Knowing by doing in sixteenth-century natural magic: Giambattista della Porta and the wonders of nature

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Abstract

In the first book of *Magia naturalis*, chapter 3, Giambattista della Porta (1535-1615) stated that natural magic was the practical part of natural philosophy. Della Porta referred to knowledge of a particular set of phenomena from which one could operate naturally. In fact *Magia naturalis* covers a broad spectrum of issues that include topics related to the art of distillation, perfumes, fireworks, cookery, fishing and hunting. The purpose of these subjects was to survey natural and artificial things to reproduce them. In this sense, one could say that natural magic was a type of art (*techne*) in the Aristotelian sense, because it implied the type of knowledge that depended on the ability of the ones who manipulated phenomena. This is why the concept of natural magic is usually closely associated with "skill." The aim of this paper is to discuss natural magic as a science that was close in meaning to *techne*, because it involved a concrete sense of craftsmanship and the connotation of the ability to devise stratagems. However, once natural magic was no longer limited to intellectual or manual activity, it could not be considered a mere technical art or technical science (i.e., a technology or technique).

Keywords

Natural magic; Science and art; Wonders of nature; Devices and apparatus; Early modern science

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Conhecer fazendo na magia natural do século XVI: Giambattista della Porta e as maravilhas da natureza

Resumo

No primeiro livro de *Magia Naturalis*, Capítulo 3, Giambattista della Porta (1535-1615) afirma que a magia natural é a parte prática da filosofia natural. Della Porta referia-se ao conhecimento de um conjunto particular de fenômenos, a partir dos quais era possível operar a natureza. De fato, *Magia Naturalis* cobre um amplo escopo de assuntos, incluindo tópicos relativos à arte da destilação, aos perfumes, aos fogos de artifício, à culinária, à pesca e à caça. Todos esses tópicos tinham por objetivo mapear os fenômenos naturais e artificiais para então reproduzi-los. Nesse sentido, pode-se dizer que a magia natural era um tipo de arte (*technê*) em sentido aristotélico, visto que implicava um tipo de conhecimento que dependia da habilidade daqueles que manipulavam os fenômenos, razão pela qual a magia natural comumente é associada à ideia de "habilidade". O objetivo do presente artigo é discorrer sobre a magia natural como uma ciência que se aproxima da *technê*, na medida em que envolvia não só destreza em seu sentido concreto, mas também habilidade em desenvolver certos estratagemas. Contudo, visto que a magia natural não pode ser reduzida a uma atividade intelectual ou manual, ela não pode ser considerada mera arte técnica ou ciência técnica (isto é, tecnologia ou técnica)

Palavras-chave

Magia natural; Ciência e arte; Maravilhas da natureza; Dispositivos e aparatos;

Ciência na primeira modernidade

Introduction

There are several studies on the relationship between science and technology and the relationship between science and magic. These studies, based on various trends in historiography, include issues and historical reflections concerning the interrelation of these topics, as well as theoretical and practical knowledge and their relationship to the origins of modern science. Historians of science have studied various issues concerning experiments; laboratories; scientific instruments; and connections between science and industry, technology and labor.[1]

In the present article, I discuss the relationship between science and art (*techne*) in the origin of modern science by employing the idea of wonders in sixteenth-century natural magic.[2] I examine Giambattista della Porta's concept of natural magic and his goal of using apparatuses and devices to reveal the hidden secrets of nature.[3] I note specific examples that show della Porta's desire to produce wonders (*mirabilia*) and his stance that natural magic was a practical part of natural philosophy. First, I address the meaning of practical knowledge in *Magia naturalis*. Then, I consider how this practical knowledge addressed natural philosophy by considering the process of distillation.

Art, science and natural magic

A number of sixteenth-century documents show us that magic influenced an entire generation of natural philosophers. Some of the leading natural philosophers dedicated to natural magic included Girolamo Cardano (1501-1576), Cornelius Agrippa (1486-1535), John Dee (1527-1608) and Giambattista della Porta. One could also say that

[1] Clifford D. Conner, *A People's History of Science: Miners, Midwives, and "Low Mechanicks"* (New York: Nation Books, 2005); J. A. Bennett, "The Mechanics' Philosophy and the Mechanical Philosophy," *History of Science* 24 (1986): 1-28; Alan Gabbey, "Between *Ars* and *Philosophia naturalis*: Reflections on the Historiography of Early Modern Mechanics," in *Renaissance & Revolution: Humanists, Scholars & Natural Philosophers in Early Modern Europe*, ed. J.V. Field & F.A.J.L. James (Cambridge: Cambridge University Press, 1997), 141-42; Sachiko Kusukawa, & Ian Maclean, eds., *Transmitting Knowledge: Words, Images, and Instruments in Early Modern Europe* (Oxford: Oxford University Press, 2006). See also: Ana M. Alfonso-Goldfarb, & Maria H. R. Beltran, eds., *O Saber Fazer e seus Muitos Saberes: Experimentos, Experiências e Experimentações* (São Paulo: Ed. Livraria da Física; Educ; FAPESP, 2006); and *O Laboratório, a Oficina e o Ateliê: A Arte de Fazer o Artificial* (São Paulo: Ed. Livraria da Física; Educ; FAPESP, 2002).

[2] On arts in the sixteenth and seventeenth centuries, see Pamela H. Smith, "Art, Science, and Visual Culture in Early Modern Europe," *Isis* 97 (2006), 83-100; and *The Body of the Artisan: Art and Experience in the Scientific Revolution* (Chicago: The University of Chicago Press, 2004), 1-55; Pamela Long, *Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge from Antiquity to Renaissance* (Baltimore: Johns Hopkins University Press, 2001); Paolo Rossi, *Philosophy, Technology and the Arts in the Early Modern Era* (London: Harper, 1970).

[3] Giambattista della Porta (1535-1615). On della Porta's life, see Pompeo Sarnelli, "Vita di Gio. Battista della Porta napolitano scritta da Pompeo Sarnelli," in *De ea naturalis physiognomoniae parte quae ad manuum lineas spectat libri duo [appendice Chirofisonomia a cura di Oreste Trabucco]* (Napoli: Edizione Scientifiche Italiane, 2003), 79-82; see also: Paolo Piccari, *La sapienza dei maghi: Giovan Battista Della Porta e la filosofia occulta* (Firenze: Propilei; Atánor, 1999), 4-10; Francesco Colangelo, *Racconto istorico di Gio: Battista della Porta filosofo napolitano com un'analisi delle sue opere stampate* (Napoli: Fratelli Chianese 1813), 2-19; and Louise G. Clubb, *Giambattista Della Porta dramatist* (Princeton: Princeton University Press, 1965), 3-56.

natural philosophers such as Francis Bacon (1561-1626), Isaac Newton (1643-1727), and René Descartes (1595-1650) were interested in the occult sciences.[4]

