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How to discover things with words? John Wilkins: from *inventio* to invention

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Wilkins and his protégés.
George Vertue's engraving of Wadham College in *The Oxford Almanack* (1738).

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Introduction

From *inventio* to invention

Bertolt Brecht in *The Life of Galileo* related the rise of the early-modern passion for discoveries to marine voyages that extended explorations of the natural world. Brecht's Galileo declares that previously the human mind had been too much impressed with the immovability of heavens, and thus encapsulated itself within the heavenly spheres.[1] The mind-opening experience of sailing the oceans promoted scientific curiosity, and the ships were the means for transforming scientific practices, operating as material-discursive objects or metaphors-in-action.[2]

The history of early-modern experimental philosophy is often viewed as a study of the steps leading to those achievements that have remained accepted as facts within the body of science until the present day. Understandably, historians show due interest in how the most recent accomplishments were attained in the evolution of the exact sciences. However, without undermining the progressive narrative, the intellectual history of science can also be viewed as a study of those developments that did not immediately lead to widely accepted insights yet contributed to the development of scientific methods. In other words, the history of science may focus not only on the *what* but also the *how* of scientific progress. Even though many early scientific achievements have sunk into oblivion, the patterns of attaining them may have survived in the integrated and sustainable practices of science.[3]

A variety of versions and hypotheses may be proposed to explain the context in which dominant scientific notions emerge, and these are discussed and evaluated in the space of discourse. In a general sense, the term "discourse" usually refers to

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1 Bertolt Brecht, *Leben des Galilei* (Berlin und Weimar: Aufbau-Verlag, 1964), pp. 15-17.

2 James J. Bono, "Making Knowledge: History, Literature, and the Poetics of Science", *Isis*, V. 101, No. 3 (September 2010), pp. 555-559, p. 558.

3 See Andy Pickering, *Mangle of Practice: Time, Agency, and Science* (Chicago: University of Chicago Press, 1995), Bruno Latour, *Reassembling the Social: an Introduction to Actor-Network-Theory* (Oxford: Oxford University Press, 2005).

the realm of written and spoken communications or conversations, featuring the special codified language of intellectual enquiry. My study employs the term "discourse" in a more technical sense, which is close to that suggested by Michel Foucault in his *Archaeology of Knowledge*, i.e. as a more abstract construct capturing the successive rules of use for the signs of a codified language or "the interplay of the rules that make possible the appearance of objects during a given period of time".[4] In this sense, discourse represents the sustainable relations between objects, definitions, and practices, or in other words, the current formative rules, which must be established in order to speak of this or that object.[5] This meaning of "discourse" can be distinguished from more general usage by pinpointing the repeatability of relations between signs, which reconstructs the subject matter as an object for investigation. More concretely, by scientific discourse we shall mean the combination of a special vocabulary of codified knowledge and the sustainable employment of dialectical and rhetorical procedures for describing the relations between phenomena.

In *Archaeology of Knowledge*, Foucault remarks that the problem he is striving to define concerns not the groups of signs but the "practices that systematically form the object of which they speak", not the conventional use of a special vocabulary but the ordering of objects, which can also be explicated in terms of the relationship between words and things.[6] In order to analyse the rules for the formation of objects, we need to "neither embody them in things", nor "relate them to the domain of words".[7] This problem of the construction of the object within a specific discourse was stated with particular clarity in early-modern debates concerning the language of science. In fact, the interlocutors in these discussions contemplated the possibility of positively affecting the techniques of making knowledge through employing specific repeatable relations between the signs in scientific communication.

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4 Michel Foucault, *The Archaeology of Knowledge*, trans. A.M. Sheridan Smith (New York: Pantheon Books, 1972), pp. 4, 32-33.
5 Ibid., pp. 38, 45.
6 Ibid., p. 49.
7 Ibid., p. 63.

Nothing epitomizes this movement better than the legacy of John Wilkins, which provides an optimal example of the innovative, prudent, and eventually successful methods of an early-modern British *virtuoso*.

My study explores how the early-modern hypotheses that were formative in scientific progress were invented through employing the repetitive discursive connections that were espoused by scientific communities. The category of *knowing-how* as the mastery of scientific techniques brings out the instrumental means of discourse-making. The employment of the category of *knowing-how* in the philosophy of science undermines the split between the contexts of discovery and epistemic justification. Bruno Latour examined the divide between "science in the making" and "ready made science".[8] The realm of epistemic justification is usually understood as including the practices of employing an empirical proof, as well as authoritative testimony and logical deduction. As Jutta Schickore demonstrates, originally, the delineation of the border between the spontaneous insights of discovery and the procedures of epistemic justification helped mark the difference between empirical studies in the history of science and studies of the assessment of knowledge claims. Although the distinction is useful for outlining methodologies, at a certain point it may complicate cooperation between the history and the philosophy of science.[9] This has convinced many authors that philosophical accounts of justification and historical accounts of discovery need to share the essential aspects of each other.[10]

The divide between the topics of discovery and justification also presumes a dissimilarity in contextual frames. The studies of spontaneous insights of discovery have been associated with a micro-contextual scope of analysis focused on a singular

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[8] Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, MA: Harvard University Press, 1999), p. 4. See also pp. 21-22 of this study.

[9] Jutta Schickore, Friedrich Steinle, "Introduction: Revisiting the Context Distinction" in *Revisiting Discovery and Justification. Historical and Philosophical Perspectives on the Context Distinction,* ed. Jutta Schickore and Friedrich Steinle (New York: Springer, 2006), pp. x-xvi.

[10] Richard Swinburne in *Epistemic Justification* (Oxford: Clarendon Press, 2001) extends the interpretation of the notion of justification, pointing out that in any single act of justification, several kinds of procedures can be at play simultaneously, including synchronic justification based on the believer's situation at a certain point, diachronic justification grounded on a series of investigations over time, internalist justification derived from introspectible factors, and externalist justification concluded from factors not immediately accessible to the believer.

narrative from a specific case study. The studies of the principles of epistemic justification have been mostly related to the macro-contextual arena of a dialogue between scientific agents. The idea of performativity may provide a convenient conceptual framework for analyzing the interplay between micro- and macro-contextual relations. The studies of scientific performativity trace the implementation of scientific ideas, starting from the *inventio* of an argument, in the sense of early-modern dialectical rhetoric where *inventio* is related to the heuristic combinatorics of *topoi*, and arriving at the invention of particular scientific solutions and technical appliances. The notion of performativity makes it possible to associate the ideas of practice with its outcome, as well as to single out the medium-context of a specific case study to display how certain scientific solutions became accepted as ingenious.

Arguably, the history and philosophy of science can maintain such a focus, but it has been observed that science itself tends to defend the distinction between the realms of discovery and justification. The canon of scientific representation cannot accept a narrative description of making a concrete discovery as a legitimate scientific result: science seeks to prove the causality among a certain range of phenomena. Successful epistemic justification entails acknowledgement of the truth-value of specific claims. How could the realms of discovery and justification ever be reconciled for analyzing not a philosophical preparation but a living specimen of scientific development?

In contrast to modern scientific practice, the early-modern science found itself at the starting point on a path toward certainty and operated not with truth- but with probability-value. The establishment of probability, as opposed to truth-value, presumed a different set of “the rules of formation as the conditions of existence”, which were essential for ensuring the acceptance of claims by the scientific community. One of these conditions was that experimental natural philosophy required the composition of precise descriptions of the history of how particular conclusions were arrived at, since the right kind of *historia* behind the argued claim was considered a key to its successful justification. The epistemic value of "moral certainty", i.e. the persuasiveness of the claim and common assent to it, was ranked higher than mathematical certainty among the epistemic values. Therefore, in early science, the realms of discovery and justification overlapped, which made the argument dependent on the quality of a probabilistic narrative.

Testing of hypotheses as part of experimental practices, as opposed to the derivation of deductions in disputations, could not retain Aristotelian logic as the main methodology for achieving justification. Aristotelian demonstrations were mostly intended for producing written statements about the permanent properties of nature, but the experimental activities of early-modern natural philosophy aimed to clarify the variable "messiness of things". To establish the probability of the suggested causality in natural events, natural philosophers employed persuasive and copious narrative descriptions of experimental endeavors. The theatricality of "staged" experiments was among the distinctive features of early scientific accounts.[11] For instance, as William West mentions, Bacon's ambivalence towards the incidents of drama in science involved, on the one hand, his repudiation of the "Idols" of the *theatrum mundi* "in the plays of this philosophical theatre", where the "stories invented for the stage" [12] and the inventions of ordinary language may persuade the mind more effectively, than the true natural *historia* of "things themselves". On the other hand, Bacon proposed a replacement for the ancient theatre of fables in the form of "action within", i.e. active engagement in one's own experience of discovery.[13] In *Sylva Sylvarum* (1626), Bacon insists that knowledge derives neither from deductions nor from experience alone, but from their combination in setting up circumstances and watching their outcome, so Bacon specifically points at the necessity of performance for the acquisition of

[11] William N. West, "Knowledge and Performance in the Early Modern *theatrum mundi*" in *Dimensionen der Theatrum-Metapher in der Frühen Neuzeit: Ordnung und Repräsentation von Wissen*, ed. Schock F, Bauer O, Koller (Hannover: Wehrhahn, 2008), pp. 1-20, pp. 13-17.

[12] Francis Bacon, "The Novum Organum", *Translations of the Philosophical Works*, ed. James Spedding et al. (London: Longman, 1858), Part I, XLII.

[13] William N. West, "Knowledge and Performance", p. 14.

knowledge.[14]

Additionally, by comparison with modern science, early-modern experimental philosophy adopted a different understanding of the *causae* of a natural event, i.e. the method, the instrument, and the scientific claim, were construed differently. The claims were not about truth-value but probability-value, the instruments were lacking in universal standards of function and calibration, and the methods of achieving certainty were essentially under development. Therefore, early science placed a particular emphasis on the mastery of performative methods and on virtuosity in persuading the community, the most handy and reliable instrument of which was the language of science.

The linguistic aspect of the relationship between the realm of discovery and that of justification was once captured by Norwood Hanson in *Patterns of Discovery* (1958) as the gap between "seeing that" and the logical function of description. Vision is essentially pictorial, and knowledge is fundamentally linguistic, and one constantly needs to explore the gulf between the visual and linguistic apprehensions, the void between sketching and describing, drawing and reporting.[15] For late Renaissance natural philosophy and early science, the drawing and the describing of nature were not rigorously separated, as both were enthusiastically practiced by artists and scholars. In some illustrative cases, such as those of Leonardo, Galileo, and Robert Hooke, drawing skills were not auxiliary to the verbal descriptions of phenomena but were documented to play a heuristic role in discerning the previously unseen properties of things and discovering ingenious answers to scientific questions. In terms of expression, the gulf between "seeing that" and reporting was to be filled primarily through the means of natural language, the resources of which allowed diverse groups of early scientific agents to communicate across a variety of thematic fields.

In the mid-eighteenth century, the establishment of more standardized epistemological terms, as well as experimental procedures and guidelines for the use

[14] Ibid., p. 17.
[15] Norwood R. Hanson, *Patterns of Discovery* (Cambridge: Cambridge University Press, 1958), p. 25.

of instruments, which are now associated with the discourse of the Enlightenment, was linked to the advancement of scientific methods from the phenomenology of nature to its theoretical apprehension.[16] But before nature came to be construed primarily as a mathematical puzzle, the main achievements of science were perceived as consisting in the ingenuity of hypotheses and methods of persuasion.[17] The "baroque principle" of early-modern science consisted not only in the interplay of intuitive insights, "deliberate distortion of regular structures to produce the asymmetric effect of baroque art", but also in the "unity of thought more dependent on imagery than on logic".[18] My study seeks to show that one of the important characteristics of baroque science, displayed in Wilkins's writings, consisted in the intentional employment of dialectical rhetoric for modulating epistemic emotions, to overcome the anxieties caused by recently discovered paradoxical behaviors in social and natural realities. The techniques of dialectical rhetoric served not only as a tool for coping with these anxieties but also as a heuristic instrument for inventing new ways of resolving contradictions and restoring the congruence among "things themselves". The temporary inconsistencies created by the first separate achievements of modern science also demanded the involvement of some framework that would define itself in terms of ethos and could, as it were, carry the weight of common scientific discourse, which was attained in natural theology in the form of divine providence. Eventually, the distorted harmony of the Renaissance cosmos was repaired with isolated areas of approximated mathematical understanding.[19] As for the mental instruments of science, experimental philosophy used language as an apt tool for both discovery and justification within a uniform framework of probabilistic narratives. The language of science was employed as the instrument of communicating experience and performing the discourse.

Scientific language deserves to be named among a variety of consciously

[16] Ibid., p. 61.
[17] Ibid., p. 72.
[18] Ofer Gal, Raz Chen-Morris, *Baroque Science* (Chicago: University of Chicago Press, 2013), p. 6.
[19] The epistemic function of mathematical approximation in early-modern science is explored in Jed Z. Buchwald and Mordechai Feingold, *Newton and the Origin of Civilization* (Princeton: Princeton University Press, 2013).

fabricated scientific instruments, and perhaps even as the most consistently used one. In early-modern England, the making of knowledge was viewed as a fundamentally linguistic process. The seventeenth-century British natural philosophy started with Bacon's polemical pleas for the operative re-orientation of natural philosophy, which departed from a critique of language abuse. Language can make raw scientific data, such as sounds, visuals, and holistically presented scenes, visible for intellectual apprehension, and thus lay out the primary textures for more specific understanding. In the mid-seventeenth century, British *virtuosi* appreciated the "artificial advantages" of adding the "artificial organs to the natural",[20] for instance, the addition of newly invented optical devices to observations with the naked eye. Like other instruments, language made it possible to see more of the natural world. Towards the late-seventeenth century, many of the personalities within British natural philosophy, including John Wilkins, demanded that the language of scientific enquiry should undergo a practical re-evaluation and be improved alongside other scientific instruments.

In the London of the 1660s, the founding members of the Royal Society devoted many of their efforts to the refinement of various scientific instruments, including language. The most reliable knowing of things was believed to derive from producing their exact imitations, and the τέχνη of using language was enhanced in the form of dialectical and rhetorical techniques as an important prerequisite for *mimesis naturae*. Throughout the seventeenth century, the search for new ingenious ways of using the language for modeling and "questioning" nature passed through several stages. The increasingly complicated relationship between the humanist "discourse of the library" and the experimental "discourse of the furnace" divided views on how to use language for expressing and imparting scientific experience. Within the new experimental discourse, the lustre of classical rhetoric was gradually losing credibility, and the objectivity of mathematized science was not yet

[20] Robert Hooke, *Micrographia* (London: Jo. Martyn and Ja. Allestry, 1665), the Preface.

performing the function of justification.[21] Around the middle of the seventeenth century, the new practices of science sought to bring together the methodologies of rhetoric and rigor, striving to retain persuasiveness while introducing greater clarity into the methods of explanatory reasoning.

From a modern point of view, the configuration of early scientific standards and values may appear confusing. What would be perceived today as a commitment to rigor, such as the use of precise mathematical calculations or the following of specific procedures, in the contemporary context could often function as a rhetorical support. For instance, by indicating the minute-precise daytime in popular astronomical almanacs, an author did not necessarily demonstrate a commitment to objectivity but rather meant to show that a certain physician was capable of measuring the time with enough precision to select the astrologically impeccable moment for performing a surgery. On the contrary, a discursive gesture that nowadays might be deemed rhetorical, such as enumerating the opinions of ancient historians while discussing the matters of astronomy, at the time was perceived as the maintenance of the highest standards of rigor in such discussions. Considering that the discursive space of early experimental science was structured as a narrative and primarily aimed at achieving probability-value, it is of little wonder that language as a scientific instrument performed a persuasive function. The balance between rhetoric and rigor in discourse was volatile, as language was trying to combine the Renaissance "spiritual optic" with the precision of mathematics.

Thesis summary

This dissertation explores early-modern ways of turning language into the key instrument of discovery by finding a satisfactory balance between rhetoric and rigor within the early discourse or performance of science. My work represents an

[21] For a recent study on the emergence of objectivity as the main value of the mid-nineteenth-century science, see Lorraine Daston and Peter Galison, *Objectivity* (New York: Zone Books, 2007).

extended case study focused on the legacy of John Wilkins (1614−1672), an educator, a theologian, an experimentalist, and a linguist, who was fascinated with promoting innovative methods for the apprehension of scientific experience through the instrumental use of language. Wilkins's versatile approach to language practices provides abundant and demonstrative material for investigating the role of language in integrating the contexts of discovery and justification in early scientific practices.

Barbara Shapiro, probably the most devoted biographer of Wilkins, shows in *John Wilkins 1614–1672. An Intellectual Biography* (1969) her agreement with Grant McColley's statement that, "when a complete biography is prepared, it will be found, I suspect, that John Wilkins was the most dynamic force in seventeenth-century England".[22] Without overemphasizing this evaluation, one may safely assert that Wilkins played a catalytic role in several movements that proved formative for British scientific life. He possessed an extraordinary ability to create the conditions for facilitating the most fruitful upsurges of scientific inventiveness, and "was able to organize the best brains of his day into groups whose collective impact surpassed that of their individual efforts."[23] Shapiro's account admits that, since the eighteenth century, Wilkins has been chiefly remembered for his best-known project, that of artificial philosophical language. However, she notes, that is because his views were formative for the spread of those practices that would later be accepted as the natural background for any tangible progress of science.

Wilkins's main contribution to the epistemological reformation of the seventeenth century consisted not in achieving revolutionary results but in promoting a range of groundbreaking methods. Although, he did have a taste for avant-garde quests; apart from his scheme of artificial philosophical language, he authored a number of pioneering surveys, including the first comprehensive Copernican *apologia* in England, the first ever English-language discourse on cryptology, and one of the first English-language publications on mechanics. At the

[22] Barbara Shapiro, *John Wilkins 1614-1672. An Intellectual Biography* (Berkeley: University of California Press, 1969), p. 2.
[23] Ibid.

same time, he was also active as one of the founders of the movement of natural theology, and the masterminds behind the reformation of scientific language within the Royal Society of London.

In the broad spectrum of John Wilkins's pursuits, my dissertation highlights his three main areas of intellectual interest, i.e. his scientific narratives, natural theology, and linguistics, and considers them against the background of dialectical rhetoric as an instrumental technique of early scientific discourse. From this perspective, Wilkins's innovative but seemingly disparate undertakings appear as a more coherent exercise in the art of making knowledge through persuasive communication.

My thesis explores how Wilkins's argumentative method and style departs from baroque rhetorical flair in *The Discovery of a World in the Moone* (1638), proceeds by employing the capacity of rhetoric to impart scientific experience in *Mathematical Magick* (1648), copes with the challenges of the social and empirical quests of science in *Discourse on the Beauty of Providence* (1649) and *Of the Principles and Duties of Natural Religion* (which appeared posthumously in 1675), and arrives at elaborating the instruments for the codification and formalization of knowledge in *An Essay towards a Real Character, and a Philosophical Language* (1668). Wilkins's humanist scholarship and involvement in semiotic debates taught him to appreciate the heuristic potential of dialectical rhetoric in the practices of making knowledge, criticizing at the same time the misapplication of figural language within the framework of the Royal Society. Wilkins's method benefited from the visualization of experience within the procedures of both rhetorical *inventio* and technical invention. Dialectical and rhetorical *inventio* was a strategy of rational persuasion that sought to discover and display new relations between phenomena. These revealed relations served as the basis for new theorizing, which eventually resulted in making technical inventions and constructing new appliances.

My study consists of six chapters, each investigating how Wilkins's discursive techniques manifested themselves in relation to specific themes in his practical pursuits and published treatises. In each of these themes, I attempt to track the course of his argument from the initial figures of *inventio* to the specific inventions made by him within the topic. My first chapter elaborates on the dissertation's methodology and the notion of performative knowing, deriving it from the ideas of the analytic philosophy of the twentieth century. The concept of performative knowing is intended to delineate the point of balance between dialectical logic and the representation of experiential data, which Wilkins displayed and promoted throughout his multifaceted career. My second chapter describes Wilkins's early cosmological narratives and traces how his argument started with the Galilean hypothesis of the similarity between the earth and the moon, and arrived at designing the means of space travel. The third chapter focuses on the context of Wilkins's work while an Oxford college warden, considering how his activities within the "invisible college" may have influenced the reformation of scientific language within the Royal Society of London, and how the performative capacities of rhetorical and poetic strategies were used for the development of new methodologies in natural studies. The fourth chapter considers Wilkins's second scientific narrative where a performative representation of the art of mechanics formed a modeling example for the new scientific knowing to be implemented in the research program of the Royal Society. In the fifth chapter, I examine Wilkins's treatment of the notion of providence and the doctrine of natural theology, which were intended to repair the gap between the government of turbulent individual affairs and the universal harmony of divine nature. The last chapter of my thesis focuses on the rhetorical and dialectical roots of Wilkins's artificial philosophical language project, identifying its performative features and formulating the conclusions of my study concerning Wilkins's most important invention, the design of a complex database, as an instrument for enhancing the scientific performativity of the human mind.

The notion of performativity helps me to link Wilkins's dialectical efforts with their remote technological outcome, which my thesis traces in a series of themed case studies. I aim to show how Wilkins's astronomical and engineering narratives, communications with the other Society fellows, his ideas about natural theology, and the artificial language project, all elaborated on the baroque dialectical means of breaking through the linear structures of natural language into the artificial, diagrammatic, and multi-dimensional space of performative representation. The dissertation explores the functions of rhetorical and dialectical devices with the aim to examine how the interplay between cognitive and performative language enhanced early-modern practices of knowledge-making. I argue that the procedures of dialectical rhetoric, apart from being popular perlocutionary tools, were effective as heuristic instruments. Language was one of the important agents in the performing of science, and my study employs the concept of "performative knowing" as a key to Wilkins's dialectical and scientific inventions. The idea of performative knowing straddles several constituents derived from the analytic philosophy and speech act theory, which helps me analyze Wilkins's advancements in the art of making knowledge through the transmitting and structuring of scientific experience. His humanist scholarship and involvement in semiotic debates made him appreciate the heuristic potential of dialectical rhetoric. Despite his criticism of the abuse of outdated figural language in scientific debates, his method benefited from the visualization of experience through both rhetorical *inventio* and technical invention.

Thesis methodology

My project views language as one of the heuristic instruments of early-modern scientific performance. To analyze the early history of performing science, I will use the concept of "performative knowing" derived from early analytic philosophy and speech act theory, including the ideas of Bertrand Russell, Gilbert Ryle, John Austin, and John Searle. The use of a conceptual tool originating in twentieth-century philosophy to explain the phenomena of early-modern scientific discourse might seem anachronistic and controversial. However, a conceptual instrument of analysis often needs to come from a more advanced point on the timeline, to mediate between our modern perceptions and the historical events.

Besides, the employment of various concepts of analytic philosophy and philosophy of mind has long been a part of early-modern studies.[24]

Due to the complex material-discursive character of early scientific practices, which involved a wide range of hands-on operations and persuasive strategies, I propose to consider discovery and justification within early-modern science in the context of scientific performance. The language of performing scientific events represents the main instrument of science, and the chief methodological skill in making science can be formulated as the knowing how to employ language for performing scientific discourse, which my study will term as "performative knowing". The concept of performative knowing emphasizes the significance of the semiotic apprehension of scientific experience through combining the dialectical-rhetorical and the experimental practices of knowledge-making.

The main research question that my thesis explores is how the early-modern techniques of dialectical rhetoric were employed as heuristic tools within early-modern argumentative style? Related issues include: what parallels in methods and skills may be drawn between the early-modern practices of rhetorical composition and the crafting of scientific argument; how the apprehension of experience could be accomplished through the verbal and visual means of dialectical rhetoric; and what role was played by language within the various styles of scientific argument?

My dissertation is greatly indebted to a number of expert accounts on the role of performativity and persuasion in early-modern scientific discourse. These prominent works include: Barbara Shapiro's publications on John Wilkins's intellectual biography and the seventeenth century epistemological situation in England;[25] Lia Formigari's account of the relationship between language and experience in early-modern British natural philosophy; Jeanne Fahnestock's views on the role of rhetorical techniques in scientific argumentation; Peter Mack's study on the functions of visualization in the Renaissance argument; Wilhelm Schmidt-Biggemann's representation of Lullist *topica universalis* in baroque science; Peter

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[24] Concrete examples of this tendency will be provided in Chapter I of this study.

[25] See the Bibliography for citation information concerning the works listed below.

Miller's considerations on the intellectual history of natural classifications; Peter Dear's investigations of scientific thought-experiments; Geoffrey Cantor's essays on the use of rhetorical techniques in crafting experimental reports; Rhodri Lewis's comprehensive account of the history and motives behind the creation of Wilkins's artificial philosophical language; the collection of articles exploring the various aspects of Wilkins's linguistic context, edited by Joseph Subbiondo; Vivian Salmon's broad historical survey of ideas about universal language; as well as the works by Fredric Dolezal on Wilkins's lexicography, juxtaposing his views on semantics with those of William Lloyd and Samuel Johnson, et al.

Current research on the role of narrative techniques in early-modern scientific discourse, as well as studies of the history of performativity in experimental scientific practices, embrace a wide scope of materials and approaches. For instance, publications by Guido Giglioni, Gianna Pomata, and the ongoing project of Sabine Arnaud (MPIWG) highlight the instrumental role of rhetorical persuasion in early-modern medical practices. Works by Wolfgang Lefèvre and Jan Lazardzig demonstrate the significance of performativity in the procreation of scientific inventions. As for current enquiries concerning John Wilkins's legacy, his best-known linguistic writings were analyzed in Rhodri Lewis's authoritative review of the development of artificial language movement, which was published in 2007 and provides a particularly detailed insight into the network of communications on early-modern linguistics. Likewise, the study by Jaap Matt, which appeared in 2012, juxtaposes the language projects of John Wilkins and George Dalgarno, also touching upon their combined influence on Leibniz and *characteristica universalis* which was the scheme intended for communicating both mathematical and metaphysical notions. Several recent studies have provided persuasive interpretations of Wilkins's scientific narratives. William Poole's edition of *The Man in the Moone* by Francis Godwin, published in 2009, primarily traces the literary stimuli behind Wilkins's cosmological conjectures. The article by Dennis Des Chene, entitled "Imaginierte Maschienen und Wirkliche Welt", which appeared in *Spuren der Avantgarde: Theatrum* *machinarum: Frühe Neuzeit und Moderne im Kulturvergleich* (2008), explores the properties of Wilkins's paradoxical machines as the models for encouraging specific engineering achievements. The publications and conference appearances of Natalie Kaoukji have highlighted the literary sources of Wilkins's inspiration in composing *Mathematical Magick*. The same material is analyzed by Koen Vermeir and Maarten Van Dyck in their recent publication highlighting Wilkins's intention of promoting wonder in making mechanical inventions. Another upcoming study by Richard Serjeantson centers on Wilkins's activities as an educator in Oxford and Cambridge.

Within this framework, my project attempts to coalesce the argumentative lines concerning rhetorical *inventio* and scientific invention, and seeks to focus on the functions of specific rhetorical figures as symbolic forms or "image vehicles"[26] in Wilkins's writings. Drawing on existing research, my dissertation aims to accentuate the role of locutionary tools in the early-modern practices of making knowledge. In my thesis, I will explore how John Wilkins displayed and elaborated on the various aspects of performative knowing across several contexts within the diverse field of seventeenth-century British natural philosophy.

The contribution to modern studies on scientific performativity

My thesis seeks to relate the studies of early-modern discursive tools to both the classical humanist legacy and current explorations of science, since rhetorical and dialectical techniques may have retained some of their functions in the making of modern science. To illustrate that with a recent example: speaking at the Davos Economic Forum 2015, Google's chairman Eric Schmidt declared that the Internet will soon disappear from human experience, in the sense that the creating, storing, and accessing of data will become a seamless part of our digital noosphere. Recently,

[26] The term "image vehicles", or *Bilderfahrzeuge*, was coined by Aby Warburg, meaning the migration of images which brings about the materialization of innovative ideas. See "Aby Warburg's Legacy and the Future of Iconology", Max Weber Stiftung, http://www.maxweberstiftung.de/themen/bilderfahrzeuge.html. Retrieved 15.01.2015.

many areas of science have witnessed a dramatic increase in the proficiency of observational instruments, and the gathering of scientific data remains no longer restricted by the limits of human sensuous perception. For instance, in modern astronomy, any comprehensive study includes a multidimensional visualization of what can be detected through radiation far beyond the range accessible to the natural human senses, e.g. via infra-red and ultraviolet light, X-rays, the emission of gamma rays and subatomic particles. A global network of scientific instruments renders an overwhelming amount of material, and the techniques of apprehension, codification, and meaningful exchange of data have once again become an acute epistemic issue. Like early-modern natural philosophy, modern science may employ the techniques that once originated in dialectical and rhetorical pedagogy for the purpose of making sense of raw experiential data. The use of dialectical techniques affects not only the accumulation of information but also the transfer of knowledge across different cultural and epistemic contexts.

However, the principles of performative knowing, derived from dialectical and rhetorical techniques, may nowadays be employed not only to produce meaningful data but also in more general practices of knowledge-making. Already in the mid-seventeenth century, Kenelm Digby warned against the creation of a false understanding of the categorical relationships between natural phenomena, i.e. against establishing the wrong relationships of cause and effect, whole and part, since this might affect the whole scenario of modeling causality in nature. In the twentieth-century, Niels Bohr's principle of complementarity implies that in nuclear physics, as the minute constituent parts of matter are too evasive for perception even through the most powerful optical instruments, the experimental access to objects cannot be obtained through their immediate observation but has to rely on scenarios of guided experimentation. The study of elementary particles occurs through their "virtual surfaces" or the virtual notional space where semiotic apprehension, i.e. the apprehension of experience through codified perception, preconditions the modeling of physical processes.[27] Like other fields, twentieth-century physics witnessed a fundamental shift in observational practices, from the observation of objects via artificial instruments of sensuous perception, such as the microscope, to the reconstruction of events in nature through advanced techniques of experimental scientific performance, i.e. by "setting up circumstances and watching the outcome".[28] For instance, the experimental activities at CERN, Geneva, do not consist in observing sub-atomic interactions through a microscope but stage numerous series of energetic collisions of accelerated particle beams, which produce new particles, as energy turns into matter in accordance with Einstein's equation. In successive experiments, different layers of detectors reveal the parameters of energy, speed, and particle trajectory that emerge from collisions, allowing physicists to conjecture with high probability the properties of their new objects.[29] Like seventeenth-century natural philosophy, in the twenty-first century, the guided procedures of experimentation aim not to obtain immediate observational results but to stage experimental performativity, thus compensating for the ineffectuality of the instruments of immediate observation. Early-modern procedures of experimentation employed principles of data organization that were developed within the techniques of dialectical composition. The performative character of modern scientific experimentation also necessitates conducting further inquiry into the role of performativity and persuasion in scientific practices.

My thesis endorses Hans Diebner's statement in *Performative Science: Reconciliation of Science and Humanities* (2012) that modern discourse on performativity within the humanities may productively contribute to discussions of the performative aspects of the exact sciences.[30] For instance, the actor-network approach, which can also be described as the "material-semiotic" method, treats objects as

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27 Niels Bohr's principle of complementarity states that by the word "experiment" we presently need to refer to a situation where we can tell others what we have done and what we have learned, and therefore the account of the experimental arrangements and results is dependent on the properties of the language employed. See Niels Bohr, "Discussions with Einstein on Epistemological Problems in Atomic Physics", *Albert Einstein: Philosopher-Scientist* (Cambridge: Cambridge University Press, 1949), p. 209.

28 William N. West, "Knowledge and Performance", p. 14.

29 CERN Brochure (Geneva: CERN Communication Group, 2014).

30 Hans Diebner, "Introduction", *Performative Science - Reconciliation of Science and Humanities or the End of Philosophy?* ed. Hans Diebner, David Turnbull et al., *Studia UBB. Philosophia*, V. 57 (2012), № 1, pp. 3-7.

parts of epistemic networks, and maps relations that are at the same time material and semiotic. The material-semiotic method departs from the ideas of Michel Foucault and Gilles Deleuze, as well as employs situational logic for the reconstruction of problems from the point of view of the acting agent, in order to understand the reasons behind specific epistemic choices. Actor-network theorizing attempts to explain how a material-semiotic network acts as a coherent meaning-producing environment. This approach emphasizes that such networks only exist by being constantly remade, as the relations inside them need to be performed continuously. However, the actor-network approach positions itself primarily, not as a universal speculative pattern, but rather as a conceptual framework for conducting case-studies that might outline the epistemic doings of scientific actors without imposing theories on the contingency of actions.

More specifically, concerning the employment of performative techniques, publications by Andy Pickering, such as his *Mangle of Practice: Time, Agency, and Science* (1995), argue that the notion of performativity can aptly explicate the specific features of modern experimental practices. Pickering distinguishes between the performative and representational conceptions of scientific experimentalism, where the performative conception concerns the non-human instrumental agency of science-making, such as material instruments, machines, and specific argumentative devices.[31] In Pickering's words, "science is itself caught up in the flow of becoming", but representational knowledge "helps to conceal the becoming" by portraying "a timeless and constant world". Pickering quotes Heidegger's aphorism that science is at best correct and never true, and stresses that "science itself appears as a veil" through which we interpret the contingencies of becoming.[32] He also articulates a plea for reconstructing the instrumental *how* of science-as-becoming.

In Bruno Latour's formulation, by penetrating the veil of representation and looking into the inner workings of science, it can be revealed that scientific discourse

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[31] Andy Pickering, *The Mangle of Practice: Time, Agency, and Science* (Chicago, IL: University of Chicago Press, 1995), p. 5.

[32] Andy Pickering, *The Mangle in Practice: Science, Society, and Becoming*, ed. Andrew Pickering, Keith Guzik (Durham, NC: Duke University Press, 2008), p. 8ff.

tends to cope with its intrinsic controversies through the agency of instrumental techniques for creating belief, which are employed to transfer specific statements from the realm of subjective knowledge onto the common space of supposedly objective understanding.[33] Examining various strategies of verification, Latour arrives at the conclusion that, while the "ready made science" repudiates rhetoric as an ideological program, the scientists as the agents of "science in the making" tend to support their claims through the rhetorical means of accumulating authority. Latour also considers argumentative style not so much as an aesthetic feature of scientific writing but rather as a means of demonstrative justification. In this sense, the techniques of "fiction-writing" and "fact-writing" share a number of similar utilities, including the capacity for transforming the further development of discourse, which also highlights the heuristic role of rhetorical techniques.[34] Latour terms the rhetorical and dialectical tools of rendering pre-determined scientific results as "inscription devices" and views them as the tools for both mediation and discovery.[35] In his view, the philosophy of science should assist the practitioners with "how-to" case studies, where "how-to" means providing guidance on how to perform meaningful discourse, based on the abundance of experience in scientific happenings.[36]

My study seeks to contribute to this agenda by exploring the heuristic functions of specific rhetorical techniques in the early history of scientific performance. I hope to show that, even though early "ready made science", as represented in the official records of the Royal Society of London, attempted to exclude rhetoric from the methods of scientific argumentation, within the framework of "science in the making", their specific argumentative styles employed rhetorical means of inventing and asserting claims alongside other legitimate instruments. In particular, the techniques of "fact-writing" and "fiction-writing" tended to overlap to yield more effective transformative outcomes within a specific discourse.

