ove è contenuta: e che quindi ne divenga medicinale: onde le virtù, che ne acquista, sono rispondenti alle materie, che fanno in essa impressione. […] La consideration dunque delle virtù medicinali dell'acque tutta dipende dall'istesse miniere: onde elleno ricevono impressione: perciò secondo le virtù di quelle si determinano le operationi dell'acque.[188]

As the quotation shows, the theory of impressions of Imperato explains the medicinal role that minerals play in infusions and beverages. His theoretical framework does not go any further. However, he describes technical processes for separating and mixing, easily diverse substances. He also gives very practical applications and medical advice about the use of certain substances.

8.3.2. Medical advice on arsenic sulphur, *sandaraca* and nitrate

In the fifteenth book of the *Natural History* Imperato talks about the medical virtues of arsenic sulphur or "orpimento." According to Imperato, arsenic sulphur mixed with fat can be used as a depilatory medicament due to its burning caustic virtues. However, Imperato warns his readers that arsenic sulphur cannot stay too long in contact with the skin, because if it is, it would be operating against the skin and not only over the hair. Moreover, arsenic sulphur also can make hair grow (in places where it used to be) instead of removing it. According to Imperato, it has to be mixed with resin. In this manner, it will burn the bad humors that prevent hair from growing.[189]

According to Imperato, the *sandaraca*, that is, the realgar (i.e. a red sulphide of arsenic), not only cures the alopecia (i.e. absence of the hair from the skin areas where it is normally present) when mixed with resin, but also much more sicknesses. For example, it becomes excellent medicament against the lice, if it is mixed with oil. Also it becomes a good medicine to the sores both in nose and mouth, if it is mixed with grease. if it is mixed with pink oil, it will be of great help with sutures. Furthermore, it is useful against the "tosse vecchia" when mixed with resin and inhaled by the mouth by means of a straw; and if it is mixed with honey is good against the asthma. In addition,

[188] *Ivi.* pp.181-182.
[189] Cfr. *Ivi.* p.431.

it clears the voice.[190] Imperato also mentions the "risagallo", that is, a substance very similar to the two just mentioned but that is more powerful, and thus one has to be cautious when mixing and applying it.[191]

In the thirteenth book of his *Natural History* Imperato, following Dioscorides and Pliny, writes that the nitrate has many virtues that make it a multi-medicament. For instance, the nitrate cleans, dries, reduces, extracts, and dissolves; it can be drunk or applied. The nitrate mixed with resin can be used against diverse kinds of bites, such as snakes or dogs. Its drying virtue make it very useful for treating putrefying wounds; and for the same reason, plus its virtue of modifying, is also good to treat leprosy. For its virtue of bitterness when nitrate is mixed with honey, it is very good for reducing the scars in the eyes and eliminating the ruggedness of the eyelids. It is also good for any face wound, if we add milk to the prior recipe. Nitrate plasters along with fig-tree are good for hydropsy. Even nitrate can be utilized as toothpaste to whitening the teeth. It also can be used as a painkiller if it is mixed with pepper and drunk in wine. Inhaling the vapor when boiled it is good for the blooding nose. And with mixed wax is good for the ulcer. And nitrate can be useful for cure many other sicknesses.[192]

As this few examples show, Imperato is focused in teaching useful and beneficial applications of natural knowledge. He is not interested in making theoretical statements when he talks of the medical virtues of the minerals he describes. On the contrary, he is more concerned with the way of making some easy and effective remedies. And he also warns future users of the possible damages and ways to prevent them. For example, he stresses always that minerals utilized as drugs have to be applied in low-dosage.

Definitely, the medicaments and recipes offered by Imperato constitute a great benefit for humankind. However, Imperato ambitions were even greater. He was interested in making a universal medicine, one which cures all sorts of sicknesses. As we have seen, he was very interested in making correctly the theriac. However, he knew that there was an even better multi-medicament, which was the most valuable secret of all nature's secrets. It was known for centuries and jealously kept by the alchemists. For example, Roger Bacon fourth hundred years before had clearly spoken of the greatest

[190] Cfr. *Ivi.* p.432.
[191] Cfr. *Idem.*
[192] Cfr. *Ivi.* p.387.

secret of nature in his *Opus Maius* (1267). Samuel Jeeb, who edited R. Bacon's *Opus* in 1733 resumes Bacon approach in the following way:

> *Ut naturae secreta penitus indagaret Baconus*, alchemia studiose operam navavit, & nobilia non pauca in ea arte exhibuit. Gebri Arabis philosophiam amplexus est, & duo mineralium posuit principia, argentum vivum scilicet & sulphur. Ex bis, y inquit, procreatur cuncta metalla & omnia mineralia, quorum multae sunt species & diversae. Semper autem natura contendit ad perfectionem auri. Si vero accidentia superveniant, quae digerentis naturae operationem impediant, metalla transformantur. Scundum autem puritatem vel impuritatem argenti vivi & sulphuris pura vel impura generantur. Unde etiam viliora docet in aurum transmutari posse, tollendo scilicet impurioris metalli immunditias, & digerendo materiam eiusdem in formam auri. *Medicinam vero, quae has impuritates tollat, confici posse dicit, reducendo elementa fere ad aequalitatem; atque hinc etiam vitae longevitati consuli posse, cum illa medicina, quae tolleret omnes immunditias & corruptiones metalli vilioris, quae tolleret omnes immunditias & corruptiones metalli vilioris, ut fieret argentum & aurum purissimum, aestimatur a sapientibus posse tollere corruptiones corporis humani in tantum, ut vitam per multa secula prolongaret*.[193]

Imperato was a skilful artificer. He knew that theriac could prolong human life and cure almost all diseases, if it was made properly. Indeed, he was trying to restore theriac's perfection. Therefore, he was not only interested in the ultimate goal of alchemy, namely, the philosophers' stone, but he actually gave the recipe of it. According to him, a preliminary state of the philosophers' stone would be a universal medicine which he calls: "medicina filosofica" in the twenty-first book of his *Natural History*.[194]

8.4. Imperato's philosophical medicine

In the twenty-first book of his *Natural History*, Imperato considers the methods for making the philosophical medicine.[195] In the previous books he has exposed many metallurgic operations, such as the separation of metals or its refining. Now, as Imperato says:

> Sarà forse hora non inconveniente far considerazon della trasmutation dell'un metallo nell'altro, de quali alcune ne sono in *commun uso, altre trattate da chimici con molta sottigliezza di operazioni, & con occulta e trasferita significazion de*

[193] Jeeb, 1733: pp.viii-ix, *emphasis added*.
[194] Cfr. Imperato, 1599: p.568-581.
[195] This subchapter consists in an exposition of the twenty-first book of Imperato's *Natural History*. There is a transcription of Imperato's twenty-first book into modern Italian made by Massimo Marra (cfr. Marra, 2000: 91-106).

> *nomi*, riferendo in questo quel che da migliori dottori ne habbiamo [i.e. di Paracel e dell'Agricola].[196]

The first thing to underline is that there are basically two types of transmutations for Imperato. He refers to the first type of transmutation in the above quotation as transmutations of "commun uso," and thus they could be called 'vulgar transmutations;' because they are the common transmutations of everyday life. We could say that when we transform one thing into another we are in the presence of a vulgar transmutation. We can think in many examples which run over a very wide range of ordinary instances, such as the pulverization of a rock, and the transformation of water into ice. However, there are other sorts of transmutations that are encrypted in the books of chemists. These excel artificers have conceal the processes to carry them out by means of using words with different references. Imperato called this type of sophisticated transmutations "trasmutazioni chimice": "[…] de quali oltre che se ne servono a perfezzionar li metalli, intendono ancora auualersene nella rinovazione e ringiovenimento delli corpi."[197] Imperato has managed to crack the alchemist code that kept them in secret. Now he is willing to diffuse these beneficial chemical transmutations for the sake of humankind.

According to Imperato, Paracelsus and Agricola are the best authorities in the subject. He seems to know it by own experience. However, it is not likely that Imperato have managed to achieve the wonderful transformations described by the authorities he quotes. However, based in his own transmutational experience, he regarded the chemical transmutations described by Paracelsus and Agricola not only as possible, but as true facts!

Following Paracelsus, Imperato says that iron can be chemical transmutated into copper by one of the following operations. Firstly, by means of a powerful fusion that transforms it into a compound of iron and "ferrugine" (i.e. sulphuric acid), and eventually into copper.[198] Secondly, by putting iron into a lye (i.e. strong caustic alkaline solution) of *marcasite* (i.e. iron sulfide), then it will transmute into copper, and it will be of better quality and more manageable than the natural copper.[199] Following Agricola, Imperato says that if one extracts "aque […] di natura atramentosa" from the wells of the Dacia region, which then melts along with iron in channels arranged in

[196] Imperato, 1599: p.568, *emphasis added*.
[197] *Ivi.* p.569.
[198] Cfr. *Ivi.* p.568.
[199] Cfr. *Idem.*

three, he will obtain copper.[200] The "ferro limato" (i.e. iron file) has to be place at the end of the channels to be digested in the mentioned waters, so it originates something akin to a black mud, which then cooked in the furnace will give pure copper.[201] As we have said, Imperato describe these three ways of transmutate the iron into copper, but he does not explicitly claim that he actually have successfully made one of them. He is appealing to the authority criterion! But he does, because Imperato himself made some successful experiences of transmutation in his life. Indeed, he remarks referring to Agricola's example that "[…] si vede con breve sperienza, che'l ferro intinto in alume & aceto, o in vitriuolo si tinge in color di rame."[202] The transmutation into copper is very important, because Imperato considers copper very similar in nature to the perfect metals, being more akin to silver than to gold.[203] Imperato also underlines the tincture processes implicated in the vulgar transmutation of iron into copper, because from a medical point of view tinctures are very useful for making chemical medicines.