These natural philosophers' search for magic turned on the possibility of manipulating natural phenomena. In a recent study, I have shown that magicians at that time considered the possibility of producing *mirabilia*, the marvelous effects produced by nature, to reproduce them and to create even greater prodigies.[5] To achieve this, the magician had to master techniques that would allow him to arouse the hidden powers found in matter. With this done, the magician could operate on nature to produce miraculous effects that had once caused awe and wonder.[6]

Although these wondrous effects were rare and extraordinary, they were not considered miraculous by the magician (*magus*). In his *Magia naturalis,* della Porta observes that these effects were miraculous only in the etymological sense. In other words, they seemed to be miraculous because people did not know what caused them. This means that a magician resorted only to natural processes and no other artifice to manipulate nature.[7]

Della Porta emphasized that a *magus* was a zealous servant of nature.[8] A magician learned how to reproduce the natural processes by observing and simulating them without claiming supernatural intervention. As he states in his *Magia naturalis,*

> "(…) Wherefore, as many of you as come to behold Magick, must be perswaded that the works of Magick are nothing else but the works of Nature, whose dutiful hand-maid Magick is. For if she find any want in the affinity of Nature, that it is not strong enough, she doth supply such defects at convenient seasons, by the help of vapours, and by observing due

[4] See Paolo Rossi, *Francis Bacon: from magic to science* (Chicago: The University of Chicago Press, 1968); William R. Shea, *The Magic of Numbers and Motion: The Scientific Career of R. Descartes* (New York: Science History Publications, 1991); Charles Webster, *De Paracelso a Newton: la magia en la creación de la ciencia moderna* (México: Fondo de Cultura Económica, 1993).

[5] Fumikazu Saito, *O Telescópio na Magia Natural de Giambattista della Porta* (São Paulo: Ed. Livraria da Física; Educ; FAPESP, 2011). See also Lorraine. Daston, "The Nature of Nature in Early Modern Europe," *Configurations*, 6 (1998): 146-72; Lorraine Daston, & Katharine Park, *Wonders and the Order of Nature 1150-1750.* (New York: Zone Books, 2001).

[6] On magic, see Paolo Rossi, *Il tempo dei maghi: Rinascimento e modernità*. (Milano: Raffaello Cortina Editore 2006); William Eamon, *Science and the Secrets of Nature: Books of Secrets in Medieval and Early Modern Culture* (Princeton: Princeton University Press, 1996); Paola Zambeli, *L'ambigua natura della magia: filosofi, streghe, riti nel Rinascimento* (Milano: Il Saggiatore, 1991); Wayne Shumaker, *Natural Magic and Modern Science: Four Treatises 1590-1657* (Binghamton: Center for Medieval and Early Renaissance Studies, 1989); Brian Vickers, ed., *Occult and Scientific Mentalities in the Renaissance* (Cambridge: Cambridge University Press, 1986). On Della Porta's natural magic, see Luisa Muraro, *Giambattista Della Porta, mago e scienziato* (Milano: Feltrinelli, 1978); Nicola Badaloni, "I Fratelli Della Porta e la cultura magica e astrologica a Napoli nel '500," *Studi storici* 4 (1960): 677-715; and Laura Balbiani, *La* Magia Naturalis *di Giovan Battista Della Porta. Lingua, cultura e scienza in Europa all'inizio dell'età moderna* (Bern: Peter Lang, 2001).

[7] Giambattista della Porta, *Magiae naturalis libri XX in quibus scientiarum naturalium divitiae et deliciae demonstrantur* (Napoli: Horatium Salvianum, 1589), I, cap. 2 (henceforth to be denoted by *Magia naturalis*). For the 1658 English version, see *Natural Magick by John Baptista Porta a neapolitane in twenty books* (London: Printed for Thomas Young and Samuel Speed, 1658), I, 2 (henceforth denoted by *Natural Magick*).

[8] According to della Porta, *Magus ministra sedula est*; see Della Porta, *Magia naturalis*, Book I, chap. 2.

> measures and proportions; as in Husbandry, it is Nature that brings forth corn and herbs, but it is Art that prepares and makes way for them (…)."[9]

Della Porta imagined natural magic to be perfect knowledge, or complete science (*consummata scientia*), which implied a survey of the entire course of nature.[10] As he states,

> "We are perswaded that the knowledge of secret things depends upon the contemplation and view of the face of the whole world, namely, of the motion, state and fashion thereof, as also of the springing up, the growing and the decaying of things; for a diligent searcher of Nature Workes, as he seeth how Nature doth generate and corrupt things, so doth he also learn to do (…)."[11]

One could say that the difference between natural philosophy in the Aristotelian sense and natural magic is that the latter referred to a particular set of phenomena that could not be deduced from pre-established principles. Della Porta referred to a type of knowledge that did not arise from the systematic tracking of natural phenomena themselves, but from information derived through a meticulous investigation of singular phenomena that could be provoked in a particular way. This type of knowledge was acquired not only by observation, but also by the physical manipulation of nature. In fact, in the first book of *Magia naturalis*, chapter 3, della Porta states, "Quoniam ipsam Magiam activam; & naturalis Philosophiae portionem describimus…"[12] (i.e., "Seeing Magick, as seen before, it is a practical part of Natural Philosophy…")[13]. By this, della Porta refers to a body of knowledge acquired through meticulous inspection of nature that could provide the magician (*magus*) with skills and tools that would enable him to manipulate this nature from within. This practical knowledge involved not only diligent observation of the behavior of things in nature, but also a concrete sense of craftsmanship to devise stratagems.[14]

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[9] della Porta, *Natural Magick*, Book I, chap. 2.
[10] Saito, *Telescópio*, 25-40.
[11] della Porta, *Natural magick*, Book I, chap. 10.
[12] Ibid., Book I, chap. 2.
[13] Ibid.
[14] della Porta, *Magia naturalis*, Book I, chap. 1. On natural magic as practical science, see Józef A. Dobrowolski, "Giovambattista della Porta e la sua concezione della scienza utile in pratica," *Bolletino di Storia della Filosofia*, IX (1986-89): 37-48. By natural philosophy, della Porta meant science (*scientia*) in the Aristotelian sense, but he took a different approach. As he reported, "(…) Magick (…) is a practical part of Natural Philosophy, therefore it behoveth a Magician, and one that aspires to the dignity of that profession, to be an exact and a very perfect philosopher (…)", della Porta, *Magia naturalis*, Book I, chap. 3; *Natural magick*, Book I, chap. 3.

I can say that della Porta pursued the procedures in nature that inspired him to imitate them. Indeed, the purpose of all subjects covered by his *Magia naturalis* was to survey natural and artificial things to reproduce them. His work covers a broad spectrum of issues that include topics related to the art of distillation, perfumes, fireworks, cookery, fishing, and hunting.