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[33] Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, MA: Harvard, 1999), p. 30ff.
[34] Ibid., p. 59.
[35] Ibid., p. 68.
[36] Bruno Latour, *Reassembling the Social: an Introduction to Actor-Network-Theory* (Oxford: Oxford University Press, 2005), p. 17.

My thesis focuses on the linguistic aspect of this development, tracing the development of John Wilkins's discursive techniques from the double perspective of early-modern and modern performative theories of language. This standpoint enables me to reveal how Wilkins's argumentative style could impart scientific experience, i.e. how it translated the experience of discovery into its communicable description. Latour defines the tools for imparting scientific experience as "inscription devices" also related to the notion of "scientific instruments", i.e. "any set-up, no matter what its size, nature and cost, which provides a visual display of any sort in a scientific text".[37] Scientific inscriptions come in the form of diagrams, photographs, equations, and tables, and the race to turn these inscriptions into ever more helpful tools for delivering experience can be identified with the progress of science itself.[38] Performative theories of language also focused on the issue of translating experience into vivid descriptions. For instance, early-modern theories of persuasion created the procedures of dialectical rhetoric, which were employed for processing experience into vivid representation. Modern theories of the performativity of language, such as the speech act theories of Austin and Searle, demonstrate that the speech act represents a framework for mediation between language and experience. Speech acts need to be considered within a total speech situation where the "words used are to some extent to be explained by the context",[39] including situational and psychological parameters.[40] Latour's theory touches upon the relationship between scientific experience and description, but speech act theory enables analysis of the procedures of translating experience into descriptions. My thesis seeks to contribute to understanding the techniques of translating scientific experience into descriptions. In this view, I will focus on Wilkins's performative "inscription devices", in particular, how they changed in the course of the social

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37 Bruno Latour, *Science in Action*, p. 68.

38 Bruno Latour, "Give Me a Laboratory, and I Will Raise the World", *Science Observed: Perspectives on the Social Study of Science*, ed. Karin Knorr-Cetina and Michael Mulkay (London and Beverly Hills: Sage, 1983), pp. 141-170, p. 161. See also Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts* (Princeton: Princeton University Press, 1986), p. 51.

39 John Austin, *How to Do Things with Words?* (Oxford: Clarendon Press, 1962), pp. 52, 100.

40 John R. Searle, *Speech* Acts*: An Essay in the Philosophy of Language* (Cambridge: Cambridge University Press, 1969), p. 12ff.

upheavals of the seventeenth century; how they evolved in the popular thematic contexts of cosmology, mechanics, theology, and language studies; and how their evolution contributed to the early-modern epistemic reformation, from employing the techniques of dialectical and rhetorical *inventio* to arriving at materialized and mathematized scientific inventions.

Chapter I

The performativity of *inventio*

Thus the theory of description matters most.
It is the theory of the word for those
For whom the word is the making of the world
The buzzing world and lisping firmament.

Wallace Stevens
Description without Place (1946)

Performativity is an interdisciplinary term that denotes the capacity of semiotic expressions to consummate an action. The word is derived from John L. Austin's Harvard lecture of 1955, *How to Do Things with Words?* which marked the transformation of the analytic philosophy of language into the theory of speech acts. Austin labeled as "performative" situations in which saying something equals doing something that cannot be identified as true or false but can only be considered in terms of its effectiveness in delivering the intended meaning or the application of locutionary force.[41] John Searle's important and seminal work, *Speech Acts* (1969), and his later *Expression and Meaning* (1979) connected speech act theory more explicitly to linguistics but at the same time implied the need to include speech acts within the framework of discourse. This made it possible to categorize even utterances without performative verbs as speech acts, so that speech acts became more reliant on discursive context instead of linguistic characteristics, such as the meaning of a verb. The notion of context involved a greater variety of factors, such as background knowledge and social situation, which meant that the analysis of speech acts was related to a rich abundance of discursive parameters. Searle also extended the application of speech act theory to various modes of discourse, such as fiction and indirect speech acts.[42]

41 John Austin, *How to Do Things with Words?* pp. 5, 12.
42 John Searle, *Expression and Meaning: Studies in the Theory of Speech Acts* (Cambridge: Cambridge University Press).

More recent understanding of performativity, associated with Judith Butler's views, suggests that any kind of symbolic action receives its meaning through negotiations within a performative environment.[43] The realm of performativity gives space for all sorts of symbolic interactions, and intertwines various fields of knowledge and types of action, including ritual, artistic, and cognitive realms. In my thesis, the notion of performativity will be employed to characterize the art of discourse in early science.

The present chapter will elaborate on my dissertation's methodology. I will first explain the notion of performative knowing, deriving it from the ideas of the analytic philosophy. Then, an account will be provided of the early-modern dialectical and rhetorical strategies that influenced John Wilkins's argumentative style as his work progressed from *inventio* to invention. Then, the relevance of the doctrine of *copia* will be explored in application to Wilkins's writing techniques, in the context of early-modern scientific writing. One may presume that the techniques of dialectical invention and the methods of achieving *copia* represent two opposing strategies within the framework of rhetorical composition, since the art of dialectic accounts for a clear structure and copiousness ensures the narrative fullness of descriptions. The notion of performative knowing is called to delineate the point of balance between dialectical logic and the representation of experiential data in the successful making of discourse. In the end, summarizing the framework of my methodological approach to interpreting John Wilkins's writings, I will highlight the most characteristic aspects of performative knowing, which he displayed and promoted throughout his career.

The concept of performative knowing

The concept of performative knowing derives from the analytic philosophy, and my study constructs and employs it to reveal the specific features of early-

[43] Judith Butler, *Excitable Speech. A Politics of the Performative* (New York & London: Routledge, 1997), p. 75ff.

modern scientific discourse. The distance between these points on historical timeline may appear too great for the drawing of conclusive parallels. However, the use of the concept as an instrument of analysis can be justified, as analytical instruments often need to come from a later point on the timeline. Besides, in this case, several concepts of speech act theory and philosophy of mind, as proposed by John Austin and Gilbert Ryle, have long been a part of early-modern studies.

For instance, Quentin Skinner cites John Austin's formula from his lecture series *How to Do Things with Words?* Skinner emphasizes that it is necessary to recover what a historical agent may have been *doing* in saying what was said, written, or published hundreds of years back in history.[44] Skinner's *Visions of Politics* (2002) invokes insights from analytic philosophy and the theory of speech acts to articulate a plea for considering the dimension of action in establishing the significance of historical texts. His version of intellectual history proposes to view texts as the signs of events, and to focus on the causality of intellectual happenings. In his best-known work on early-modern studies, *Reason and Rhetoric in the Philosophy of Hobbes* (1996), Skinner elaborates on the approach of drawing attention to the pragmatics of historical texts, for which they need to be considered "within such contexts as enable us in turn to identify what their authors were *doing* in writing them".[45] He qualifies Hobbes's *Leviathan* as an exercise in *ars rhetorica* and argues that, even though Hobbes was known to repudiate rhetorical efforts in philosophy, he also realized that knowledge taken on its own lacks persuasive force and needs rhetorical support. Skinner insists that no philosophical prose, including the writings on early-modern natural philosophy, should be viewed as "a clear window through which we can gaze uninterruptedly".[46] Without taking note of the author's tone and epistemic manner we may come up with oversimplified interpretations of events and

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[44] Quentin Skinner, "Regarding method", *Visions of Politics* (Cambridge: Cambridge University Press, 2002), V. I, pp. 2, 104, 133.
[45] Quentin Skinner, *Reason and Rhetoric in the Philosophy of Hobbes* (Cambridge: Cambridge University Press, 1996), p. 7.
[46] Ibid.

realities.[47] My study employs a similar principle in analyzing the material of John Wilkins's narratives, as I attempt to reveal what Wilkins was *doing* by composing his seemingly random accounts of contemporary astronomical, mechanical, theological, and linguistic knowledge. In particular, my enquiry will question why he found it necessary to endow his miscellaneous descriptions with the full power of dialectical-rhetorical humanist learning available to a scholarly mind.

It has already become evident to the authors of numerous publications that early-modern studies may benefit from employing the ideas derived from the writings of the legitimate founder of the school of analytic philosophy, Ludwig Wittgenstein, especially his notion of the language game.[48] It is also possible to mention several examples of using Gilbert Ryle's concept of "knowing-how" for explicating the specificity of the early-modern practical knowledge of artistry. For instance, Manfred Pfister refers to Gilbert Ryle's lecture *Knowing How and Knowing That* (1945), which distinguished between "knowing-that", as knowledge that can be expressed in propositions, and "knowing-how", as the performative mode of knowledge possessed by an artist or a craftsman, which accounts for the mastery of methods acquired through practical training. More specifically, the knowing-how of poetry often exhibits itself in the intelligent deconstruction of poetic knowing-that implemented in the devices of canonical masters. The poetic composition breaks into the realm of knowing-how through using the language of immediate subjective experience. The language of knowing-how translates a text into practice and showcases the limitations of current knowing-that, creating a realm of productive uncertainty.[49] As another example, Horst Bredekamp in *Galileo, the Artist* argues that knowing-how in the form of artistic training and "motoric intelligence" enabled Galileo to notice the possibility of a three-dimensional interpretation of the imagery of

47 Ibid., pp. 10, 14.
48 Cf. Joachim Frenk, "Games", *The Ashgate Research Companion to Popular Culture in Early Modern England*, ed. Andrew Hadfield, Matthew Dimmock, Abigail Shinn (Farnham: Ashgate, 2013), p. 221ff.
49 Manfred Pfister, "What and how do poems know? An ancient question reconsidered in the light of Gilbert Ryle's distinction between 'knowing that' and 'knowing how'", *Letteratura e altri saperi*, *Testi e linguaggi. Rivista del Dipartimento di Studi Linguistici e Letterari dell'Università degli Studi di Salerno*, 3/2009, ed. Lucia Perrone Capano and Carla Perugini (Salerno: Carocci, 2009), pp. 19-34.

the moon during his observations through the telescope.[50] The possession of knowing-how describes the difference between Galileo and many of his peers, which turned out to be a crucial skill for the emerging generation of scientific experimentalists, as it allowed them to develop a new perception of the space-continuum. My study employs Ryle's notion of knowing-how as part of the concept of performative knowing, to pinpoint the mastery of dialectical methods employed in Wilkins's epistemic narratives. My thesis aims to determine what Wilkins was *doing* by presenting his diverse accounts, and to identify the significance of his work as a series of epistemic acts. Therefore, it is imperative that my methodology should include the theoretical instruments that would enable me to bring into focus the action side of Wilkins's writings. My study aims to reveal the knowing-how of methods that Wilkins invested into his narrative compositions.

The decision to ground the methodology of my thesis on a concept originating from the analytic philosophy of language was also motivated by my view that analytic philosophy can be especially apposite for reflecting upon the early British approaches to performing science. The early analytic philosophy of the twentieth century and early-modern theorizing on scientific discourse happen to share a number of targets, as both traditions were preoccupied with finding ways to incorporate the non-logical and experiential aspects of discourse into the formal structures of language and knowledge.

The school of analytic philosophy started with G.E. Moore's and Bertrand Russell's challenging of the British version of absolute idealism, which at the time represented a version of university scholastics. After World War II, Ludwig Wittgenstein, Gilbert Ryle, John Austin, and Peter Strawson turned more radically to "linguistic realism" by focusing on the relationship between language structures and the experience of speech. At some point, it became difficult to define analytic philosophy and the early philosophy of mind in terms of uniform intrinsic features, but

50 Horst Bredekamp, *Galilei der Künstler* (Berlin: Akademie Verlag, 2007), p. 25.

their philosophical commitments were clearly linked to the analysis of the relationship between language structures and the domain of experience, as opposed to the post-phenomenological continental tradition of studying the symbolism of language. Similarly, seventeenth-century British philosophy of language was mainly interested in the relationship between language units and "things themselves", as well as the truth-conditions for statements about nature. Already in the fifteenth century, Luis Vives had proposed a project of scientific reformation, where university scholars would have to learn from the experience of ordinary people.[51] In the seventeenth century, many British authors saw the main task of philosophy as improving the structures of ordinary language, the vernacular, to turn it into a more powerful scientific instrument. As a characteristic example, Wilkins's *Mercury* (1641) attributed the imperfections of natural languages to the corporeal character of human communication.[52] Wilkins's *Essay towards a Real Character and a Philosophical Language* (1668) attempted to provide the means for connecting things and notions more directly, not through the sounds of speech but through the pure operations of the mind, as happens in mathematical notations. The linguistic turn in the philosophy of the twentieth century is a well-recognized reality, but the same can be affirmed about the early-modern linguistic turn, as many of the philosophical attempts of seventeenth-century England investigated the links between language and experience.[53]

Analogously to early-modern language philosophy, the analytic philosophy of the twentieth century was working on a method for systematic reflection upon the relationship between language and experience. The task was formulated by Ludwig Wittgenstein: "Sketching the bounds of the sayable, we see, for free, what is unsayable."[54] Outlining the main ideas of *Tractatus Logico-Philosophicus* (1921) in a letter to Russell, Wittgenstein explicated his position: "The main point is the theory of

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[51] See Richard Waswo, *Language and Meaning in the Renaissance* (Princeton: Princeton University Press, 1987), pp. 113-133.

[52] John Wilkins, *Mercury* (London: I. Norton for John Maynard and Timothy Wilkins, 1641), pp. 2-3.

[53] See Lia Formigari, *Language and Experience in 17th Century British Philosophy* (Amsterdam, PH: John Benjamins Publishing Company, 1988).

[54] Ludwig Wittgenstein, *Tractatus Logico-Philosophicus* [1921], trans. D. F. Pears and B. F. McGuinness (London: Routledge, 1974), 4.113-4.115.

what can be said by propositions – i.e. by language … and what cannot be said by propositions, but only shown; which, I believe, is the cardinal problem of philosophy."[55] The influence of late Wittgenstein inspired the analytic tradition to elaborate on the understanding of language as part of a performative environment, and to study the links between performativity and the knowledge of propositions.

The concept of performative knowing, which I intend to employ to delineate the specificity of early scientific discourse, is based on the notion of experient knowledge or "knowledge-by-acquaintance", which initially meant knowledge derived from immediate, primarily visual, sensuous experience. The term was introduced into the field of early psychology by Hermann von Helmholtz who distinguished between *kennen*-knowledge, i.e. the sensuous acquaintance with phenomena, and *wissen*-knowledge expressed in notions.[56] Helmholtz maintained that all thought constitutes knowledge, and both *wissen*-knowledge and *kennen*-knowedge can yield precise judgments and have propositional content.[57] However, *kennen*-knowledge cannot be directly expressed in the language of words, and consequently is incommunicable. A popular example of *kennen*-knowledge states that it is not possible to impart the experience of a sense phenomenon, for instance, it is impossible to describe what blue color is to a color-blind person.[58]

Later, the concept of *kennen*-knowledge was construed in philosophical terms within early analytic philosophy. In *Problems of Philosophy* (1910), Bertrand Russell introduced the concept of knowledge-by-acquaintance, which, like *kennen*-knowledge, meant the knowledge obtained immediately from experience without any process of inference. Russell traced the concept's origins back to George Berkley's notion of "idea", i.e. something that is known immediately, the way sense data

55 Ludwig Wittgenstein, *Letters to Russell, Keynes, and Moore* (Oxford: Blackwell, 1977), p. 71, 19 August 1919.
56 H.L.F. von Helmholtz, "The Recent Progress of the Theory of Vision" [1868], in *Popular Scientific Lectures*, trans. P.H. Pye-Smith (New York: Dover Publications, 1962), pp. 93-185.
57 For a study employing Helmholtz's theory for interpretation of early-modern scientific experience, see Gregor Schiemann, *Hermann von Helmholtz's Mechanism: The Loss of Certainty: A Study on the Transition from Classical to Modern Philosophy of Nature* (Springer Netherlands, 2008), pp. 28-40.
58 William James, *Principles of Psychology* (London: Macmillan, 1891), V. 2, p. 629.

can be present in the mind.[59] Russell maintains that knowledge-by-acquaintance or experient knowledge functions as a cognitive value compass, building awareness of the existence of a certain phenomenon, which places it in the arena of the mind's attention and arouses cognitive interest. The experience of existence promotes the "desire for knowledge", which is required for initiating any cognitive processes.[60]

The notion of experient knowledge aptly pinpoints one of the most characteristic features of early-modern forms of performing science. As was mentioned by Lorraine Daston in her Nicolai Rubinstein Lecture "Histories of Scientific Experience in Early Modern Europe" (2011), nowhere in the realm of early science were the changes more dramatic than in the reconceptualization of scientific experience. The cultivation of concomitant practices, such as experimenting, observing, collecting, and note-taking, relied heavily on both the artisan's experience and Baconian "learned experience", which demanded vigilance and the special skills of perception. Furthermore, in the course of the sixteenth and seventeenth centuries, the forms and methods of scientific observation evolved from the activities of illiterate artisans to a prestigious form of university learning, which necessitated refinement of the available modes of experient knowledge.[61] The methodological notion of performative knowing, employed in my study, involves the idea of experient knowledge as a means of capturing this aspect of early-modern learning.

Russell distinguished between experient and descriptive knowledge, defining the latter as knowledge "as it is opposed to error".[62] The reception of Russell's views clarified the difference between experient and descriptive knowledge as follows:

> In knowing my own feelings with regard to the state of world affairs, the evidence upon which I would apply the concept "sad" to them consists of the feelings themselves, while if I know that your feelings are also sad, the evidence is clearly not

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[59] Bertrand Russell, *Problems of Philosophy* (Cambridge: The Home University Library, Williams and Norgate, 1912), Chapter IV.

[60] Ibid.

[61] Lorraine Daston, Nicolai Rubinstein Lecture "Histories of Scientific Experience in Early Modern Europe", University of London Queen Mary, 10.03.2011. See also Peter Dear, "The Meanings of Experience" in *The Cambridge History of Science*, ed. David C. Lindberg and Ronald L. Numbers (Cambridge: Cambridge University Press, 2003), V. 3, pp. 106-131.

[62] Bertrand Russell, *Problems of Philosophy*, Chapter V.

your feelings themselves, but the word sounds that you produce in my mind, which are the effects of your intention to tell me how sad you feel.[63]

Experient knowledge, as the immediate awareness of things without any inference, can be neither true nor false, whereas descriptive knowledge yields judgments of truth and falsity. Russell also defines experient knowledge as “the knowledge of things”, noting that it should precede descriptive knowledge. He acknowledges though, that in reality, judgments often need to be made without any immediate acquaintance with things. In such cases both types of knowledge interact: the experient knowledge can be inferred from the descriptive knowledge “in virtue of some true proposition of acquaintance”, i.e. if I am able to connect the description with something that I know to be true via experient knowing. When making a statement about the things that we only know via descriptive knowing, we need to infer that this is how we view the things themselves. Descriptive knowledge can only be considered true if some experience stands behind the descriptive proposition. The absence of experient knowledge is compensated for by the assuredness that such knowledge is possible. When we consider the experient knowledge of something as existing, it attracts our attention and creates “the desire for knowledge”.

Although current research on early science shows a pronounced interest in the topic of scientific experience,[64] in many cases the analysis synonymizes the notions of empirical and descriptive knowledge. For instance, the introduction to *Historia: Empiricism and Erudition in Early Modern Europe*,[65] which explores the early-modern genre of *historia* as the interrelated study of nature and culture, highlights the coupling of observational skills with philological learning as a key epistemic tool within early-modern intellectual practices. Although this argument proves very effective in elucidating the role of humanist learning in the rise of early-modern empiricism, in other contexts it may eclipse the functioning of specific language

63 Dewitt Parker, “Knowledge by Acquaintance”, *The Philosophical Review*, V. 54, No. 1 (Jan., 1945), pp. 1-18, p. 4.

64 Relevant book-length studies, to which my thesis is indebted, include publications by Barbara Shapiro, Gianna Pomata, Pamela H. Smith, Jutta Schickore, and Lorraine Daston, all of which appeared between 2000 and 2011.

65 Gianna Pomata, Nancy G. Siraisi (eds.), *Historia: Empiricism and Erudition in Early Modern Europe* (Cambridge, MA: MIT Press, 2005), p. 29.

features in communicating experience. Besides, the distinction between language and experience seems to be a helpful methodological assumption for comprehending the early-modern practices of natural philosophy in Britain, where a considerable number of debates touched upon the issues of philosophical semantics and theories of the sign. My study employs "experient knowledge" as a part of "performative knowing", to take into account the problematics of the early-modern British philosophy of scientific language.

Russell draws parallels between the type of knowledge and the language of its expression. Experient knowledge bears witness to the existence of the matter in question but resists logical formulation, whereas the descriptive kind of knowledge allows for a non-contradictory formulation of whatever may exist. Most of the sentences of ordinary language combine both types of knowing and employ various means to approximate the immediacy of experience. Later, the concept of "locutionary force" in speech act theory came to refer to the components of speech that attribute the power of communicating experience to specific utterances.[66] My study will focus on how John Wilkins employed dialectical and rhetorical tools, including verbal and visual, figural and emblematic forms, to approximate experience and yield sufficient locutionary force for grounding his propositions.

Certain aspects of experient knowledge exemplify the similarity between the programs of early-modern dialectical rhetoric and analytic philosophy. Russell reproduced an attitude analogous to Ramist dialectical reform which consisted in separating the learning of topics from the teaching of propositions,[67] or in other words, separating the procedures of discovering the argument from those of its justification. The Ramist combinatorics of topics was to come before judgment, so as to ensure the maximum freedom and effectiveness of composition. Russell performs an analogous move, explaining his use of "know" in two different senses:

[66] John R. Searle, *Speech Acts: An Essay in the Philosophy of Language* (Cambridge: Cambridge University Press, 1969), p. 30.

[67] Peter Mack, *A History of Renaissance Rhetoric 1380-1620* (Oxford: Oxford University Press, 2011), p. 142.

> In its first use it is applicable to the sort of knowledge which is opposed to error … i.e. to what are called *judgments*. In this sense of the word we know *that* something is the case. This sort of knowledge may be described as knowledge of *truths*. In the second use of the word "know" above, the word applies to our knowledge of *things*, which we may call *acquaintance*. This is the sense in which we know sense-data [including "intellectual" sense-data].[68]

According to Russell, experient knowledge is not associated with logical judgment, but rather with the "self, as that which is aware of things or has desires towards things", and such "desires" may be implemented through hypothesizing. My thesis seeks to demonstrate how the flexible configuration of dialectical and rhetorical argumentation permitted Wilkins to compensate for the lack of observational experience on the part on his readers, which he does through specific procedures of invention and an appeal to scientific imagination. By declaring the hypothetical nature of his claims, Wilkins creates a legitimate way to shift the reader's attention away from familiar philosophical postulates. The contents of his narrative does not require validation via truth-claims, since Wilkins only claims the probability-value of his statements. But he achieves assent through the high level of argumentative techniques, which implies "moral certainty" and the mastery of dialectical methods. Ultimately, Wilkins's method of hypothetical *inventio* helps him explore the materiality of "things themselves" and promote technical inventions.

According to the analytic tradition, the frame of reference for an issue in question can be adjusted by building up experient knowledge. In modern linguistics, reference means a relation between specific representational tokens, such as names, imagery, and linguistic features, which invoke and reconstruct a certain subject matter as an object of discourse.[69] Using John Searle's terms of reference analysis, a successful act of reference, as it occurs in ordinary language, is not a formal logical operation, where the mentioning of an object equals its precise identifying.[70] Referring is performed as a propositional and an illocutionary act which invokes an

68 Bertrand Russell, *The Problems of Philosophy*, Chapter IV.
69 Magda Reimer, "Reference", *Stanford Encyclopedia of Philosophy* (Stanford, CA: Stanford University, 2014).
70 John R. Searle, *Speech Acts: An Essay in the Philosophy of Language* (Cambridge: Cambridge University Press, 1969), pp. 72-96.

object through its name, and where the object is evoked through a varied context of meanings. In the act of reference, the object is identified in a dialectical way: the reference implies answering certain questions about it, which clarifies the links relating the object to other objects relevant for both the speaker and the audience.[71] The act of referring can be performed across various types of context, assembled together through the illocutionary core of a reference act, i.e. the speaker's intention to delineate a particular object in a specific situation: "Underlying our conception of any particular object is a true, uniquely existential proposition".[72] Within an act of reference, the speaker may be said to process an object through a series of implied questions about it, establishing its relations with a certain meaningful context which can be categorical, hypothetical, or fictional; then the existence of an object can be established against this range of contexts. Applied to scientific discourse, the act of referring allows for an overlap between the hypothetical context of discovery and the categorical context of justification. John Searle's reference analysis mostly defines the "topics" through which the existence of an object is determined in grammatical terms, noting that these topics may look different for different languages.[73] However, these topics of reference need not only be syntagmatic characteristics but can also be the experient features of a "total speech situation". Building up experient knowledge shifts the frame of reference for the properties of a particular object, thereby making new views about it more comprehensible.

Using the terms of Searle's analysis of reference, the rhetorical procedure of *stasis* can be construed as the technique of shifting the scope of reference for a specific subject matter.[74] In both classical and dialectical rhetoric, the procedure of *stasis* consisted in a temporary refraining from judgment and questioning the subject matter from the point of various discursive contexts, which facilitated the connections between conflicting pleas. Within the framework of performative

71 Ibid., pp. 72-73.
72 Ibid., p. 93.
73 Ibid., p. 84.
74 More detailed analysis of *stasis* is provided below.

knowing, the act of reference accounts for the ability to communicate and shift the experient knowledge of phenomena through establishing new relations within a suitable range of contexts. Both *stasis* and the act of reference make it possible to reconstruct the subject against a certain context, so as to arrive at an adjusted meaning of the notion in question. This part of performative knowing is most pronounced in John Wilkins's project of artificial philosophical language, which essentially was an attempt to provide a universal scientific template for performing reference acts in the mind.

Searle also attributed social features to the act of reference, by stating that the perlocutionary force of utterances relies on the shared background memory of the speaking community. He sees the theory of language as a part of the theory of intelligent practices of performing speech acts: "[p]ropositional acts cannot occur alone; that is, one cannot refer and predicate without making an assertion or asking a question or performing some other illocutionary act",[75] meaning that illocutionary force originates from the speaker's intention to refer to things within a shared context.[76]

As was mentioned above, Searle mostly views illocutionary indicators in terms of language characteristics, but "often, in actual speech situations, the context will make it clear what the illocutionary force of the utterance is, without it being necessary to invoke the appropriate explicit illocutionary force indicator."[77] Searle uses a chess metaphor, following Ferdinand de Saussure, and noting that, no matter what kind of figures and rules there might be, "the rules must be realized in some form in order that the game be playable. Something, even if it is not a material object, must represent what we call the king or the board".[78] The illocutionary and perlocutionary forces affect the discourse through the rules of the relationship between the items participating in the language game. Searle also introduces the concept of in-

[75] John R. Searle, *Speech Acts*, p. 17.
[76] Ibid., p. 25.
[77] Ibid., p. 30.
[78] Ibid., p. 39.

stitutional fact, i.e. an item of knowing, whose truth-value is conditioned by the reference acts performed within institutions.[79] In other words, a new hypothesis can be treated as a fact or fiction, depending on the referential context of institutional practices. Austin's and Searle's interpretation of performativity can be helpful for reconstructing the functioning of early-modern "persuasive communities".[80] Whereas Searle's analysis of reference is useful for explicating the patterns of communicating experient knowledge, Ryle's notion of knowing-how may assist in accounting for the mastery of dialectical methods within Wilkins's epistemic narratives. Gilbert Ryle's concept of knowing-how was an elaboration on Wittgenstein's thesis that the principle of meaning is placed outside the language of words. Ryle maintained that intelligence cannot be reduced to considering concepts and propositions, as "concepts are not things that are crystallized in splendid isolation".[81] The analysis of concepts cannot be detached from "the live force of things that we actually say. It is to examine them not in retirement, but doing their co-operative work".[82] Ryle introduces the concept of knowing-how to account for the intelligent performing of practices. All intellectual practices are exercised by human agency "knowingly on *qui vive*", i.e. not detached from dispositions, motives and emotions, all of which need to be viewed as part of intelligent practices. Ryle's knowing-how forms part of the concept of performative knowing, where it allows for bringing the whole range of dialectical skills and methods into the orbit of discursive analysis.

Ryle's knowing-how elaborated on Russell's "experient knowledge", bringing out its operative potential. For Ryle, many practices are intelligent, even if involving little theoretical apprehension. Ryle coins knowing-that to refer to propositional knowledge, and knowing-how represents the mode of knowing which precedes knowing-that and consists in the "ways and methods of doing things".[83] In

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79 Ibid., p. 52.

80 Bryce Allen, Jian Qin, F. W. Lancaster, "Persuasive Communities: A Longitudinal Analysis of References in *The Philosophical Transactions of the Royal Society*, 1665-1990", *Social Studies of Science*, V. 24, No. 2 (May, 1994), pp. 279-310.

81 Gilbert Ryle, "Phenomenology versus the Concept of Mind", *Collected Papers* (London: Hutchinson, 1971), V. 1, p. 185.

82 Ibid.

83 Gilbert Ryle, "Knowing How and Knowing That", *Collected Papers* (London: Hutchinson, 1971), V. 2, p. 215.

Ryle's view, the advancement of learning does not consist exclusively in the accumulation of truths but also involves the "cumulative mastery of methods".[84] Ryle defends the role of imagination as an important constituent of scientific practices, wherever they are not determined by a fixed procedure. In fact, scientific concepts "serve as spring board for imagination".[85] Gilbert Ryle's concept of knowing-how, together with the other aspects of performative knowing, also help reveal the traits of qualitative assessment and moral certainty within the discourse of natural philosophy. Ryle emphasizes that knowing-how accounts for what "can be characterized in terms of more or less successful thinking, i.e. thinking that is not only limited by achieving the truth and not perhaps even exclusively targeting the truth. It is targeting by its own nature the good-quality argument".[86] The concept of knowing-how presumes that the quality of an argument is dependent on the non-propositional elements of discourse, as "we must look beyond the performance itself and consider the powers and propensities that are exercised in performing the action".[87]

John Wilkins, along with many of his contemporary experimentalists, regarded "moral certainty" as the highest epistemic standard of reliability in discourse about nature. By including the concept of knowing-how in the idea of performative knowing, my study seeks to address the theological and ethical implications of early-modern scientific argumentation. The pietistic ideals of ethical conduct were translated by early scientists into ethical principles of scientific practices. Many seventeenth-century British authors, such as Joseph Glanvill, who was associated both with early pietism and the Royal Society of London, agreed with Thomas Sprat on the necessity to avoid "fierceness" in homiletics and scientific styles.[88] Sprat's *The History of the Royal Society* (1667) records faithfully how the first meetings of the

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[84] Ibid., p. 224.
[85] Gilbert Ryle, "Thought and Imagination", *On Thinking* (Oxford: Blackwell, 1979), p. 59.
[86] K. Kolenda, Introduction to Gilbert Ryle's *On Thinking*, p. 4.
[87] Ibid.
[88] Barbara Shapiro, *Probability and Certainty in Seventeenth-Century England: a Study of the Relationships between Natural Science, Religion, History, Law, and Literature* (New Jersey: Princeton University Press, 1983), pp. 107-109.

eventual Society members in Oxford in the mid-1640s were a distraction from religious and civil atrocities. Sprat concludes that "the doubtful, the scrupulous, the diligent *Observer of Nature*, is nearer to make a modest, a severe, a meek, a humble *Christian*, than the man of Speculative Science".[89] Promoting an attitude of humility in the observation of nature represented a conscious ethical and rhetorical step aimed at ensuring constructive discussions. The idea of the primacy and unattainable perfection of divine truth reduced the status of any conclusions of early science to probability.[90] However, within scientific discussions, much attention was given to verifying the truthfulness of travelogues and experimental accounts.[91]

Using Ryle's terms, early-modern reflection upon scientific practices can be given as the history of "knowing how to move from acknowledging some facts to acknowledging others",[92] since "the advance of knowledge does not consist only in accumulation of discovered truths, but also and chiefly in the cumulative mastery of methods".[93] In the early-modern understanding, knowledge was structured as a system of arts, whose content could be represented as the branches of knowing-how. For instance, Wilkins's manuals on homiletics and his natural theology schemes together promoted the knowing-how of interaction with divine intelligence through the framework of special providence. From a modern point of view, the early-modern form of representing knowledge might seem too narrative, rhetorical, and inconclusive. However, the early-modern arts valued the operative and persuasive description of actions, and viewed the mastery of discursive performance as an essential criterion for justification. In this context, Wilkins's epistemological *disegno*, the artificial philosophical language project, was intended to improve the performative knowing of scientific discourse, suggesting how to operate natural taxonomies and

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89 Thomas Sprat, *The History of the Royal Society* (London: Printed by T.R. for J. Martyn, 1667), pp. 426-427, 367.
90 Ibid., p. 100.
91 See Sprat's *History*, as well as numerous secondary literature, including David Gooding, Trevor Pinch, and Simon Schaffer (eds.), *The Uses of Experiment: Studies in Natural Sciences* (Cambridge: Cambridge University Press, 1989).
92 Gilbert Ryle, "Knowing-how and Knowing-that", *Proceedings of the Aristotelian Society*, V. XLVI, 1946, pp. 212-225, p. 215.
93 Ibid., p. 224.

thus encouraging an increase in formalization and universality of the method of early science.