The chemic dyeing of metals, such as the dyeing of copper, has powerful medical virtues bodies. Imperato by own experience, and by the testimony of many honest physicians along Europe, agrees with Paracelsus; he claims that if a well prepared dyeing is taken in low-dose, it acts like a potent medicine for all kind of sicknesses:

> Diciamo dunque, che *la tintura convenientemente preparata, è medicina che consuma li mali tutti*, non altrimente che il fuco consuma il legno. *Dassene di essa piccolissima quantità, percioche nelle operaioni sue è potentissima. & io con questa medicina ho curate* la lepra, l'hidropsia, il mal caduco, li morbilli pericolosi, il mal colico invecchiato, la goccia, il lupo, il cancro, le sistole: & ogni sorte de mali interni, oltre di quel che potrebbe credersi. *E di ciò possono farne fede più provincie di Europa.*[204]

The reason why metal dyeing has so powerful medical virtues is because it produces "trasmutazioni chimice", that is, the ones who instead of transforming one body into another transform it into its *own state of perfection*.[205] In other words, chemical transmutation operates regenerating bodies to a better condition (its perfect

[200] Cfr. *Idem.*
[201] Cfr. *Idem.*
[202] *Idem.*
[203] Cfr. *Ivi.* fifteenth book: p. 447.
[204] *Ivi.* p.569, *emphasis added.*
[205] Cfr. *Idem.*

condition), and metal dyeing ingested in low-dose causes chemical transmutations. In this way sickness is eradicated from its very origins:

> dunque per detta medicina [i.e. la tintura convenientemente preparata] il corpo si modifica, & il mal del tutto si toglie dalla radice, *& ogni superfluità si trasmuta in condizion migliore*.[206]

Imperato tell us that according to Paracelsus this kind of medicine was found when some chickens have eaten by mistake the metallic dyeing of imperfect metals and, consequently, all their feathers have fallen, phenomenon which Imperato seems to perceive as a rejuvenated process or "rinovazione."[207] Imperato also affirms to have *experienced by himself* the effects that metal dyeing can produce in chickens: "[…] mangiata la tintura da galline, son loro cascate le penne, e rinate l'altre nove, come io stesso ho visto."[208]

To take advantage of metal dyeing, one has to know very well how to prepare and administrate it. For Imperato it's a fact that the copper metal dyeing has powerful medicinal virtues. Therefore, for him, it naturally follows, that one could manufacture a universal medicine from the perfect metals. In other words, he believed in the authority of alchemists, that is, in what famous alchemists said was possible to be accomplished. As a matter of fact, he seems to be sure that is possible to realize such a medicine, because he exposes the steps to artificially produce such a panacea.

Imperato consecrates the rest of the twenty-first book of his *Natural Philosophy* to teach us with all detail how to produce the philosophical medicine through chemical operations. The Archimedean point consists in extract the purest spiritual part of bodies. The reason is simple, this purest spiritual part, called the fifth essence or chemical ether, has medical virtues. According to Imperato, the artifice can obtain an "ethre chimico quasi universal" capable of regenerate all corrupted bodies.[209] In medical terms this means that the chemical ether can cure all ilnesses by restoring human health by means of regenerating the human body. Imperato resumes the theoretical idea that drives chemists' efforts very briefly:

> [...] questo ethre chimico quasi universal materia, & universal forma, che può contener in se le forme tutte distinte, che dalla universal forma procedano. perloche

[206] *Idem. Emphasis added.*
[207] Cfr. *Idem.*
[208] *Idem.*
[209] Cfr. *Ivi.* p.571.

> coloro che fanno per quest'arte ridur le forme particulari in una universale, & in questa rimettono le virtù speziali, haranno una universal medicina, con cui si potranno torre tutte le corrutioni, & infermità da gli corpi, e nell'universale, e nel particolare.[210]

As it can be read, Imperato claims that the material chemical ether is very similar to the universal form from which all particular individuals come. Therefore, those who by the art can reduce the particular form to a universal one, and then are capable of reintroduce the special virtues of the universal form to the particular forms, could produce a universal medicine. This universal medicine is not other than the philosopher's stone use to healing human beings. Well, to be more precise, the "medicina filosofica" is not the very philosopher stone, because it can be obtain before carrying out the production of the philosophers stone, as we will see. The philosopher's stone would have always the medical virtues of the philosophical medicine plus many more.

8.4.1. The making of the philosophical medicine and the philosopher's stone

The making of the philosophical medicine starts with a complex process of separation of the perfect form from the corporal imperfection. According to Imperato, this process is technically known as the "separazione dell'ethere."[211] It consists in detaching the pure part which composes a body, namely, separating the pure from the impure by means of laboratory operations.[212] Imperato claims that the wine is the body where the mentioned separation is more easily made.[213] However, the process of separate the ether of the wine is not so simple but very complicated, one which is composed of various and reiterative steps.