As a practical part of natural philosophy, one could say that natural magic was a science that retained the meaning of both artifice and nature (*physis*). In fact, as I shall consider below, because the agent's source of motion in nature lies in natural things themselves, a magician had to learn from this the processes necessary to reproduce these movements. In contrast to the Aristotelian natural philosophy, natural magic copied nature in its ability to reproduce and perfect nature. In other words, each phenomenon described in *Magia naturalis* was singular and could be known by only an empirical bias of investigation. This is why all reports in *Magia naturalis* are reduced to the formula of "how to make" or "how to do". In this sense, one could say that natural magic is a type of art (*techne*) in the Aristotelian sense, because it requires the type of knowledge that depends on the ability of those who manipulate phenomena. This is why the concept of natural magic is usually closely associated in meaning with "skill".

However, one cannot see natural magic as an imperfect human imitation of nature, as implied in the Aristotelian notion of art (*techne*). It should be noted that although della Porta remarks that natural magic is the practical part of natural philosophy, this does not mean that it is a type of knowledge that is only fit for use. Indeed, natural magic did not rely on a whole set of knowledge available to users to perform intended actions; it involved heterogeneous bodies of learning that could be tacit or codified. A magician needed to have broad knowledge in natural philosophy to articulate its theoretical part and its practical counterpart. In fact, in *Magia naturalis*, della Porta asserted that a magician should have broad acquired knowledge not only by means of acknowledged tradition but also by observing and manipulating nature.[15]

According to della Porta, knowledge without practice is meaningless, and practice without knowledge is useless. In addition to being knowledgeable in philosophy, astrology, medicine, and mathematics, a *magus* "must be a skillful workman, both by natural gift, and also by the practice of his own hands"[16]. He referred to a magician as an *artifex* or a *mechanicus*, who needed to take into consideration the material as well as the way to manipulate nature using the necessary tools, which implied that a magician had to consider all the materials and know how to prepare and organize them.[17]

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[15] See della Porta, *Magia naturalis*, Book I, chap. 3; *Natural Magick*, Book I, chap. 3.

[16] della Porta, *Magia naturalis*, Book I, chap. 3; *Natural Magick*, Book I, chap. 3.

[17] At that time, both *artifex* and *mechanicus* were close in meaning to *ingenium*, which alluded to someone who had a natural talent. *Ingenium* (and the Italian *ingegno*) means talent, the natural gift of a person, and is opposed to what may be learned from art and experience. See David Summers, *The Judgment of Sense: Renaissance Naturalism and the Rise of Aesthetics*. (Cambridge: Cambridge University Press, 1990), 99.

A magician was someone who had dexterity in manipulating nature using the necessary tools. It was by watching and imitating natural metamorphoses that the magician acquired the knowledge and practice of his art. This, in turn, involved a constant trial and retrial that could lead to a deep knowledge of nature. Nevertheless, this does not mean that della Porta was an experimenter in the modern sense. These trials and retrials to which della Porta refers in his *Magia naturalis* and his other works were not controlled tests of hypotheses, as in its modern connotation. Rather, della Porta referred to *experimentum* or *experientia* in the sense of *experta*, which was close in meaning to the idea of expertise. In other words, a *magus* was an *expertus* or someone who had expertise in a particular subject. He had not only hands-on experience, but also the ability to manipulate nature in all of its aspects.

Physical manipulation was required because nature could not reveal all of its aspects or all of its potentiality without being overcome by trial and retrial. In this sense, the production of wonders was an important task that a magician needed to embrace to master nature, as it is discussed below.

The natural metamorphosis and the production of wonders

Della Porta adopted empirical standards that were radically different from ours. His *Magia naturalis* is concerned with the rare and singular phenomena that did not occur in the ordinary course of nature in an Aristotelian fashion. These were wonders (*mirabilia*) of nature, but they were not unnatural despite belonging to that nebulous domain of the marvelous. Indeed, della Porta referred to phenomena that were extraordinary but not miraculous in his *Magia naturalis*. The wonders produced by magicians did not exceed the limits of nature.

Della Porta's deep interest in this set of phenomena was twofold. On the one hand, his purpose was to pursue knowledge of how nature produced such wonders to manipulate it from within and to produce greater wonders. On the other hand, these wondrous effects provided him with access to the most hidden secrets of nature.

These types of phenomena were singular in the sense that they were a manifestation of particular occurrences for which one could not understand the causes. Because this set of phenomena was not miraculous but rather was marvelous, it was identified with *admiratio*, or wonder. Thus, one could have two attitudes toward this: disinterested delight or the interested wish to grasp the working process of nature to use it in a profitable way or to obtain a deeper understanding of natural operations.

In this sense, natural magic disrupts the deductive process of *scientia* in the Aristotelian fashion and multiplies the number of phenomena that have been explained, which implies a reorganization of knowledge to include all types of natural and artificial phenomena. Della Porta held that nature could not be easily grasped because it is in constant flux. As della Porta saw it, nature is in a progressive process of coming into being and revealing itself in the phenomena of growth and realization. The characteristics of growth always originate from something else that has already

been formed and tends toward a new form or shape. For example, in Book II of his *Magia naturalis*, where della Porta addresses the generation of animals, he reports,

> *"Serpents may be generated of mans marrow, of the hairs of a menstruous woman, and of a horse-tail, or mane* (…). We have experienced also, that the hairs of the horses mane laid in the waters, will become serpents: and our friend tried the same. No man denies but that serpents are easily gendred of mans flesh, especially of his marrow (…)."[18]

One could say that, in accordance with Aristotelian natural philosophy, della Porta admits that the entire coming-into-being and directing activity of nature occur through its own agency in such a way that the source of the movement that is the coming-into-being lies in the thing itself that comes to be. The whole self-movement of nature is not simply effected (in the sense of being caused) but is ordered in a purposeful manner. Nevertheless, della Porta gives a different account of that movement. According to him, nature enjoys the movement of changing and disguising, because it likes metamorphosing itself into various and astonishing forms and playing (*ludere*) with those who want to hold its secrets.[19]

Della Porta introduces us to the playful element as a resource that conciliates practical operation and theoretical speculation. The ludic incursions in his work seem to be related to his purpose of informing readers about natural metamorphosis and its inevitable coming-into-being, which should be understood by the magician.

In fact, in his *Magia naturalis*, della Porta refers to a double aspect of nature: at the same time that it makes itself visible to the human eye, it conceals itself under the veil of appearances. This means that nature does not reveal its secrets easily.[20] In other words, nature plays (*ludere*) with whoever wants to understand its secrets and deceives (*ludere*) those who disregard the hidden causes. Taking into account this latter fact, *Magia naturalis* seems to create an aura of exoticism and excitement with a pleasant connotation similar to that of comedy.[21]

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[18]della Porta, *Natural magick,* II, 2.

[19] Saito, *Telescópio*, 40-50. Natural playfulness played a central role in della Porta's natural magic. As Paula Findlen remarks, in the sixteenth century, various approaches to nature celebrated the ludic in their own peculiar ways, See P. Findlen, "Between Carnival and Lent: The Scientific Revolution at the Margins of Culture," *Configurations* 6 (1998): 243-67.