John Austin's and John Searle's elaborations on the concepts of performative utterances and speech acts help clarify further the relationship between *inventio*, hypothesizing, and early-modern practices of persuasion. As was mentioned at the start of this chapter, when defining the category of performative utterances, Austin states that they are neutral in terms of truth and falsity, possess perlocutionary force, and form a part of doing an action.[94] The reception of Austin's views suggested that the performative utterances, or performatives, may also come in "strict" and "extended" forms,[95] where "strict" or primary performatives[96] immediately form a part of doing some action, for instance, to say "I apologize" means to accomplish apologizing, i.e. saying immediately makes it so. The "extended" or secondary performatives may stand for primary performatives in specific situational contexts suggesting the doing of some action.[97] For instance, in the act of conjecturing, the use of secondary performatives would first open up a new discursive space, the space of hypothesis, which stands beyond the propositional parameters of truth and falsity. But then the context of the scientific practice, where the hypothesis originated, may support its probability-value. My study employs Austin's ideas about the performative features of utterances to explain the status and functions of scientific conjectures within the probabilistic paradigm of early-modern experimental philosophy. For instance, in Wilkins's cosmological narratives, the performative representation of the Copernican hypothesis allowed for its successful defense, as well as worked as an instrumental construct, in the manner of a "spiritual optic" for conjecturing about the technical means of space travel.

Summing up these detailed considerations on the concept of performative knowing, my study construes it as representing the mode of knowledge which allows

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94 John Austin, *How to Do Things with Words?* (Oxford: Clarendon Press, 1962), pp. 12, 5.

95 Jan S. Andersson, *How to define "Performative"* (Uppsala: University of Uppsala, 1975), p. 8.

96 On the distinction between "primary" and "secondary" illocutionary acts, see John Searle, *Expression and Meaning: Studies in the Theory of Speech Acts* (Cambridge: Cambridge University Press, 1979).

97 Roderick Chisholm, *Theory of Knowledge* (Englewood Cliffs, NJ: Prentice-Hall, 1966), pp. 16-17.

for the coherent apprehension of some experient knowing through an act of reference, accomplished with the use of the "cumulative mastery of methods", which results in opening up a new hypothetical perspective of discourse, the feasibility of which is supported through perlocutionary means. By using a form of "knowing" instead of "knowledge" for the basic term, I seek to highlight the contingent character of this mode of knowledge, which represents not so much a scope of information as a skill to be learned in practice. The concept of performative knowing will be instrumental for my subsequent analysis of early-modern dialectical and rhetorical strategies, as well as for characterizing their formative role in early-modern argumentative style, as exemplified in John Wilkins's writings on different subjects. In my study, the terminology of early analytic philosophy serves as the interpretative prism for looking into the heuristic functions of dialectical and rhetorical devices. Further in this chapter, I will employ the concept of performative knowing to review those techniques of dialectical rhetoric which influenced Wilkins's methods of narrative description.

The performing of rhetorical *inventio*

In early-modern discussions of natural philosophy, the scope of performative knowing involved the skills of processing the experient knowledge of phenomena through the procedures of *inventio*. The dialectical method of *inventio* was a strategy for finding material suitable for moving and persuading an intended audience. For instance, in John Wilkins's scientific narratives, in particular in *Mathematicall Magick* (1648), *inventio* assisted in assembling material on various mechanical wonders through the technique of *topoi*, otherwise known by the Latin name as *loci communes*. In Aristotelian rhetoric, *topoi* represented the categories that helped delineate the relationships between concrete phenomena. In the classical rhetorical doctrine of memory as a storehouse of knowledge, *topoi* were also part of the system of retrieval of information via well-defined search strategies. Throughout the

Renaissance and early-modern period, *loci communes* were widely applied in collecting scientific data and note-taking. Early-modern notation systems have enjoyed much scholarly attention in recent years.[98] Renaissance humanist learning was the first to emphasize the value of stockpiling notes for storing and classifying knowledge. Thanks to the availability of paper, the art of memory became supplemented with the art of producing the data that were retrievable from notes. In early-modern England, starting from Bacon, the practices of note-taking became an important instrument of the scientific revolution. The founder members of the Royal Society of London, as well as common artificers and family households, kept notes in the manner of commonplace books. No doubt, if we could only access John Wilkins's notes, it would provide us with a wealth of evidence on early experimental activities in London. Unfortunately, his personal archive, the legendary collection of scientific instruments and other curiosities, as well as the first draft of his artificial language project, did not survive the Great Fire of London in 1666. Nevertheless, his extant publications provide plenty of material for the analysis of his argumentative stylistics.

The efforts of the Renaissance and early-modern scientific rhetoric often aimed to overcome the restrictions of scholastic natural philosophy which reduced knowledge about nature to a consideration of propositions. By using the full resources of speech, dialectical techniques endeavored to facilitate the practices of experimental debates. In his foundational textbooks, Rudolf Agricola was one of the first to explore the relationship between the narrative and the argumentative parts of discourse, which was later elaborated in the textbooks of Ramus and Erasmus. Agricola related dialectic to coaxing where "what is said should be plausible and should be believed".[99] He rationalized persuasion, seeing the key to acceptability in the topics of invention, and not in tropes and figures which he viewed as "the bait

[98] See publications by Ann Blair, the ongoing project of Sietske Fransen (MPIWG), as well as Richard Yeo, *Notebooks, English Virtuosi, and Early Modern Science* (Chicago, IL: University of Chicago Press, 2014).

[99] Quoted in Peter Mack, *A History of Renaissance Rhetoric 1380-1620* (Oxford: Oxford University Press, 2011), p. 60.

for capturing ears".[100] Agricola's version of dialectical procedures provided a framework for the whole process of *inventio*, from *stasis* to *expositio*, reducing the role of rhetoric in the ancient sense to matters of style and the delivery of speech, such as tropes, voice, and bodily gestures.

Agricola's reform of rhetoric much facilitated the Renaissance method of *loci communes* and placed topical invention at the forefront of discursive development. The procedures of *inventio* placed an emphasis on establishing new relations between notions. Surrounded with a new relational context, an issue was viewed differently, which opened up new possibilities for argumentation. Aiming to make it clearer how to perform the new complicated topical *inventio*, Agricola visualized the procedures. His *De inventione dialectica* (1479) compares the allocation of an argument through topics to storing "jewels in a treasury". According to a diagram composed by Agricola's earliest commentator Phrissemius,[101] the topics became organized in the order of their logical remoteness from the subject matter, starting with the attributes that formed part of its own identity (species and properties), and ending with the aspects that were most distant from it (comparisons and opposites). This order resembled the Aristotelian scheme of categories, and as Peter Mack points out, "organizing the topics in this way was an attempt to instill some order and logic into the list of headings".[102] Although Agricola succeeded in structuring the argument to enhance its perlocutionary effect, his reform was not entirely successful in doctrinal terms, since the list of topics remained arbitrary, and the headings were not exhaustive. However, for Agricola's method, this seeming lack of order was by no means problematic, since he specifically suggested that the structure of dialectical invention and definition should not be prescribed by a fixed order of topics but should be contrived anew for each individual argument. The orator needed to process an issue through a number of topics, but he had a free hand in fashioning the argumentative narrative. Agricola also elaborated an understanding

[100] Ibid.
[101] Ibid., p. 63.
[102] Ibid.

of the narrative aspect of argumentation, emphasizing the fact that one and the same cause can be counted, by Aristotelian description, as the final, the assisting, or the efficient cause, depending on its placement in the argument.

For Agricola, the perlocutionary quality of a particular argument depended on the coherence of reconstruction of the subject matter. Referring to similitude as a connective figure, Agricola stresses the perlocutionary role of rhetorical techniques in the sense that they do not provide a direct proof but condition the mind to think in a particular way:

> [Similitude], if it is correctly applied, opens up a thing and places a sort of picture of it before the mind so that although it does not bring with it the necessity of agreeing, it does cause an implicit reluctance to disagree. … Similitude often has an appearance of proving by the very fact that it shows how something is. … Once someone has conceived the matter in his mind according to this image, he persuades himself that it cannot be otherwise.[103]

Agricola's dialectic was an intellectual instrument for creating belief, not detached from the experient knowledge of phenomena. On the contrary, each argument needed to depart from something that could be related to the audience's own experience. Agricola also advised that argumentative syllogistics, though employed, should be masked by the connective logic of commonplaces as if they were the major propositions. The most advantageous points should be supported with vivid metaphors, so that the audience feels the weight of these aspects.[104] Agricola does not repudiate the arousal of emotions but stresses the importance of consistency in successful argumentation.

Distinguishing between the various displays of logic, emotions, and persuasion within an individual argumentative style, Agricola nevertheless views discourse as a coherent enterprise, "a matter of density of texture, of the way material is presented".[105] The arrangement of discursive parts is conditioned by

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[103] Agricola, *De inventione dialectica*. Quoted by Peter Mack, *A History of Renaissance Rhetoric 1380-1620* (Oxford: Oxford University Press, 2011), pp. 64-65.
[104] Ibid., pp. 64-65.
[105] Ibid., p. 66.

experient knowledge, since the "density of texture" is arranged in order from the points closest to the audience's experience to the most speculative ideas. Agricola's advice about starting the discourse with vivid similitudes and then pursuing the perspective of less obvious logical argumentation made the dialectical and rhetorical strategies applicable for a whole range of intellectual tasks, including scientific experimenting. Agricola's reform transformed the main body of rhetorical learning from being primarily the art of styling to becoming a heuristic tool for discovering an argument.

Agricola's version of rhetoric provided effective means for the apprehension of what can be called in Russell's terms "experient knowledge". In the history of analytic philosophy, the idea of experient knowledge raised numerous debates,[106] but in the framework of the present study, it can help clarify the role of dialectical and rhetorical techniques in early-modern argument. As was mentioned before, Russell's notion of experient knowledge and Searle's notion of the reference act can be related to *stasis*, another rhetorical procedure within the framework of *inventio*, which facilitates the finding of connections between facts, arguments, and taxonomies. When introducing a new fact or category, it can sometimes be difficult to legitimately relate it to another fact or category within an argument or system. In Ciceronian rhetoric, which dominated in the late Renaissance, *stasis* represented a point of clash between conflicting pleas, which was employed in legal pleading but could also be applied to process any discursive theme.[107] *Stasis* meant the temporary refraining from judgment and exposing your subject matter to a series of questions coming from a variety of contexts, "the arguing of the case appears to stand in need of a demurrer and also of some alteration".[108] Employing the terminology of analytic philosophy, the argument "appears to stand in need of some alteration" because the experient knowledge of it refers to the different experiences of separate individuals.

[106] For a summary of these debates as of the late 1960s, see Paul Hayner, "Knowledge by Acquaintance", *Philosophy and Phenomenological Research*, V. 29, No. 3 (Mar., 1969), pp. 423-431.

[107] Cicero, "De inventione", *The Orations of Marcus Tullius Cicero*, trans. C. D. Yonge (London: George Bell & Sons, 1888), V. 4, pp. 241-380, Book I, 10-16.

[108] Ibid., Book I, 8.

However, the descriptive knowledge of it needs to infer some commonly shared perspective of reference, which is where the debates usually start. To perform *stasis* meant to question whether the considered legal deed or a definition may form part of an existing coherent system of reference, or whether this particular scope of reference yet remains to be discovered.

For successful *stasis*, Cicero advised the orator to find an appropriate viewpoint, from which the clashes of definitions can be plausibly resolved. In Russell's later terms, the debaters needed to locate a scope of experient knowledge, where the desired descriptions and definitions can be grounded in a plausible, non-contradictory way. Quintilian created an application of *stasis* for non-legal rhetoric:

> We must therefore accept the view of the authorities followed by Cicero, to the effect that there are three things on which inquiry is made in every case: we ask *whether a thing is*, *what it is*, and *of what kind it is*. Nature herself imposes this upon us. For first of all there must be some subject for the question, since we cannot possibly determine *what a thing is*, or *of what kind it is*, until we have ascertained *whether it is*, and therefore the first question raised is *whether it is*.[109]

For Quintilian, the question about the existence of a thing or an issue is crucial for promoting a "desire for knowledge" in the audience. In Russell's terms, it is imperative to start an argument by examining the experient knowledge of a thing or issue, as this needs to precede its descriptive knowledge. The performative knowing of *stasis* consists in locating such a scope of experient knowledge, which would provide enough grounding for the acceptable formulation of the desired descriptive knowledge. However, both types of knowledge need to be made "members of the same self",[110] i.e. the issue needs to be related to the experient knowledge possessed by most of the individuals within a specific audience.

Analyzing the category of *stasis*, Otto Dieter remarked that it was deemed the opposite of movement, which can be best understood through an analogy with the

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[109] Quintilian, *Institutio oratoria*, trans. Harold Edgeworth Butler (Cambridge, MA: Harvard University Press, 1922), Book III, 5:80-81.

[110] Dewitt Parker, "Knowledge by Acquaintance", *The Philosophical Review*, V. 54, No. 1 (Jan., 1945), pp. 1-18, p. 4.

physical sciences. *Stasis* is an occurrence between the movements of a subject in different directions, "it is both a stop and a start of a motion, the transitional standing at the moment of reversal of movement, single in number but dual in function and in definition".[111] *Stasis* meant stopping the discourse to ruminate on the possible paths of its further development. Richard McKeon in his *stasis* analysis notes that the procedure was meant to give a start to conjecturing about multiple worlds. *Stasis* meant questioning whether the thing (issue) was existing or not, i.e. fitting in ontological terms with the current experient knowledge of things in this world, or falling out of it beyond repair.[112] Since *stasis* was essentially a procedure for asking questions, it was logically neutral, which allowed for exploring diverse discursive possibilities without distorting existing beliefs. Considering the issue from different viewpoints also endorsed the subtle renegotiation of the matter, in order to "save appearances". The dual function of *stasis* as a stop and the beginning of a new movement made it into the point of emplotment for multiple discursive paths. For instance, John Wilkins's cosmological narrative employed *stasis* to muse on the material nature of the moon and open up possibilities for arguing that it represents a solid body similar to the earth, which would be a crucial support for Copernicanism.

As Lawrence Prelli notes, in *stasis*, the questioning equips the rhetor with the means of providing the audience with specific "hinges" for making their argumentative decisions.[113] The orator's speech builds on the experient knowledge of the audience, which is then translated into favorable preconceptual understanding. The accumulation of experient knowledge also increases the relevance of the issue, so that the procedures of *stasis* also work as the logic of relevance, serving as a compass of cognitive value and promoting a "desire for knowledge". The procedures of questioning in *stasis* have an effect like the focus of a lens, as they adjust the audience's concentration between the micro-context of an individual issue and the

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111 Otto A. L. Dieter, "Stasis", *Speech Monographs* 17 (1950), pp. 345-369, pp. 347-348.

112 Richard McKeon, "The Uses of Rhetoric in a Technological Age: Architectonic Productive Arts", *Essays in Invention and Discovery*, ed. Mark Backman (Woodbridge, CT: Oxbow Press, 1987), pp. 1-25.

113 Lawrence Prelli, *A Rhetoric of Science* (Columbia, SC: University of South Carolina Press, 1989), p. 46.

macro-context of more general beliefs, thus outlining the space for a discursive performance. In the modern application of rhetoric to science, Richard McKeon sees the procedure of *stasis* as the key point of developing an architectonic structure for promoting discoveries, as *stasis* bridges the gulf between the situational context of individual insights and the universalized context of epistemic justification. In early-modern scientific rhetoric, we find that *stasis* performs a similar architectonic function, particularly in language terms, since *stasis* provides the arena for connecting the language of the bodily arts with the language of formal demonstration. From this perspective, the concept of performative knowing refers to an essential competence in how to perform the discourse of natural philosophy, which involved the employment of rhetorical procedures, including *stasis*. Early experimental science used the procedures of actual and implied questioning as an instrument for directing discourse by building up experient knowledge and creating favorable preconceptions, on which to ground further plausible argumentation.

The discursive functioning of *stasis* can be compared with the "hinges", a term coined by Jacques Derrida. In his *Of Grammatology* (1976), Derrida follows Robert Laporte's advice and calls "the hinge" (*la brisure*) a situation where the continuum of discursive space and time is shifted through *différance*.[114] As Derrida explicates in the essay of the same name,[115] *différance* captures a specific phenomenon in the production of meaning, which consists in defining words and signs through an appeal to an additional set of different words and signs. In *différance*, the meaning is displayed but at the same time alienated from the reader through a chain of related signifiers. The experience of *différance* occurs outside the linear continuum of an argument; however, *différance* opens up dimensions for possible argumentative paths. Similarly, the procedure of *stasis* allows the orator to present a relational or experiential definition of the meaning in question, by

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[114] Jacques Derrida, *Of Grammatology*, trans. Gayatri Chakravorty Spivak (Baltimore & London: John Hopkins University Press, 1997 [1967]), pp. 66-67.
[115] Jacques Derrida, "Différance", *Margins of Philosophy*, trans. Alan Bass (Chicago, IL: Chicago University Press, 1982).

processing it through a series of related signifiers. Furthermore, a specific choice of these signifiers, working as argumentative prisms, enables the orator to adjust the contents of the meaning in question.[116]

Following Agricola, Petrus Ramus believed that rhetoric, if viewed as a practical dialectical system, should help coalesce even the most diverse notions into a coherent framework of the various branches of knowledge. Ramus's reformation of rhetorical teaching consisted in emphasizing the role of practice in composition exercises.[117] More space for live practice meant reductions in the classical theoretical canon of genres and styles. The point of Ramus's reform can be best clarified by comparing it with the procedures of logic. Aristotelian logic operated via simplified sentences made of nouns, adjectives, and quantifiers, and examined their possible variations. Classical rhetoric used to encompass a more complex and diverse range of sentences, accounting for various illocutionary and perlocutionary parameters. Ramus brought dialectical rhetoric closer to logic, reducing the number of parameters to be considered in rhetorical analysis, for which he was severely criticized. However, the simplified structure of dialectical art enabled students to produce more easily novel variations in rhetorical composition exercises. Ramus believed that upon performing the exercises with basic parameters, the students would learn how to extrapolate the combinatorial skills in real and more complicated rhetorical tasks. The advantages of Ramist rhetoric consisted in greater combinatorial freedom, which answered the purpose of fulfilling real argumentative assignments. Those more varied intellectual tasks eventually included scientific experimenting, and the Ramist version of dialectical rhetoric formed an immediate part of performative knowing in early-modern scientific discourse.

Ramus developed his own operational system of "places of argument", using the Aristotelian idea of *topos* and the tradition of commonplaces or "place logic".

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[116] A similar effect can be achieved by employing the figure of *ekphrasis*; see pp. 64-65 of this study.

[117] See Peter Mack, *A History of Renaissance Rhetoric 1380-1620* (Oxford: Oxford University Press, 2011), pp. 136-153.

The topically organized Ramist commonplace book was meant to work as a generator of novel combinations and permutations. Carolyn Miller agrees with Richard McKeon in her "The Aristotelian Topos: Hunting for Novelty" that routinely *topoi* were deemed the instruments of decorum, but they could also be perceived as sources of novelty due to their generative function.[118] To be rhetorically useful, a novelty needed to be allocated a place in the argument which would mediate between the known and the unknown. The method of *topoi* achieved this by specifying some well-known region of knowing, without specifying its precise content. Thereby, this region of the known, which in formal Aristotelian logic would be rather shielded with a definition, could be turned into a "region of productive uncertainty" producing new discursive sprouts. Experimenting with place-logic refreshed the structures of *topoi* and mapped the language resources with partitioned "scenes" of potential discourse or "sites of discovery".[119]

This part of the early-modern rhetorical legacy is especially relevant for my study, since John Wilkins's approach to language was clearly congruent with Ramist rhetoric, the way it was taught at schools in the sixteenth and seventeenth centuries. In particular, Wilkins's artificial philosophical language project relies on the background of Ramist dialectical rhetoric and Lullist combinatorics. Wilkins primarily elucidates his ideas on linguistics and epistemology in *An Essay towards a Real Character and a Philosophical Language* (1668), where he also repeats some material from the previously published *Mercury, or the Secret and Swift Messenger* (1641). Wilkins's language project follows the method of Ramist dialectical rhetoric in organizing the architectonic structure of categories into a multi-level semiotic network of topical "commonplaces". The graphic signs that he planned to use were meant to be as self-evident as possible, to create an operable and experientially transparent representation of scientific material. The four-level architecture of categories

[118] Carolyn R. Miller, "The Aristotelian Topos: Hunting for Novelty", *Re-Reading Aristotle's Rhetoric*, ed. Alan G. Gross, Alan E. Walzer (Carbondale, IL: Southern Illinois University, 2000), pp. 130-148, p. 130.
[119] Ibid., p. 141.

in the artificial language allowed for flexible distribution of meanings within the system, even if posing challenges in accommodating novelties.

Many artificial language schemes of the mid-seventeenth-century were based on Aristotelian universals, i.e. common types, properties and relations, and their derivatives. In contrast, Wilkins's project was based on Aristotelian "simple apprehensions", i.e. the most basic apprehensions that translated sensuous experience into thoughts through the operation of species.[120] Scholastic philosophy had long disputed whether simple apprehensions could be considered as true, since the Aristotelian position concerning them left room for interpretation. Aristotle implied that, since simple apprehensions participate in concept formation, they can be considered as leading to truth.[121] However, many scholars followed Aristotle's explicit guidance and maintained that only judgments, and not simple apprehensions, can be true or false. In any case, simple apprehensions could not be false, since what makes X a simple apprehension of X is conformity with X, i.e. X must be a true apprehension. This was an important part of scholastic doctrine, since it explained why the idea of God cannot be false, even though no human conception of God is adequate.[122]

Ramus had criticized Aristotelian approach for that it did not distinguish between *inventio* and judgment within dialectic.[123] Ramus's system needed this distinction to ensure more freedom for the procedures of *inventio*, as his pedagogy separated the learning of topics from the teaching of propositions.[124] Wilkins seems to follow the Ramist dialectical principle: he grounds his language scheme on simple apprehensions which come before judgment, cannot be false, and may lead to truth, so that the dialectical operations within his language scheme could not be prejudiced. Using the terms of analytic philosophy, Wilkins grounds his language project on the experient knowledge of species as notions (not things), which is

[120] Rhodri Lewis, *Language, Mind and Nature: Artificial Languages in England from Bacon to Locke* (Cambridge: Cambridge University Press, 2007), p. 199.
[121] Deborah K. Modrak, *Aristotle's Theory of Language and Meaning* (New York: Cambridge University Press, 2001), p. 65.
[122] Daniel Garber and Michael Ayers (eds.), *The Cambridge History of Seventeenth-century Philosophy* (Cambridge: Cambridge University Press, 1998), V. 2, pp. 1069-1070.
[123] Peter Mack, *A History of Renaissance Rhetoric*, p. 137.
[124] Ibid., p. 142.

derived from the analysis of their relations. The experient knowledge of species precedes their descriptive knowledge, so that the discourse could be grounded on the simple apprehensions of species and at the same time retain certain freedom of operations, also because Wilkins never insisted that his language scheme was final. Wilkins's artificial philosophical language project was to promote performative knowing in mind. The dialectical pattern provided the necessary formalization, and the hundreds of pages of species tables, which Wilkins never believed were completed, were meant to preserve the fullness of philosophical description. The next subchapter will consider the role of the rhetorical doctrine of *copia* in early scientific discussions.

The performativity of copia

The etymology of *copia* suggests that its original meaning, "natural plenty and figurative abundance", was primarily associated with spoken discourse, whereas the meaning of *copia* as "copy" appeared in connection with the medieval occupation of copying manuscripts, which made it related more closely to written texts.[125] The notion of *copia* as "the effective richness of discourse", which remained valid in rhetorical doctrines for hundreds of years, started to be formulated in Quintilian's *Institutio Oratoria*. Book X of the *Institutio* distinguishes copiousness from the mere imitation of ancient authors. In Quintilian's words, "imitation alone is not sufficient", because in that case "nothing would ever have been discovered".[126] While emulating the authoritative texts, the deep difference between the original model and its imitations consists not in the level of *mimesis veterum*, in which they may be equal, but in the purpose or the quality of the illocutionary force invested by the orator into a specific composition. In Quintilian's view, the difference between an original speech and an exercise in the emulation of famous authors lies in the

[125] Terence Cave, *The Cornucopian Text: Problems of Writing in the French Renaissance* (Oxford: Clarendon Press, 1979). p. 4.
[126] Quintilian, *Institutio oratoria*, Book X, 2:4.

degree to which "the models which we select for imitation have a genuine and natural force, whereas all imitation is artificial and molded to a purpose which was not that of the original orator".[127] Quintilian maintains that those who excerpt an abundant number of words and ideas from the works of famous authors may think themselves to "have produced the perfect *copia*", but in fact "words become obsolete or current with the lapse of years". In general, "they are not good or bad in virtue of their inherent nature" but "solely in virtue of the aptitude and propriety" with which they are arranged in respect to a particular context and intention.[128] The imitative work has "less life and vigor than actual speeches" not because of a lack of the imitator's skills but mainly because of the specific nature of their purpose which is "real" for the original and "fictitious" for any subsequent imitation.[129] Here, the distinction between the "real" and "fictitious" character of an oration is based not on the ontological status of its subject matter but on its illocutionary quality. This might seem peculiar but would appear less so if we remember that the techniques suggested by Quintilian were meant to facilitate primarily the agonal discourse of forensic oratory. Unlike Aristotelian syllogistics, which was primarily intended for producing conclusive written statements about the permanent properties of *cosmos*, Quintilian's discursive pragmatics was meant to reinforce the judicial polemics "on the spot", where the vividness of representation was no less important than logic.

For Quintilian, the subject matter of an oration could not be reduced to the words manipulated within rhetorical figures; but it could also not be reduced to Aristotelian "things" as the permanently definable entities of meaning to be manipulated through syllogisms. Quintilian chose the middle position, which is reminiscent of the modern philosophy of mind: he insists that the art of speaking is dependent neither on words, nor on subject matters themselves, but rather on the propriety of inventions concerning the subject matter, which he terms as

[127] Ibid., Book X, 2:11.
[128] Ibid., Book X, 2:12. Quintilian also defines the quality of rhetorical *inventio* in ethical terms, as the "life and vigor" of speech are derived from its good purpose. See Martin Procházka, "'New Languages': Pragmatism, Rhetoric and War in Shakespeare's Second Tetralogy and Ford's *Perkin Warbeck*", *Litteraria Pragensia*: *Studies in Literature and Culture*, Volume 23, No. 45 (September 2013), pp. 43-64, p. 49.
[129] Ibid., Book X, 2:11.

"thoughts".[130] The main point of rhetorical efforts consists in seeking ways for "moving" the thoughts and the mind as a whole, in particular, the judge's mind.[131] The focus on moving the thoughts in mind or prompting acts of thinking takes Quintilian's theorizing away from the fixed precision of Aristotelian logic and makes it aware of the volatility of cognitive responses.[132]

Quintilian also points out that Cicero's *De Oratore*, as well as other classical treatises, implies that the types of oratory can be classified not only by the subject matter but also according to the emotions instigated in the audience, however various those emotive reactions might be.[133] However, Quintilian himself prefers to summarize them into "three kinds of oratory", where "in each of them, part is devoted to the subject matter and part to display".[134] He distinguishes between the epideictic, the deliberative, and the judicial kinds of orations as the functional genera, under which some particular species will fall.[135] The subject matter of discourse is inseparable from its mode of "display" or speech performance, so that the category of the subject matter effectively becomes enriched with locutionary and situational features. Quintilian's suggestion shifts the meaning of "subject matter" towards "performative subject matter", which could answer the requirements of spontaneous polemical discourse.

For Quintilian, the performative intention forms an integral part of the subject matter, and both of them must be "real" for the speech to gain the necessary "force". The copiousness of discourse is linked to the available variety of fresh argumentative resources, in the absence of which the "performative subject matter" is not constituted. Therefore, copiousness primarily results not from the meticulous imitation of classical examples but from discovering uniquely appropriate "figures

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130 Ibid., Book XI, 1:7.

131 Ibid., Book VI, 2:3-6. On the role of epistemic emotions in Quintilian's approach, see Olga Tellegen-Couperus (ed.) *Quintilian and the Law: The Art of Persuasion in Law and Politics* (Leuven: Leuven University Press, 2003).

132 Ibid., Book XII, 2:11.

133 Ibid., Book III, 4:2-4.

134 Ibid., Book III, 4:14.

135 Ibid., Book III, 4:15.

of abundance".[136] It was not Quintilian's but Cicero's version of rhetoric that prevailed in humanist learning during the Renaissance. However, Bacon's approach to the style of scientific writing, and in particular his denunciation of excessive *imitatio veterum*, bore evident similarities with Quintilian's approach. In the *Advancement of Learning* (1605), Bacon describes the "first distemper of learning" as a consequence of Ciceronian stylistic domination, due to which "men began to hunt more after words than matter" and to care more about the terminology than about natural discoveries. As A.C. Howell noted in his account of the early-modern history of the *res et verba* dichotomy, in the later Latin edition of Bacon's *De Augmentis Scientiarum* (1623), the phrase about the excessive hunting after words is translated with a formula derived from Quintilian: "Curam ergo verborum, rerum volo esse solicitudinem".[137]

Within Quintilian's context employed by Bacon, both "words" and "subject matter" represent intelligible, not material, entities. Bacon positions these notions in the setting of the rhetorical figure of *antithesis*. According to the rules of rhetorical artistry, *antithesis* was built for being mediated, and indeed Bacon mediates *res* and *verba* in the course of his argument in *Advancement of Learning*. According to him, "words are but images of matter", which highlights the "matter" but also brings out the notion of image as an effective mode of representing thoughts.[138] However, even though supporting Quintilian's emphases on "matter" and "enargeia", Bacon refrains from reproducing Quintilian's "philosophy-of-mind" approach. Bacon agrees with a few points that were essential for Quintilian, such as that words can be images of matter because God framed the mind of man as a mirror capable of picturing the universal world.[139] Bacon also mentions several times the "life of

[136] Terence Cave, *The Cornucopian Text*, p. xx.
[137] A.C. Howell, "*Res et Verba:* Words and Things", *Journal of English Literary History*, No. 13 (1946), pp. 131-42, p. 133.
[138] In *Valerius Terminus* (1603), Bacon explicated his understanding of the role of visualization in cognition: "God hath framed the mind of man as a glass capable of the image of the universal world, joyning to receive the signature thereof as the eye is of light, yea not only satisfied in beholding the variety of things and vicissitude of times, but raised also to find out and discern those ordinances and decrees which throughout all these changes are infallibly observed". See Francis Bacon, *Valerius Terminus: of the interpretation of Nature* (1603), Chapter I "Of the limits and ends of knowledge".
[139] Francis Bacon, *Advancement of Learning*, Book I, Chapter I:3.

invention" as an indispensable cognitive value,[140] but he insists that fresh invention should be practiced more within the understudied realm of material things. Appreciating all the effective means of imparting scientific experience, Bacon values the experience of "things themselves" more than that of performative subject matter, i.e. he is interested less in the responses of emotions or inner senses, and is more fascinated with the responses of the outer physical senses. As will be analyzed in more detail in Chapter III of this study, Philip Sidney's famous criticism of the excessive adherence to *mimesis veterum* in poetry, although it was essentially different from Bacon's focus on the materiality of things, can be considered as a development parallel to the Baconian restoration of Quintilian's "philosophy of mind" approach.[141] In the England of the mid-seventeenth-century, scientific thinking followed the Baconian agenda of experimenting with the material properties of "things themselves". However, as for the description of these experimental practices, guidance also followed a Baconian agenda derived from Quintilian's advice on performing the discourse, as well as employing humanist literary techniques. Both of these strategies stressed the value of the "real" performative subject matter of discourse, which is constituted by the abundant originality of argumentative resources. Therefore, from all didactic perspectives, the scientific writers of John Wilkins's generation were obliged to seek out the unique "figures of abundance"[142] which would enable them to yield a wealth of original argumentation.

The Baconian strategy of mediating the *antithesis* between words and matter through an appeal to image and *enargeia* had been much elaborated by Rudolf Agricola in *De inventione dialectica* (1479). Agricola relied on Quintilian's work, especially his Book X of *Institutio oratoria,* where the notion of *copia* is linked to the delight incited by the profuseness of ingenious argumentative material.[143] Agricola sought to improve his method of dialectical invention in the part dedicated

[140] Ibid., Book I, Chapter IV:2ff.
[141] Philip Sidney, *Defence of Poesie* (London: Printed for William Ponsonby, 1595), p. 17.
[142] Terence Cave, *The Cornucopian Text*, p. xx.
[143] Peter Mack, *A History of Renaissance Rhetoric*, p. 70.

to finding the right kinds of examples and details to build an appealing and coherent argument. Like Quintilian's and Bacon's subsequent approach, Agricola's dialectic was neither primarily focused on operating mere words, nor on ordering the judgment about things. As was mentioned earlier, he distinguished his dialectical method both from pure rhetoric or stylistics and from the judgment rendered through propositions.[144] As Peter Mack notes, Agricola's definition of the scope of dialectic may appear somewhat negative,[145] but this *via negationis* contrasts with the importance that he ascribed to his dialectical techniques. For Agricola, dialectic was not about what to say, but "more positively, it is about how to think about what to say".[146] Agricola reproduces Quintilian's "philosophy-of-mind" approach to thoughts as mediators between words and matter.

Agricola's didactics emphasized the advantages of exercises in composition over passive studies of ancient authors. This practice involved comparing the words that an ancient author used with those that he could have used but did not, which is a utilization of Quintilian's more speculative advice about considering the effectiveness of rhetorical moves within the specific context of an encounter with an audience. The practice of considering the rich thesaurus of possible word-options was supposed to connect the orator with the reality of thoughts in mind. Another crucial element of the practice recommended by Agricola consisted in processing the key words of an argument through a list of topics, such as genus and species, whole and parts, adjacents and actions, efficient and final cause, place and time. Apart from providing a coherent structure, this also meant rendering an abundance of additional material to be present in a *copious* way, i.e. within the "figures of abundance" that would enhance the argument.

The focus neither on words, nor on things, but on thoughts in mind, as well as the ability to display an abundance of categorized details, enables the orator to subtly

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[144] Rudolf Agricola, *De inventione dialectica libri tres*, hg. von Lothar Mund (Tübingen: Max Niemeyer Verlag, 1992), L. II, "Materiam dialectices quaestionem esse, et quid alii de hoc senserint". Cap. VI, 30.

[145] Peter Mack, *Renaissance Argument: Valla and Agricola in the Traditions of Rhetoric and Dialectic* (Leiden: E.J. Brill, 1993), p. 120.