The first step consists in repetitive distillations of wine. The distillations have to stop only when the distillated liquor taste insipid. Then it starts the second phase. The chemist has to gather all remains of the distillations, and distillate them as many times as the liquor boils without leaving any phlegm. After these two long distillations phases, he will obtain "acqua ardente rettificata."[214] The process has not finish yet, now the chemist has to cook all the remains until they acquire a honey consistence. Next, he will restart the distillation operations. This time the reiterative distillations will stop with the apparition of an oily liquor, which has to be recollected into one vase by an

[210] Cfr. *Idem.*
[211] Cfr. *Ivi.* p.569.
[212] Cfr. *Ivi.* p.571.
[213] Cfr. *Ivi.* p.569.
[214] Cfr. *Ivi.* p.570.

hour and then into another vase by another hour. Finally, the chemist count with three substances, namely, the *Mercurial* substance recollected the first hour, the *Marsian* substance, recollected during the second hour, and the *Saturnian* substance recollected in the last hour, that is, all the distillation's remains.[215] However, the separation has not finished yet. Now is time to extract a pseudo fifth essence from each mentioned substance. This last process consists in transmutate each substance by means of the "artificio."[216]

The Saturnian substance will be transform into "licor giovale."[217] The first step consist in transforming into dust the remains, dried them, and then calcinate them to start distilling them. The exact process would be repeated until it does not come any substance, which means that the Saturnian water has been condensate into a clear and white water, namely, the jovial liquor, which could be gathered after waiting an hour from having stopped the distillation.[218]

Then the Marsian substance will be transform into "licor solare."[219] It has to be placed into a retort with coal; and then, distilled in a very powerful furnace used until the nineteenth century known as "fornace di riverbero."[220] The iteration of this operation would give the solar liquor, which is clearer than the first one. Imperato only warns the chemist to gather the Solar Liquor prior to the ending of the distillation to avoid its contamination with the remains.[221]

The following step consists in transform the Mercurial substance into "licor lunare" through the same operations utilized to obtain the solar one, but in this case it has to be used an alembic and has to circulate during forty days approximately to avoid the ascension of vapors.[222] This way, it will appear a liquor fixed at the bottom which has a very fragrant smell and a celestial color, namely, the moon liquor.[223]

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[215] Cfr. *Idem.*
[216] Cfr. *Idem.*
[217] Cfr. *Idem.*
[218] Cfr. *Idem.*
[219] Cfr. *Idem.*
[220] Cfr. *Idem.* The technology used by the chemists of the sixteenth-century still was used by the chemists of the eighteenth century: «Les opérations réelles que faisaient les alchimistes, nous les connaissons toutes et nous le répétons chaque jour dans nos laboratoires ; car ils sont à cet égard nos ancêtres et nos précurseurs pratiques. Nous opérons les mêmes fusions, les mêmes dissolutions, les mêmes associations de minerais, et nous exécutons en outre une multitude d'autres manipulations et de métamorphoses qu'ils ignoraient.» (Berthelot, 1885: pp.285-286)
[221] Cfr. Imperato, 1599: p.570.
[222] Cfr. *Idem.*
[223] Cfr. *Idem.*

According to Imperato, extracting the spiritual part of the wine (i.e. the pseudo fifth essence) is the easiest separation of all. The separation process in the case of the solid bodies involves the use of more complex laboratory techniques. The process to extract the form from solid bodies is called "Guida."[224] The Guide operation makes manifest the occult form of metals.[225] According to Imperato, metals could not reach its perfection at the place where they were generated, because it was missing the adequate hot to make them become perfect. Therefore, when an imperfect metal has lost all his grossness and impediments, that is, when the metal is in its liquid state, it is possible to operate freely in it.[226] We can assume that the same applies for all the other bodies. Actually, Imperato exemplifies the guide operation extracting from fodder seeds a pseudo "tartaro chimico", that is, a pseudo natural salt of everything.[227]

The Guide laboratory process could be resumed as follows. Firstly, the seeds have to be macerated in water until they blow up, moment in which they have to be taken out of the water and pile up together until they germinate. Secondly, they are dried, and then milled. Thirdly, the milled seeds are put into a closed wooden vase with boiling water in it. When the vase is cool, the water is extracted without mixing it with the seed grains. This process is iterated reutilizing always the water that is extracted till all the seed grains become liquid. Fourthly, the resulting substance has to be cooked up to it acquires the consistency of blond honey. Finally, the chemist is ready to start properly the separation of the spiritual part of the prior fodder seeds—now as blond honey—by means of reiterated sublimations. The remains of such multiple distillations are dry up by evaporation and eventually reduced into dry ashes by means of powerful fire. The ashes are introduced into hot water and boil. In this manner, lye is obtained. The lye has to be once again distilled and dry up in a glass vase to produce the chemical tartar, which put into a cold-stone becomes tartar water.[228]