[20] The idea that nature did not reveal its secrets easily was not new. See Pierre Hadot, *Le voile d'Isis: Essai sur l'histoire de l'ideé de nature* (Paris: Gallimard, 2004). See also Gabriella Belloni, "Conoscenza mágica e ricerca scientifica in Giovan Battista Della Porta," in *Criptologia*, G. della Porta (Roma: Centro Internazionale di Studi Umanistici, 1982), 45-101, on 57.

[21] Della Porta published comedies; see Clubb, 88-249. Further, one should note that della Porta was associated with nobility, and he was educated to attend the Neapolitan court; see Piccari, 4, and Clubb, 3-4. Della Porta enhanced his reputation as a *magus,* which fostered his relationship with princes; see Eamon, 227.

The readers of the work were most likely astonished because it stimulated the imagination. The revelation of the invisible power that is the cause of those exceptional phenomena of magic had two purposes: on the one hand, it enabled a magician to create effects that could cause delight and wonder; on the other hand, it supplied him with useful knowledge by which he could quicken some long and laborious processes of nature.

For a simple reader, the phenomena described in *Magia naturalis* offered only fun (*ludus*). However, for a magician, these phenomena had to be taken as challenges that offered the prize of knowledge obtained by applying the instructions given in the book, which were not always explicit. In this latter sense, one can say that the results acquired by applying such instructions were seen by magicians as prizes reserved only for those who could put the acquired knowledge into practice. By providing a mix of fun and knowledge, natural magic demonstrated playfulness as the reconciliation of manipulations, operations, practices and theoretical speculations.

As mentioned, the self-movement of nature is ordered in a purposeful manner. Every natural thing exhibits specific growth and achieves its own particular final form. This suggests that nature does not make mistakes and is not easily deceived. At della Porta's time, the idea of a stable nature intertwined with the idea of a coming-into-being nature because nature was a magician (*maga*) itself whose first rule (*lex*) was the power (*vis*) of love,[22] which meant that nature was alive. As G. Belloni (1982) emphasizes, the purpose of natural magic was not to understand the "rule of necessity", but to inquire about the production of exceptional phenomena and to reveal the wonders of nature. Because the entire world under regular circumstances was a manifestation of a chain of causes and effects, nature could be understood as an agent that was predictable within certain limits.

In this sense, nature was an open book for those who had the will, patience and ability to read it. To della Porta, this book was written in an encrypted language. The world was a vast system of signs perfectly arranged in various orders of nature.[23] Consequently, a magician had to know how to decipher these signs by discovery. To achieve this, the magician had to find the key by which he could decode these signs. As

[22] On the idea that nature is a magician itself, see della Porta, *Magia naturalis*, Book I, chap. 2; *Natural magick*, Book I, chap. 2.

[23] It should be noted that the doctrine of *signatura* was the cornerstone of della Porta's natural magic. He dedicated some works to this subject; see G. della Porta, *Della fisionomia dell'huomo del signor Giovan Battista della Porta Napolitano Libri Sei. Tradotti dal Latino e dallo stesso Authore accresciuti di Figure, e di passi necessarij à diverse parti dell'Opera. Aggiontavi la Fisionomia naturale di Monsignor Giovanni Ingegnieri, Polemone, e la Celeste dello stesso Porta... et aggiontovi il Discorso di Livio Agrippa sopra la natura, e complessione humana. Et il Discorso de'Nei di Lodovico Settali Gentilhuomo Milanese* (Venetia: Christoforo Tomasini, 1644); *Phytognomonica. Io. Baptistae Portae Neap. Octo Libris contenta. In quibus nova, facillimaque assertur methodus, qua plantarum, animalium, metallorum, rerum denique; omnium ex prima extimae faciei inspectione quivis agditas vires assequatur* (Napoli: Horatium Salvianum, 1588). On Paracelsus' influence on della Porta's natural magic, see Massimo L. Bianchi, *Signatura rerum: segni, magia e conoscenza da Paracelso a Leibniz* (Roma: Edizioni dell'Ateneo, 1987), 90-1.

we will see below, a magician had to survey all the "passions" of nature to determine the affinities between natural things.

A magician had to learn the processes of nature from nature to reproduce those movements. In contrast to Aristotelian natural philosophy, natural magic was believed to copy nature in being, which suggests that a magician imitated nature to perfect what nature is unable to achieve alone. It was precisely by watching and imitating natural metamorphosis that the magician acquired knowledge and practice of his art. By imitating natural processes, a magician could hold nature's secrets to produce even greater wonders.

However, this was not enough; nature could reveal its secrets only by negotiation with the magician. In other words, a magician needed to court nature and place it in a constrained situation using his abilities and knowledge. This meant that in addition to the magician's fundamental diligent observation and inspection of the behavior of whole things in nature, an intervention in the ordinary course of nature was required. As we shall see, a magician had to simulate (and even emulate) nature to seize it and operate upon it without exceeding its limits. To achieve this, a *magus* had to devise various devices and apparatuses. These devices were designed "according to nature" in such a way that, by using them, he could take nature out of its ordinary course to constrain and lure it.

The role of apparatuses in natural magic

Della Porta established a parallel between the natural process of transformation and the skill of the magician who seeks to imitate and improve it in an attempt to shape and recreate it in the "laboratory". In this sense, the order of subjects in his *Magia naturalis* is suggestive. With the exception of book one, in which della Porta considers the principles that should guide and inspire the magician's theoretical and practical activities, the following books address practical issues (Table 1):

Table 1. The twenty books of *Magia naturalis*

De mirabilium rerum causis – Of the Causes of Wonderful things
De varijs animalibus gignendis – Of the Generation of Animals
De novis plantis producendis – Of the Production of New Plants
De augenda supellectili – Of increasing Houshold Stuff
De metallorum transmutatione – Of changing Metals
De gemmarum adulterijs – Of counterfeiting Gold
De miraculis magnetis – Of the Wonders of the Load-stone
De portentosis medelis – Of strange Cures
De mulierum comesticis – Of Beautifying Women
De extrahendijs rerum essentijs – Of Distillation
De myropoeia – Of Perfuming
De incendiarijs ignibus – Of Artificial Fires
De raris ferris temperaturis – Of Tempering Steel
De miro conviviorum apparatus – Of Cookery
De capiendis manu feris – Of Fishing, Fowling, Hunting, &c.
De invisibilibus literarum notis – Of Invisible Writing
De catoptricis imaginibus – Of Strange Glasses
De staticis experimentis – Of Statick Experiments
De pneumaticis – Pneumatick Experiments
Chaos – Of the Chaos