[146] Ibid.

but favorably adjust the frame of reference for his key concepts. For instance, when explaining the use of the topics of genus and species, Agricola effectively recommends placing the key concepts, as it were, into the uncharted space between the antithetical *topoi* and then see how these concepts might fit with the assigned categories. If necessary, a concept can be transferred to another genus, if it seems to share many essential features with one of its species.[147] Later, similar techniques proved fruitful for inventing new scientific arguments and even whole new scientific methodologies. For instance, John Wilkins applied in manifold ways a similar dialectical ploy to ground his main argument in such writings as *The Discovery of a World in the Moone* (1638) and *A Discourse Concerning the Beauty of Providence* (1649).

Agricola's interplay of antithetical categories is continued on the level of the list of topics themselves. All topics can be viewed as internal and external, i.e. as *topoi* related to the matter in question (such as genus, species, adjacents, actions), and those viewing the matter from the point of outside (such as causes, effects, place, time, opinions, comparisons).[148] External topics, which are less connected with the experient knowledge of the matter, are generally deemed to produce weaker arguments, but if an external topic can render an abundance of references reaching "the heart of the matter", this external topic may also help to build a strong argumentation.[149]

Agricola strove to turn the practice of processing the subject matter through the topics into an instrument for triggering thoughts about all possible kinds of arguments, claiming that his system reflects the natural order of all thinkable relationships between concepts.[150] This instrumental approach is largely based on analogies with visual perception, such as external and internal points of view, etc. Although arguing in terms of the language of words, Agricola employs a direct

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[147] Ibid., p. 132.
[148] This is how it was presented in Alardus's adaptation of Phrissemius diagram of Agricola's topics. Quoted in Peter Mack, *Renaissance Argument*, p. 146.
[149] Ibid., p 149.
[150] Rudolf Agricola, *De inventione dialectica libri tres*, L. I, Quid sit locus. Cap. II, 110; Divisio locorum. Cap. IV, 95.

comparison with the visual arts. As Peter Mack notes, an analogue with painting helps Agricola display a clear difference between the subject matter and its medium.[151] This was intended to persuade the students that both clear beautiful lines and clear beautiful speech may not spring solely from *mimesis veterum* but must result from industrious exercises in the art of invention. Besides, the visual analogues matched the existing rhetorical guidance on producing *enargeia*, stressing the necessity to bring the subject matter before the eyes of the audience through the detailed description and persuasive disposition.[152] Agricola's legacy was significant for the later formation of new scientific methodologies, also due to various other sensuous analogues that Agricola used on equal terms with those of visual perception.

In Book III, Chapter xv of *De inventione dialectica*, as well as less directly earlier, Agricola states that everything that appropriately appears in *dispositio* should be "brought before the eyes of the audience".[153] According to rhetorical doctrine, this effect of bringing the matter before the eyes could be achieved through several means, including the principles of *enargeia* or the vividness of details, but also by employing the technique of *ekphrasis* or the enhanced description of one work of art through the means of another art. Agricola employs *ekphrasis* in his next (and last) chapter which is entitled *De usu et exercitatione* and devoted to the significance of practical dialectical training. Agricola explains the nature of dialectical exercises through an analogue with the art of painting. Agricola's point (mentioned by Peter Mack) is that even after a student of painting has learned everything that is necessary for the art from his teacher, such as how to draw the lines of figures and apply shadows, the pupil's work will be of no real worth before he has faced his own probes and trials in producing a piece of art. The analogue with the visual arts is indicative of the principles of *enargeia*, however, some modern accounts tend to

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[151] Peter Mack, "Agricola's Use of the Comparison between Writing and the Visual Arts", *Journal of the Warburg and Courtauld Institutes*, V. 55 (1992), pp. 169-179, p. 179.

[152] Ibid., p. 172.

[153] Rudolf Agricola, *De inventione dialectica libri tres*, L. III, Cautiones aliquot inter argumentandum diligenter observandae. Cap. XV, 135.

disregard Agricola's precise emphasis at this point, which seems to refer equally to the visual aspect of painting and to its general bodily aspect. In his own words, the pupil will produce nothing of worth before he has "applied his own hand" to the studies, which involves making a lot of physically awkward first attempts.[154] The next thing Agricola states is that exactly the same applies to playing music,[155] which does not refer to the experience of visual perception but rather to the knowing-how of the physical skill or practical knowledge of playing. In Agricola's formulation, neither studies of harmonies nor the theoretical knowledge about the instrument, will bring about the dexterity of playing, unless by the means of exercising, the skill is "transferred into flesh and blood, and has become one's second nature".[156] Later, Agricola asserts that the same in fact applies to all fields of human activity, and the transferable skill of dialectic helps build the experience of human affairs.[157] At the very end of the last chapter of his set of three books, Agricola repeats once again this apparently crucial pedagogical proposition: dialectic is a skill similar to playing a musical instrument, where "the power of mind is so strong that one's hands and feet move without direct involvement of the intellect, and still are able to act upon external directions, playing previously unseen pieces".[158] Overall, Agricola seems to be less anxious about elaborating on the Renaissance instructions for producing *enargeia* as "bringing the matter before the eyes", but employs the technique of *ekphrasis* which refers more immediately to a wide range of sensuous experience. The figure of *ekphrasis* also yielded a particular kind of interpretative result, as it expanded the sense of what can be imagined to induce the reader to believe in the possibility of existence of previously unimaginable objects.[159] First in forensic

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[154] "cuncta haec quamvis à praeceptore perceperit, nisi tamen ipse admoverit tabulae manum, et multa tentaverit, multam operam spe profectus perdiderit, multaque prius fecerit improbanda, ne faciet quidem unquam, quae debeant aliquando probari". Rudolf Agricola, *De inventione dialectica libri tres*, L. III, Cap. XVI, 25.
[155] "Hoc idem in musicis contingit". Ibid.
[156] "qui modi, si non omnia diligens meditatio assuefecerit, firmaverit, indiderit, et prope in naturam verterit". Ibid., 35.
[157] Ibid., 55-60.
[158] "qui musicis organis canunt, tantum potest animi vis praestare, ut manus pedesque membra rationis expertia et sequentia alieni imperii nutum, non visos antea canendi modos propositos ex tempore psallant". Ibid., 125.
[159] See Claire Preston, "Ekphrasis: painting in words", *Renaissance Figures of Speech*, ed. Sylvia Adamson, Gavin Alexander, et al. (Cambridge: Cambridge University Press, 2007), pp. 115-129, pp. 116, 120.

oratory, then also in other descriptive genres, *ekphrasis* was employed as an instrument of "narratorial patterning", contributing to the significance of dialectic as a variation of intelligent performative knowing. This feature of Agricola's rhetorical pedagogy also develops Quintilian's point that the mastery of oratory means being able to consider the matter as if without thinking. Agricola's dialectical invention emulated the doctrine of *copia* as a means of revealing the "articulate energy" of speech through action.[160] Agricola's pedagogy answered the existing didactic needs: on the one hand, it denounced the excesses of *mimesis veterum*; on the other hand, it supported an emerging appreciation for practical crafts, which later facilitated the experimental study of nature.

Agricola's interpretation of dialectic as an intelligent practice was intended to promote an understanding of *copia* as neither a richness of words nor subject matter, but as a variety of performative cognitive experience. Terence Cave notes that initially Agricola's version of dialectical *descriptio* represented a system that produced *copia* independently of *verba* or *res*, simply by filling in the specific *topoi*. But later, in *De inventione dialectica*, the *descriptio* tends to display *res* through making the *verba* transparent. If the surface of discourse is properly and pleasantly animated, the topics appear to be "enacted"[161] and the language itself "disappears" from sight.[162] To evoke this notion of "transparent enactment" in a dialectical exercise, Cave employs the term "performance" instead of "practice", as the antonym to "theory". In this sense, "[p]erformance is the primary manifestation of the figures of abundance",[163] which in Agricola's case, means an abundance of transparent thought experience as a warranty for dialectical productivity. Further steps towards the implementation of this ideal were suggested by Desiderius Erasmus.

Erasmus improved further the capacity of rhetoric to accommodate the emerging needs of natural philosophy. The Erasmian version of *copia* encouraged

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160 Terence Cave, *The Cornucopian Text*, p. 5.
161 Ibid., p. 33.
162 Ibid., p. 30.
163 Ibid., p. xx.

writers to add more details to the argument, thus increasing the relevance and the fullness of incident in their narratives. The second book of Erasmus's *De copia* (1512) recommends generating an abundance of additional material to enhance the vividness of description. Erasmus praises colorful examples and juicy details as the effective means for communicating experience.[164] For Erasmus, the tools of dialectical invention and literary style complement each other in imparting combined intellectual and sensuous experience. In *Adagia* (1515), he exemplifies his own technique, describing in great detail the sights, sounds, and other occurrences of war, thus making the point that the successful combination of clear argumentation and suitable figurative language may arouse a certain moral denunciation.[165] This point became important in early-modern experimental practices, since experimental philosophy only claimed the probability of its conclusions, which attributed the highest epistemic authority to "moral certainty" and elevated the role of persuasion. Early-modern experimental philosophy copiously implemented Erasmus's rhetorical advice.[166] For instance, the records of the Royal Society of London strove to enumerate as many details as possible, including the social rank of witnesses to a specific experiment. The employment of dialectical strategies in the arrangement of particulars came to mark the difference between mere experiences and guided experimentation.[167] The written accounts of experiments were meant to impart the experience of presence with all human senses at the scene of events, and experimental philosophy appreciated the vividness of scientific communication. The mastery of applying language as an instrument for imparting experience became an integral part of performative knowing within the discourse of early science.

Erasmus' inspiration for *De copia* (1512) might have sprung from *Institutio*

[164] Ibid., p. 81-85.
[165] Ibid., p. 79.
[166] See Geoffrey Cantor, "The Rhetoric of Experiment", *The Uses of Experiment: Studies in the Natural Sciences* (Cambridge: Cambridge University Press, 1989), pp. 159-179.
[167] See Peter Dear, "Narratives, Anecdotes, and Experiments: Turning Experience into Science in the 17th Century", *The Literary Structure of Scientific Argument*, ed. Peter Dear (Philadelphia: University of Pennsylvania Press, 1991), pp. 135-161.

oratoria, Book X where Quintilian declined to give practical examples on how to achieve copious style, on the grounds that each case requires a unique solution. This may have challenged Erasmus to fill the gap by producing his own guidelines. From the start, *De copia* makes it clear that the abundance of style is not to be identified with the simple number of *res* and *verba*.[168] The key to *copia*, as well as the chief aim of Erasmian instructions, consists in composing the right "figures of abundance" or the forms that "include the essential in the fewest possible words".[169] The performance of thought can be enhanced or disfigured by the style,[170] and performing with the "figures of abundance" requires a certain ingenuity,[171] which implies that the essence of epigrammatic and copious discourse lies in the "pointed brevity"[172] of description. The use of metaphors may facilitate this figurative performance, especially when certain *verba* are yet missing from the ordinary language in the equivalent for particular *res*.[173] The "figures of abundance" help setting up *peristases* or the distinctive situational circumstances which can "fill out the whole case and reinforce it with close-packed convincing details, and even if you do not deploy them and lead them out to battle, so to speak, they fight on their own and contribute not a little to the winning of the case".[174]

In Terence Cave's words, Erasmus' recommendations for the successful performance of discourse are reduced in theory and enriched in *exercitatio* or *experientia*, i.e. "the practice is already gaining the upper hand over codified theory",[175] which was congruent with the methodological mottos of early-modern experimentalists. However, in terms of theory, Erasmus advises the writers to follow the multiple existing patterns of *mimesis*, so that their "figures of abundance" remain diverse, which is intended to ensure their original and ingenious quality. Within the

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168 Desiderius Erasmus, "De copia", *Collected Works of Erasmus*, ed. by Craig R. Thomson (Toronto: University of Toronto Press, 1978), p. 5.
169 Ibid., p. 301.
170 Ibid., p. 306.
171 Ibid., p. 580.
172 Ibid., p. 687.
173 Ibid., p. 335.
174 Ibid., p. 592.
175 Terence Cave, *The Cornucopian Text*, p. xi.

Erasmian tradition, the doctrine of *copia* provided guidance on how to productively mediate *res et verba*, avoiding the dictate of theory, and instead cultivate a taste for the ingenuity of intellectual performance as a warranty for epistemic success.

By the end of the sixteenth century, Erasmus' approach spread widely on English soil,[176] as can be seen, for instance, from Gabriel Harvey's lecture delivered in 1576. There he urges his students to "learn from Erasmus to keep an abundance of words with an abundance of matters" and "pay attention not only to the brilliant greenery of words, but more to the ripe fruit of meaning and reasoning".[177] The mood displayed by Harvey resembles that of Sidney and Bacon, even though the founders of English literary and scientific language created very different applications of Erasmian doctrine.

Summing up the contents of the methodological chapter of my study, I employ the concept of performative knowing to pinpoint a specific mode of scientific competence, which allows for the coherent apprehension of a variety of experient knowledge by means of processing it through an abundance of reference acts, which results in discovering new heuristic solutions. In Terence Cave's words, performative knowing reveals the figures of abundance for a certain scope of experience, balancing the structures of *inventio* and the fullness of *copia*. The concept of performative knowing will be instrumental for my further analysis of the early-modern use of dialectical and rhetorical techniques in their heuristic function. By singling out the expertise of "performative knowing", my thesis seeks to create a framework for considering the dynamics within the heuristic line of scientific development. From outlining the procedures of dialectical *inventio* of an argument, which were a characteristic part of early-modern scientific writing, I intend to proceed to describing specific intellectual and technical inventions, which were arrived at in Wilkins's writings on science, theology, and linguistics. This pattern,

[176] For an account of the impact of Erasmian theories in England, see Neil Rhodes, *The Power of Eloquence and English Renaissance Literature* (New York: Palgrave Macmillan, 1992).

[177] Gabrielis Harveii Ciceronianvs, Vel Oratio post reditum, habita Cantabrigiæ ad suos Auditores (London: Henry Bynneman, 1577), F2v–F3r. Quoted in Abigail Shinn, Angus Vine "Theorizing copiousness", Renaissance Studies, V. 28, Issue 2 (April, 2014), pp. 167-182, p. 170.

from argumentative *inventio* to technical invention, will be reproduced in each chapter, as well as determining the general course of my study, from describing the techniques of dialectical *inventio*, employed by Wilkins, to depicting Wilkins's most accomplished invention, his "darling" project of artificial philosophical language.

Chapter II

Inventio and the discovery of the moon

No places distance hindring their Commerce
Who freely traffick through the Universe,
And in a minute can a Voyage make,
Over the Oceans universal Lake.

Sir Francis Kinaston
To Mercury the elder (1641)

According to Paul de Man's interpretation of Blaise Pascal's views, early-modern discursive analysis widely accepted the idea that the language of proof and the language of pleasure should be different. The language employed for establishing the truth of certain statements and the language satisfying the desire for aesthetic or epistemic novelty were to feature dissimilar pragmatic and stylistic characteristics. However, in some cases, especially when the situation required finding a solution for a nontrivial problem, these divergent argumentative strategies might overlap. Somewhat pessimistically, Pascal admitted that man, although accessible to the language of reason, is much more susceptible to the language of seduction. On certain occasions, in particular during times of political change and epistemic confusion, the languages of rigor and those of rhetoric might form a binary opposition or "a dubious balance" in the mind, initiating "a combat of which the outcome is very uncertain".[178]

Pascal suggested a way out of this basic controversy between proof and pleasure, proposing to focus on the performative faculty of mind, which finds in one the features of the other. He suggested to deconstruct the strict opposition between proven reality and pleasant fiction, not to downgrade the status of reality, but to bring out the realm of individual experience of the interplay between the two. Instead of categories, the domain of experience is structured through the figures of

[178] Blaise Pascal, *De l'esprit géométrique et le l'Art de persuader.* Quoted by Paul de Man, "Pascal's Allegory of Persuasion" in *Allegory and Representation: Selected Papers from the English Institute, 1979-1980,* ed. Stephen J. Greenblatt (Baltimore: The John Hopkins University Press, 1981), p. 4ff.

apprehension as “a single system of exchange that is structured like a trope”.[179] The focus on experience also transforms the distinction between discovery and justification, as well as between popular and professional knowledge. Without being merged, they are “pursued toward a totalization that may be infinitely postponed, but that remains operative as the sole principle of intelligibility”.[180] Figural language provides feasible patterns for the apprehension of experience, which reveals the clandestine coherence of things. Unlike propositional statements, the language of figures, including the figures of dialectical rhetoric, allows one to perform the discourse, aiming at an intuitive apprehension but also creating an articulated cognitive experience.

Shortly before the time of Pascal’s publications, John Wilkins, who held more optimistic views on human nature, elaborated pragmatically on the scientific use of the techniques of dialectical rhetoric. Wilkins’s argumentation interchangeably employed the tools of the cognitive and the performative language. For instance, his scientific narratives interlink the persuasive authority of ancient historical accounts and the data of the contemporary astronomical observations, to productively rework the opposition between the scholastic and the experimental paradigms of natural philosophy.

At the time, the established scholastic mode of natural studies was reproduced through the specific socio-professional identity of the ordained university faculty. The emerging experimental ways of doing science promoted an appeal to those aspects of their competence, which remained marginal within the scholastic text-commenting methods of epistemic justification. Most conspicuously, this concerned the gaining of scientific insights through the direct interaction with “things themselves”. Wilkins’s narratives created a space of overlap for the contexts of exploring the “things themselves” and text-commenting. This not only highlighted the individual experience of discovery but also emphasized the interfaces between the domains of individual and collective experience.

[179] Ibid.
[180] Ibid., p. 7.

Wilkins's *The Discovery of a World in the Moone* (1638), instead of enumerating the classical historical testimonies or citing the newly acquired observational data, employs the performative properties of language to focus the reader's attention on his or her own experience of discovering the new cosmological knowledge, which can be named the practice of making knowledge for themselves. The Chapter II of my study will consider the methods behind Wilkins's early hypothetical cosmological constructs, which should also provide a perspective on his subsequent writings. I will first review the intellectual context of Wilkins's astronomical treatise and then analyze the main aspects of the epistemological legacy of Wilkins's first scientific publication.

Wilkins's astronomical narrative in the context of natural philosophy

Approximately what we now call "scientific knowledge" was referred to by the seventeenth-century British intellectuals as "natural history", marking a similarity in the subject matters and the methods of study of both history and nature.[181] Ancient sources, which were highly respected by the Renaissance humanists, had associated history with the realms of politics, uncertainty, probability, and changeable experience. History accounted for volatile, temporary occurrences and received a lower standing, according to classical epistemic ranking. In contrast, studies of nature were linked to more prestigious disciplines of philosophy, which produced certain truth and the permanent conclusions of logic. However, at the turn of the sixteenth to seventeenth centuries, the practices of learning within the discipline termed "natural history" benefited from combining the logical and theoretical apprehension of phenomena, and the vividness of experiential scientific accounts. The overlap in epistemic values brought out the commonalities between socio-professional practices: on the one hand, the sustainable understanding of nature was reproduced through studies of historical sources in the

[181] John G. Burke, Introduction to Barbara Shapiro & Robert G. Frank, Jr., *English Scientific Virtuosi in the 16th and 17th Centuries* (Los Angeles: University of California Press, 1979), p. vi.

framework of university curricula; on the other hand, the encounter with new natural realities occurred through amateur experimenting at less institutionalized clubs and societies.

This strategy for creating a performative fora for communication between classical historical scholarship and "courtly" experimental learning proved to be a very successful one in early self-defence of Copernican cosmology.[182] For instance, Galileo composed his *Dialogue on the Two Chief World Systems* (1632) as a series of carefully staged appearances, resembling the popular episodes of *Commedia dell' Arte*. In Galileo's imaginative dialogue, the philosophers Simplicio (a Ptolemaic supporter) and Salviati (a Copernican) compete to win the good opinion and agreement of Sagredo, an intelligent layman and a neutral bearer of common sense. Galileo's *Dialogue* was not only performative in itself but also assumed a sympathetic and perceptive audience. Galileo's readers were expected to possess a certain familiarity with geometry, the methods of observations, and thought experiments, as well as to appreciate the non-pedantic innovative terminology of courtly scientific debates. This elaborate specialized language answered the pragmatic purposes of immediate interaction with "things themselves" but also satisfied the Renaissance cultural appetite for the *ingenuous*, i.e. the dignified state of intellectual freedom gained in the critical assessment of political, cultural, and philosophical issues. The metalanguage of Galilean performative rhetoric contributed to creating a new socio-linguistic identity for the adepts of the new culture of astronomy.[183] Wilkins acknowledges Galileo's *Dialogue* as one of the main sources of inspiration for his *Discovery*.

In spite of Baconian warnings concerning the malice of the "Idols", mid-seventeenth-century England widely employed the rhetorical means of supporting scientific claims. Natural philosophers often had no choice but to defend their acquired insights with staggering rhetoric, even if equally fiercely repudiating

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[182] See Mario Biagioli, *Galileo, the Courtier* (Chicago and London: University of Chicago Press, 1993).
[183] See Pietro Daniel Omodeo, *Copernicus in the Cultural Debates of the Renaissance Reception, Legacy, Transformation* (Leiden: Brill, 2014).

rhetorical gestures on the part of their opponents. For instance, the controversy between John Wallis, a personal friend of Wilkins, and Thomas Hobbes, a rigid denouncer of rhetoric in natural studies, may provide an illustration of how rhetorical persuasion was employed in early-modern mathematical disputes. Hobbes's *De corpore* (1655) presented a claim on squaring the circle, which was not accepted by the mathematical community, and led to a series of debates involving a whole group of renowned mathematicians for about two decades. Hobbes approached geometry from a kinematic position, viewing the interaction of lines in terms of the properties of matter in motion. This caused a lot of discussions about the method of kinematic geometry and Cartesian analytical geometry as two different strategies of mathematical thinking. From the start, both Hobbes and Wallis admitted that the controversy was not merely mathematical but touched upon epistemic and theological matters.[184] Questions of ordinary language were also resurfacing in this discussion, and the emphasis that Hobbes and Wallis placed on the use of literary expressions in their technical argument demonstrates that seventeenth-century mathematicians attributed a lot of significance to linguistic matters. In particular, both Hobbes and Wallis employed eloquence to reveal a lack of epistemological depth in the approaches of an opponent.[185] Considering some of the titles appearing between 1655 and 1674, we find such formulae as *Elenchus geometriae Hobbianae* (Wallis, 1655), *Six Lessons to the Professors of the Mathematics* (Hobbes, 1656), *Marks of the Absurd Geometry, Rural Language, Scottish Church Politics, and Barbarisms of John Wallis* (Hobbes, 1657), and *Hobbius heauton-timorumenos* (Wallis, 1662). *Heauton Timorumenos* or *The Self-Tormentor* was a popular play by Terence,[186] featuring a character punishing himself

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[184] Hobbes perceived the infinitesimal calculus to be a method that might potentially revive scholastic speculations.
[185] Douglas M. Jesseph, *Squaring the Circle: The War between Hobbes and Wallis* (Chicago and London: University of Chicago Press, 1999), p. 331. On Hobbes's employment of specific rhetorical techniques, see also Luc Borot, "Hobbes, Rhetoric, and the Art of Dialogue" in *Printed Voices: The Renaissance Culture of Dialogue*, edited by Dorothea B. Heitsch, Jean-François Vallée (Toronto: University of Toronto Press, 2004), pp. 175-192.
[186] Terence, or Publius Terentius Afer (195-159 BC), a playwright of comedies whose most famous quotation from *Heauton Timorumenos* was "Homo sum, humani nihil a me alienum puto", "I am a human being, I consider nothing that is human alien to me". At the time of the debate, the play itself and the well-known quote from it were part of commonplace literary education, and therefore could be supposed to add colours to the allegorical palette of the controversy.

with excessive severity for a misunderstanding caused by his words being taken literally, instead of interpreted figuratively. Hobbes viewed geometry as a demonstrable art where the conclusions were partly derived from the tacit content of preconceptions. This popular Renaissance view of geometry can be related to the methods of *inventio*, based on visualization through drawing, which was exemplified in Leonardo's series of drawings on squaring the circle. Wilkins was personally involved in the Hobbes-Wallis debate[187] which demonstrated that many discussions concerning the matters of geometry (and the disputes on cosmology were part of them) were not free from the involvement of rhetoric both on practical and theoretical levels. The strategies of the performative presentation of claims and those of verbal persuasion were important in terms of epistemic theorizing, as well as in terms of its empirical implementation.

Towards the mid-seventeenth century, the "unified art of discourse"[188] within the broadly construed field of natural history recombined in itself the elements of logic, dialectic, and rhetoric. The emerging argumentative style had to sustain the contrary pulls of narrative vividness and rigorous verification, aiming to impart scientific experience through the performative elements of discourse. The techniques of dialectical rhetoric formed part of the core university curricula and were employed not only as the most feasible tool for conveying experience but also for coping with a diverse multitude of scientific data. The practices linked to *loci communes* helped organize the realm of raw experiential information. On the one hand, they permitted scientists to disseminate experimental results across the disciplines, on the other hand, humanist techniques of assessing the quality of narratives provided evidential criteria for the evaluation of accounts within natural history. The base of this pyramid of the ranks of knowing was occupied by hypothesis, followed by opinion, probability, and moral certainty in the higher

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[187] Although in 1650 Wilkins's poem prefaced an edition of a part of Hobbes's *Elements of Law*, after the publishing of *Leviathan* (London: Printed for Andrew Crook, 1651) and *De corpore* (London: Printed for Andrew Crook, 1655), many of Hobbes's allies distanced themselves from his claims. In 1656, Seth Ward dedicated to Wilkins his *In Thomae Hobbii philosophiam exercitatio epistolica*, which represented a critical review of Hobbes's position.

[188] Barbara Shapiro, *Probability and Certainty*, pp. 4-8ff.

ranks. Usually, the debates started with the vivid performative presentations of hypotheses, and continued by arguing the probability of the proposed statements, and establishing the moral certainty of the suggested propositions.

In comparison with the scholastic discursive model, which aimed at the logical infallibility of its claims, the experimental model raised the epistemic significance of the notion of probability. Between the hypothesis and the moral certainty, as the points of beginning and ending of a certain discourse, the central locus of debate was occupied by probability, because for the most part, the discussants were claiming the probability of their statements. This also extended the understanding of belief from a notion pertaining to theology to a broader attitude of assent about the matters of natural causality.[189] The discussions, which were focused on the probability of statements concerning experience, required a new standard for consensual truth.[190] Apart from the humanist criteria for the quality of narratives, which depended on how they fulfilled the function of imparting experience, specific regulations concerning "eye-witnessing" were employed for attaining assent about experimental propositions.

However, as Galileo had reasons to complain earlier, the knowledge obtained immediately from observations often could not be perceived or accepted as probable or even trustworthy.[191] In addition to the doubts cast by the scholastic paradigm, theories of vision began to question the character of the perception of visible objects. In 1609, Galileo's astronomical investigations were facilitated through building of the telescope which magnified objects up to thirty times and produced a blurry but straightforward and non-inverted image. Kepler improved the Galilean telescope, using a convex lens instead of a concave one as the eyepiece, which allowed him to increase the light-gathering power of his device but at the same time displayed an inverted, upside-down image for the viewer. Kepler's experiments confirmed that

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[189] Barbara Shapiro, Robert G. Frank, Jr., *English Scientific Virtuosi*, pp. 23-25.

[190] See Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life,* (Princeton, NJ: Princeton University Press, 1985).

[191] Elizabeth Spiller, *Science, Reading and Renaissance Literature. The Art of Making Knowledge, 1580-1670* (Cambridge: Cambridge University Press, 2004), p. 115.

within the eye the light rays also cross, and the produced image is inverted in a similar way. His theory of vision interpreted the "pictura" produced on the retina as "a real optical image", but that was not enough to eliminate the question of how the "pictura" is linked to the function of subjective visualization. Kepler became interested in "how an infinity of rays from each point in the visual field is drawn into a coherent, point-to-point correspondence in the eye."[192] The issue of how a coherent projection of the world may be constituted from the infinity of sensuous experience received new interest and formulation on the level of optical theories. Later on, optical and anatomical constructs were supplemented with some new theorizing on sensuous apprehension, which allowed the scientific community to ground theoretically the acceptance of eye-witnessing as a criterion for probability. Wilkins's astronomical narrative also had to take into account the accepted methods of arguing the probability and achieving assent for astronomical propositions derived from visual experience.

While optical theories emphasized the geometrical modeling of vision, in the early seventeenth century, emerging interest in the material properties of light provoked a shift "from sight to light" in the theorizing on perception. In 1637, the year preceding the publication of Wilkins's *Discovery*, Descartes' *Dioptrique* appeared in print as part of his *Discours de la méthode*, suggesting various models for understanding the nature of light. Descartes' examples depicted light as both liquid continuum and discreet corpuscular substance, which may have remotely contributed to the later perspective of construing light as both waves and particles.[193] *Dioptrique* compared visible light to "subtle material" that flows like the juice of grapes in a vat, and then also to a tennis-ball that "reflects" off the walls. However, the primary challenge in the Cartesian system consisted in connecting the observer and his object. In relation to vision, Descartes attempted to overcome the

[192] Quoted in Robert A. Hatch, "Vision", *Encyclopaedia of the Scientific Revolution: From Copernicus to Newton*, ed. Wilbur Applebaum (New York: Garland, 2008).
[193] For a study on the further role of these metaphors in the physics of light, see Geoffrey Cantor, "Weighing light: the role of metaphor in 18th-century optical discourse", *The Figural and the Literal. Problems of language in the history of science and philosophy, 1630-1800*, ed. Andrew E. Benjamin (Manchester: Manchester University Press, 1987), pp. 124-146.

conventional dualism by treating eyesight as a manner of touch, comparing light to a blind person's stick or a sensitive medium for discerning the shapes of objects.[194] Mid-seventeenth-century British natural philosophy supported these mechanistic theories of perception, but questions about the recognition of images remained treated in terms of semiotics. Towards the end of the century, as theories of vision became the concern of the medical and optical sciences, the philosophy of vision shifted back "from light to sight", drawing more attention to the properties of the "sensitive subject". Wilkins's thinking followed this trajectory, and his early astronomical narratives employed various dialectical and rhetorical techniques to achieve assent in the interpretation of the depicted visual experience of astronomical phenomena.

Mid-seventeenth-century philosophers of language generally held the opinion that mental reckoning is performed with conventional linguistic signs. Bacon's *Advancement of Learning* distinguished between artificial and natural "divination". The first was performed through an argument, which involved signs and tokens; the second was presented to the mind "without the inducement of the sign".[195] Using Russell's terms, we might interpret this distinction as the difference between a descriptive knowledge that is expressed in signs, and an experient knowledge that is present in the mind without any process of inference.[196] Bacon already supported the idea of the conventionality of signs, since he contrasted *lingua Adamica* with human language, which is fraught with "Idols" and devoid of a proper natural connection with things.[197] Following Bacon, language was viewed as a translational tool that transformed the trains of thoughts into the sets of arbitrary sounds that formed trains of words. Towards the end of the century, John Locke replaced the conception of words as the arbitrary tokens for concepts with an understanding of words as "signs for internal conceptions" that can also operate "a multitude of

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[194] For scholarship on Descartes' theory of vision, see Celia Wolf-Devine*, Descartes on Seeing: Epistemology and Visual Perception* (Carbondale, IL: Southern Illinois University Press, 1993).

[195] Francis Bacon, *Advancement of Learning*, Book II, XI, 2.

[196] These terms of Russell's are explored in more detail in Chapter I of this study.

[197] Lia Formigari, *Language and Experience*, p. 11.

particular things",[198] which highlighted the fact that natural philosophy was dependent on the language of knowledge articulation.[199] But already in the late 1660s, some sceptical readers of Robert Hooke's *Micrographia* (1665), such as Margaret Cavendish, would insist that the "patterning" of the visible world must influence the conclusions derived from our observations, and looking at "things themselves" in fact means "reading of the signs".[200]

The Royal Society was only once attended by the Duchess of Newcastle, which was the only female visit to the Society in the seventeenth century, and resulted in raising very moderate mutual sympathy, as the Duchess remained silent most of the time.[201] However, the Society did view the problem of the "patterning" of the visible world, for instance, in experimental reports and travelogues, as a crucial one on the agenda. The minutes and protocols of experiments could specify the procedures for eye-witnessing and increase the moral certainty of experimental results. The assent of a large number of respected and qualified witnesses could also resolve positively the intellectual fate of a proposition. But many authors continued naming language itself as an influential agent in attaining knowledge, which meant that the adequacy of visual perception and that of verbal expression were closely interrelated.

Around the time when Wilkins was composing the *Discovery*, the issue of the patterning of natural reality through vision was also considered in the semiotic theorizing of artistry. Kenelm Digby's *Of Bodies and of Man's Soul* (1644) criticized the tendency of the human intellect to discern things according to the "pictures" of them in the mind, instead of conceiving of them according to their nature. Digby synonymized "conceptions" and "images", which both represented multiple facets

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[198] John Locke, *An Essay Concerning Human Understanding* (London: S. Manship, 1690), Book III "Words", Chapter I, 2-3. See also Chapter II of Locke's *Essay*.

[199] For a comparative account of Locke's contribution to this development, see Lia Formigari, *Language and Experience*, pp. 98-99.

[200] Elizabeth Spiller, *Science, Reading and Renaissance Literature*, p. 162.

[201] In the seventeenth century, the corporate attitude to female presence was made explicit by Abraham Cowley in his "Ode to the Royal Society" (London: J. Martyn, 1667): "Philosophy, I say, and call it, He, / For whatsoever the Painters Fancy be / It a Male Virtue seems to me". The Society was never officially barred to women, but it was impossible for any woman to join it before well into the twentieth century, and even today the current share of female fellows comprises up to 6%.

of an object and could instigate us "out of our unwary conceit" to "give actual Beings" to accidents of things "as if they were different Entities".[202] Digby criticized Thomas Browne's *Religio Medici* (1643) in his own hastily composed *Observations on Religio Medici* published in the same year, where he emphasized the role of ingenuity in finding true patterns in nature through the practice of the arts, as opposed to the significance of imagination and "faith alone", which he saw Browne endorsing.[203] Around the 1640s, discussions on the patterning of natural world left room for literary applications. Wilkins's treatise on astronomy was one of the pioneering works employing a variety of rhetorical and dialectical techniques for promoting the ingenuity of hypothetical performativity in the interpretation of observational experience.