In the case of metals, even if they do not sprout, the process is very similar. We do not have to forget that for alchemists all metals vegetated. For example, Imperato argues in favor of the vegetation of the rocks claiming that they are found as part of aquatic animals.[229]

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[224] Cfr. *Idem.*
[225] Cfr. *Ivi.* p.576.
[226] Cfr. *Idem.*
[227] Cfr. *Ivi.* p.571.
[228] Cfr. *Idem.*
[229] Cfr. "Dall'histoira del Lyncurio più che da alcuna altra delle pietre narrate possiamo argomentar la virtù vegetale nella natura delle pietre, qual molti hanno negato come cosa da quelle aliena: ma che la

Imperato has exemplified the two principal extraction methods: the separation and the guide. He has obtained what he has called “pseudo moon liquor” and “pseudo chemical tartar”. Now is time to begin the separation of the real fifth essence, that is, to properly manufacturing the philosopher stone. For achieving this ultimate goal, the chemist must completely mastery both separation operations. Furthermore, he also has to be already in possession of abundant pseudo moon liquor; otherwise, he will not be able to culminate successfully the Minor Work.

According to Imperato, the first operation of the Minor Work consists in calcinate the raw metal files within the moon liquor.[230] Once extracted its humor, it will be remain at the bottom a very subtle powder, which have to be boiled along with moon liquor for twenty-four hours in a vase of long neck; and then, it will be digested for two days. Eventually, the gross parts will be separated from the subtle ones. Lastly, the water is dropped by drip, and the resulting remains will be submitted to the same process as many times as required to separate the spirit from the body. The test to know whether the separation is completed is simple. The chemist only needs to place a little sample of the remaining powder into a slab in fire: if it makes smoke, then the separation is not complete, and the process has to be redone until the smoke does not appear.[231] The separation has not been completed yet. It is indispensable to carry out an “evacuazione,” that is, the body has to be submitted to a multiplication and a rectification.[232] In this way the spirit of the body would be taken away and the rest of the body would be reduced into a subtle powder. This is made by means of what is called “divacamento” (i.e. a process of purification in the sense of depuration or refinement).[233] The operation consists in sinking the remains in moon liquor and distilling them the times needed, so they turn into a very subtle and almost impalpable powder. The water of this distillation is distillated once more until it acquires the consistence of honey. Then, it is added the water gathered of the multiplication; and it is left for twenty-four hours for its digestion. The distillations restart once again, and they do not stop until there are no more remains to distill. In this moment, the artifice has to

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vegetazione che propriamente intendiamo esser l'accrescimento da principio interno, non sia da questo geno aliena, possiamo riconoscere nelle parti dell'istessi animali. Percioche le corteccie degli animali marini, che sono nel geno ostracino, e non meno delle chioccie terrene: sono manifestamente di consistenza di pietra, e si cuocono in calce non altrimente che le pietre ricevute da tutti [...].” (Imperato, 1599, twenty fourth book: p.659)

[230] Cfr. Imperato, 1599: p.572.

[231] Cfr. *Idem.*

[232] Cfr. *Idem.*

[233] Cfr. *Idem.*

mix all the water resulting of each previous distillation to obtain the virginal milk or "argento vivo dimonto".[234] This impalpable powder obtained from the multiplication and the reification, would be used to obtain "solfo di natura."[235] The operation starts by introducing the impalpable powder into a closed vase with virginal milk for eight days. Then it follows the distillation process. The remains will have to be dried moderately, and then they have to be again put into distillated water. Here accurate measures are important; the quantity of water in all cases is the half of the weight of the total powder in the vase. The reiteration of distillations stops only when a sample of the powder makes smoke, if it is introduced into fire in a slab. Finally, the powder has to be sublimated by increasing the fire from low to very high; this way, the chemist obtains the sulphur of nature or "sal di chimici."[236] Finally, this sulphur of nature has to be waxed (i.e. "incerato") with oil of silver to become "[…] medicina perfetta, di cui un peso ne transmutarà cento di stagno, se il sal sia di stagno, e cinquanta di piombo, se il sal sia di piombo, in corpo perfectisimo."[237]

However, even if the chemist is in possession of the sulphur of nature, also called "sal di chimici," which is a perfect medicine, the manufacture of the "medicina philosophica" has not yet finished. Elaborating the philosophical medicine also requires the "oglio chimico," which is obtained by means of separating and reducing it from the "argento vivo," that is, the quicksilver extracted from the limes of any metal.[238] Once in possession of this chemical oil, the artificer can operate chemical transmutations. We could resume the process as follows. The quicksilver have to be distilled along with moon liquor until the remains acquire a honey consistence. Then, they have to be digested by a day. Immediately after, the distillations will restart until the remains are transformed in clear water. Only then, the distillation process stops, and its resulting substances are left to repose for eight days. At the end of this period, the distillation process will restart once again, and again, and so on; each time the process restarts, the same distilled water has to be reintroduced into the remains until they acquire an oily consistence. Then, the process ends. The chemist has successfully obtained the sulphur of the quicksilver. However, if he repeats again all the cycle, the oily remains will