The first five books correspond to the three realms of nature (mineral, vegetal and animal) and is followed by subjects that address processes that should help men obtain larger and tastier fruits, more malleable metals, and so on[24]. Furthermore, in his *Magia naturalis,* Della Porta distinguishes between "Natural and Mathematical Sciences", saying,

> "(…) I shall begin with the Natural; for I hold that most convenient, that all may arise from those things that are simple, and not so laborious, to Mathematical Sciences. I shall from Animals first proceed to Plants, and so by steps to Minerals, and other works of Nature (…)."[25]

The expression "works of nature" means that della Porta pursued nature to learn from its procedures, which he would eventually be able to imitate. To achieve this, della Porta presented a small set of devices. Most of them were endowed by tradition, some were developed by his contemporaries, and others were designed by him. These devices and apparatuses were designed to produce certain effects. Moreover, they were designed on an empirical basis not only to promote the

[24] della Porta, *Natural magick,* Books II-IX.
[25] Ibid., Book II, "Proemio".

understanding of nature but also to make visible those powers (*vis*) that were developed within nature. Della Porta believed that a magician could set apart those powers once the process was known. Then, these powers could be used artificially in the "laboratory" to uncover other occult aspects of nature or to use them for practical purposes.

It should be noted that some aspects of nature could not be grasped only by observation. Devices then were required to make nature reveal these powers. For example, a compass is an instrument that displays the direction of the terrestrial magnetic field. However, such an instrument also shows us that this very magnetic field exists. Other examples can be found in the books that address pneumatics and hydrostatics. Like the compass, a water clock was a device that manifested nature's abhorrence of a vacuum. It should be noted that most natural philosophers at that time agreed that nature abhorred a vacuum (*horror vacui*). Most of them understood that a vacuum was nothing (i.e., a non-being) and consequently that it would be contradictory to say, "nature admits nothing".[26] To della Porta, *horror vacui* was not a simple abstract principle but a type of *vis* that preserved nature (and, consequently, the entire universe) in its wholeness and fullness. In other words, because the world was as alive as an animal, it was provided with a type of "self-preservation principle", just like a human body whose parts are assembled harmonically. According to della Porta, the structure of a whole world was ensured by a power (*vis*) of regeneration that was manifested by *anima mundi*, the soul of the world.[27] In this sense, *horror vacui* was more than a principle that explained the impossibility of a void in nature; it was a power that kept the whole world in harmony. Indeed, experiments presented by della Porta in books eighteen and nineteen, which address pneumatics and hydrostatics, are not supposed to experimentally demonstrate that nature abhors a vacuum. Instead, they are presented to show how *horror vacui* could be used for practical and profitable purposes to, for example, pump water to high altitudes, build water clocks and make weapons and guns that eliminated the use of fire to shoot.[28]

These devices follow a certain process of nature. A distiller and chemistry apparatuses (*Chymisticis organis*) are good examples of this concept.[29] To della Porta, distillation was a process learned by the magician from nature itself. By observing the process of rarefaction and condensation in nature, the magician was able to improve the art of distillation. Nevertheless, distillation was not only a procedure to reveal

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[26] On the abhorrence of a vacuum, see Fumikazu Saito, "Alguns Aspectos da Idéia de Experiência de Blaise Pascal (1623-1662)," in *O Saber Fazer e seus Muitos Saberes: Experimentos, Experiências e Experimentações*, ed. Ana M. Alfonso-Goldfarb, & Maria H.R. Beltran (São Paulo: Livraria da Física; Educ; FAPESP, 2006), 119-43; Edward Grant, *Much Ado about Nothing: Theories of Space and Vacuum from the Middle Ages to the Scientific Revolution* (New York: Cambridge University Press, 1981), 67-100.

[27] This was based on the Neoplatonic idea of the hierarchical ordering of reality. See della Porta, *Magia naturalis*, Book I; *Natural magick*, Book I, and Saito, *Telescópio*, 51.

[28] della Porta, *Magia naturalis*, Book XIX.

[29] Ibid., Book X, "Proemium".

those processes but also an art that allowed a magician to extract the virtues of plants and herbs. Thus, a device had two roles in natural magic: it followed nature and reproduced phenomena, and it could be used as a tool to manipulate nature to make it reveal new phenomena. In this sense, an apparatus used by a magician was not invented by the human mind because it had its source in nature itself and the lessons taught by nature.

This subject was further developed in his treatise on distillation, *De distillatione*, published in 1608. In this work, della Porta remarks, "Nature produced things and provided them with faculties" and art could "ennoble them and provide them with many qualities". In this sense, the art of distillation taught a magician how to extract "dewy vapors, spirits, lumpy, sticky or viscous humors and that very essence which is hidden in the depths and intimate parts of things".[30] In other words, the virtues of plants, herbs and minerals could be revealed to a magician by means of distillation.

Della Porta's work on distillation was not notably different from other traditional books. In the tenth book of *Magia naturalis*, he addressed several types of apparatuses and processes that a *magus* needed to use to extract the virtues of various plants and herbs. Moreover, he explained why various devices had to be used for various materials that could be distilled. In this regard, della Porta ingeniously imagined and built various types of arrangements for each required situation.

He observed that the distillatory equipment had to be prepared according to the nature of the things to be distilled. If a magician wished to distill vaporous or flatulent things, he had to use wide and low vessels and collect the distilled matter in a receiver with a large capacity. In contrast, if he wished to distill warmer and lighter things, he had to use vases with slender and long necks.

According to della Porta, the reason for using various types of vessels and receivers was suggested by nature:

> "(...) All which the industrious Artificer may easily learn by the imitation of Nature who hath given angry and furious Creatures, as the Lion and Bear, thick bodies, but short necks; to shew, that flatulent humours would pass out of Vessels of a larger bulk; and the thicker part settle to the bottom: but then, the Stag, the Estrich, the Camil-Panther, gentle Creatures, and of thin Spirits, have slender bodies and long necks; to shew that thin, subtile Spirits, must be drawn through a much longer and narrower passage, and be elevated higher to purifie them (…)."[31]

This idea is developed in more detail by della Porta in his treatise titled *De distillatione*. In the first book, after discussing distillation in general and presenting

[30] Ibid., Book I, chap. 3.

[31] Ibid., Book X, chap. 1. It should be noted that this idea was better developed in della Porta, *De distillatione libri IX* (Roma: Ex Typographia Ver. Camerae Apostólica, 1608), Book I, chap. 19.

various types of furnaces used in this art, della Porta discusses various types of vessels that can be used according to the material to be distilled. According to della Porta, by observing the behavior and other aspects of various animals, a magician could learn how to make various types of material rise in the vase. For example, earthy and dried things, whose parts are minimally vaporous or flatulent, require larger and lower vessels for their distillation. The animal that corresponds to these vessels is the tortoise (*testudo*) because it is an earthy animal and has a dry and hard hull that corresponds to the covered part of the land. Additionally, a tortoise has a wide body that is always bent and tilted.[32] Thus, these types of materials must be taught how to rise. This large and low vessel filled with the material to be distilled must be placed into the furnace and tilted vertically gradually from time to time. If this is done diligently, the material in the vessel learns to rise, and the distilled part can be collected in a receiver. In contrast, materials whose parts are moist, thick and less airy must be distilled in a vessel that imitates a bear, which is "fat, sticky, stupid and crude"[33]. In other words, this type of material requires a vase with a short neck and large belly like a bear, which has a large body that is short, chubby and without a neck (see Figure 1).