Before the introduction of Newtonian mathematical determination, many fields of natural studies, including astronomy, lacked the means of computational proof. This necessitated the use of other means of persuasion, in particular, because early-modern experimental discourse evaluated the argued propositions on the basis not of truth-value but of probability-value. Thomas Kuhn noted that modern scientists "don't see something as something else, they simply see it",[204] but in the seventeenth century, they tended to notice numerous obstacles in the way to "things themselves". In Merleau-Ponty's words, early science "clung to a feeling for the opaqueness of the world, and it expected through its constructions to get back into the world".[205] The instruments that should have facilitated the "reading of the phenomena" from the pages of the book of nature included the lenses of telescopes and microscopes, as well as the "blazing worlds" of imaginative literary produce. For instance, *The Blazing World* (1666) by Margaret Cavendish offered not only a romantic adventure story but also a hypothesis on the possibility of reaching different worlds, with "each of these Worlds having its own Sun to enlighten it", and

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[202] Kenelm Digby, *Of Bodies and of Man's Soul* (London: John Williams, 1669), p. 3.
[203] For a concise comparison of Digby's and Browne's views on the notion of *religio medici* see Henry Craik, "The Critical Introduction on Sir Kenelm Digby", *English Prose* (New York: Macmillan Company, 1916), V. II.
[204] Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1972), p. 85.
[205] Maurice Merleau-Ponty, "The Eye and Mind", *Basic Writings* (New York: Psychology Press, 2004), p. 291.

even though “they being too far off to be discern by our optick perception”, “skillful Astronomers have often observed two or three Suns at once”.[206] In the words of Cavendish, “Novelty discomposes the mind, but acquaintance settles it in peace and tranquillity”.[207] The performative elements of discourse, “far from being a mere ornament, became the key to the expansion of understanding beyond its current limits”.[208] Using Russell’s terms, the performativity of discourse built “knowledge-by-acquaintance”, which substituted for the often lacking experient knowledge of recently discovered phenomena. Wilkins’s early work employed the performativity of narrative descriptions to approximate the experient knowledge of the moon and present the remote celestial body as one of the accessible “things themselves”.

The Copernican context and the visualizations of the moon

Wilkins’s first book went through several editions and circulated well in Europe. The third edition of the *Discovery*, published in 1640, formed the basis for its second French translation made by Sr. de la Montagne in Rouen in 1656. De la Montagne particularly praised Wilkins for his decisive refutation of scholastic dogmas and his extensive citing of ancient and contemporary astronomical theories. In the 1640 edition, Wilkins added a proposition on flying to the moon, as well as a second part of the discourse entitled *Concerning a new planet, tending to prove, that (“tis probable) our earth is one of the planets*, in which he defended Copernicanism against a variety of Catholic and Ptolemaic allegations.

Employing humanist literary techniques,[209] Wilkins composed the *Discovery* as a compendium of astronomical knowledge and its history.[210] The fusing of history and natural philosophy into a discipline called “natural history” allowed the

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206 Margaret Cavendish, *The Description of a New World, Called The Blazing-World* (London: Printed by A. Maxwell, 1668), p. 6.
207 Ibid., p. 8.
208 W.H. Leatherdale, *The Role of Analogy, Model and Metaphor in Science* (Amsterdam: North-Holland Publishing Company, 1974), p. 125.
209 For a systematic study on the reception of cosmological ideas in literary produce, including early-modern examples, see Monroe Spears, *One Writer’s Reality* (Columbia: University of Missouri Press, 1996), esp. pp. 21-39.
210 Dmitri Levitin, “The Oxford Experimental Club”, presentation at symposium “John Wilkins and His Legacy”, University of Oxford (Wadham College), 15.09.2014.

seventeenth-century astronomers to tackle some conceptual problems through historical appeals.[211] Ancient historical accounts were used rhetorically to function as auxiliary "patches", which assisted in "saving appearances" for the new cosmology. The notion of "saving appearances" is used here in the technical sense of explaining the complex observed trajectories of celestial motions or "appearances". Ancient astronomy saw one of its goals as "rescuing" the postulates of the Ptolemaic system through the ordering and coordination of observational data. Various argumentative devices were invented for this purpose, such as theories on Ptolemaic cycles, epicycles, and the astronomical tables, all meant to legitimately predict the movements of planets, based on the Ptolemaic model. Eventually, the assembly of a complicated apparatus for "saving appearance" became one of the reasons to believe that Copernican theory may actually have been more probable. When Galileo managed to render the observational data that supported the theory, the Copernican hypothesis became more coherent and persuasive. However, some gaps remained in the explanation, primarily due to the lack of a new physical theory, which could only be attained towards the end of the seventeenth century. Therefore, Aristotelian physics and the ancient accounts on cosmological theories kept resurfacing in the criticism of the Ptolemaic system, if they happened to "save appearances" for Copernicanism. The same historical accounts often served in a similar way to support the opposite Ptolemaic claims. In some cases, if the subject matter permitted, the early-modern studies of historical and mathematical objects could coalesce into an indivisible scholarly enterprise, as happened in John Greaves's *Pyramidographia* (1646), devoted to measuring the dimensions of Egyptian monuments.[212] However, Wilkins's aim in the *Discovery* consisted not so much in merging history and cosmology as in retrieving all feasible astronomical knowledge from historical studies and making it available for critical assessment.

Although the *Discovery* was a pioneering achievement, Wilkins was not the

[211] Barbara Shapiro, Robert G. Frank, Jr., *English Scientific Virtuosi*, p. 25.
[212] For a recent study on John Greaves's mathematical explorations in the East, see Zur Shalev, "Measurer of All Things: John Greaves (1602-1652), the Great Pyramid, and Early Modern Metrology", *Journal of the History of Ideas* 01/2002; 63(4), pp. 555-575.

first English scientific writer to refer to Copernicanism.[213] Robert Recorde's *The Castle of Knowledge* (1556) holds priority for a cautious mention of Copernican "supposition" in the context of an "introduction into the Sphere".[214] The tract *De sphaera mundi*, or *The Sphere* had been composed by Johannes de Sacrobosco around 1230 as a Ptolemaic manuscript textbook. By the mid-seventeenth century, it went through at least 84 richly commented printed editions, answering a new demand for the skill of using astronomical instruments in navigation. *The Sphere* became a part of compulsory university curricula and a reference system for various branches of practical knowledge,[215] hence the publication of Recorde's textbook. Recorde encourages his students to occupy themselves with "practices of the globe" but reflects tentatively on Sacrobosco's methodology.[216] His reservation is that the technical computational competences of an astronomer may be insufficient for discussing the metaphysical matters that derive from "the doctrine of the principles".[217] Mathematical proofs for a system like that of Copernicus, "the man of greate learninge, muche experience, and of wonderful dilligence in observation", are accessible only to those possessing a rare profound mathematical learning. Recorde also comments on the rhetoric of the debate: Ptolemaic cosmology is "so firmelye fixed in moste menne headdes, that they accopt it mere madness to bring the question in doubt". On the other hand, it would be equally "muche follye" to attempt to disprove Copernicanism, since "no manne praiseth" it in the first place. Finally, Recorde assures his students that one day Copernican supposition may be adopted so widely that "you shall … peradventure be as earnest then to credit it, as you are now to condemne it".[218] The public mistrust of Copernicanism, as well as the great difficulty of its pertaining computations, were hampering its success even

[213] For a study on the arrival of Copernicanism in England, see John Russell, "The Copernican System in Great Britain" in *The Reception of Copernicus" Heliocentric Theory*, ed. J. Dobrzycki (New York: Springer, 1972), pp. 189-240.
[214] Robert Record, *The Castle of Knowledge* (London: Reginald Wolfe, 1556), The contents.
[215] Matteo Valleriani, "Accumulation of Knowledge and the Tradition of Sacrobosco's Tracts "The Sphere"", presentation at "The Structures of Practical Knowledge" Workshop, Berlin, MPIWG, 06.09.2013.
[216] Robert Record, *The Castle of Knowledge*, p. 279.
[217] Ibid., p. 164ff.
[218] Ibid., p. 165.

a hundred years later. Both these circumstances prompted Wilkins to address the problem primarily with the expert methods of creating belief, which were most conventionally available within the framework of dialectical rhetoric.

In more narrow professional circles, Copernicanism became appraised in England in the writings of John Dee and Thomas Digges, the latter actually making the first explicit Copernican statement in England. In 1576, twenty years after the publication of Recorde's textbook, Digges reprinted an almanac composed by his father, entitled *A Prognostication everlasting*, to which he added an appendix *A perfit Descripton of the Caelestiall Orbes* containing a summary translation of Copernicus's *De revolutionibus orbium coelestium*. Ironically, Copernicanism debuted in England as *Prognostication everlasting*, and since its mathematics did not correlate with the astrological advice, Digges had to reinforce the persuasive power of geometry with an outstandingly elaborate diagram of the heliocentric model.[219]

In the late sixteenth century, William Temple and Gabriel Harvey supported studies of astronomy as part of the Ramist pedagogical program at London colleges. However, these studies mostly covered the practicalities of navigation and barely touched upon any advanced cosmological theories. Astronomy at Oxford and Cambridge remained largely devoted to geocentric views. In 1600, William Gilbert's *De Magnete*, which combined Renaissance astrology and heliocentric ideas, named magnetism as the force that moves celestial bodies according to their "primary form and natural desire, for the conservation, perfecting, and beautifying of its parts".[220] This brief quote indicates that it was not only mathematical demonstrations but also Stoic reminiscences, Renaissance Platonist aesthetics, and cursory allusions to divine providence that assisted Gilbert's argument in defending Copernicanism. Book VI, Chapter VIII of *De Magnete* convinces the reader:

And surely it must seem more probable that the appearances of the heavens should

[219] Leonard Digges, "A Perfit Description of the Caelestial Orbes" in *A prognostication everlasting* (London: Thomas Marsh, 1576). See also Wolfgang Neuber, *The Making of Copernicus: Early Modern Transformations of a Scientist and His Science* (Leiden: Brill, 2014), pp. 72-78.
[220] William Gilbert, *De Magnete,* trans. Paul Fleury Mottelay (London: Bernard Quaritch, 1893), p. 332.

> be produced by a deflection and inclination of the small body, the earth, than by a whirling of the whole system of the universe – especially as this movement is ordered for the good of the earth alone, and is of no benefit at all to the fixed stars of the planets.[221]

Wilkins's *Discovery of the World on the Moon* (1638) reproduces a similar teleological providential argument which remained popular even well into the eighteenth century. Wilkins mentions *De Magnete* on multiple occasions, but his own treatise tends to use such animistic notions, which were characteristic for Gilbert, only in the manner of an illustrative metaphorical example, and in cases where the necessary mathematical theory could far exceed the expertise of his university-educated readers.

Due to its dual function of bringing the geometrical theory of Copernicanism into the space of refined cultural discourse, Wilkins's narrative in the *Discovery of a World in the Moone* derives not only from the available astronomical hypotheses but also from the imaginary projections of the "other world". In the seventeenth century this was by no means an exception, as scientific and general cultural spaces were not yet distanced from each other, partly because they still tended to use similar terminology. For instance, Gilbert's *De Magnete* exercised immediate influence on Francis Godwin's *The Man in the Moone* which was published posthumously in 1638 but composed in the 1620s or even earlier.[222] Godwin reproduced directly Gilbert's view that the earth and the moon were both solid bodies and magnets, mentioned Copernicus, and drew on the fictional but accurate description in Kepler's *Somnuim*. Godwin probably attended Bruno's lectures in Oxford in 1580s, which argued that the cosmos might be home to a variety of habitable worlds. Godwin's character follows a flock of domestic geese in a towed chariot, and Wilkins's 1640 edition of the *Discovery* stated that his fascination with the technical details of flying to the moon was mainly due to "a late fancy to this purpose under

221 Ibid., p. 349.

222 Francis Godwin, *The Man in the Moone* (London: Printed by John Norton, 1638). For recent scholarship on Francis Godwin, see William Poole's edition of *The Man in the Moone* (Peterborough, ON: Broadview, 2009).

the feigned name of Domingo Gonsales”.[223] Godwin’s narrative also inspired Wilkins to extend his argument with another part entitled Proposition XIV. There he asserts not only that occasional travel to the moon should be possible, but also the pleasures and benefits of regular commerce and habitation.[224]

Previously, the early-modern history of travel to the moon included the adventures of Ariosto’s Orlando in search of his lost wits, as well as sketches of the moon in Galileo’s *Starry Messenger*. Travel to the moon received a fresh stimulus in English 1603 with the translation of Plutarch’s *Moralia*. Wilkins extensively quotes its part “Concerning the Face which appears in the Orbs of the Moon” which summarized Greco-Roman speculations about whether the moon represented a great fire or a solid body. In 1609, an appendix to the third edition of Edmund Spencer’s *Faerie Queene* depicted Mutability as climbing up to the Palace of the Moon and conversing with “the Moon Men”.[225] In 1611, John Donne, in a piece of biting satire against the Jesuits, portrayed Copernicus as someone who at first noisily claims to have given motion to the earth and then suddenly becomes “quiet, as he thinks the sunne”.[226] In 1620, Ben Jonson’s masque *News from the New World discovered in the Moon* was performed twice before the King James I. The play mentioned Galileo’s analogy between the moon and the earth, which provided the main framework for Wilkins’s narrative. Wilkins also quotes from the English translation of Lucian’s *True History* (1634), which pictured a group of adventure-seekers lifted to the moon by a whirlwind and getting involved there with the turbulent events of lunar politics, such as a colonial war. Sixty years after the publication of Wilkins’s moon travelogue, English intellectuals were ready to discuss the principles of lunar society. Still, travel to the moon enjoyed much greater success as a fictional plot, and the Enlightenment saw it more like a diverting theatrical and literary endeavor.

[223] John Wilkins, *A Discourse Concerning a New World and Another Planet* (London: Printed by John Norton for John Maynard, 1640), p. 240.
[224] Ibid., p. 242.
[225] Edmund Spencer, “Two Cantos of Mutability”, *The Faerie Queene* (London: Mathew Lownes, 1609), Book VII. The third edition of *The Fairy Queen* was supplemented with “Two Cantos of Mutability”, without any comments given as to their origins, which come to be referred to as Book VII.
[226] John Donne, *Ignatius His Conclave* (London: William Stansby, 1611), with new editions in 1634 and 1635.

Quotes from popular literature and historical hypotheses on the materiality of the moon helped Wilkins imprint on the public mind his Copernican statement, i.e. that the moon was not a ball of light or fire but a separate earth-like material world.

Apart from the tradition of dramatic representations of the moon, Wilkins's narrative was also part of an advancement in the visualizations of the moon through drawings and maps. The masterful exaggerated sketches made by Galileo were meant to raise the credibility of his verbal argument, and afterwards many schematic illustrations served the same purpose of helping visualize claims about the moon's uneven surface. In the late 1630s, when Wilkins published his discourse, assent about the moon's "roughness" was spreading, and its existing verbal descriptions could not completely satisfy an interest in observational details. In 1641, an intermediate product between a precise drawing and a map was crafted by Claude Mellan and Pierre Gassendi. Mellan invented an engraving method of parallel lines, which allowed for particular exactitude of his imagery. His prints represented an accurate replica of the moon's observed *pictura*, including the long shadows thrown by the highlands. But the astronomers soon demanded an image that would be less of a drawing and more of a map, i.e. less experiential and more schematic. In 1647, Johannes Hevelius, a talented and wealthy amateur astronomer from Danzig, published his *Selenographia*, the earliest astronomical atlas of the moon. Hevelius described the work of translating his imagery from lens to paper as a specific experience involving many hours of imagining and "exploring" the moon through sketches and notes.[227] He was searching for a new visual language of astronomy, a technique of representation that would create a seamless environment of "virtual witnessing". The translation from the image in a telescope to the image on a printed page required developing a convincing style.[228] Hevelius developed a technique of

[227] Kathrine Müller, "How to Craft Telescopic Observation in a Book: Hevelius's *Selenographia* (1647) and its Images", *Journal for the History of Astronomy* (August 2010, V. 41, no. 3), pp. 355-379, p. 356.
[228] Mary G. Winkler and Albert van Helden, "Johannes Hevelius and the Visual Language of Astronomy", *Renaissance and Revolution: Humanists, Scholars, Craftsmen and Natural Philosophers in Early Modern Europe*, edited by Judith Veronica Field, J. V. Field, Frank A. J. L. James (Cambridge: Cambridge University Press, 1997), pp. 97-116, pp. 99, 109, 111.

immersing readers in a detailed narrative of observational art, starting with the making of astronomical instruments and ending with the achieved imagery of the moon. John Wilkins, who was composing his *Discovery* over ten years before the naturalistic visual representation became a standard in observational literature, attempted to achieve the same naturalistic effect through the verbal techniques of dialectical rhetoric. His imaginative descriptions also meant to reconstruct an environment for “virtual witnessing” of the moon.

Wilkins’s moon travelogue represented not a fictional plot but an exercise in discursive performativity. Although some of its factual and textual material repeats Godwin’s story, Wilkins’s intention was manifestly different. He appealed to figural language and rhetorical tools in their capacity for modeling probabilistic narratives, which represented a legitimate method for imparting scientific experience. As opposed to the language of astronomical statements based on mathematical demonstrations, Wilkins’s language invoked the experience of individual discovery of the new probable knowledge. Combining the languages of pleasure and proof, his probabilistic narrative created an arena overlapping the domains of experient knowing and authoritative testimonies. Throughout the *Discovery*, as well as in his other scientific writings, Wilkins juxtaposes and intertwines the contexts of experiential discovery and historical justification, and makes them support each other in the structure of his probabilistic argumentation. Wherever the experient knowing of observational realities is not accessible, Wilkins renders a historical authority, and whenever an ancient philosophical authority is missing to uphold a particular statement, Wilkins relies on the vivid plausibility of his own hypothetical constructs, which allows him to maintain a sufficient level of probability in the discourse.

Within the probabilistic paradigm, rhetorical techniques did not prevent but facilitated the subsequent development of a rigorous assessment of experience, which helped crystallize the domain of solid facts.[229] Sustaining the pulls of the

[229] Thomas Kuhn, *The Structure of Scientific Revolutions*, p. 15ff.

figural and the literal, Wilkins's storyline carries Copernican cosmology further away from fiction and closer to the domain of coherent representation. Successfully performing with the "pointed figures" of discourse, Wilkins creates a copious and persuasive account of an essentially rigid mathematical theory.

The performativity of *inventio* in the discourse on the moon

In seventeenth-century England, the techniques of rhetorical composition influenced the methods for "setting up the circumstances" in scientific experimentation. The aim of experimental procedures was not only to observe natural phenomena but also to perform experimental events, in order to make nature reveal its clandestine aspects.[230] Experimental performance needed to make sense of the specific experiential evidences. Early-modern epistemic culture employed carefully staged visualizations, which not only attributed scientific authority to ordinary experiences but also transformed accumulations of facts into coherent systems of knowledge. The urge to experience scientific knowledge in the form of "installations" was transferred to natural studies from the realm of drama and social rituals.[231] Wilkins's probabilistic narratives employed the literary techniques of performative description to attain the experience of "things themselves".

The full title of John Wilkins's book explicitly states his projected goals: *The Discovery of a World in the Moone or a Discourse tending to prove that 'tis probable there may be another habitable world in that Planet*. Wilkins composed the volume once a 24-year old graduate of Magdalen Hall (later Hertford College), Oxford. At the university, Wilkins had studied mathematics and astronomy with John Bainbridge, then the first Savilian Professor of Astronomy. While working on the *Discovery*, Wilkins was ordained and became vicar of the hamlet parish of Fawsley in his home county of Northamptonshire. This position was obtained through the

230 The performativity of early scientific experimentation is explored in more detail in Chapter I of this study.
231 For a detailed study of this development, see, among others, William N. West, *Theatres and Encyclopedias in Early Modern Europe* (Cambridge, 2006), as well as *Dimensionen der Theatrum-Metapher in der Frühen Neuzeit: Ordnung und Repräsentation von Wissen*, ed. F. Schock, O. Bauer, A. Koller (Hannover: Wehrhahn, 2008).

support of his grandfather John Dod, a Church of England clergyman with Puritan leanings. By that time, Wilkins's argumentative style was also influenced by his Oxford tutor John Tombes who later became a distinguished Baptist preacher. In many ways, Wilkins kept up the cause of his clerical ancestors in promoting the liberalization of Puritan ideology, which also informed his initial inspiration for the critique of scholastic cosmology.[232] In 1638, Wilkins's imaginative vision reached out from his rural clerical home all the way to the moon as the fabulous and ultimate traveling destination of his time.

Throughout his career, Wilkins is said to have acted as a popularizer of scientific novelties. Barbara Shapiro, an authority on Wilkins studies, consistently maintains this interpretation: "All of Wilkins's scientific works are informed by a desire to spread scientific information to those who would not ordinarily come upon it or who were themselves incapable of dealing directly with scientific discourse due to a lack of education".[233] While the argument in Wilkins's *Mathematicall Magick* (1648), written ten years later, is indeed structured through repeated appeals to intelligent artisans, laymen, and the interested gentry to learn about use, and otherwise support the invention of mechanical wonders, the argument in the *Discovery* may have a less straightforward motivation. Wilkins never made any secret of his communicative intentions. For instance, in *Mathematicall Magick* he directly outlines his target audience of gentlemen and "common artificers" who may be in various ways advantaged by studying mechanical tools.[234] But his ultimate purpose for the *Discovery*, as stated in the Preface, consisted in proving the probability of a contemporary astronomical hypothesis, i.e. that there indeed is "another habitable world" on the moon. In the England of 1638, Wilkins's publication could still hope to enter state-of-the-art debates on this point. The *Discovery* indeed sought to overcome certain prejudices, but Wilkins was primarily

[232] Mordechai Feingold, "John Wilkins and the Rise of English Science", a presentation at symposium "John Wilkins and His Legacy", University of Oxford (Wadham College), 15.09.2014.
[233] Barbara Shapiro, *John Wilkins 1614-1672. An Intellectual Biography* (Berkeley: University of California Press, 1969), p. 30.
[234] John Wilkins, *Mathematical Magick* (London: Printed by M.F., 1648), To the Reader.

addressing the educated part of his potential readership:

> Since it must needs be a great impediment unto the growth of sciences, for men still so to plod on upon beaten principles, as to be afraid of entertaining anything that may seem to contradict them. An unwillingnesse to take such things into examination, is one of those errours of learning in these times observed by the judicious Verulam. Questionless there are many secret truths, which the ancients have passed over, that are yet to make some of our age famous for their discovery. If by this occasion I may provoke any reader to an attempt of this nature, I shall then thinke my selfe happy, and this worke successefull.[235]

Apparently, in the *Discovery* Wilkins, a recent Oxford graduate, keeps an approachable but essentially academic profile. He aims not to popularize the established facts in a simple form but to eliminate the fear of accepting new hypotheses among his peers, and to inspire further discoveries of "secret truths". We could accept Wilkins's own statement concerning the purpose of writing his discourse, i.e. that he was rather trying to prove the probability of a disputed astronomical hypothesis, promoting new discoveries, than to deliver the results of contemporary research in a simplified form to an audience that would otherwise not be prepared to perceive them.

As we have seen above, according to Wilkins's own declaration, he composed and published the *Discovery* to help overcome the "unwillingness to take things into examination" and the fear of contradicting the "beaten principles". Wilkins's statement sounds sincere and authentic, and although he obviously aims to communicate new knowledge, he does not formulate his task in terms of filling gaps in education. Wilkins assumes that his readership is versed in the "doctrines of the principles" of scholastic Ptolemaic cosmology, as well as that they are familiar with the new "things" articulated according to the Copernican hypothesis. However, he sees the problem being that these contexts of cosmological discovery and epistemic justification cannot be juxtaposed in a legitimate discussion. Furthermore, in the reason he indicates for that, he also does not stress a lack of education but resorts to

[235] John Wilkins, *The Discovery of a World in the Moone* (London: Printed by E. G. for Michael Sparl. and Edward Forrest, 1638), To the Reader.

the realm of epistemic emotions. At one point, he even expresses emotions in his *apologia pro Galileo*: "how horrid so ever this may seeme at the first, yet is it likely enough to be true".[236] Wilkins commits himself to addressing the "fear" and "unwillingness" in discussions, which in themselves represent not the phenomena of knowledge but those of cognitive experience.

Like Hobbes' *Leviathan*, Wilkins's *Discovery* can be named an exercise in *ars rhetorica*, but to estimate the pragmatics behind this exercise we need to take a note of his tone and epistemic manner.[237] Wilkins's discourse aims to provide an arena for dialogical communication between the "principles" and the "things", which required "commensurability, comparability, and communicability",[238] i.e. certain homology of experience and the coherence of the narrative grids of astronomic description. This task was routinely solved through the dialectical procedures of *inventio*, such as *stasis*, as was mentioned above.[239] Wilkins's *Discovery* copiously questions the accounts of both sides in the astronomical controversy, creating a space for dialogical communication and the reader's own experience of making astronomical discoveries. By softening the opposition between the contexts of discovery and justification, Wilkins brings out the performative faculty of the mind, blurring the distinction between popular and professional knowledge. Using the words of Foucault, the categories of amateur and professional science represent "reflexive categories, principles of classification, normative rules", and not "intrinsic, autochthonous, and universally recognizable characteristics".[240] Wilkins's illocutionary standing in the *Discovery* could be most accurately described not as popularization but as participation in current debates from a humanist position.

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[236] John Wilkins, *The Discovery of a World in the Moone*, p. 93.
[237] Quentin Skinner, *Reason and Rhetoric in the Philosophy of Hobbes* (Cambridge: Cambridge University Press, 1996), pp. 10, 14.
[238] Thomas S. Kuhn, "Commensurability, Comparability, Communicability", *PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association*, V. 1982, Volume Two: Symposia and Invited Papers (1982), pp. 669-688.
[239] See Chapter I of this study.
[240] Michel Foucault, *The Archaeology of Knowledge*, trans. A.M. Sheridan Smith (New York: Pantheon Books, 1972), p. 22.

The reputation of Wilkins as a popularizer of the Copernican hypothesis is chiefly based on two factors: that he employed non-mathematical arguments in support of a fundamental mathematical statement, and the fact that his approach was indeed popular. Wilkins's patent combination of mathematical and rhetorical argumentation appears to be an eclectic transitional mixture of old and new methods in early-modern astronomy.[241] However, a modern estimation of Wilkins's methodology relies on a post-Newtonian interpretation of celestial mechanics, where the proper certainty of conclusions should be supported with mathematical demonstrations. The epistemic views of seventeenth-century British *virtuosi* were radically different, to the extent that mathematical certainty was actually rated lower than "moral certainty", i.e. assent of a large segment of the scholarly community composed of professionals and amateurs. Furthermore, within the probabilistic experimental paradigm of natural history, mathematical proofs were sometimes deemed unacceptable precisely because in mathematics "one may be sure of the truth of the conclusion without consulting experience".[242]

Additionally, taking into account the specific mathematical training that Wilkins's readers might receive as part of the scholastic university curricula, it could be a questionable strategy for him to use conventional mathematical demonstrations for proving that the moon is a solid body. In scholastic terms, the materiality of objects was demonstrated through their weight, in the words of Aristotle, "every sensible body has either weight or lightness, and if a body has a natural locomotion towards the centre if it is heavy, and upwards if it is light".[243] Therefore, to demonstrate that the object was "sensible", one needed to establish its "locomotion towards the centre", which posed problems with such a huge object as the moon. Besides, Aristotle considered the quality of weight on a par with the quality of lightness, for instance, fire did not have any weight but had lightness, since it tended

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[241] See Barbara Shapiro, *John Wilkins 1614-1672*, p. 59.

[242] *The Works of the Honourable Robert Boyle*. In Five Volumes, ed. by Thomas Birch (London, 1744), V. IV, p. 182.

[243] Aristotle, "Physics", Book III, Part 5. *The Complete Works of Aristotle*, trans. R. Hardie, R. Gaye (Oxford: Clarendon Press, 1930), V. I.

upward.[244] Both weight and lightness were regarded as “qualities”, i.e. inherent features that made objects “tend” in a particular direction, and qualities were deemed incalculable.[245] Therefore, it would be difficult for Wilkins to claim the materiality of the moon in mathematical terms, since in that case he would have to refer to its weight, which could be neither observed immediately, nor established through calculations. Although scholastics employed mathematics for measuring “quantities” or the parameters of objects whose material status has been established, it would be complicated for Wilkins to claim specifically the material nature of the moon through geometry, since the category of materiality was not yet legitimately associated with mathematical demonstrations.

The full extent of these complications would be later assessed in the hands-on activities of the Royal Society of London. However, before and after that point, even though geometrical theorems and demonstrations were widely applied in astronomy, it was difficult to use them for claiming the materiality of a certain celestial object. Ten years after the publication of *Discovery*, Wilkins would encounter this issue again in *Mathematical Magick* where he would still have to argue the legitimacy of calculating bodily weight. Among other opinions, Hobbes was famous for holding a rigid empirical position, but even he was convinced that, as opposed to geometry where the lines are drawn by us, “of natural bodies we know not the construction, but seek it from the effects, there lies no demonstration of what the causes be we seek for, but only of what they may be”.[246] From this point of view, before the arrival of Newtonian mechanics in the end of the seventeenth century, it was especially difficult to argue mathematically the material character of astronomical phenomena, since their bodily properties could be neither derived immediately from “the lines”, nor concluded from “the effects”. Consequently, if a specific field of experimental philosophy or natural history was “immersed in

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244 *The Cambridge Companion to Aristotle*, ed. Jonathan Barnes (Cambridge: Cambridge University Press, 1995), p. 142.

245 On a similar problem and Wilkins’s solution provided in his *Mathematical Magick*, see Chapter IV of this study.

246 Thomas Hobbes, *Six Lessons to the Professors of Philosophy* (London: Printed by R. & W. Leybourn for Andrew Crooke, 1656), the Epistle Dedicatory.

corporeal matter", it was hardly possible to claim the mathematical certainty of its conclusions. Besides, mathematical exactness needed to rely on the precision of definitions for astronomical terminology, which was difficult to achieve within the framework of early Copernican conjectures.[247] All this contributed to creating an epistemic situation, in which the findings concerning the materiality of celestial objects had to be based on "moral certainty" or "moral assurance", which increased the importance of perlocutionary discursive techniques. As an example, this feature of early scientific discussions was always taken into account when composing experimental reports.[248] Wilkins's astronomical description of the moon relied heavily on the assumption of the moon's materiality and similarity to the earth, which had to be argued not through an appeal to mathematical certainty but through the perlocutionary strategies of achieving assent and establishing probability.[249]

By the early seventeenth century, Copernican astronomy asserted itself by showing a great potential for transforming the "monster" of the incoherent trajectories of planetary motion into a congruent mathematical system. But the acceptance of the Copernican turn involved agreeing not only about mathematical but also about many acute theological issues. This required achieving "commensurability, comparability, and communicability" in the use of dialectical rhetoric and the other available performative discursive techniques.

Indeed, Wilkins's *Discovery* was meant to be popular, but we need to principally construe this popularity in a technical epistemic sense. Wilkins's argumentation needed to be popular for to gain the obligatory amount of "moral assent", as required by the paradigm of early-modern probabilistic science. Wilkins appreciated the role of observational perception and mathematical demonstrations in astronomy. But even in his most mature writings he kept rating "moral certainty" as the highest epistemic value and level of reliability in natural history.[250] The

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247 Isaac Barrow, *The Usefulness of Mathematicall Learning* (London: Cass, 1734), pp. 53-56.

248 See Steven Shapin, "Pump and circumstance: Robert Boyle's literary technology". *Social Studies of Science*, V. 14, No. 4 (Nov., 1984), pp. 481-520.

249 Barbara Shapiro, *John Wilkins 1614-1672: An Intellectual Biography* (Berkeley and Los Angeles: University of California Press, 1969), pp. 32-34.

250 John Wilkins, *The Principles and Duties of Natural Religion* (London: Archive, 1675), pp. 3-5.

contemporary tradition of astronomical accounts suggested treating the ancient opinions on questions about the moon as full-fledged testimonies. Wilkins's lecturer in astronomy at Oxford, John Bainbridge, employed very similar methods in his *An Astronomical Description of the Late Comet* (1619). In December 1618, Bainbridge became one of the first astronomers to conduct observations of a comet through the telescope. He was able to estimate its parallax and calculate the distance from the earth as about ten times the distance from the earth to the moon. Although placed at the forefront of contemporary astronomical observational practices, Bainbridge at the same time employed very mixed descriptive strategies. Deploring the prognostications of "vulgar Astrologie", he used the pictorial layout of the constellations of the Zodiac to determine and explain the position of his observed comet against the stars and planets. Similarly, clearly stating his loyalty to Copernican views, and providing a conspicuous up-to-date depiction of the central solar system up to Jupiter, he did not forget to enumerate any remotely supportive quotations from Plato, Seneca, Gerolamo Cardano and "our Fathers".[251] In the second part of his pamphlet, entitled "Moral Prognosticks of Applications", Bainbridge assembled a range of poetic, literary, and mystical quotes, all meant to communicate his vision of "celestial Hieroglyphickes". Bainbridge used precise geometrical diagrams to explain the parameters of motion for his observed comet, but he also accepted that "the Fates by winding Riddles Wisemen teach",[252] and that the rays of a new comet represented a messenger of providence,[253] from which he drew some specific theological implications. Wilkins was well familiar with the descriptive methods of Bainbridge's astronomical treatise, as he reproduced them in his own discourse, and he similarly supported his geometrical statements with historical accounts derived from ancient texts. Presently, we cannot help viewing these historical inclusions as narrative additions, but in Wilkins's time they were not perceived as entertaining inclusions but as professional testimonies that ensured the

[251] John Bainbridge, *An Astronomical Description of the Late Comet* (London: Jacobi Flesher, 1619), p. 13.
[252] Ibid., p. 32.
[253] Ibid., p. 40.

"popularity" or, strictly speaking, the moral certainty of conclusions, i.e. the highest level of epistemic success for any contemporary astronomical argument.

In the framework of early-modern scientific ethics of probability, the word "discovery" in the title of *The Discovery of a World in the Moone* represented a rhetorical claim. Wilkins's discourse is placed within the space of hypothetical modeling in compliance with the Renaissance principle of "know[ing] for certain both the existence and the cause of those things which we understand fully how to make".[254] In addition, the creation of a hypothetical model instead of a truth-claim in astronomy allowed for less pressure in political terms, which had been noticed on a similar occasion by Descartes in his posthumously published *Le Monde*.[255] Wilkins's astronomy employed hypothetical modeling and geometrical thought experiments as a means of gaining experiential access to the phenomena that were not accessible in direct observations. The Copernican hypothesis worked for him as an instrumental construct in the manner of a "spiritual optic" or a semi-fictional lens, allowing him to lay out the primary structures of his description. Wilkins employed Copernicanism as an instrument of *inventio* for his argument, as well as an instrument of technical invention for the means of travel to the moon.