[234] Cfr. *Ivi.* p.573.
[235] Cfr. *Idem.*
[236] Cfr. *Idem.*
[237] *Idem.*
[238] Cfr. *Idem.*

become an impalpable powder at the bottom, known as the salt of the quicksilver.[239] There is not difference in nature between the two, except that the salt is more intense than the sulphur. The salt of the quicksilver can become oily by being eight days in hot bath in a well close vase.[240]

Now Imperato proceeds to teach us how to transform both metal oils into "oglio incombustibile" by means of waxing them.[241] In this manner, both combustible oils will reach their perfection. Firstly, they have to be put into the crucible among hot coal, when they become hot, drops of oil will be added until it become as honey. The chemist knows that he has successfully completed the waxing, if once the oil is cool, it liquefies easily with a candle flame. Otherwise, he has to repeat again the waxing process.[242]

At this point, if the artificer has diligently followed all the mentioned steps, he is in possession of the philosophical medicine. Now he has to take an important decision. He could decide to finish his work here; or he could continue further and finish the Minor Work obtaining the philosopher's stone. But he even could go further and engage in the Major Work. He could transform the philosopher's stone into "veneno transformante."[243] In other words, he could obtain the most powerful philosopher's stone, namely, the one that it is capable of generate "il suo simile."[244] Imperato resumes the Major Work in a simple paragraph which we quote next:

> Se fatta la congiuntion dell'ethre, e della forma, si pongano in vase con molta diligienza chiuso, e si ritengano fomentati in continuo calore, quasi concetto nel ventre materno, avverrà in questo, che fatto discioglimento della sustanza, piglino alteratione, & apparirà il color nero. dunque continuatole la fomentatione che le vien dal calore, la forma di mano in mano verrà in digestione. e fatta la generatione, per diversi colori si verrà all'essenza perfetta. percioche dopo che il color nero auuenuto nello scioglimento si annulla, li succede il bianco. & all'hora comincian li membri a formarsi, finche si venga al giallo, che mostra già esser fatta preparatione alla virtù vegetale: e quando sia avvenuto il color rosso è segno di perfettione. perloche considerato il tempo passato nelle dette operationi, si continuarà per due altrettanti di tempo il calore, senza tralasciare. & compito il tempo si raffreddaranno le cose tutte, e si ritrovarà l'ovo de filosofi formato, qual cavato si riporrà in altro vase nettissimo, e si dipurarà dandogli fuoco potente per ispatio di sei giorni, in forno di cottura, o stufa secca, indi tolto si conservarà. dicui una parte ne può convertire due milia nella forma sua.[245]

[239] Cfr. *Ivi.* p.574.
[240] Cfr. *Idem.*
[241] Cfr. *Ivi.* p.575.
[242] Cfr. *Idem.*
[243] Cfr. *Ivi.* p.580.
[244] Cfr. *Idem.*
[245] *Idem.*

As we can see, Imperato's description of the Major Work is very brief and hardly clear. However, it consists in the paramount thing that can be ever artificially created. Thus, it is the *highlight* item in Imperato's catalogue. Imperato has just revealed the secret of secrets for the benefit of humankind. Instead of Calzolari, who crowns his museum with the theriac, Ferrante Imperato humbly offers humankind the "veneno transformante."

8.5. Epilogue

Imperato describes the properties of natural things, and teaches how to make them useful by means of the art. From water gathering to the "transforming venom," Imperato appeals to authorities as well as to experience. However, for him, it is experience the maximum criterion concerning nature inquiries. Through experience, Imperato accepts or rejects the statements of authorities. He accepted Paracelsus' statements, because his own experience in spagyrics constitutes evidence on favor of the ultimate goal of alchemy.

We can assume by Imperato's poor description of the transforming venom that he had never produced such a thing. But he believed it was possible. It was extremely difficult to restore the perfection of one of the most complex and powerful compound drug of all times, namely, the theriac. Thus, Imperato was aware of the difficulty, complexity, and monumentality that both Minor and Major work represented from the point of view of the artificer. As we have seen, Imperato's description for making the philosophical medicine shows the high degree of sophistication of the alchemical work. Not only knowledge and skill, but also patience and diligence were very important to realize successfully all the artificial processes that alchemical demanded to his adepts. Newton used to say that "[t]hey who search after the Philosophers' Stone [are] by their own rules obliged to a strict & religious life. That study [is] fruitful of experiments."[246]

Imperato, surely, did not achieve to make the philosopher's stone, but what about his philosophical medicine. At least the description given by Imperato suggests that he probably try to make it. Unfortunately, there is not much information about the issue, which suggests that Imperato's philosophical medicine was also a scientific agenda that he has to complete. However, Andrea Fodio in his *Camaleonte antipodagrico* (1651) invented a drug against the gout which was based on theoretical

[246] Newton quoted by Manuel, 1968: p.173.

and methodological principles of Imperato's *Natural History* among other authors.[247] Regrettably, we also do not know if this drug was effective. It is very likely that Fodio's drug against the gout had the same fate of the philosophical medicine of Imperato. But at least Fodio's attempt show that Imperato was a strong influence in the naturalist panorama of their time; and that alchemy, medicine and natural history were essentially linked.