Fig. 1 Vessels for the distillation of various materials[34]

As one can see, these chemistry apparatuses (*Chymisticis organis*) represented lessons taught by nature that could not be reduced to simple tools. In other words, in contrast to modern instruments that are used as simple tools in a laboratory, magical

[32] della Porta, *De distillatione*, Book I.
[33] Ibid.
[34] della Porta *De distillatione*, Book I.

devices were processes that were used to make nature reveal its secrets. By specific processes, someone could prepare *Waters*, *Oils*, *Quintessence Magistery*, *Tincture* and *Elixir* and could split the four *elements* from various materials.

One can say that each of these preparations required not only knowledge of several types of materials found in the three kingdoms of nature but also the ability and skill to manipulate and prepare them to acknowledge them in their transmutation in the distillation process. For instance, to describe how to prepare *aqua vitae*, della Porta reported the elevation of water and the condensation of the spirits and the phlegm in great detail by taking into account the conditions of cucurbit heat and the cold in the head of alembic.[35] The process of obtaining these "waters" was complex because it involved digestion, successive distillation and circulation. This involved complex laboratorial procedures that required a continuous flow of material in the vessels until all impurities were eliminated to obtain a thin and subtle essence.

These devices and apparatuses, such as various lenses and mirrors (and their sundry arrangements), sophisticated distillers with many types of vases, and diverse types of furnaces and water clocks, were used by della Porta to deceive nature. By using these devices, he could divert nature from its ordinary course to constrain and lure it. In this respect, it should be noted that della Porta embraced the view that nature and art had the same ontological status. He emphasized that art was immanent in nature and posited an analogy between art and nature without opposing them because he understood that the operations found in nature were mysteries gradually introduced to the magician. When he manipulated nature and intervened in its ordinary course, he was not attempting to control nature to secure power over it but was looking for means that could enable him to "operate from within"[36].

Magical devices were more than simple tools used to examine nature. They were part of nature and enabled a magician to penetrate it from within. Thus, the magician designed apparatuses to serve two purposes: to illustrate a process that was intrinsic in nature and to create useful tools by which he could go into nature and grasp its most occult secrets. This meant that a device had two roles in natural magic: it followed nature and reproduced phenomena, and it could be used as a tool to manipulate nature to make it reveal new phenomena.[37]

In this sense, three words played central roles in della Porta's natural magic: "devising," "improving" and "knowing". These terms roughly referred to three important steps toward understanding nature. The first step involved imitating the natural process. A magician needed to devise stratagems to imitate the working process of nature. However, to achieve this aim, a magician had to know how to

[35] della Porta, *Magia naturalis,* Book X.

[36] Ibid., Book I, chap. 2.

[37] Fumikazu Saito, "Revelando Processos Naturais por meio de Instrumentos e Outros Aparatos Científicos," in *História da Ciência: Tópicos Atuais 3*, org. M. H. R. Beltran, F. Saito, & L. S. P. Trindade (São Paulo: Livraria da Física; CAPES; OBEDUC, 2014), 95-115.

prepare and organize various materials. The imitation of nature involved not only observing and representing it, but also understanding the properties of materials to manipulate them. The second step was related to the first one but differed from it slightly. After acquiring knowledge of how to imitate nature, a magician needed to consider how to improve these processes to produce greater wonders. This assured the magician that nature could be controlled and enabled him to manipulate it to produce various tangible effects. The third step was related to the two other steps and required a deep understanding of natural philosophy. In addition to knowledge that enabled a magician to imitate nature, he needed to operate nature from within and lure it. To achieve this, a magician needed to consider his understanding of nature along with natural philosophy, which could shed light on the meaning of these phenomena. Furthermore, after learning how to devise various wonders from nature, a magician had to build various types of instruments and apparatuses by which he could constrain nature and grasp its most hidden secrets.

Distilling

Again, the distillation exemplifies the process described above very well. By this art, a magician could extract four virtues for each thing in nature: *Quintessence*, *Magistery*, *Tincture* and *Elixir*. However, della Porta also referred to a fifth virtue that could be obtained by this process, which he called *clissus*. This substance was a mixture of all the subtle parts of a plant and was very useful for medicine .[38]

The procedure for *clissus* preparation involves the three steps mentioned above, namely, "devising," "improving" and "knowing". This procedure consisted of extracting all the essences or subtle parts from a single plant, which were then distilled again:

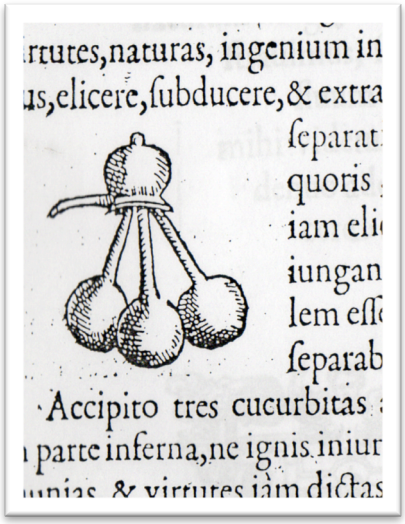
> "(…) There are in a Plant, the root, leaf, flower, fruit and seed, and in every one of these parts, there is a peculiar nature. The operation is thus: Dig the roots when they are full of juice, the leaves when they are fresh and green, the flowers when they are blown, the fruit and seeds in their due time. Extract the spirits or essences out of all these by Distillation, Maceration or Calcination, or any other of the former wayes. But when they are all extracted severally, one in the form of oyl, another of Salt or Liquor; then mix them all together, so that they may be conjoined and united in one body, which is called a Clissus".[39]

In other words, oils, salts and liquors obtained in this way were placed in three distinct vessels, which had long necks and were united in a single head. These recipients were sealed and placed on a fire. The heat in each recipient raised the

[38] della Porta, *Magia naturalis*, Book X, chap. 18.
[39] della Porta, *Natural magick*, Book X, chap. 18.

subtlest essences, which were mixed in the head. There, the *clissus* mixture was condensed and trickled through the nose of the still and then collected in a vessel (Figure 2).

Fig. 2 Obtaining *clissus*[40]



The equipment used to prepare *clissus* indicates a step beyond the imitation of nature: a magician imitated nature to perfect what nature could not achieve alone. However, the process indicates another important aspect of magical devices. Once the magician grasped and learned these processes from nature, he could control nature from within. Another good example of this can be found in the use of optical devices with these *Chymisticis organis*.