Wilkins's argument in the *Discovery* (1638) contains thirteen chapters or Propositions, and starts with a severe critique of the certainty of common sense: "The First Proposition: That the strangeness of this opinion is no sufficient reason why it should be rejected, because other certaine truths have been formerly esteemed ridiculous, and great absurdities entertained by common sense."[256] Following the Baconian criticism of the "Idols" as the typical mistakes of the ordinary mind, the critique of common sense was symptomatic for the paradigmatic change in scientific knowing, which occurred around the mid-seventeenth century. Later, Descartes' *Meditationes de prima philosophia* (1647) implied that the new subtle truths of natural philosophy could be more effectively discovered by cultivating a solitary but

[254] Paolo Sapri, *Pencieri filosofici e scientifici*, no. 1, 1578. Quoted in Alistair C. Crombie, *Styles of Scientific Thinking in the European Tradition* (London: Duckworth, 1994), pp. 1102-1103.
[255] Alistair C. Crombie, *Styles of Scientific Thinking*, p. 1170.
[256] John Wilkins, *The Discovery of a World in the Moone*, p. 1.

authentic voice speaking from the dictates of "natural light".[257] Although criticizing common understanding, Descartes did not break the rules of common practices. The modern study of how true and false statements were differentiated in the legal discourse of early-modern France shows that the evidence that conveyed authentic vocality and preserved recognizable stylistics "from own mouth" was usually perceived as more trustworthy.[258] Cartesian rationalism appealed to the authentic inner voice to avoid the deception of common sense speaking from the data of the outward senses. In contrast, experimental philosophy often strove to convey the authentic voice of the individual's outward senses to avoid the errors of common reasoning. For instance, Thomas Browne's *Pseudodoxia Epidemica* (1646) humorously enumerated many reasons for skepticism towards the opinions of ancient authors.[259] Acting as one of the first popular scientific journalists, unlike Bacon and Descartes, Browne did not search for warranties in attaining truth but explored a diverse range of hypotheses. Letting out the authentic voice conveying his impressions, Browne accentuates the immediate experience of making knowledge. Similar to Wilkins's *Discovery*, he mentions a popular point about antipodes, who for centuries had been deemed fictitious beings and whose existence was later fully certified, meaning by that the inhabitants of the American continent on the opposite side of the globe.[260] Whereas Browne highlights the absurdities of old superstitions, Wilkins's criticism targets not so much the false ancient authorities themselves but the unqualified and credulous "general opinion" that impedes the search for probable knowledge.[261] Wilkins's narrative also acquires the vocality of authentic experiential testimony, when he speaks about his astronomical hypotheses. However, he makes his voice engage in a polyphonic dialogical performance equally participated in by many classical authors. Wilkins's discourse, which was published

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257 Andrew E. Benjamin, "Descartes' fable: the Discours de la Méthode" in *The Figural and the Literal: Problems of language in the history of science and philosophy, 1630-1800*, ed. by Andrew E. Benjamin (Manchester: Manchester University Press, 1987), pp. 10-30, pp. 14-15.

258 Natalie Zemon Davis, *Fiction in the Archives: Pardon Tales and their Tellers in Sixteenth Century France (*Stanford, CA: Stanford University Press, 1987), p. 3.

259 Thomas Browne, *Pseudodoxia Epidemica* (London: Printed by I. H. for Edward Dod, 1646), Chapters VI-VIII.

260 Ibid., Chapter VI.

261 John Wilkins, *The Discovery of a World in the Moone*, pp. 4-5.

earlier than both treatises mentioned above, aspires to achieve assent among a university-educated readership on matters of high philosophical and political sensitivity. Therefore, he feels obliged to employ all the legitimate perlocutionary techniques that might warrant the moral certainty of his claims.

Having specified his attitude to the classical authorities, Wilkins employs the figure of *antithesis*, which often worked as a dialectical tool for inventing an argument. The figure of *antithesis* stimulates the discovery of specific material by delivering a contrast, which helps formulate premises built on opposed concepts. After casting doubt on the certainty of common sense, Wilkins attempts to counterbalance it with its opposite, i.e. a hypothetical construct in the imagination, as he deems it a potentially more reliable foundation for cosmological propositions. An Oxford graduate demonstrates cutting-edge skills in orchestrating a dialectical performance. He builds up several pairs of opposites, such as common sense/imagination, qualified/unqualified common sense, and true/false imagination, and sets them against each other in complex combinations. This masterful interplay of opposites helps him outline the arena of his subsequent explications. For instance, he criticizes Plutarch's criticism of the notion of antipodes whom "a false imagination was not able to fancy as possible".[262] Wilkins also compares the circumstances of his own attempt to "discover" a world on the moon with the suspicious attitude surrounding the early travels of Columbus, indicating that even the mind best qualified for reasoning about things may lack the capacity to imagine "an incredible thing".[263] Advocating in biblical terms the "earnestnesse and hungary after novelty" and pointing out the vulnerability of a new truth that "may seem absurd and impossible",[264] Wilkins comes to formulate the main goal of his discourse as proving the probability that the moon is indeed a solid material body. Then he insists that he is grounding his probabilistic argument on the insight obtained from a qualified hypothesis. Wilkins also acknowledges that human

[262] Ibid., p. 9.
[263] Ibid., p. 2.
[264] Ibid., p. 19.

perception of probability is context-dependent, and therefore "things are very hardly received which are altogether strange to our thoughts and our senses".[265] Using Russell's term of experient knowing for explicating Wilkins's views, the experient "knowledge-by-acquaintance" needs to precede the descriptive propositional knowledge of astronomical phenomena. As Wilkins himself states, the understanding of a new truth begins with being "formerly acquainted with some colours and probabilities for it".[266] Further, Wilkins's narrative takes the proposed leap of imagination and acquaints the reader with various "colors" and probabilities concerning the moon.

Wilkins's another dialectical trick consists in drawing attention to the gaps in the commonly accepted assortment of astronomical observational data and historical accounts. Wilkins construes these gaps as the breaks in the coherent texture of cosmological description and employs the figure of *antithesis* to analyze and mediate the contradictory premises. He realizes that the lack of observational experience makes it unavoidable to use the specific tools of discourse, as "things that are not manifested to the senses, are not assented unto without some labour of mind".[267] These dialectical and rhetorical techniques help him prepare the ground for making "a diligent enquiry" which should present the new probabilities "as certain and plaine, as sense or demonstration can make it".[268] Ultimately, Wilkins strives to build a "positive argument" bringing together the main statements by Plutarch, Galileo, and Kepler into a coherent description. He believes that the proposition "it is probable that there is another habitable world" can and should be "confirmed by such strong authority".[269]

Using the concept of performative knowing, as suggested in the first chapter of the present study, Wilkins's probabilistic discourse can be viewed as a framework of performative utterances. Even though he often labels his propositions as

[265] Ibid., p. 21.
[266] Ibid.
[267] Ibid.
[268] Ibid., p. 12.
[269] Ibid., p. 23.

"statements", throughout his discourse he makes it clear that those are only probable conjectures. When considered in the rigid terms of modern philosophy, Wilkins's "propositions" or "statements" cannot be qualified as formal logical propositions or statements, since the rules regulating their relationships to each other and the epistemic context are different from what formal logic should endorse. Wilkins's use of "statement", the typical use of the term within early-modern probabilistic paradigm, can be aptly pinpointed in the formulation of Michel Foucault: "a statement is always an event that neither the language (langue) nor the meaning can quite exhaust".[270] Foucault suggests that the analysis of discourse should consider the statement together with the perspective of its use, "in the exact specificity of its occurrence".[271] Wilkins's "propositions" can be authentically construed in terms of Austin's performatives, as they do not ultimately state anything and cannot be identified as true or false but form a part of doing some action or performing an intelligent practice, i.e. hypothesizing about the nature of the moon. More precisely, the elements of Wilkins's elucidation of the Copernican hypothesis can be qualified as performatives in the extended sense, as they might represent proper logical statements in other contexts but would act as performatives in the specific context of probabilistic scientific space. The concept of performative knowing also involves perlocutionarity as a capacity of utterances to exercise an intended persuasive effect that supports the probabilistic value of the communication. Wilkins's performatives are first born into the "grey zone" of an imagined hypothetical construct but then have their probability-value supported by the pragmatics of the masterful practice of rendering descriptive contexts.

Wilkins's performative hypothetical space is modulated through his intelligent use of the literary skills of creating probabilistic narratives. Gilbert Ryle mentions that an intelligent practice cannot be reduced to considering propositions. Even though Wilkins labels his probabilistic statements "propositions", he does not offer any formally conclusive logical solutions concerning them. Instead, he is

[270] Michel Foucault, *The Archaeology of Knowledge*, p. 28.
[271] Ibid.

proving their probability, demonstrating a high level of *knowing-how* as a cumulative mastery of mathematical and rhetorical methods. His performative construct works as an instrumental “springboard” for “approaching” the moon or bringing it closer to the human senses.

Rhetoric and experience in the discovery of the moon

The performativity of Wilkins’s narrative compensates for the lack of experient knowing of the moon. In Russell’s terms, experient knowing works as a compass showing the cognitive value of a certain phenomenon, pointing at the possibility of its existence and provoking cognitive interest on the part of the beholder. Wilkins’s hypothetical construct appeals to his readers’ imagination, increasing their awareness of the possibility of the existence of a moon world, which was supposed to stimulate their interest in joining the “diligent enquiry” of the new cosmology. Russell maintains that experient knowing needs to precede descriptive propositions, and Wilkins indeed notes that “things altogether strange to our thoughts and senses” are more difficult to perceive as probable, even if they are in fact perfectly true. On the contrary, he continues, employing another *antithesis*, an absurdity can be accepted, if the mind is “acquainted with some colours and probabilities for it”. The creation of hypothetical performative space promotes the experient knowing of Copernicanism, which also allows Wilkins to mark the distance between this new understanding and the authority of scholastic cosmology. The shattering of a classical authority that previously provided ample historical “testimonies” necessitated the building of a new authority of “hypothetical eye-witnessing”. Wilkins uses performative techniques to display things in the narrative as if they were “manifested to the senses”. For this purpose, he alternates the familiar historical sketches with geometrical demonstrations, to bring closer a new vision of the moon through the optic of language.

Wilkins’s steps in developing his probabilistic performative space follow the scenario of first arguing for the possibility of the existence for a certain phenomenon, with the assistance of historical testimonies, then building the hypothetical experient knowing of this phenomenon through a sequence of various narrative descriptions, then employing more rigorous means, wherever possible, to argue the probability of specific propositions, and finally sometimes employing a common sense authority, such as providence, to patch over the remaining argumentative gaps.

Detaching himself from both the ancient and the scholastic visions of the moon, Wilkins nevertheless elaborates on the relationship between the Copernican hypothesis and theological doctrines, to render sufficient moral certainty for his argument. The second Proposition of the *Discovery* argues that "the plurality of worlds doth not contradict any principle of reason or faith".[272] By the time of publishing the *Discovery*, Wilkins already was an ordained member of the clergy, and his argumentative style often shows structural traces of a theological dispute or a Puritan sermon.[273] But he maintains the attitude of cautious criticism towards the contents of clerical views on nature, sometimes mockingly suggesting various political reasons for their domination. For instance, he facetiously supposes that Aristotle could have subscribed to the idea of the plurality of worlds but was obliged to reconsider his position on civil grounds, "because he feared to displease his scholler Alexander, of whom 'tis related that he wept to heare a disputation of another world, since he had not then attained the Monarchy of this".[274] Wilkins even permits himself some unusually stinging irony towards the generally worshipped Philosopher himself, supposing that Aristotle might be "as loth to hold the possibility of a world which he could not discover."[275]

Apart from Aristotelian commentaries, much argumentation against the possibility of multiple worlds was presumed to be found in Scripture. Wilkins rejects this view by declaring the absurdity of the literal reading of sacred texts, since "many things (such as the windows of heaven) need to be understood in a special sense".[276]

[272] John Wilkins, *The Discovery of a World in the Moone*, p. 24.
[273] Ibid., p. 36.
[274] Ibid., p. 29.
[275] Ibid., p. 29.
[276] Ibid., pp. 39-40. The discussion about literal and metaphorical readings of Scripture became the core issue in

Wilkins even calls on St. Augustine of Hippo for support, to declare that "when the words of Scripture shall seem to contradict common sense or experience, there they are to be understood in a qualified sense, and not according to the letter."[277] However, the question of how to render sufficient moral certainty are solved not through appealing to a cumulative clerical authority but through the uncompromising Puritan ethics of the individual's responsibility for spiritual development. The ultimate intellectual answerability for interpreting the book of nature is placed with an individual mind, as "it were a superstitious, a lazie opinion to thinke Aristoteles workes the bounds and limits of all humane invention, beyond which there could be no possibility of reaching."[278] Wilkins's vivid scriptural and historical reminiscences help him legitimize the contemplation of hypothetical multiple worlds, but he remains compliant with the obligations of a Puritan clergyman. In this way, he successfully reveals weaknesses in the "common sense" of scholastic cosmology, without disturbing any moral or ecclesiastical conventions.

Further in the discourse, Wilkins attacks the Ptolemaic position in a variety of sophisticated ways. Analogy remains an important driving force behind Wilkins's argument. Combining geometrical conclusions from Galileo's *Starry Messenger* and the teleological suppositions of Gilbert's *De Magnete*, Wilkins stresses the similarities between the earth and the moon, depicting

> …a compendium of providence, that could make the same body a world, and a Moon; and world for habitation, and Moone for the use of others, and the ornament of the whole frame of Nature … as the members of the body serve not only for the preservation and convenience of themselves, but for the use and conveniency of the whole.[279]

However, apart from the similarities between two providently created worlds, one would expect certain differences to be revealed between them as celestial bodies.

Wilkins's controversy with Alexander Ross, a school headmaster from Southampton, whose views on the literal interpretation of sacred texts made him an adversary of Copernican cosmology. See Grant McColley, "Ross-Wilkins Controversy", *John Wilkins and 17th Century British Linguistics*, ed. Joseph L. Subbiondo (Amsterdam, PH: John Benjamins Publishing Company, 1992), pp. 95-131.

[277] John Wilkins, *The Discovery of a World in the Moone*, pp. 39-40.

[278] Ibid., p. 33.

[279] Ibid., p. 43.

Since Wilkins's argument mainly underlines the analogy, the differences are bound to break openings in his argument, but even that he manages to put to good use. Since within probabilistic reasoning the arguments are not essentially estimated as right/wrong but probable/improbable or convincing/unconvincing, it brings forward the quality of argumentative performance, making it into one of the criteria for winning the case. Therefore, when a rival theory contradicts Wilkins's proposition, he estimates the quality of the attacked argumentation and sometimes acknowledges that this particular statement may be weak or outdated. Then, since the victory of the rival theory was sustained over a weak author or supposition, Wilkins declares that the skills employed for disproving it must have also been rather crude. This implies an insufficient mastery of methods on the part of his opponent and possibly entails a deficiency in moral certainty, which eventually undermines the prestige of the rival narrative.

As an example, enumerating ancient opinions prohibiting the existence of multiple worlds, Wilkins comments on a discussion by Aquinas, who stated:

> If there be more worlds than one, then they must either be of the same, or of a diverse nature, but they are not of the same kinde, for this were needlesse, and would argue an improvidence, since one would have no more perfection than the other; not of divers kinds, for then one of could not be called the world or universe, since it did not contain universal perfection.[280]

This excerpt from Aquinas epitomizes the method of scholastic argumentation in astronomy. Characteristically, it also reveals the importance of language issues, as Aquinas's moderate realism connects the phenomena and the universals. However, Wilkins mainly quotes Aquinas because this particular statement "is so much stood upon by Julius Caesar la Galla". Lagalla published a response to Galileo's *Starry Messenger*, doubting that telescopic observation could provide enough ground for conclusions on the three-dimensional materiality of the moon. Elizabeth Spiller argues that, unlike Galileo, Lagalla was prone to use the optical instrument not as a tool for observing three-dimensional objects but as a reading device for discerning

[280] Ibid., p. 34.

two-dimensional images.[281] Indeed, Galileo had to use his artistic training to notice the possibility of a three-dimensional interpretation of the observed imagery.[282] The difference of opinion between Lagalla and Galileo was because Lagalla's perception was trained within the culture of reading and commenting on printed texts, whereas Galileo represented a new generation of experimentalists who needed to develop a perception of the space-continuum, which gave room for the live observation of scientific events. The difference of opinion between Lagalla and Wilkins, although not explicated in the *Discovery*, consisted in that, among others, Lagalla repudiated, and Wilkins embraced the transformative effect of optical aids in promoting a new kind of performative and hypothetical epistemic experience. There was no noticeable difference of opinion between Galileo and Wilkins, but Wilkins was more prone to project his moon-narrative into the future of actual space explorations. In the *Discovery*, Wilkins treats Lagalla's argument as such a triviality that it deserves few comments. Wilkins also mentions that, apart from trying to prove the necessity of one world, Lagalla endeavored to "take much needlesse pains to dispute against Democritus, who thought that the world was made by the casuall concourse of atoms in a great vacuum".[283] Although nowadays the physicists at CERN in Geneva might appreciate Democritus' insight as surprisingly accurate, this is where Wilkins declares that Democritus's claim is weak, and therefore Lagalla's argumentative skills might also be not particularly prominent, "or else he would have ventured upon a stronger adversary". To do justice to Lagalla, this is exactly what he in fact accomplished in his anti-Galilean pamphlet *De phaenomenis in orbe lunae novi telescopii usu nunc iterum suscitatis* (1612).

Wilkins sometimes estimates the probability of rival hypotheses based on the criterion of argumentative *knowing-how*, but even if the rival theory does deserve commendation, then Wilkins appeals to emotions: "let it serve for the better

281 Elizabeth Spiller, *Science, Reading, and Renaissance Literature*, pp. 101-102.
282 For detailed analysis of how the artistic practices may have influenced Galileo's approach, see Horst Bredekamp, *Galilei the Artist* (2007), based on a discovery of an edition of Galileo's *Sidereus Nuncius* featuring a previously unknown set of Galileo-attributed drawings. Although in 2012 the copy was proved to be a forgery, Bredekamp's work shed suggestive light on the epistemic function of drawing skills in Galileo's work.
283 John Wilkins, *The Discovery of a World in the Moone*, p. 35.

confirmation of that which is true; the sparkes of errour, being forc"d out by opposition, as the sparks of fire, by the striking of the flint and steel".[284] This patch of fiery rhetoric covers for a potential failure in argumentation and helps indicate that even if the purely logical strength of Wilkins's argument is failing, the more important "moral certainty" of his endeavor remains intact, which upholds the prestige of his argument.

On ensuring the balance and respectability of his position in relation to basic common sense and the latest cosmological novelties, Wilkins proceeds by more actively attacking other cosmological claims supported by Ptolemaic doctrine. Propositions numbered three to six of the *Discourse* form a coherent argumentative development departing from the statement that the moon is composed of material substance similar to the other earthlike bodies,[285] and arriving at the conclusion that the existence of a world in the moon has been the opinion of many mathematicians, ancient and modern.[286] Wilkins does not uncritically rely on these opinions but adds them as illustrations or crowning results of a long historical discussion. He indicates that his purpose consists not in simply replacing some opinions with the others but in creating an experience of discovering the moon through the narrative optic of his probabilistic hypothesis.

When citing historical testimonies on astronomy, Wilkins is not selective in picking only the sources that were known to sustainably defend Copernicanism. He uses any source supporting his thesis on the materiality of the moon, even though in another case that same historical authority was proved spectacularly wrong. At some point, he mentions that there is "no mathematician such a foole as to thinke it [Ptolemaic cosmology] true",[287] which represented a plea for rigor in geometrical demonstrations. Yet, at another point he claims that "learned Egyptian (and Ptolome) seemed to agree that the body of the moon is moister, and cooler than any of the

[284] Ibid.
[285] Ibid., p. 44.
[286] Ibid., p. 79.
[287] John Wilkins, *The Discovery of a World in the Moone* (London, 1638), p. 87.

other Planets".[288] Considering the Ptolemaic system as controversial, Wilkins respects it as an authoritative adversary and strives to have its assent, at least in part, about his proposition.

Starting from the third Proposition, which is devoted to the hypothetical materiality of the moon, Wilkins maintains the same measure between persuasion and demonstration as was characteristic of his approach to Scripture. As long as the verbatim reading of a statement is supportive of the argued proposition, all historical and Scriptural accounts related to astronomy remain a literal authority. But as soon as any such account contradicts observational data or astronomical common sense, it is treated as a metaphorical interpretation for the sake of "saving the appearances".[289] Later Wilkins will continue to apply this pattern, while explaining the *modus operandi* of divine providence. In the *Discovery*, the flexibility of moving between literal and metaphorical interpretations, as well as the occasional appeals to the notion of divine providence, aid Wilkins in repairing the remaining argumentative gaps. The same trick also ably assisted the defenders of Ptolemaic cosmology. In cases, where some traditional views, being part of the core experient knowing of Wilkins's readership, simultaneously intervened with the very fundamentals of Copernicanism, Wilkins leaves the contradictions unresolved on the level of moral certainty. At the same time, he feels free to evaluate such views at the level of hypothetical conjecture. For instance, discussing historical opinions concerning the materiality of the moon, Wilkins mentions that some of the ancients believed that eclipses occurred when "the Sun leaving his wonted seate in the heavens, vanished away". This experiential view radically contradicted the Copernican scheme but was firmly imprinted on "common sense" mind. Therefore, Wilkins provides a non-conclusive double interpretation: "some there are who interpret all these relations to bee hyperbolicall expressions, and the noble Tycho

[288] John Wilkins, *A Discourse Concerning a New World and Another Planet* (London: Printed by John Norton for John Maynard, 1640), p. 49.

[289] For a summary of Wilkins's theological references in cosmology, see Ryan Oliver, *Aliens and Atheists: the Plurality of Worlds and Natural Theology in Seventeenth-century England* (Ann Arbor, MI: ProQuest, 2007), pp. 21-28.

thinkes it totally impossible".[290] In this way, Wilkins displays his mastership of the dialectical skill of moving freely not only between literal and metaphorical interpretations but also between levels of certainty.

The deciphering of symbols and metaphors typically worked as *copula mundi* in the arguments of theology, but also represented a common technique in early-modern experimental discussions. For instance, due to Lullist influences, medieval metaphorical language, symbolic signs, and emblematic patterns were transferred into the practices of alchemy and medicine. Scholastic argumentation, in spite of the claims for logical rigor, employed similar shifts in the level of interpretation for the sake of "saving appearances". Aristotle himself deemed the metaphor applicable for situations of intellectual emergency, when new meanings had to be expressed in the absence of established terms. These practices remained common throughout the seventeenth century and beyond, but there is a curious difference between the editions of 1638 and 1640 of Wilkins's *Discovery*, which suggests an evolution in his views on the function of occult rhetoric. In 1638, he explained that it was inappropriate to abuse Scriptural authority, "however we may deal pro or con in Philosophy, yet we must not jest with divine truths, or bring Scripture to patronize any fancy of our own, though, perhaps, it be true."[291] In the edition of 1640, he additionally compares the abuse of Scriptural authority with "that Melancholly humor of the Chymicks", who "doe perswade themselves, that the most learned and subtile of the ancient Authors, in all their obscure place doe mean some such sense as may make to their purpose."[292] Wilkins's amendment made in 1640 is indicative of the tendency to overexploit the methods of metaphorical interpretation in the rapidly growing fields of occult experimentation, such as Paracelsan medicine. This remark by Wilkins can be viewed as an early sign of his lifelong commitment to the transparency of scientific language.

Sometimes Wilkins alternates arguments from authority and extended

[290] Ibid., p. 62.
[291] Ibid., p. 121.
[292] John Wilkins, *A Discourse Concerning a New World and Another Planet*, pp. 119-120.

narrative diversions, which represented a common method for balancing rhetoric and rigor in dialectical exercises. Wilkins would employ it even more softly and skillfully in *Mathematical Magick* (1648), whereas in 1638 his discussions still appear reminiscent of the battles between the ancients and the moderns in the framework of literary criticism.[293] Wilkins places each of the disputed propositions against the background of various, often conflicting, narrative and argumentative contexts, which allows him to deal with concealed weak points and to highlight the strongest claims of his thesis. Trying to dismiss the statement that the moon emits its own light, which contradicted his proposition concerning its opaqueness and materiality, Wilkins first introduces the information about the moon's own radiation as "a fancy of some of the Jewes". He reproduces a picturesque animistic narrative portraying an overambitious Moon discontented not to be the only light in the sky but in the end rejoicing in preserving at least some of her own independent shining.[294] The myth suffers from a double disadvantage of being non-Christian and a fictional fable, and Wilkins employs it to shatter the credibility of claims about the moon's own light. However, later he ventures to gain positive support from a source of even more dubious doctrinal origin, when it becomes necessary for "saving appearances". Still arguing that the moon is an opaque body, Wilkins concludes:

> Unto these I might also adde the imperfect testimony of Mahomet, whose authority of grant can adde but little credit to this opinion, because he was an ignorant imposter, but yet consider that originall, from whence hee derived most of his knowledge, and then, perhaps, his witness may carry with it some probability."[295]

The defense of Copernicanism with "the imperfect testimony of Mahomet" might seem a bit extreme for a newly ordained Puritan vicar, but it would appear less so within the dialectical patterns that were widely adopted in early-modern natural philosophy. Wilkins positions the statement about the moon's materiality against the context of various existing views which contradicted the statement itself

[293] Cf. Jonathan Swift, *The Battle of Books* (London: John Nutt, 1704).
[294] John Wilkins, *The Discovery of a World in the Moone*, pp. 65-66.
[295] Ibid., pp. 84-85.

and often disagreed with each other. For instance, on the one hand, he extensively quotes from pagan Stoic philosophers who repudiated the qualitative difference between the lunar and the sub-lunar parts of cosmos. On the other hand, he reproduces the views of Christophorus Clavius, a renowned Jesuit Ptolemaic expert. Clavius, who was once called “the Euclid of the sixteenth century”, around Galileo’s time recognized the difficulties of verifying the mathematics of geocentric cosmology. He enjoyed an enormous respect as an author of textbooks that shaped Jesuit mathematical education. The Jesuit Catholic approach to natural philosophy emphasized thought experiment, which was an antecedent of the Newtonian method of experimental mathematical modeling. Clavius certified many new astronomical phenomena as real and admitted that through the telescope the moon “appears so remarkably fractured and rough”.[296] However, it only made him reproduce the standard contemporary view that the lunar body might have “denser and rarer parts”. Clavius’ Jesuit background taught him to be particularly sensitive to the theological ramifications of any cosmological novelties. In the doctrinal context, the “fractured” appearance of the moon compromised the perfection of its spherical form, which was an essential element of the Aristotelian universe divided into the perfect lunar and the imperfect sub-lunar states of being. Therefore, the main conclusion that Clavius seems to derive from the new discoveries was that now astronomers needed to arrange the celestial orbs in a different way, so as to “save the appearances”. Nowadays, the great crater Clavius, neighbouring the Tycho crater, is visible with the naked eye in one of the most “rugged” areas of the moon.

Quoting the views of Clavius and many other adversaries of Copernicanism, Wilkins sets up a stage for imaginary debates. By allowing Copernican proponents and opponents to contest each other on the printed pages of his *Discovery*, he followed a standard recommendation that dialectical rhetoricians received on the use of the procedure of *stasis* as a tool for connecting a new fact or an argument to the

[296] Christophorus Clavius, *Opera Mathematica* (Bamberg, 1612), 3:75. Quoted in *Galileo in Context*, ed. Jürgen Renn (Cambridge: Cambridge University Press, 2001), p. 201.

scope of accepted understanding.[297] *Stasis* essentially meant asking questions and establishing if a particular statement may comply with a certain adopted narrative. Since in different contexts the statements "appear differently to different people,"[298] and thus display their different sides, the rhetorician was supposed to consider them against the background of several narrative perspectives to detect the emerging clashes and congruities. Employing Russell's terminology, the experience of considering the statement in different contexts helped locate a scope of knowing where its content may legitimately appear compliant with the previously accepted narrative. Wilkins considers how the proposition about the materiality of the moon may interact with a variety of different theological and philosophical contexts, and finds that his hypothesis is supported by a majority of them, in one way or another, which was supposed to confirm the probability and ensure assent about his proposition.

Another common rhetorical advice that Wilkins never failed to employ consisted in implementing the principles of *enargeia*, the technique of transferring living experience into written or spoken discourse. Scholastic methods based on Aristotelian syllogistics were primarily intended for use in conclusive written statements. Wilkins's discourse entered the realm of contemporary experimental polemics, where the vividness of representation was no less important than logical coherence. Wilkins's choice of classical authorities often depends on the vividness of their accounts. For instance, mentioning that Diodorus agreed that "the Moon was full of rugged places" and acknowledging Diodorus to be "a fabulous writer", Wilkins still notes that "you may see more express authority for the proofe of this in the opinions of Anaxagoras and Democritus, who held this Planet was full of champion grounds, mountaines and valleys."[299]

By that time, the "rugged" surface of the moon had already been captured in Galileo's drawings *Sidereus Nuncius* (1610) which portrayed the moon as if split

[297] A more detailed account of the early-modern use of *stasis* is provided in Chapter I of this study.
[298] Cicero, *De inventione*, i.8.11.
[299] John Wilkins, *The Discovery of a World in the Moone*, p. 122.

apart and with an exaggeratedly distorted borderline between the light and the dark halves. In fact, it was the specific conspicuous form of that broken line that allowed Galileo to prove the moon's "ruggedness" and its earthlike materiality. Galileo's formal training as an artist enhanced his ability to accurately reproduce in the manuscript what he saw through the telescope. The exercise of the physical skill of drawing played a key role in his arriving at the right conclusions concerning the three-dimensionality of the moon surface. Interestingly, Thomas Harriot, a practiced British astronomer, mathematician, optician, ethnographer, and translator, who in 1588 described his experience of staying with the Algonquin Indians in the Roanoke colony, in August 1609, several months before the appearance of Galileo's publication, also conducted telescopic observations and made drawings of the moon. However, his drawing of 26 July 1609 Julian (5 August Gregorian), for instance, shows only a slightly curved borderline between the light and the dark parts of the moon disk. Unless a skilled artistic analysis of the form of that line is performed, it could be easily attributed to the limitations of the optical instrument, and the interpretation of the moon surface could remain at the stage of flat, two-dimensional perception.[300] Galileo's illustration from *Sidereus Nucius* or *The Starry Messenger* are reproduced in the *Discovery*, and the detailed depiction of "champion grounds, mountaines and valleys" helps Wilkins prove the probability of his proposition that the moon represents a three-dimensional celestial body. Galileo's discovery of the moon's materiality did not necessarily destroy Ptolemaic argumentation, but it undermined the Aristotelian postulate concerning the fifth element, i.e. incorruptible substance, the presence of which marked the qualitative boundary between the sub-lunar sphere and the realm of heaven. Therefore, the argument for the corruptible earth-like materiality of the moon was crucial for Wilkins's Copernicanism, and he reproduced it according to the principles of *enargeia*, providing vivid verbal and graphic visualizations of observational and mathematical experience.

[300] Matthew Hunter names several social reasons, such as court tastes and the impact of the Civil Wars, why the skills of drawing were not very common among the early seventeenth-century British scientists. See Matthew Hunter, *Wicked Intelligence* (Chicago and London: University of Chicago Press, 2013), pp. 4-5.

In some cases, the requirements of verbal *enargeia* demanded the use of extremely vivid forms of ordinary language. In one of Wilkins's rare episodes of falling back upon the Renaissance's animated view of nature, he quotes from Kepler on how "Venus … lies downe in the Perige or lower part of her supposed epicycle".[301] As a virtuous *matrona* she is then "in conjunction with her husband the Sunne, from whom after she hath departed for the space of ten moneths, she gets plenum uterum, and is in the full".[302] This performative description means to invoke the gender-oriented experience of human relationships, which in Wilkins's argument compensated for the lack of experient knowing of Kepler's version of the laws of motion among the readership. At another point, Wilkins is obliged to use a similar descriptive strategy, when proving one of his most complex propositions concerning the moon's reflected light. The law of reflection, i.e. that the angle of incidence equals the angle of reflection, was formulated by Euclid in c. 300 BC. However, in the *Dioptrics* (1637), which appeared only a year before Wilkins's *Discovery*, Descartes had to reproduce the Euclidean metaphor of the ball to elucidate the laws of reflection and refraction. In Wilkins's argument, it would have been hard to explain how the sunlight is reflected between the moon and the earth, even if he were to employ the metaphor of the ball. An astronomical thought experiment involves huge distances, and the difference in scale would have made the metaphor of the ball irrelevant. The Cartesian mechanical narrative describing the behavior of a tennis ball would also fail to account for the serious theological implications of the cosmological issue of reflecting light. In any case, Wilkins does not make any mention of *Dioptrics* in this argument; instead, he describes the reflection of light in the performative language of *magia naturalis*, again comparing it with a sort of personal relationship: when the moon cannot receive the light from the sun, "the gratefull Earth returnes to her a great, nay greater light when shee most wants it",[303] and "as loving friends equally participate in the same joy and grief, so doe these

[301] John Wilkins, *The Discovery of a World in the Moone*, p. 160.
[302] Ibid.
[303] Ibid., p. 154.

mutually partake of the same light from the Sun."[304] Wilkins also complements his efforts on narrative *enargeia* concerning light reflection with a graphic illustration, which is one of the rare occasions when he employs visual supports in his astronomical discourse. The illustration portrays the sun together with his "family members", the moon and the earth, all of similar size on the printed page, the light streaming and reflecting from one to another. In the edition of 1638, the sun's face appears contented, with fashionable courtly moustache, and bearing a remote resemblance to the official portraits of Charles I; in the 1640 edition, the same face bears a more alarmed expression.