Also it is important to underline that the conception of natural magic as "purely natural" was not accepted in common consensus by all the magicians and thinkers of the time. Many rejected it, because they did not believe it was purely natural, such as Lefèvre d'Etaples and Charles de Bovelles.[248] And many other important magicians, as Trithemius, the very mentor of Agrippa, were against the notion of natural magic proposed by the Florentines. For Trithemius, the theurgical rites and the invocation of demons cannot be expelled from magic.[249] Trithemius even recommended making covenants with demons to achieve marvelous things.[250] With respect to this topic Agrippa and Trithemius diametrically disagreed.[251] According to Zambelli, Trithemius was a popular magician interested in folklore, recipes, and rites; on the contrary, Agrippa and both Florentines were academic magicians. The natural magic proclaimed by Ficino and Pico surely opposed to the popular methods of sorcerers. Thus, it was normal that Trithemius had fought them.[252] But as Zambelli claims, it was a practical notion that allowed magicians to continue inquiring nature under the magical framework. Surely, it was convenient to be a natural magician, that is, one that is purely natural and that speaks the least in terms of alchemical allegories, when the Inquisiton was functioning.[253] However, we claim that natural magic also allowed the magicians to reveal their secrets to humankind, as Imperato exemplifies.

During the Renaissance, science still was not consolidated, but there was not any hegemonic brotherhood of magicians either. It is true, magicians shared common

[247] Cfr. Rinaldi, 2005: pp.168-173.
[248] Cfr. Zambelli, 2007: p.8.
[249] Cfr. *Ivi.* p.15.
[250] Cfr. *Ivi.* p.65.
[251] Cfr. *Ivi.* p.60; p.64.
[252] Cfr. *Ivi.* pp.15-16.
[253] Indeed, it is interesting to underline that magic was banned as a part of philosophy as well as of any Christian domain; however, in someway its status and efficacy are acknowledged, but at the same time condemned. Moreover, Christianity condemns magic and considers it evil but, at the same time, it has its own magic. The Church claims there is only one difference between the magical practices, rites, and incantations of magicians and the ones of Christians: magic does not benefit anyone, but the miracles in name of God are good for humanity. (Thorndike, 1929: 417)

believes, but they were everything except homogenous. As we have just seen, many could not accept natural magic as magic, however others could. The subject was controversial. Moreover, also within natural magic history, and particularly of alchemy, there have been many different approaches. For example, Imperato can be labeled as a materialist alchemist, that is, one that interprets allegoric emblems of alchemist as laboratory processes and phenomena. Nevertheless, not all alchemists could be labeled like that. The motivations that drive intellectuals of sixteenth and seventeenth centuries were very particular and diverse. Robert Boyle wanted to make the philosopher's stone to talk with angels;[254] Isaac Newton wanted to mathematically deduce the existence of God from the phenomena, and thus require alchemy to unite the material with the immaterial world in one scientific discourse;[255] instead, Ferrante Imperato desired to elaborate a universal medicine.

[254] Cfr. Principe, 2000: pp.310-317
[255] Cfr. Dobbs, 2000: p.38; Marquina, 2006: pp.101-102, p.268.

Conclusion

There is a strong methodological continuity between Maranta's Della *Theriaca et mithridato* (1572) and Imperato's *Dell'Historia Naturale* (1599). Both read carefully and attentively to authorities. Maranta searches to elucidate correctly their words by means of a rigorous philological approach. And Imperato interprets the alchemists' allegories as real laboratory processes. Both Maranta and Imperato resort to the authority criterion, but they do not follow it blindly. For them, natural knowledge comes from experience. Therefore, the ultimate tribunal of natural truth is the book of nature: only experience verifies or refutes the statements of authorities.

Relying in experience for inquiring nature is neither an innovation of Maranta or Imperato, nor of any other naturalist of the sixteenth-century. Galen, for example, had already proclaimed it the fundament and origin of his medicine. However, it is precisely during the sixteenth-century that new methodologies for inquiring nature through experience were developed. From a meta-methodological point of view, the physicians of the University of Padua had transformed the Aristotelian theory of logic consequence into a theory of scientific discovery. Reason and experience harmoniously functioned for discovering the unknown causes of natural phenomena through their experimented effects. From a methodological point of view, the naturalists of the sixteenth century were introducing many new methodologies to read the book of nature. Not only was important the direct observation of nature through well trained sensory organs, but also to collect, experiment, and catalogue specimens at physical places built *ex professo* for inquiring nature: the museum and the botanical garden. Museums constituted the place

to experience nature not only by sensory organs but also by means of *artificial procedures*. The use of artifacts to experiment nature enlarged the concept of experience as an epistemological criterion. In addition, museums were meeting points of intellectual exchange. Communities of natural researchers gravitated around them. The construction of knowledge became a public activity. In other words, shared experience functioned as an epistemological criterion. The unfounded statements of authorities could not pass the experimental public tests, and eventually they will be rejected at all.