When della Porta deals addressed optical apparatuses,[41] he sought to investigate the properties of light and heat by means of sundry lenses and mirrors. For each specific situation, as in the case of distillation, della Porta used various combinations of lenses and mirrors to pursue the nature of light, vision and heat and to manipulate them to produce wonders and to quicken some natural processes.

The magician needed to be aware of optics, because optics gives sense to some prodigies that appeared to deceive vision. Della Porta emphasized this by declaring,

> "(...) he must be skilful in the Opticks, that he may know how the sight may be deceived, and how the likeness of a vision that is seen in the water, may be seen hanging without in the air, by the help of certain Glasses of divers fashions; and how to make one see that plainly which is

[40] Della Porta, *De distillatione*, Book X, chap. 18.

[41] On optics, see Ibid., Book XVII; and della Porta, *De refractione optices parte libri novem* (Napoli: Io. Iacobum Carlinum & Antonio Pacem, 1593).

> great way off, and how throw fire very far from us: upon which sleights, the greatest part of the secrecies of Magick doth depend."[42]

To della Porta, optics was the most privileged field in natural magic because its apparatuses yielded effects that deceived visual perception when they were placed in a certain way. By researching reflection and refraction della Porta used various types of mirrors (plane, caved, and convex), lenses (concave and convex), and their combinations to produce wonders.

As he had done previously with distillation, the optic devices enlarged the possibility of investigation by producing various effects. However, a magician needed to have an acute knowledge of optic theory (i.e., reflection and refraction) to produce the desired effects. For example, della Porta observes that before operating with caved spherical mirrors, a magician must know their point of inversion. To find it, he suggests,

> "Do thus: Hold your Glass against the Sun, and you see the beams unite, know that to be the point of Inversion. If you cannot well perceive that, breathe a thick vapour from your mouth upon it, and you shall apparently see where the coincidence is of the reflected beams; or under it a vessel of boyling water (…)."[43]

Della Porta does not explain why the point of inversion is the same as the point of combustion in his *Magia naturalis*. He supposes that a magician must know the reason and the cause for that, and he reports only that this subject is described in more detail in his optics treatise, *De refractione optices parte libri novem*, which was published in 1593. In this work, he explains how the various types of lenses and mirrors work. In his optics treatise, he demonstrates that caved spherical and parabolic mirrors reverse the images of the objects reflected in them. According to della Porta, objects that are located at a certain point in front of those mirrors appear upside down. Coincidently, this point of inversion is the same place where fire can be kindled, suggesting important implications for optics, as I have shown elsewhere.

It should be noted that della Porta locates this point in the center of the curvature of caved spherical mirrors in his *Magia naturalis*.[44] However, in *De refractione* and in the *De telescopio* (*c.* 1612), he demonstrates that this point is in the fourth part of

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[42] della Porta, *Natural magick,* Book I, chap. 3.

[43] Ibid., Book XVII, chap. 4.

[44] It had been common since antiquity to think that the focal point was the center of the curvature of spherical mirrors; see Sven Dupré, "Mathematical Instruments and the 'Theory of the concave spherical mirror': Galileo's Optics beyond Art and Science," *Bulletin or the Scientific Instrument Society*, 49 (June, 2001): 551-88, 575-6.

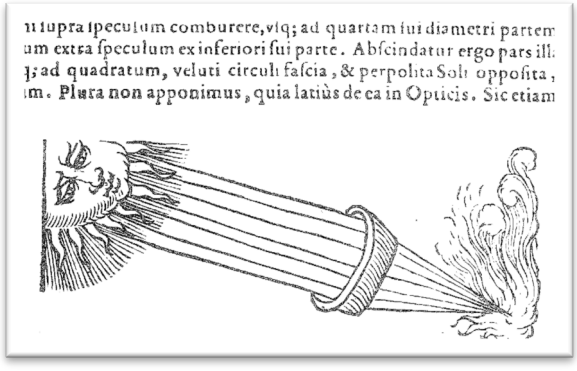
the diameter of the caved spherical mirrors.[45] Wherever this point is, the real issue in this passage is that once the point of inversion and the reason for the image reversion are known, the magician can produce many wonders, such as "*To kindle fire with a Concave-Glass*":

> "This Glass is excellent above others, for this, that it unites the beams so strongly, that it will shew forth a light Pyramis of its beams as you hold it to the Sun; and if you put any combustible matter in the centre of it, it will presently kindle and flame, that with a little stay will melt Lead (*plumbum*) or Tin (*stannum*), and will make Gold or Iron red hot; and I have heard by some, that Gold and Silver have been melted by it; more slowly in winter, but sooner in summer, because the medium is hotter; at noon rather than in the morning, or evening for the same reason."[46]

Della Porta does not hesitate to enlarge the effect. He provides instructions for how to settle some elements to create a wondrous effect, such as, "*At any hour of the day with a Concave-Glass, to set a House or Fort on fire*":

> "You may so burn the enemies Ships, Gates, Bridges, and the like, without danger or suspicion, at a set hour of the day, appointed the day before. Set you Glass against the Sun, and order it so, that the coincidence of the beams may fall upon the point: lay fuel there, and things that will take fire, as I shewed you: and if you would blow up Towers, make heaps of Gun-powder: at night set your Glass, and hide it, that it be not seen, for the next day the Sun will fall upon the same point where you set fuel for the fire." [47]

Fig. 3 Burning glasses[48]



[45] See G. della Porta, *De telescopio* (Firenze: Leo S. Olschki, 1967). It should be noted that this manuscript was never published. The original document is deposited in the Accademia Nazionale dei Lincei in Rome. On this subject, see Saito, *Telescópio*.

[46] della Porta, *Natural magick*, Book XVII, chap. 4.

[47] Ibid., Book XVII, chap. 4.

[48] della Porta, *Magia naturalis*, Book XVII, chap. 14.

It should be noted that the placement of the concave mirror and the fuel is simple in theory, but not easy to accomplish (Figure 3). Indeed, della Porta believes that this is possible because once the magician knows how light, heat and other properties related to them work, he can operate with them. Thus, a magician needed to endeavor to make tasks feasible and never consider any task impossible. The production of these types of effects was a possibility that the magician should never discard. Furthermore, optical devices were useful for manipulating and controlling heat and light.

Like the compass, which attested to the existence of magnetic fields, convex lenses and concave spherical mirrors made evident the burning property of light. However, unlike the compass, which only displays the direction of the magnetic field, light could be manipulated and disciplined conveniently using mirrors and lenses for military purposes or for the delight of man.