In the *Discovery*, Wilkins's astronomical message comes delivered in the same metaphorical language as that in thirty years' time would be repudiated under his close supervision by the Royal Society of London, as representing but vulgar "fancies and fables". However, in 1638, Wilkins needed to employ the formulae of *magia naturalis* not only because of their wide circulation and accessibility but sometimes also due to the complete absence of more rigorous terms. For instance, explaining the phenomenon of gravity, Wilkins does not compare it to, but actually names it, "a respective mutual desire of union".[305] This understanding was well-compliant with the animated depiction of "condensed [celestial] Bodies, when they come within the Sphere of their own Vigour, do naturally apply themselves one to another by attraction or coition."[306] Wilkins displays awareness of inaccuracy in the animistic model and strives to compare this "attraction or coition" to the "affection which causes the union betwixt the Iron and Loadstone". But in the end he is forced to admit that it "is some kind of nearenesse and similitude in their natures, for which Philosophie as yet has not found a particular name."[307] On several occasions he quotes William Gilbert's *De Magnete* (1600) which described many experiments on magnetism performed with a model of the globe of earth named *terrella*. In Gilbert's Copernican view, the earth possesses magnetism, which brought him to the

[304] Ibid., p. 156.
[305] Ibid., pp. 211-212.
[306] Ibid.
[307] Ibid., p. 213.

conclusion that the force keeping the moon in its orbit was of a similar magnetic nature. Although incorrect, this view had an undisputed advantage over the Aristotelian scholastic scheme of the five elements. Gilbert's model was even employed by Kepler as a working hypothesis for calculating the parameters of planetary motion. However, Wilkins cannot accept these recent advances in physics and instead prefers to express himself concerning the notion of gravity in hermetic Rosicrucian terms reminiscent of Robert Fludd's *Philosophia Moysaica* (1638). Fludd related the notion of cosmic magnetism to the early explications of natural theology, speaking of "creating of love and unity" through magnetic forces.[308] Fludd was not a member of any controversial spiritual organization, but he associated himself with the Paracelsan physicians, debated with Kepler and Gassendi on matters of cosmic harmony, and proposed several famous designs for *perpetuum mobile*. Wilkins might have taken particular interest in this pursuit of Fludd's, due to his father's passion for similar mechanical experiments, as well as he would devote a chapter to them in *Mathematical Magick*. Interestingly, in composing his cosmological narrative, Wilkins always strives for accuracy in lexis, but in the absence of a satisfying formal term, chooses to employ neo-Platonic poetic expressions instead of more conventional and technical but misleading terminology. Together with other examples, this episode provides us with a window on how early scientific language was developing new terminological units, flexibly adjusting the measure between vividness and verifiability to enhance the performative probability of proposed hypotheses.

Summarizing the difficulties that Wilkins encountered due to a lack of observational data, he notes that "'tis very imperfect and difficult, by reason of the vast distance of those bodies from us, we could not by our senses see such alterations [in heavenly bodies], yet our reason might perhaps sufficiently convince us of them."[309] In the late sixteenth to early seventeenth century, a lack of immediate

308 Koen Vermeir, "Divine Magnetism: Natural Philosophy and Magnetic Theology (1631-1648)", presentation at the Research Colloquium of Prof. Friedrich Steinle, Technische Universität Berlin, 06.06.2014.
309 John Wilkins, *The Discovery of a World in the Moone*, p. 50.

observational experience and data in astronomy was often compensated for through the practice of thought experiments.[310] For instance, Clavius called "experiences" those Jesuit astronomical discussions that demonstrated the motions of celestial bodies according to common observation.[311] Throughout the seventeenth century, the invention of various popular and professional astronomical and navigational instruments, such as astronomical clocks, sundials, astrolabes, and orreries, vastly expanded the experient knowing of celestial mechanics.

Another hallmarks of seventeenth-century British intellectual life was to enhance observational experience with the strategies of guided experimentation. In the early seventeenth century, Galileo, similar to Clavius, still named his observations "experiences" and documented the results by referring to multiple events as a repetition of the same occurrence. Towards the end of the century, the Royal Society started to emphasize specific figures for organizing the "particulars" in documenting experimental practices, which marked the difference between "experiences" and experiments.[312] The guidance on procedures for experiments, employing the principles of data organization that were developed within the techniques of rhetorical composition, aimed not only to accept observational results but to considerably reconfigure the apprehension of experimental events. Experiments began to feature a strategy that was meant to compensate for a lack of particular experiential evidence and highlight the specific properties of a phenomena, so that the related discussions could arrive at certain conclusions.

Due to the rarity of direct observational experience at the time, Wilkins's *Discovery* could not assume that all his readers had had a chance to use Galileo's "famous perspective",[313] which would allow them to observe the moon closer and "approach" it visually. Therefore, compensating for this shortage of experience,

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[310] Geoffrey Cantor, "The Rhetoric of Experiment", *The Uses of Experiment: Studies in the Natural Sciences*, ed. David Gooding, Cambridge, 1989, pp. 159-180, p. 170.

[311] Peter Dear, "Jesuit Mathematical Science and the Reconstruction of Experience in Early Seventeenth Century", *Studies in History and Philosophy of Science*, Part A 18 (2), 1987, pp. 133-175, p. 148.

[312] Peter Dear, "Narratives, Anecdotes and Experiments: Turning Experience into Science in the 17 Century"*, The Literary Structure of Scientific Argument*, ed. Peter Dear (Philadelphia: University of Pennsylvania Press, 1991), pp. 135-161.

[313] John Wilkins, *The Discovery of a World in the Moone*, p. 88.

Wilkins employs the techniques of performative hypothetical *inventio* and stages his astronomical narrative as a guided thought experiment. Wilkins likens the effectiveness of Galileo's "perspective" as an instrument of scientific vision to his own narrative presentation of the moon. Noting this similarity, he distinguishes the newly acquired experiential vision of the moon from that of the ancients, who "were said by their magical charms to represent the Moones approach", whereas "we cannot onely bring her lower with a greater innocence, but may also with a more familiar view behold her condition."[314] He emphasizes the similarity of targets pursued by his probabilistic *inventio* and Galileo's technical *invention*, in that they both strive for such a mode of vision that "those things that could scarse at all bee discerned by the eye, … might plainely and distinctly bee perceived, … and that as they were really in themselves, without any transposition or falsifying at all".[315]

The perspective of Wilkins's discoveries

Even if performed with literary techniques, Wilkins's probabilistic narrative aims at the knowledge of things themselves, as opposed to verbal demonstrations. In thirty years' time he would inspire the members of the Royal Society to accept it as one of their primary goals. In 1638, the first discourse ever composed by this ambitious Oxford graduate already projects into the future his versatile occupations. While weighing the possibility, of whether Galilean "famous perspective" could be used as an ultimate device for reading the book of nature irrespective of the distance, Wilkins mentions an alternative opinion by Gerolamo Cardano who thought it "impossible that any image should be conveyed so farre as there to be represented unto us at such a distance",[316] i.e. meaning that the limits of optical discerning might

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314 Ibid., p. 89. Wilkins mentions that he refers here to the experience of Johannes Fabricius who, together with his father David, in March 1611 employed a camera obscura to conduct the observations of spots on the sun. In the late spring of 1611, he published a brief tract interpreting these observations, entitled *De Maculis in Sole Observatis et Apparente earum cum Sole Conversione Narratio* (Wittenberg, 1611). See Albert Van Helden, Eileen Reeves, *On Sunspots. Galileo Galilei & Christopher Schneider* (Chicago, IL: University of Chicago, 2010), pp. 30-36.

315 John Wilkins, *The Discovery of a World in the Moone*, p. 91.

316 Ibid., p. 97.

eventually impede experimental practices. Wilkins's next publication, *Mercury, or the Secret and Swift Messenger* (1641), and his much later *An Essay towards a Real Character and a Philosophical Language* (1668), would elaborate on the possibilities of viewing scientific language as a "tool for linguistic therapy",[317] enhancing the experience of "things themselves". The *Essay* would depict a laboratory process for deepening the understanding of nature through language as an artificial instrument of the apprehension of experience, augmenting the natural apprehension of phenomena.[318] The performative narrative in Wilkins's *Discovery* was intended to "bring the Moon lower with a greater innocence" and eventually generated the technical discursive invention reaching out to various "things themselves" through the facilitating optic of scientific language.

Another of Wilkins's future writings, *A Discourse Concerning the Beauty of Providence* (1649), develops some of the theological notions that he first expressed in the *Discovery*. In the edition of 1638, on establishing that in all probability the moon is another world, the argument of Propositions VII to XIII explores the concrete features of this world, largely deriving them from the analogy between the earth and the moon, since "if our earth were one of the Planets … then why may not another of the Planets be an earth?"[319] Thus the probabilistic *inventio* in Wilkins's argument begins to generate new conjectures about the physical properties of phenomenon in question, including the presence of water and air and consequently the possibility of habitation.[320]

For Wilkins, it appears probable that "if there be any such sea and land as ours that it bears some proportion and similitude with ours."[321] But he follows the Baconian advice about interpreting analogies cautiously and avoids attributing the status of high probability to his conjecture, since the analogical model may prove

317 Lia Formigari, *Language and Experience in 17th Century British Philosophy* (Amsterdam, PH: John Benjamins Publishing Company, 1988), p. 78.
318 Ibid., p. 32.
319 John Wilkins, *The Discovery of a World in the Moone*, pp. 94, 143.
320 Ibid., p. 139.
321 Ibid., p. 105.

wrong under such a distance and difference of physical conditions: "There is no great probability in this consequence ... for since there is such a difference betwixt them in divers other respects, they may not, perhaps, agree in this."[322] However, acknowledging his lack of understanding of the functioning of remote worlds, Wilkins manages to support his conjecture through theological means. Wherever his observational argument seems to fail, he tends to fall back on the coherence of providential narrative, arguing that the similarity between the moon and the earth can be "morally certain". The notion of divine providence serves him as a solid framework for interpreting the sometimes inexplicable data obtained through observations. In spite of the fact that the earth and the moon may possess different material features, nevertheless they are both to be found within the uniform domain of nature governed by providence. Interestingly, the fact that Wilkins rarely employs the collocation "divine providence" in this context, which he almost invariably uses in his theological explications, can be considered as a step towards the views of natural theology. Appealing to the teleology of providence allows him to raise the certainty of his conclusions and state that "this in all probability was her [nature's] intent to make it a fit body for habitation with the same conveniences of sea and land, as this inferior world doth partake of".[323] Providence furnished the moon with a set of conveniences, similar to that it supplied to the earth, which testifies to the providential intention of establishing the same natural order on both the earth and the moon, "since providence hath some speciall end in all its works, certainly then these mountaines were not produced in vaine, and what probable meaning can we conceive there should be, than to make that place convenient for habitation."[324]

This appeal to the teleology of providence solidifies Wilkins's position in moral terms but also serves as a criterion for evaluating the probability of specific properties of rival cosmologies. The notion of providence is employed not only as a moral hinge but also as a primary warrant for the coherence of the laws of nature.

[322] Ibid., p. 107.
[323] Ibid., p. 103.
[324] Ibid., p. 138.

Reviewing the opinions of ancient authors on the existence of solid crystal spheres or orbits, Wilkins remarks that the abolition of these features would bring about other shifts in celestial matters. For instance, in the absence of solid orbits, no element of fire could exist, as well as no music of the spheres. However, the teleological coherence of providential operations presumes that "the world would have no great losse in being deprived of this Musicke, unless at some times we had the priviledge to heare it",[325] i.e. even though the music of the spheres may exist in its own right, it seems to be unnecessary for humans, which makes its existence less compliant with providential tasks, and it becomes less probable that any such feature of the cosmos should be existent.

The first edition of *Discovery*, which appeared in 1638, comprised thirteen Propositions and climaxed with an elegant expression of hope that the author has successfully demonstrated the probability of that the moon is another habitable world. In the third edition published in 1640, Wilkins added Proposition XIV on "that 'tis possible for some of our posteritie, to find out a conveyance to this other world; and if there be inhabitants there, to have commerce with them".[326] New inspiration came to him after reading Francis Godwin's *The Man in the Moone*, published posthumously in 1638, where the enumeration of the copious technical details of flying chariots as a means of travel to the moon made Wilkins "rayse up some spirits as eminent for new attempts and strange inventions"[327] and contemplate the pleasures and benefits of regular commerce with the moon.[328] Wilkins's *inventio* becomes focused on exploring the practical ways for "bringing the Moon closer" by traveling through space. Proposition XIV considers various opportunities for and obstacles to such attempts: Wilkins discusses the nature of gravity, the ways for overcoming the heaviness of the human body, the coldness and thinness of the moon's air, etc. Interestingly enough, at this point, his conjectures begin to suggest

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325 John Wilkins, *The Discovery of a World in the Moone* (London, 1638), p. 54-55.
326 John Wilkins, *A Discourse Concerning a New World and Another Planet* (London, 1640), p. 203.
327 Ibid., p. 206.
328 Ibid., p. 242.

certain doubts in the universal teleology of providence.

In the 1638 edition, he appeared to accept that providence could be "not presently showing us all, but to lead us a long way from the knowledge of one thing to another".[329] In the edition of 1640, he professes a slight vexation towards divine nature that "did not apparently mean a human body to fly on its own".[330] Having previously used providence as a pattern of coherence for natural laws, Wilkins now approaches the issue of travel to the moon from the prospective of an engineer, where coherence is ensured not through the means of verbal teleology but through the rigor of mathematical calculations.[331] Enumerating impediments to travel to the moon, he humorously warns that there are going to be no "Castles in the Air ... to receive Poor Pilgrims, or Errant Knights".[332] However, speaking of the technicalities, Wilkins switches from the humanist's irony to the pragmatic tone of an artisan: "I doe seriously, and upon good grounds, affirme it possible to make a flying Chariot. … This engine may be contrived from the same principles by which Archytas made a wooden dove, and Regiomontanus a wooden eagle."[333] This change of tone indicates a shift from the conjecturing to the technical implementation of the idea of human flight. Wilkins's engineering thought stops relying on the teleology of providence, which also makes him abandon the probabilistic universe and enter the realm of mathematical certainty.

Medieval tradition associated human flight with the effects of magic, for instance, the edifying examples of Simon Magus and Eilmer of Malmesbury were meant to categorize the attempts at human flight as nothing short of blasphemy. Renaissance experiments with flying started with gliding, as in the case of Leonardo,

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[329] John Wilkins, *The Discovery of a World in the Moone* (London, 1638), p. 207.

[330] John Wilkins, *A Discourse Concerning a New World and Another Planet* (London, 1640), p. 208.

[331] Following Lucian, Wilkins imagined a proper voyage to the moon, though admitting that the journey through the air was a difficulty. Reportedly, he once had to defend his vision against an objection raised by the Duchess of Newcastle, who asked him where she was to bait her horses if she undertook the journey, to which Wilkins replied: "Your Grace could do no better, than to stop at one of your castles in the air." Wilkins's utopian travelogue was parodied in *Peter Wilkins' Journey to the Moon* (1751) by Robert Paltock, which was sometimes taken for Wilkins's own work.

[332] John Wilkins, *A Discourse Concerning a New World and Another Planet*, p. 210. This could be an allusion to Miguel de Cervantes's *Don Quixote* which had been published in English translation in 1620.

[333] Ibid., pp. 238-239.

whose glider had the wings fixed in their inner section, closest to the pilot, and mobile in their outer section. Around 1505, Leonardo's *Codex of the Flight of Birds*, comprising only 18 folios, examined the behavior of bird flight and proposed mechanisms for *mimesis naturae*. Similar to Wilkins's discussion, Leonardo starts considering the problem by examining the nature of gravity which is "caused by one element situated higher than another, and moves in an imaginary line towards the center of another object".[334] Leonardo was searching exclusively for an engineering solution, analyzing the parameters of the center of gravity, geometric center, the flexibility of wings, and the control of movements. Leonardo's language in the codex departs from alternating two separate styles: the half-verbal notes of a naturalist's observations of birds' behaviors and the drawings of geometric diagrams. But gradually these strategies merge into a more uniform descriptive pattern combining the imagery of ornithology with the mechanical terms of forces and angles, which creates the experience of "virtual witnessing". Interestingly, Wilkins employs a similar strategy in his later *Mathematical Magick* (1648), which will be considered in more detail in Chapter IV of this study. Wilkins's narrative on mechanics reproduces Leonardo's argument on the epistemic status of mechanical art, which said: "The science of instruments, or rather machines, is very noble and the most useful above all others, since by means of it all animated bodies, which have motion, follow the rules of this science".[335] However, Leonardo and Wilkins differed in that Leonardo was focused on how to get his gliders, parachutes, and ornithopters to soar through the air, whereas Wilkins confidently assumes that it should be possible and busies himself with the complicated logistics of traveling to his dream destination. Wilkins demonstrates with perfect assurance that the means of conveyance through the air would eventually be discovered. He predicts that "as soone as the art of flying is found out", or "whenever that Art is invented", humans "will make one of the first Colonies, that shall transplant into that other world".[336]

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[334] Leonardo da Vinci, *Codex on the Flight of Birds* (Washington, DC: Smithsonian National Air and Space Museum, 2013), Folio 2^{r}.
[335] Ibid., Folio 3^{r}.
[336] John Wilkins, *A Discourse Concerning a New World and Another Planet*, pp. 206-207.

Autobiographical papers of Robert Hooke also mention some attempts to design a flying mechanism in collaboration with Wilkins. Around 1655, at Wadham College, they together constructed a small device which could fly "by the help of Springs and Wings, raised and sustained itself in the Air".[337] The model should have served for building a functional flying machine which would not only be capable of flying itself but also of carrying a human. However, Hooke's trials and subsequent calculations showed that "the Muscles of a Mans Body were not sufficient to do any thing considerable of that kind".[338] Hooke tried solving the problem by inventing "artificial Muscles", but these attempts also remained unsuccessful. Later, Hooke discussed his schemes with a wide range of friends and colleagues, including Francis Lodwick, Christopher Wren, and William Petty. The latter had already experimented with inflated bladders to lift weights over London-bridge, and Wilkins encouraged Hooke and Petty to combine their expertise, arranging the birth of a new invention.

Wilkins's *Discovery* comes a long way from humbly confirming the status of the moon as a material object for observations to boldly projecting the actual space travel through 240 million miles. But the *Discovery* mainly strives to promote wonder and inspire the desire for the experient knowing of the moon among ordinary people, as "[t]he perfecting of such invention would be of such excellent use, that it were enough, not only to make a man famous, but the age also wherein he lives."[339] In the finale of *Discovery*, Wilkins's tone is very similar to that of his next popular science narrative, *Mathematical Magick* (1648), where he would advertise further "the great benefit and pleasure" of technical experimenting. Chapters VI to VIII of the second part of *Mathematical Magick* would be devoted to historical accounts of inventing various flying apparatuses. In Chapter VIII we even find a range of designs for flying chariots driven by manpower or towed by majestic exotic birds, all glorifying the future of air travel. There Wilkins would also analyze the cultural and social patterns of scientific progress, which will be considered below.

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337 See Lisa Jardine, "The 2003 Wilkins Lecture: Dr Wilkins's Boy Wonders", *Notes and Records of the Royal Society of London*, Vol. 58, No. 1 (Jan., 2004), pp. 107-129, pp. 113-115.

338 Ibid.

339 John Wilkins, *A Discourse Concerning a New World and Another Planet*, p. 239.

Summarizing Wilkins's argument in the *Discovery*, his probabilistic performative narrative shows a flexible configuration of dialectical and rhetorical argumentation. The breaks in coherence, occurring due to a lack of experient knowing of the moon, are filled by various performative strategies of persuasion. The appeal to imagination in declaring the hypothetical nature of his description allows Wilkins to legitimately shift the reader's attention away from familiar astronomical realities. The contents of the narrative does not achieve validation via truth-claims, since Wilkins claims the probability-value of his propositions, but he achieves assent through evaluation of argumentative practices, involving the criteria of "moral certainty" and the mastership of dialectical methods.

Wilkins's early method of hypothetical *inventio* would later help him promote specific inventions for exploring the materiality of "things themselves". The last Proposition of the first edition of *Discovery* says that posterity is likely to be surprised at the ignorance of his age. This might not be exactly what we feel reading Wilkins, but many of his conclusions about the moon are indeed wrong. However, even though his answers were premature, current investigations of the moon still follow the same trajectory of questions that were proposed by him four centuries ago, such as the presence of water on the moon and the possibilities of regular travel and colonization. Wilkins chose to focus on proving the materiality of the moon, since in the context of contemporary discussions of natural history, the issue of earth-like materiality of celestial bodies was perceived as one of the crucial proofs for heliocentric cosmology. However, by defending Copernicanism, Wilkins not only reinforced lunar studies but also validated a much wider range of astronomical conjectures concerning the plurality of worlds. Eventually, his defense of Copernicanism planted the seeds of the search for other inhabited and potentially habitable worlds in the visible cosmos, which means that if Wilkins indeed, as he stated, intended to "provoke any reader" to an attempt to discover of "secret truths" about nature, his first publication fulfilled this purpose. The discursive methods of early-modern cosmology are of primary interest to historiography but may also be relevant to a consideration of the modern pragmatics of scientific rationality. Till today, the probability of knowledge in science is viewed in connection with the performative properties of scientific language. The principles of epistemic justification are embedded into the value-laden interactions within scientific practices.[340] The experiential character of scientific investigation is difficult to deny even in the case of modern mathematics, whose methods are suspected of being not purely logical but containing a contingent persuasive context-dependent function.[341] Recent developments in quantum physics also create an ever more acute awareness of the fact that some scientific statements cannot be but probable, which makes it more significant to pay attention to the strategies of performative persuasion in discourse.[342] The argumentative style and style of data representation are argued to play a crucial epistemic role, especially due to the overwhelming amount of data that can be generated by modern scientific instruments.[343] Early-modern dialectical techniques may attract interest not only in terms of accounting for the patterns of persuasion but also for their capacity to facilitate the apprehension of multifaceted scientific experience. Wilkins employed the principles of probabilistic performativity as "spiritual optic" displaying phenomena at a closer intellectual distance and "making things to speak".[344] The next chapter will describe how these principles informed his efforts as a founder member of the Royal Society of London.

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340 Melinda B. Fagan, "Social Construction Revisited: Epistemology and Scientific Practice", *Philosophy of Science*, V. 77, No. 1 (January 2010), pp. 92-116, p. 93.

341 Paul Ernest, "Forms of Knowledge in Mathematics and Mathematics Education: Philosophical and Rhetorical Perspectives", *Educational Studies in Mathematics,* Vol. 38, No. 1/3 (1999), pp. 67-83, p. 82.

342 André Kukla, "Scientific Realism, Scientific Practice, and the Natural Ontological Attitude", *British Journal for the Philosophy of Science*, V. 45, No. 4 (Dec., 1994), pp. 955-975, p. 965.

343 Zachary C. Irving, "Style but Substance: an Epistemology of Visual versus Numerical Representation in Scientific Practice", *Philosophy of Science*, V. 78, No. 5 (December 2011), pp. 774-787, p. 755.

344 Florian Nelle, "Im Rausch der Dinge: Poetik des Experiments im 17. Jahrhundert" in Helmar Schramm, Hans-Christian von Herrmann et al. (Hg.), *Bühnen des Wissens: Interferenzen zwischen Wissenschaft und Kultur* (Berlin: Dahlem University Press, 2003), pp. 140-167, p. 151.

Chapter III

The Royal Society of London and the problem of *res et verba*

A noble subject which the mind will lift
To easie use of that peculiar gift,
Which poets in their rapture hold most deare,
When actions by the lively sound appeare.

Sir John Beaumont
To His Late Majesty,
Concerning the True Form of English Poetry (1629)

Due to the cultural situation in England, the ten years between the appearance of John Wilkins's *Discovery of the World in the Moone* (1638) and *Mathematical Magick* (1648) were not particularly suitable for peaceful scholarly innovations. In 1638, the country was already sinking into the Civil Wars with the signing of National Covenant, an agreement inaugurated by Scottish churchmen for preventing King Charles I from introducing English innovations into the Scottish liturgy. While the second edition of *Discovery* was in print in 1640, the Short Parliament at Westminster was defied with a financial plea from the King to support his crusade against the non-innovative Scots. After three weeks of sitting, Charles dissolved the parliamentary body, unnerved with the growing debates about his Royal abuses, which mainly resulted in more substantial charges that would be considered by the Long Parliament. Two years later, the first Civil War broke out, after Charles raised his standard into the stormy skies of Nottingham. Two years after that, the Scots and the Parliamentarians sustained a major victory over the northern Royalists at Marston Moor. In 1646, Charles opted to surrender to the conservative Scots. In 1648, when Wilkins's *Mathematical Magick* was published, the abruptly united Scottish troops and the Royalists were defeated, after which the Rump Parliament sanctioned trying Charles I for high treason as a "tyrant, traitor, murderer and public enemy". All these events were to influence John Wilkins's career and the endeavors of experimental philosophy.

In this chapter, I will focus on the context of Wilkins's work while an Oxford college warden, considering how his activities within the "invisible college" may have influenced his epistemological views. I will argue that in the context of the political and cultural situation after the Civil War, John Wilkins and his contemporaries used the performative capacity of rhetorical and poetic strategies for the development of new methodologies in natural studies.

The politics of discourse within the early Royal Society

Wright Henderson mentioned in *The Life and Times of John Wilkins* that the late 1640s had been the times of "great questions and events which shaped the life and character of remarkable man".[345] After Wilkins graduated from Oxford, clashes of interests during the Civil War shaped his career, moving him from the position of vicar at Fawsley to that of private chaplain to a number of illustrious personalities. Apparently, he was first recommended to William Fiennes, the First Viscount Saye and Sele, whom King Charles had nicknamed "Old Subtlety". Fiennes actively supported the early parliamentary opposition to the King but later unsuccessfully attempted to bring the conflicting parties together.[346] After that, Wilkins became private chaplain to the Eighth Lord Berkeley, an offspring to a dynasty of patrons of literature and philosophy, from whom the young author sought patronage through the dedication of his *Mercury, or the Secret and Swift Messenger* (1641). This book, a comprehensive study of secret means of communication, might have been intended to gain practical advantage in the political tumults, as the Civil Wars stimulated a growing need for cryptography skills. For instance, in 1645, John Wallis, a close friend of Wilkins, was able to distinguish himself by deciphering the King's letters at Naseby.[347]

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345 P.A. Wright Henderson, *The Life and Times of John Wilkins* (Edinburgh and London: William Blackwood and Sons, 1910), Preface.

346 D.L. Smith, "William Fiennes, first Viscount Saye and Sele", *Oxford Dictionary of National Biography* (Oxford: Oxford University Press, 2004).

347 P.A. Wright Henderson, *Life and Times of John Wilkins*, p. 81.

Around the same time, Wilkins became private chaplain to Charles Louis, the Prince Elector of Palatine, who was a nephew of Charles I and at some point had even been suspected of angling for the English crown himself. Charles Louis chose Wilkins for his expertise in what was broadly construed as "mathematics", and later Wilkins defined the subject of his *Mathematicall Magick* as "mixed Mathematicks". The Prince Elector was familiar with the "wonders of geometry", since his father Frederick V had been the owner of the Hortus Palatinus, a fabulous pleasure park full of curious mechanical devices designed by Inigo Jones and Salomon de Caus. The Hortus Palatinus was not only famed for its grottoes, mazes, and exotic plants, but also for ingenious waterworks.[348] Wilkins mentioned some of them in *Mathematicall Magick*, where they served him as examples of mechanisms producing articulated sounds, which will be given more attention in the next chapter.

While living in London around 1645, Wilkins for the first time became associated with the group that would eventually form the devoted core of the Royal Society. As John Wallis later reported, it was "Mr. Theodore Haak (a German of the Palatinate, and then resident in London), who, I think, gave the first occasion, and first suggested those meetings".[349] Theodore Haak was not an experimenter himself but was an active figure in the Hartlib circle and in early scientific networking between England and the continent.[350] The future fellows of the Royal Society would "meet weekly in London on a certain day … at a time when by our civil wars, academical studies were much interrupted in both our Universities, … to treat and discourse of such affairs".[351] However, he continues:

> ... about the year 1648, 1649, some of our company being removed to Oxford (first Dr Wilkins, then I, and soon after Dr Goddard), our company divided … those of us at Oxford … continued such meetings in Oxford, and brought those studies into fashion there.[352]

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[348] Salomon de Caus, *Hortvs Palatinvs: A Friderico Rege Boemiae Electore Palatino Heidelbergae Exstructus* (Franckfurt: Theodor de Bry, 1620).

[349] *The Record of the Royal Society of London* (London: Harrison and Sons, 1897), p. 1.

[350] See Dorothy Stimson, *Hartlib, Haak and Oldenburg: Intelligencers*, *Isis*, V. 31, No. 2 (Apr., 1940), pp. 309–326.

[351] *The Record of the Royal Society of London*, p. 1.

[352] Ibid., p. 2.

In 1648, the company moved to Oxford, also because Wilkins was assigned Warden of Wadham College. This appointment ensued from a political regrouping after the defeat of the Royalists. Wilkins was supposed to replace John Pitt, a stout Royalist,[353] and was nominated for the position by the Visitors, a Puritan commission sent to check on the College's political standing. Wilkins made a point of fostering religious tolerance and attracting intellectual talents to the school that would later become known as "a nursery of bishops". It may also be called the cradle of the Royal Society, since many of its future prominent members, such as Christopher Wren, Thomas Sprat, and Robert Boyle, joined the "invisible college" at Wadham.

Initially, the College Warden was expected to maintain celibacy, but by 1648 it became undesirable to uphold the practices associated with the papal system, so the Visitors allowed Wilkins to marry. In 1656, his marriage with Robin French, née Cromwell, the youngest sister of Oliver Cromwell, gained him a strong position out of reach of his adversaries. The couple joined the high Parliamentary society, and shortly before his death Cromwell secured for Wilkins the position of Master of Trinity College at Cambridge, where he was soon able to befriend and promote Isaac Barrow.[354] Between 1648 and 1659, when a change of wind made Wilkins resign the Wardenship, his lodgings in Wadham College hosted the foundational meetings of the Royal Society of London.

The elderly couple who decided to establish Wadham[355] ordered that the College Warden was always to be "a virtious and honourable man of stainless life, not a bishop, nor a foreigner".[356] The portrait of John Wilkins, which can be seen in the Common Room of Wadham College till the present day, bears a positive likeness to the description by John Aubrey in *The Brief Lives* as "a lustie, strong-grown, well-

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[353] P.A. Wright Henderson, *Life and Times of John Wilkins*, p. 57.
[354] Although Wilkins was popular as Master of Trinity College, he was removed from the office when the previous, Puritan-evicted Master claimed the right to regain his position. See Alan Chapman, "Warden Wilkins of Wadham", *Wadham College News*, 5 November 2013, available at http://www.wadham.ox.ac.uk/news/2013/november/warden-wilkins-of-wadham. Retrieved 15.02.2015.
[355] The college was founded in 1610 by Dorothy Wadham who acted upon the will of her late husband, Nicholas Wadham who had died in 1609. The decision about founding the college was made together by the spouses, but all practical implementation was effected by the widow. For the family history of Wadham founders, see P.A. Wright Henderson, *Life and Times of John Wilkins*.
[356] P.A. Wright Henderson, *Life and Times of John Wilkins*, p. 57.

set, broad-shouldered person, cheerful and hospitable", "no great-read man; but one of much and deepe thinking, and of a working head; and a prudent man as well as ingeniose".[357] According to universal opinion, Wilkins "possessed to an extraordinary degree the faculty of seeing the two sides of a question".[358] He should have made good use of this talent in his new job as Warden of Wadham where the university routines suffered visibly during the war times. From 1642 to 1646, Oxford was the Royalist capital, a fact which led to the Siege of Oxford. From 1644, in addition to thousands of the King's men, the old university grounds were invaded by about 250 parliamentarians whom Charles summoned to assemblies at Christ Church College. University life was exhausted and disrupted, and tensions would persist between politicians and academics until long after the Restoration. John Wilkins as Wadham Warden had to deal with an academic community divided by burning political and religious issues that had been previously resolved by force and now had to be resolved with bitter words instead of swords.

Before the war, the university was supposed to resemble a monastery more than a royal court, but now the habits acquired in the political storms would die hard. Antony Wood, an appointed antiquarian at Oxford, left a statement confirmed by many similar testimonies, on how distinctly the conflict was felt to have brought about changes in the cultures of scholarship:

> Before the warr we had scholars that made a thorough search in scholasticall and polemicall divinity, in humane authors, and naturall philosophy. But now scholars studie these things not more than what is just necessary to carry them through the exercises of their respective Colleges and the Universitie. Their aime is not to live as students ought to do – viz., temperat, abstemious, and plaine and grave in the apparel; but to live like gentlemen, to keep dogs and horses, to turne their studies and coleholes into places to receive bottles, to swash it in apparel, to wear long periwigs, &c, and the theologists to ride abroad in grey coats with swords by their sides.[359]

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[357] John Aubrie, "John Wilkins", *Brief Lives: A Modern English Version* (Woodbridge: Boydell & Brewer, 1982), pp. 324-325. This John Wilkins's portrait by Mary Beale painted after he became Bishop of Chester in 1668 is available at upload.wikimedia.org/wikipedia/commons/5/53/John_Wilkins.jpeg. Retrieved 10.01.2015. Alan Chapman has also noticed that the portrait "displays a quizzical smile rarely found in formal portraits of seventeenth-century ecclesiastical and state dignitaries". Alan Chapman, "Warden Wilkins of Wadham". Retrieved 15.02.2015.

[358] P.A. Wright Henderson, *Life and Times of John Wilkins*, p. 37.

[359] Quoted in P.A. Wright Henderson, *The Life and Times of John Wilkins*, p. 22.

The witness noted that the studies of "scholasticall and polemicall divinity", as well as "humane authors", started to be pursued more as a matter of formality. The Civil War legacy, such as a loss of students to the army, disruptions in Latin studies, and religious hostility, created a shift in university practices. The scholarly devotion to texts was replaced by an inclination for the more immediate rewards of political debates. The lifestyle of theologians as the chief reproducers of ideological values came to be indistinguishable from the restless ways of soldiers engaged in campaigns. The confusion of social practices was accompanied by a certain hermeneutic vacuum or "a confluence of anxities which were … focused on the loss of interpretative authority in the decades around the civil war".[360] The breakdown of the laws of state and humanity, as well as an increase in arbitrary readings of Scripture by popular radicalized sects, promoted a "hermeneutic anarchy" that reshuffled the epistemological values relating to the categories of the written and the observed, the exegetical and the empirical.[361]

During the Civil Wars and the Interregnum, political thought eagerly grasped at various conceptions of nature to argue in favor or against existing political hierarchies. The most conspicuous groups, such as the Diggers and Ranters, tended to support vernacular animistic views and interpreted the divine attributes of nature (the source of all purpose and activity) as found in all things.[362] These groups, together with other movements, staged their appearances, using a mixed language of power, theology, epistemology, and experimental philosophy. The reconsideration of functions of writing and speaking, of the doctrines and their social appropriation, created new identity for the "fellowship of discourse".[363] The will for knowledge started to be implemented as the will to perform, as opposed to the will for doctrinal analysis. The specific features of post-war English discourse made its agents seek

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[360] Kevin Killeen, *Biblical Scholarship, Science and Politics in Early Modern England* (Farnham: Ashgate, 2009), p. 16.
[361] Ibid., p. 22.
[362] Steven Shapin, *The Scientific Revolution* (Chicago, IL: University of Chicago Press, 1996), p. 152.
[363] Michel Foucault, "The Discourse on Language", Appendix to *Archeology of Knowledge*, pp. 215-237, pp. 226-227.

for the sources of methodological innovations outside of scholarly artifice and within social artistry.