Maranta and Imperato exemplify these new attitudes and methodological innovations of the sixteenth-century. Furthermore, they both contributed to their development and diffusion. For example, the teamwork of colleagues with the same epistemological status, but with different qualifications, is clearly exemplified by Maranta and Imperato. Maranta represents the scholarly physician and Imperato the experienced artificer. Two virtuosi of a huge network of naturalists enrolled in the monumental enterprise to discover the correct recipe of theriac, by facing experience against the statements of authorities.

However, in many cases, the artificial instruments and technical procedures for experiencing nature still had not been developed enough to fulfill the requirements of strict methodological norms. Consequently, some experimental procedures still could not count as experimental public tests. For example, Maranta considers mandatory to fix a set of normative rules to assure the quality of compound drugs. However, at the same time, he recognizes the difficulty of following strict criteria when making complex compound drugs, such as theriac; because its production relies in the trained sensory organs as well as in the intuition of experienced artificers. Therefore, for Maranta, the artificer’s subjective judgment remains being the last word to solve any practical dilemma concerning the production of theriac.

In the sixteenth-century, the naturalists' goal consisted in studying nature to render it useful to humankind. Definitely, this practical goal encouraged an experimental scientific culture. Nature had to be studied by doing and not only by thinking. The mere contemplation of nature was pointless and infertile. Natural knowledge had to be also beneficial, and medicine was the highest benefit of a fruitful natural inquiry. Also here we appreciate a strong continuity between Maranta’s theriac and Imperato’s philosophical medicine. Imperato himself exemplifies the paramount goal of the sixteenth-century: the discovery of a universal remedy. Imperato along with Maranta were working together in developing a multi-medicament capable of healing

almost all sicknesses. The following step would be to develop not only a universal medicine, but an elixir capable of transforming the human body entirely into its own perfection, namely, the philosopher's stone.

The search for alchemical chimeras seem irrational from our current scientific standards. However, from an historical point of view, it is completely justified. We have seen that pharmaceuticals played a key role within medicine; particularly, for the naturalists who sought useful benefits of natural knowledge. The elaboration of medicines was intrinsically linked with alchemy as were the arts and crafts that transformed things in any artificially way.[1] Making compound drugs consisted in manipulating nature by artificial means. Thus, appeal to the magic-laden laboratory techniques of alchemy was unavoidable. Therefore, the most useful activity for the benefit of humankind during the sixteenth-century was essentially linked with alchemy. And the noblest and the most beneficial goal for humankind, namely, an almost universal medicine, such as theriac, only could be achieved by the mastery of alchemical laboratory procedures. According to the state of knowledge of the sixteenth-century, it was even possible to make a more powerful universal medicine than theriac resorting to minerals instead of plants. Imperato also engaged in this pharmaceutical agenda, namely, the making of the philosophical medicine, with very partial results, we assume. However, their experimental results encouraged him to firmly believe in the feasibility of the alchemists' Major Work.

We do not have to forget that science, as we know it today, did not exist yet in the sixteenth-century. A scientific canon for inquiring nature was missing. Therefore, there were different motivations and ways to apply the new methodologies among the naturalists. The same happened with magical thinking. For example, there were apothecaries that believed in the possibility of achieving the ultimate alchemical goals, such as Imperato; and others who thought that those sorts of artificial transformations were unrealizable, such as Quatramio.[2] However, both Imperato and Quatramio, and the vast majority of the sixteenth-century apothecaries, such as Oddus, agreed in one thing: the miracolous efficacy of theriac could be restored.

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[1] As we have seen in part three, 'alchemy' and 'chemistry' refer to the same cluster of activities. It is not possible to match their sixteenth-century meanings with the ones of nowadays, concluding categorically that the former was a pseudo science and the latter a science.

[2] For example, Quatramio claims that "[…] chimere, & metafore de scrittori Alchimisti, che da molti ignoranti son ricercate […] realmente non si trovano, tali di tal nome, per essere metafore de filosofi alchimisti, che li danno la similitudine de varij semplici, varij animali, & gioie, & minerali, & del cielo ancora: alla pietra de filosofi, all'elixir della vita, quinta essenza, & oro potabile […]." (Cfr. Quatramio, 1597: p.6)

The continuities between Maranta and Imperato show there was an essential link among natural history, medicine, and alchemy. They also show a little but valuable debt that modern science has with natural magic. The Renaissance was the crucible in which the flame of experience gave birth to a new experimental culture that eventually would become the canon of modern science.

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