In this respect, the combination of a distiller with a caved spherical or parabolic mirror is an interesting case. The purpose of this combination was to quicken the process of distillation or to supply more heat to the distiller.[49]

In Book X, chapter 4 of his *Magia naturalis* and in Book I, chapter 16 of his *De distillatione*, Della Porta introduces us to an apparatus of distillation. He explains that this is the best way to obtain "waters" that are employed to make medicines to heal eye diseases: "The heat of the fire changeth the Nature of thing, and very useful for many Medicines. Wherefore in all Medicines for eyes, we must use Waters extracted from the Sun: for others do fret and corrode the eye, these are more gentle and soft (…)"[50]

Furthermore, he observes that this process is recommended because "(…) the work is done without wood, or coals, or labour. It is but filling the Vessels with the Ingredients, and setting them in the Sun, and all the pains is past"[51]. Della Porta describes this device in this manner:

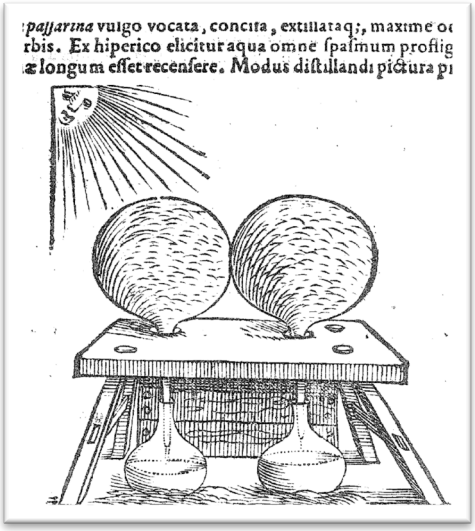
> "(…) Prepare a Form of three foot in height, two in breadth, and of a length proportionable to the number of the Vessels you intend to set to Work: if many, make it longer, if a few, let it be shorter. Board up that side of the Form next the Sun, left the heat do warm the Receivers, and make the Water ascend again. In the middle of the upper plank of the Form, make several holes for the necks of the Glasses to pass down through."[52]

He says that the gathered herbs must be placed inside the vessels. He recommends that these herbs be picked before sunrise and cleansed of dust or any type

[49] della Porta, *De distillatione*, Book I, chap. 16.
[50] della Porta, *Natural magick*, Book X, chap. 4.
[51] della Porta, *Magia naturalis*, Book X, chap. 4.
[52] della Porta, *Natural magick*, Book X, chap. 4. It should be noted that similar apparatuses called *destilatio per solem* can be found in previous texts. For example, see Phillipp Ulsted, *Coelum philosophorum seu De secretis naturae líber* (Argentorati: J. Grüninger, 15[29]), XVIII, xxvi-xxvii.

of impurity. Once this is done, he instructs that they be placed into the vessels, and care should be taken to place some curled sitar strings at the opening of each pot to prevent the herbs from falling when the vessels are overturned. Thereafter, the necks of the vessels should be inserted in the holes of the board (Figure 4). Then, della Porta says to set the apparatus in the sun when it "hath passed Gemini, (for this must be performed in the heat of the Summer only)(…)"[53].

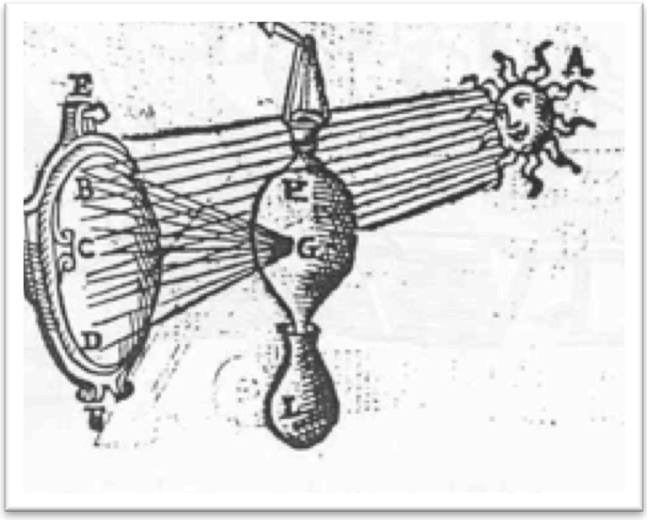
Fig. 4 Apparatus used to distil with the heat of the sun[54]



The same device description can be found in della Porta's treatise of distillation. In his *De distillatione*, he observes, "(…) in cold places, where Sun does not heat well, this process must be performed otherwise. In other words, by using mirror reflection (…)"[55]. He then suggests coupling a caved spherical or parabolic mirror between the vessels to supply enough heat to them: "(…) in fact, the caved spherical mirror, or even better the caved parabolic mirror, once placed in front of the Sun, drives the reflected sun beams to the bottles (*ampullae*); because the bottle with what must be distilled is in the middle between Sun and the mirror (…)".[56]

[53] della Porta, *Natural magick*, Book X, chap. 4. See also della Porta, *De distillatione*, Book I, chap. 16.
[54] della Porta, *Magia naturalis*, Book X, chap. 4.
[55] della Porta, *De distillatione*, I, 16.
[56] Ibid.

Fig. 5 Apparatus described by della Porta in his *De distillatione*[57]



Once it was known that it was possible to kindle fire using concave mirrors, della Porta believed that it was possible to supply enough heat to the distiller when it was placed in the point of combustion (Figure 5). This arrangement illustrates the idea of controlling and manipulating natural powers (*vires*) in useful ways in natural magic.

This arrangement illustrates two additional points. The first is that a magician can manipulate matter, light and heat using various types of apparatuses. This was possible because these apparatuses incorporate nature itself in the sense that they reproduce a natural process. The second is that a wise magician should know how to use this knowledge and design new devices to uncover the properties and qualities of all things in nature.

Final remarks and conclusion

Della Porta designed devices and apparatuses by considering the effects they could produce. His purpose was to multiply and create larger and more wondrous effects. However, these devices were more than simple tools used to examine nature; they were part of nature and enabled a magician to penetrate nature from within. The magician designed apparatuses to serve two purposes: to illustrate a process that was intrinsic in nature and to create useful tools by which he could enter nature and grasp its most occult secrets.

The two cases related to distillation considered in this work show that natural magic was more than an experimental or technical program. The idea of distilling the three newly extracted "spirits" (oil, salt and liquor) separately to obtain *clissus* requires

[57] Della Porta, *De distillatione*, I, 16.

a deep knowledge of matter, especially of the materia medica. As mentioned, the knowledge of these materials and their preparation required a theoretical ground. Therefore, we cannot establish a neat division between knowing and doing in natural magic. These two spheres of knowledge were interchangeable in many ways. Natural magic was not limited to skills and know-how or to intellectual or manual activity. Practical and theoretical knowledge must both be considered parts of natural philosophy.

In contrast to Aristotelian natural philosophy, natural magic proposed investigating nature horizontally instead of vertically. Knowledge in magic was expanded to the extent that new phenomena were assimilated and the technical difficulties of controlling them were overcome. Finally, singular phenomena were connected to the general principles of natural philosophy by ties that arose from the intersection between the production of wonders and the methods used to improve those phenomena.