Almost twenty years later, Thomas Sprat in *The History of the Royal Society* (1667) would describe the foundational wisdom behind the new scientific understanding acquired during the inaugural meetings of the "invisible college". He generally acknowledges the social conditions of any epistemic development, observing that the English nobility prefers to live in the country, whereas foreign aristocrats tend to reside in cities:

> For the same reason, why our streets are built not so well as theirs, will hold also, for their exceeding us in the Arts of Speech: They prefer the Pleasures of the Town; we, those of the Field: whereas it is from the frequent conversations in Cities, that the Humour, and Wit, and Variety, and Elegance of Language, are chiefly to be fetch'd.[364]

Various "pleasures of the field" provided an exemplary model for experimental endeavors, and Sprat uses a similitude suggested by "the present Time of the Year, and the ripe Fields" before his eyes. "It is in Philosophy as in Husbandry", where "a few Hands will serve to measure out, and fill into Sacks that Corn, which requires very many more Labourers, to sow, and reap, and bind, and bring it into the Barn."[365] Considering the etymology of "corn" as "small seeds", Sprat's rhetoric also hints at the prospective fruitfulness of philosophical husbandry, as opposed to the "holy speculative Warrs" that mainly inspired notions "in no way answerable to the practical ends of Life".[366] The schoolmen may thrive in disputations, he remarked, but let them "not hinder the enlargement of the territories of other *Sciences*".[367] Disputation is regarded a very good instrument but not the substance of science, as "those subtle webs were not at all collected by a sufficient information from the things themselves".[368] Sprat insists that science is essentially a job for

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364 Thomas Sprat, *The History of the Royal Society* (London: Printed by T.R. for J. Martyn, 1667), p. 41.
365 Ibid., pp. 20-21.
366 Ibid., pp. 25-26.
367 Ibid., p. 21.
368 Ibid., p. 18.

hands, “as many hands as can be found”,[369] and for those minds who instead of disputational wars are willing to collectively explore the various practical branches of peaceful and constructive natural learning.[370]

Outlining the principles of the new science also seems to be a work for feet, since Sprat repeatedly refers to his writing as “walking”, or taking “a fit time to stop, and breathe a while, and to take a review of the ground, that we have pass’d”. In the end of the first part of the *History*, after having triumphantly denounced the attempts of certain conservatives to undermine the Society’s aspirations, he declares the journey made, the work done, and himself “weary of walking in a rode of trodden”.[371]

The founding members indeed had to depart from their respective fields of expertise to collectively assess matters of common interest. Their meetings were held at “some space after the End of the Civil Wars at *Oxford*, in *Dr. Wilkins* his Lodgings, in *Wadham College*”.[372] Similar to the meetings in London, the first gatherings in Wadham mainly brought “the satisfaction of breathing a freer air, and of conversing in quiet with one another, without being ingag’d in the passions, and madness of that dismal Age”.[373] The “candid company” got together in a “gloomy season”, and “if they were tossing about a theological question, that would not have been different from what they disliked in public”, and could bring “too melancholy a reflexion”.[374] Therefore, they were mainly considering “some particular Trials, in Chymistry, or Mechanicks” and proceeded “rather by action, then discourse”,[375] “settling inviolable correspondence between the hand, and the brain, … to render it an Instrument, whereby Mankind may obtain a dominion over *Things*.”[376] On reaching this point, Thomas Sprat realizes that his narrative stroll is over, and from “the

369 Ibid., p. 20.
370 Ibid., p. 38.
371 Ibid., p. 49.
372 Ibid., p. 53.
373 Ibid., p. 53.
374 Ibid., pp. 55-56.
375 Ibid., p. 56.
376 Ibid.

top of the Hill" he can now clearly see the "wonderful Model" which he is determined to deliver to the readers, even though it may be "disfigured by …[his] unskillful hands".[377]

Poetics and plainness in the argumentative style of the Royal Society

The new community decided that "the compass of their Design" would be "to make faithful *Records,* of all the Works of *Nature,* or *Art,* which can come within their reach".[378] In the early-modern understanding, knowledge was divided into three realms where "men doe busie their endevours": the divine, the natural and the artificial. The "invisible college" was keen to eschew the bitterness of debates in divinity, and therefore first focused their attention on the realms of art and nature. Nature encompassed the multiplicity of created beings, whereas art allowed for a reflection upon them in interpretations. The concept of art was also associated with the application of force, meaning the force of impressive performance for the intellectual liberal arts, and the force of violent physical motion for the practical bodily arts. In *Mathematical Magick*, Wilkins mentioned that mechanical art usually "refers likewise to violent and artificial motion, as Philosophy doth to that which is natural".[379] Characteristically, on establishing that mechanics in fact belongs to the liberal arts, Wilkins declares it to surpass philosophy in significance, and at the same time his narrative about mechanics begins to employ the techniques of dialectical invention instead of considering the realities of physical motion. Mechanics switched its position from being a bodily art to becoming a liberal art, which also changed the type of force at the center of its official narrative. However, the concept of art was also associated with the notion of artifice as in the inappropriate and cunning application of force and power for the purpose of deceiving others. In the ode *To the Royal Society*, prefacing Sprat's *History*, Abraham Cowley asserted that the

[377] Ibid., pp. 60-61.
[378] Ibid., p. 61.
[379] John Wilkins, *Mathematicall Magick, or the Wonders that may be Performed by Mechanical Geometry* (London: Printed by M.F., 1648), p. 11.

task of the new scientific community consisted in discovering "all the Beauties nature can impart, and all the comely Dress without the paint of Art".[380] During the Civil Wars, the future members of the Society must have witnessed numerous instances of inappropriate application of all kinds of forces, which made them feel suspicious about the force-applying character of the arts in general. Partly due to that, they chose to abstain from employing the interpretative capacities of the arts and focused their attention on only one of the three early-modern variaties of human knowledge, i.e. the study of nature alone: "It was *Nature* alone, which could pleasantly entertain them, in that estate... *that* gives room to differ, without animosity; and permits us, to raise contrary imaginations upon it, without any danger of a *Civil War*."[381]

It was primarily "to free it from the Artifice, and Humours, and Passions of Sects"[382] that "they have endeavored to separate the knowledge of Nature, from the colors of Rhetoric, the devices of Fancy, or the delightful deceit of Fables".[383] It needs to be mentioned that what early-modern scientific writers meant by the devices of rhetoric, fancies and fables was not equal in function to what we might mean by these terms nowadays. In the seventeenth-century England, Bacon formulated influential standards for the use of eloquence and rhetorical persuasion in the study of nature, which allowed it to perform an illustrative function but repudiated the "vulgar fables" bearing no relation to experience. Bacon's critical attitude to eloquence needs to be considered within the context of his contemporary rhetorical doctrines. Bacon's own argumentative style was influenced by Quintilian's art of speaking[384] and Ramist dialectical rhetoric,[385] but he complained about the prevalence of Ciceronianism in his time, which was associated with a baroque ornamental

380 Abraham Cowley, "Ode to the Royal Society", *The History of the Royal Society* (London: Printed by T.R. for J. Martyn, 1667).
381 Thomas Sprat, *The History of the Royal Society*, pp. 55-56.
382 Ibid., p. 62.
383 Ibid.
384 For an account of Quintilian's influence on Bacon's treatment of *res et verba* dichotomy, see A. C. Howell, "*Res et Verba:* Words and Things", *Journal of English Literary History*, No. 13 (1946), pp. 131-142.
385 On the employment of figures of dialectical rhetoric in Bacon's inductive reasoning, see Jeanne Fahnenstock, *Rhetorical Figures in Science* (Oxford: Oxford University Press, 2002), pp. 59-65; for a more general account of the

flair. The Ciceronian enrichment of speech arrived and spread in England with the teaching of Erasmus, whose pedagogy recommended a very particular use of fables, including those about natural objects, as material for rhetorical similes and examples.[386] Erasmus pointed out to his readers that it is necessary to collect knowledge about nature from the classical authors who wrote on agriculture, minerals, plants, and animals. He bemoaned a lack of expertise "for the names of trees, plants, animals, tools" among common educators.[387] However, the expertise that Erasmus praised as rare and desirable in the early sixteenth century became for Bacon, one hundred years later, a source of concern about a spreading tendency. By the mid-seventeenth century, "fables" about nature, such as Aesop's and biblical narratives about natural phenomena, were part of popular educational materials. Their content evidently contradicted the knowledge obtained within the framework of experimental philosophy, which was only logical, since the "fabulous" natural objects primarily functioned not in epistemic terms but as signs within allegorical representations of social reality. This made them part of completely different discourse and program of inquiry in comparison with studies of "plain" natural "things themselves".[388] Therefore, the specific criticism of "fancies and fables" by the early Royal Society targeted not rhetoric as a broad scope of techniques of persuasion but rather a specific pedagogical technique of the dissemination of popular knowledge through classical historical narratives.

The Society's ultimate target consisted in designing a model of scientific learning that would not be "over-pressed by a confusing Heap of vain and useless Particulars, or from being streightned and bound too much up by general Doctrines",[389] i.e. the scholastic doctrines about nature and the methods of scholastic

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role of rhetorical strategies in Baconian experimental methods, see John C. Briggs, *Francis Bacon and the Rhetoric of Nature* (Cambridge, MA: Harvard University Press, 1989).

386 Desiderius Erasmus, "De copia", *Collected Works of Erasmus*, ed. by Craig R. Thomson (Toronto: University of Toronto Press, 1978), pp. 631-633, 638-639.

387 Ibid., p. 674.

388 For a comparative study on the visual representation of "fables" in early-modern natural history and experimental practices, see Katherine Acheson, "The Picture of Nature: Seventeenth-Century English Aesop's Fables", *The journal for early modern cultural studies*, V. 9, No. 2 (Fall/Winter 2009), pp. 25-49.

389 Ibid.

disputation. The motto of surmounting the bounds of both the general and the particular sounds characteristic for the moderate course that Wilkins was habitually steering in his endeavors. Later, the philosophical task of mediating between the doctrines and the details would become part of Wilkins's agenda in his works on providence and artificial language. The new cultures of scholarship required a rearrangement of the measure between doctrine and the details, trying to make sense of a multitude of new experiences acquired in experiments. A recalibration of intellectual tools, although not in terms of measurements, was necessary for achieving a new mode of assent about things.[390] The rejection of outdated rhetoric, fancies, and fables "bearing no relation to nature" in favor of "things themselves" created its own utopian discursive project where the common work of hands and minds would break the web of polemical wars and get to "know the works of Creation, and the secrets of them".[391] The shift from text to action in both the subject and the method made it possible "to invent a sphere that seems far removed from the manipulations of the everyday".[392]

This pocket for the accumulation of social energy would license the negotiation of authorities and discursive techniques. The new scientific arena largely defined itself in terms of language, eschewing the discredited vocabulary of disputations but welcoming the tongues spoken within the other spheres of action.[393] Galileo once had to defend the independence of his discourse from scholastic cosmology, within which his own investigations simply would not make sense, by proclaiming the use of a different language, mathematics, for approaching the book of nature.[394] The early Royal Society used the language of experimental artistry to set up the identity of their own discursive undertakings. In Bacon's *New Atlantis*, held by them

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[390] David Gooding, Trevor Pinch, and Simon Schaffer (eds.), *The Uses of Experiment: Studies in the Natural Sciences* (Cambridge: Cambridge University Press, 1989), p. 4.
[391] Francis Bacon, *New Atlantis* (London: Printed by J.H., 1628).
[392] Stephen Greenblatt, *Shakespearean Negotiations: The Circulation of Social Energy in Renaissance England* (Berkeley, CA: University of California Press, 1989), p. 18.
[393] Ibid., p. 19.
[394] Manfred Pfister, "Renaissance Dialogues of Literature and the Sciences", *Dialoge zwischen Wissenschaft, Kunst und Literatur in der Renaissance* (Wiesbaden: Harrassowitz, 2011), pp. 17-25, p. 20.

in veneration, the Solomon's House[395] as a college of sages represented "the very eye of the kingdom". On adding the hand to the eye and promoting "motoric intelligence",[396] the Wadham sages enabled a focus on such properties of nature that could not have been observed before. The language of the hand would be essentially metaphorical but containing no outdated formulae that might interrupt the freedom of experimental operations. The new language would "constrain thought without controlling it" and would allow any new hypothesis to be tested, which required acting out a particular script employing a set of assumptions and a cast of characters.[397] The dramatic and dialogical structure of this new scientific space presented nature as an interlocutor that sometimes speaks out against a confirmed theory but in favor of unexpected experimental results.[398] In view of this purpose, the language made up of poetry, metaphor, and narrative, i.e. things traditionally appropriated by literary criticism, became an effective tool for imagining, learning, and probing conceptions in various areas.[399] As in the case of dramatic theatre, "the elements were crossed, torn apart, recombined, set against each other", all of which was "magnified by the stage", where the participants were absorbed into "free-floating intensities of experience", modeled by the "collective dreams"[400] of the New Atlantis.

The program of new experimental learning demanded innovative means for expressing new discursive realities, and an important role in the early-modern scientific revolution was played by poetics.[401] The new science sought to approach things themselves as close as possible, but those were not yet conveyed in words, which meant that they were barely visible and almost silent. But "the silence of

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395 Cf. "Solomon's House, and sometimes the College of the Six Days' Works, whereby I am satisfied that our excellent King had learned from the Hebrews that God had created the world and all that therein is within six days: and therefore he instituted that house, for the finding out of the true nature of all things, whereby God might have the more glory in the workmanship of them, and men the more fruit in their use of them, did give it also that second name." Francis Bacon, *New Atlantis* (1628).

396 Horst Bredekamp, *Galilei der Künstler* (Berlin: Akademie Verlag, 2007), p. 25.

397 Amy Cook, "If: Lear's Feather and the Staging of Science", Paul Cefalu, Gary Kuchar et al. (eds.), *The Return of Theory in Early Modern English Studies: Tarrying with the Subjunctive* (New York: Palgrave Macmillan, 2011), p. 51.

398 Geoffrey Cantor, "The Rhetoric of Experiment", in Gooding David, Trevor Pinch, et al. (eds.), *The uses of experiment: studies in the natural sciences* (Cambridge: Cambridge University Press, 1989), pp. 159-179, p. 175.

399 Amy Cook, "If: Lear's Feather and the Staging of Science", p. 51.

400 Stephen Greenblatt, *Shakespearean Negotiations*, p. 19.

401 Richard Nate, *Wissenschaft und Literatur im England der Frühen Neuzeit* (München: Fink, 2001), p. 148.

facts" was not only deemed a problem within experimental philosophy but also in poetics. The art of poesy and the art of science were both bringing things to speak, touching upon a layer of nature that was not immediately accessible.[402] In experimental science, things were first brought to speak through hypotheses, but then their discursive status was too close to rhetorical *inventio*, since hypotheses could neither gain a sure grounding in classical authority, nor hold their own ground in verifiable justification. They remained regarded as speculations, or matters of heuristic choice, whereby the ethical and aesthetic circumstances of their development and presentation grew in importance.[403]

The early Royal Society claimed that its aim was "to promote the same rigid way of Conclusion in all other *Natural things,* which only the *Mathematics* have hitherto maintained".[404] The socially stimulated program of attaining the "plain truth" about things sanctioned the demand for the plainness of scientific language. In *The History of the Royal Society*, Thomas Sprat praises truthful plainness of style and banishes ancient mythologies from the republic of letters, because "they have this peculiar *imperfection*, that they were only *Fictions*".[405] However, the reasons behind Sprat's exertions might not be so plain in themselves. Sprat was entrusted with the task of creating the first historical account of the Royal Society "in a way of an apology", i.e. seeking to gain popularity. At the same time as he denounces ancient "mythologists" he also acknowledges the talent of the ancient Platonists "to speak plainer about the Divine Nature".[406] He approvingly notes that this particular capacity, together with the "sweetness, and powerfulness of Plato's Writings",[407] made the Platonists such popular disputants, that even the Church fathers could not help appealing to Platonism, despite its heathen allegories. Following Aristotelian

402 Florian Nelle, "Im Rausch der Dinge: Poetik des Experiments im 17. Jahrhundert". *Bühnen des Wissens: Interferenzen zwischen Wissenschaft und Kultur* (Berlin: Dahlem University Press, 2003), p. 157.
403 Peter Dear, "Totius in Verba: Rhetoric and Authority in the Early Royal Society", *Isis*, V. 76, No. 2 (Jun., 1985), pp. 144-161, p. 157.
404 Thomas Sprat, *The History of the Royal Society*, p. 326.
405 Ibid., p. 414.
406 Ibid., p. 11.
407 Ibid.

and Baconian views, Sprat also admits the capacity of imagery to convey a fact or truth. In the context of his political pursuits, his "plain language" claim deserves somewhat closer attention.

The "plainness of language" was a widespread category in early-modern discussions on various subjects. *The History of the Royal Society* shows a considerable diversity of meanings for "plain".[408] Sprat speaks, for example, of a plain or easily understandable style of reasoning, plain or human reason, plain or industrious men, plainness or calmness of debates, plain or descriptive history, plain or undigested objects of senses. "Plain" then had several meanings, and even though they all pointed in the same direction, it is not compelling to interpret "plain" as the opposite of "figurative" and "rhetorical".[409] The category of "plain" must have characterized a particular discursive style that was modulated by the values of evidentiality, approachableness, political and religious tolerance, as well as respect towards the "matter of fact". In spite of the demand for "plain speaking", figurative language preserved its role in the performance of specific discursive operations, which Sprat displays himself, for instance, when comparing the new experimental philosophy with husbandry.

The introduction to *The History of the Royal Society* sheds suggestive light on the pragmatics behind Sprat's claim for plainness. Early-modern introductions, as well as other paratexts, were often meant to assist the reader in establishing a certain mode of presence, as if he or she were a live witness to the discussion, although, the introduction only planted the seeds of the debate, leaving open questions about its conclusion. Denouncing the "infection of wit" and the "ornaments of speaking" that have infested his times, Thomas Sprat shares with his collaborators within the Royal Society a piece of mythological poetry. The first edition of *History*, which repudiated the use of "fancies and fables" on multiple occasions, was prefaced with

[408] Werner Hüllen, *Their Manner of Discourse: Nachdenken über Sprache im Umkreis der Royal Society* (Tubingen*:* Gunter Narr. Juckerbingen, 1989), p. 109. Hüllen offers a different interpretation of the distribution of the meanings of "plain" in Sprat's *History*.

[409] Ibid.

an ode by Abraham Cowley, entitled "To the Royal Society".[410] Cowley's poetic plot depicts a spirit-of-the-age character called Philosophy, "the great and only Heir of all that Human Knowledge". Philosophy was kept "in Nonage till of late", so that his natural powers were prevented from growth by his guardians and tutors who fed him with "Desserts of Poetry" instead of the "healthy meat" of facts. Instead of exercising him in actions, they "led him into the pleasant Labyrinths of ever-fresh Discours". Instead of the treasures of nature, Philosophy was made to visualize "painted Scenes" and "Pageants of the Brain", until Francis Bacon "whom a wise King and Nature chose Lord Chancellour of both their Laws", stood up for the interests of the confused pupil. If not the condemned "fancies and fables", then what is it? Especially considering that as much as the poetical genius of Cowley was admired by his friend Thomas Sprat and the community, by 1667, Cowley had already expressed his support for the advancement of experimental philosophy in a pamphlet of the same name, which was written in clear prose.

The answer emerges from the subtleties of Cowley's mythopoetic narrative that juxtaposes the value of words with that of the immediate experience of things. Cowley was familiar and much concerned with the problem of the relationship between words and things, which represented one of the axes around which seventeenth-century epistemology was revolving. A celebrated poet and a good friend of Sprat, Cowley shared the Royal Society's commitment to the Baconian choice of experimental explorations over verbal disputations. In Stanza 4 of his Ode, Cowley formulated one of the Society's chief epistemic goals: "From Words, which are but Pictures of the Thought,/ (Though we our Thoughts from them perversely drew)/ To Things, the Mind's right Object, he [the Philosophy character] is brought."[411] Thereby Cowley implicitly refers to *Advancement of Learning* (1605) where Bacon denounced "Pygmalion's frenzy" or the vanity of "falling in love with words", which he deems similar to falling in love with a picture.[412] In Bacon's

410 Abraham Cowley, "Ode to the Royal Society".
411 Ibid.
412 Francis Bacon, *Advancement of Learning* (London: Printed for Henrie Tomes, 1605), Book I, IV, 3.

understanding, it is “the first distemper of learning, when men study words and not matter”, since “words are but the images of matter”. What makes the words “alive” is the “life of reason” and “the weight of matter”, as well as “worth of subject, soundness of argument, life of invention or depth of judgment”.[413]

However, there is a subtle difference between the formulations of Bacon’s and Cowley’s mottos. Bacon mostly refers to “thing” as the subject matter of discourse, the attributes of which include “worth”, “soundness”, and “life”, whereas the qualities of “weight” and “depth” are employed in the metaphorical sense, which was a commonplace in the contemporary manuals of rhetoric. Bacon also includes “life of invention” in the list of his priorities in relation to the subject matter, by which his method legitimizes the procedures of dialectical rhetoric.[414] Compared to this position, Cowley’s statement of purpose for the Royal Society appears more radical, than Bacon’s methodological suggestions. Through Cowley’s poetry the Society shows itself committed to making another step from “thing” as immaterial subject matter of discourse to “thing” primarily construed as a material object of experimental action.

The author of *New Atlantis* and his later acolytes formulated their concerns with a subtle difference in meaning, and their treatment of the category of object can be illustrative for measuring the distance covered by English natural studies during the sixty turbulent years between the publications of *Advancement of Learning* and *The History of the Royal Society*. In Bacon’s understanding, the object finds itself at a point half-way between representing the logical object of applying predicates, as was proper in the scholastic apprehension of nature, and being the material object of experimental manipulations. Bacon mentions “objects” a few times in *Advancement of Learning*, for instance, referring to the object of human will and desires,[415] the object of a historical account,[416] the human body as the object of

413 Ibid.
414 Cf. Jeanne Fahnenstock, *Rhetorical Figures in Science*, p. 60.
415 Francis Bacon, *Advancement of Learning* (London, 1605), p. 56.
416 Ibid., p. 29.

divine miracles,[417] and the object of learning and knowledge.[418] He also criticizes Platonic philosophy for considering only forms and ideas to be the objects of knowledge, and those were "absolutely abstracted from matter".[419] In Cowley's programmatic depiction, the interpretation of "object" arrives at the point where it comes to be perceived as primarily a material entity, which makes it appear more opaque and less accessible for the discursive strategies based on textual processing. When construed as primarily material, things become increasingly "silent" in conceptual terms, since they now represent a side of natural reality beyond the language of existing concepts. However, being "silent" for the new object does not mean that it remains vague and undefined. The object as a subject matter had appeared in scholastic discourse with an adherent verbal definition of its contents, but being approached "from the other side", the new material object obtained a different, syntactic definition. The material object is defined through its surrounding operative context, i.e. its relations with the other objects at the scene of experiments.

The fascination with the other, material side of objects affects the method of their categorizing and the structuring of the epistemic world-view, which also reverses the flow of concrete experimental narratives. The object as a subject matter was a potentially transparent entity structured as finely as the perceptiveness of mind would allow, which made it accessible for narration and conceptualization. But the object as a separate and opaque material entity needed to be conceptualized anew in its as yet unavailable fine particulars. This multiplied the possibilities for construing the causality of phenomena within an experimental context. Whereas in scholastic disputations the logical objects were perceived as more or less passive, the early scientists dealing with material objects suddenly saw them in active, visible, unpredictable and almost animated interaction, which made them look for clues from "things themselves" about how to build a coherent narrative and conceptualize the discovered features of natural reality. A material object engaged in experiments,

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417 Ibid., p. 42.
418 Ibid., pp. 22, 34, 36.
419 Ibid., 36.

which at the time was also deemed to be part of divine nature and providence, was desired to suggest its own ways of how it should be apprehended. In Cowley's words, "The real Object must command/ Each Judgment of his Eye, and Motion of his Hand".[420] Cowley describes here the epistemic ideal where "things themselves" are viewed as material objects "commanding" the human choice of their predicates, thus ensuring the *objectivity* of discourse.

In his *History of the Royal Society*, Thomas Sprat himself took a detailed note of the shift that had occurred in the contemporary understanding of the role of object.

> But now on the other side, the Men of Works and Experiments perhaps do not always handle the very same Subjects that are acted on the Stage of the World, yet they are such as have a very great resemblance to them. It is Matter, a visible and sensible Matter, which is the Object of their Labours.[421]

Sprat's historical narrative captures the crucial point where the "thing" that is "handled" or "acted upon" within the conceptual reality "on the stage of the world" becomes re-invented from an intelligible "subject matter" into a material "object" of experimental actions. It can be argued that this shift occurs in the mid-seventeenth century, when the new understanding of "object" emerged following many years of experimental practices carried out by groups similar to "invisible college". For Sprat, the performing of experiments is a procedure of revised conceptualization of the particulars:

> He [the experimenter] invents not what he does out of himself; but gathers it from the Footsteps and Progress of Nature. He looks on every Thing (landing equal to it, and not as from a higher Ground: He labours about the plain and undigested Objects of his Senses, without considering them as they are joyn'd into common Notions.[422]

The scientific object is reconstructed as an "object of the senses", as opposed to an "object of theorizing", through experimental practices involving new scientific instruments. Cowley's introductory poem to *The History of the Royal Society*

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420 Abraham Cowley, "Ode to the Royal Society".
421 Thomas Sprat, *The History of the Royal Society*, p. 339.
422 Ibid., p. 34.

already mentions the qualities of observed objects, such as smallness and remoteness, which required the improvement of optical instruments to conduct proper observations. The author of *The History of the Royal Society* repeatedly refers to approaching the object of the senses through optical devices,[423] reconfirming the position of constructing the object through human sensuous experience enhanced with scientific instruments. Sprat's views on this point are not entirely consistent with the evidence he presents, which creates an impression that he confuses "material object" and "object of thought". For instance, at some point Sprat also mentions "object" in the Baconian sense, i.e. as a target for conceptualization, pointing out that doctrines of causality cannot be the primary "object" of science.[424] However, unlike Bacon's writings, Sprat's narrative tends to mention the notion of object, referring to the components of experimental devices, such as "the Object Glass of a Microscope".[425] There the object is perceived as an observational target, but it is material enough to be attached to a glass slide. Then Sprat describes "a new Instrument for taking Angles by reflection; by which means the Eye at the same time sees the two Objects",[426] which presents "object" within a certain observational practice. Considering the notion of object in the context of ancient philosophy, Sprat notes that in those times students were encouraged to "first handle Material Things, and grow familiar to visible Objects, before they entered on the retired Speculations of other more abstracted Sciences".[427] Sprat also never forgets his apologetic agenda and addresses the scholastically minded part of his readership, saying that it cannot be "imagined to be a sinful and carnal Thing, to consider the Objects of our Senses, when God, the most Spiritual Being, did make them all".[428]

Both Bacon and Sprat regard the goal of natural philosophy as being in the study of material things, but Bacon's treatment of "object" is closer to "object of contemplation", whereas in Sprat's narrative "object" acquires materiality through

423 Ibid., pp. 227, 246.
424 Ibid., p. 257.
425 Ibid., p. 227.
426 Ibid., p. 246.
427 Ibid., p. 330.
428 Ibid., p. 369.

relationships with the other objects within experimental actions. Sprat effectively translates "object" as "the material entity as it is constructed through the instrumentally enhanced sense perception", which legitimately admits the category of object into the terminological apparatus of the new science. When the silent "things themselves" became conceptualized as "instrumentally constructed objects", they were brought to speak through the enhanced properties of scientific instruments. According to Sprat's own explicit confession, the composing of the *History* was much influenced by the Society's two secretaries, Henry Oldenburg and John Wilkins. In Sprat's own words, "it is only my hand that goes, the substance and direction came from one of them", which undoubtedly refers to Wilkins, since Oldenburg was much less occupied with the *History*.[429] Wilkins's project of artificial philosophical language, developed around the same time, sought to improve the conspicuity of language as the main instrument of the scientific mind.

When "things themselves" were conceptualized as the objects of enhanced human senses in observation, the number of the observed details of natural forms and qualities showed an immediate growth, which Sprat viewed as one of the advantages of the new approach: "To the Eyes therefore there may still be given a vast addition of Objects: And proportionably to all the other Senses".[430] Moreover, the Royal Society entertained hopes that the range of discoveries would soon be extended much further, since the other human senses, such as "Tasting, Touching, Smelling, and Hearing, are as improvable, as the Sight".[431] At least, so it was believed upon Robert Hook's "excellent Performance" of experiments with optical devices. The firm establishment of the new notion of object as an instrumentally constructed material entity made it possible to include a great multitude of specific phenomena into the realm of legitimate scientific apprehension. The new properties of nature suddenly became visible for legitimate phenomenological analysis, instead of representing just some obscure and marginal, possibly even sinful, experiences

[429] "Sprat, Thomas", *Complete Dictionary of Scientific Biography*, 2008. Encyclopedia.com. (September 7, 2014). http://www.encyclopedia.com/doc/1G2-2830904106.html
[430] Thomas Sprat, *The History of the Royal Society*, pp. 384-385.
[431] Ibid., p. 385.

of the "fallen" human body. Sketching a wider horizon of remote implications of applying the emerging instrumental practices, Sprat describes various branches of learning that may yet benefit from such stimulus for growth. He expresses confidence that "very much more Matter, which has been yet unhandled, may still be brought to light".[432] Through "the hands of the most exact Surveyors", by "the Labours of Geographers", by the means of microscope, everywhere on Earth "there may be an infinite number of Creatures … which have hitherto escaped all mortal Senses".[433] Upon successfully applying the microscope "we have a far greater Number of different kinds of Things revealed to us, than were contained in the visible Universe before".[434] Sprat views the next immediate task in hand as that of bringing these instruments of vision to ultimate perfection, by experimenting with different "Figures of Glass".[435] In the project of artificial philosophical language, Wilkins was also experimenting with the mental "figures of glass" that would make "things themselves" more transparent for human understanding.

The treatment of "object" as material entity construed within experimental actions required a considerable change in discursive vision. The expression about "Figures of Glass", which first literally referred to the different ways of arranging lenses inside the microscope tube, received a metaphorical development as "figures on glass" in *The History of the Royal Society*:

> "Tis true, the Mind of man is a Glass, which is able to represent to itself, all the Works of Nature: But it can only shew those Figures, which have been brought before it: It is no magical Glass like that with which Astrologers use to deceive the ignorant by making them believe, that therein they may behold the Image of any Place, or Person in the World, though ever so far removed from it.[436]

Sprat notes that all knowledge is obtained in the same way as language,[437] and

432 Ibid., p. 384.
433 Ibid.
434 Ibid.
435 Ibid.
436 Ibid., p. 97.
437 Ibid.

therefore the right figures of language must be brought before the "glass of mind",[438] so that the new true knowledge could be developed. In Sprat's view, the English language possesses an extraordinary capacity to be "enriched with beautiful Conceptions, and inimitable Similitudes, gathered from the Arts of Men's Hands and the Works of Nature".[439] The new discoveries to be made would also result in "supplying mens Tongues with very many new things, to be named, and adorned, and described in their discourse".[440] Some sixty years later Swift's bitter satire of the language school at the grand academy of Lagado depicted "a scheme for entirely abolishing all words whatsoever"[441] and for conversing with material objects, which was intended to show that it is impossible to discourse in a figurative and metaphoric vacuum. Sprat's *History of the Royal Society* also noted that shortly after its publication there would appear "the exact Method of the Ranks of all the Species of Nature, which has been composed by Dr. Wilkins", for the purpose of promoting "a Communion of Speech amongst all Philosophers" and "a general agreement" amongst virtuous and wise men.[442] At that point John Wilkins was working on the second version[443] of his *Essay towards a Real Character and a Philosophical Language* (1668), where the "ranks of species" would work as figures for presenting the suddenly discovered multitude of "things themselves" before the glass of mind. The discourse of the new science, which became much more detailed and adopted finer distinctions, needed to be enhanced with a new instrument containing "figures of glass" as topical operators and the figures of apprehension.

Cowley's famous criticism about words being but pictures of the thought does not necessarily denounce all possible figurative ways of speaking. As he clarifies in the subsequent lines, the reason for repudiating "fables" is that "Who to the life an exact Piece would make/ Must not from others Work a Copy take".[444] Put differently,

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438 Cf. "God hath framed the mind of man as a glass capable of the image of the universal world." Francis Bacon, *Valerius Terminus: of the interpretation of Nature* (1603), Chapter I "Of the limits and ends of knowledge".
439 Ibid., p. 417. Cf. Ibid., p. 113.
440 Ibid., p. 324.
441 Jonathan Swift, *Gulliver's Travels* (London: Printed for Benj Motte, 1726), pp. 158-159.
442 Thomas Sprat, *The History of the Royal Society*, pp. 252-253.
443 The first version of the *Essay* was destroyed inside a print-house in the Great Fire of London in 1666.
444 Abraham Cowley, "Ode to the Royal Society".

to attain the surest knowing of things themselves, the work must be of ingeniously original quality, not a copy of someone else's making. The first history of the Royal Society confirms its appreciation for the knowing derived from the first-hand experience of details. In Cowley's description, words are dismissed as "pictures of the thought" in the sense that they are often but comments or copies of someone else's thinking, since the original intellectual product can only be obtained from the immediate encounter with "things themselves" in experiments. Cowley's poetic introduction explains twice, the second time more metaphorically, that only those suit the cause of natural philosophy who do not passively let the stream of knowledge pour into their mouths, but act like "those Few who took the Waters up, And made of their laborious hands the Cup".[445]

Sprat constantly complains about the spread of fanciful wit in the discussions on natural philosophy of his contemporaries. However, in Cowley's poem, Sprat's own work receives the praise that in the context of his claims might seem controversial:

> … And ne'er did Fortune better yet,
> Th' Historian to the story fit,
> As you from old Errors free
> And purge the body of Philosophy;
> So from all modern Follies He
> Has vindicated Eloquence and Wit.
> His clean Style as clean Stream does slide
> And his bright Fancy all the way
> Does like a Sun-shine in its play;

In other words, in accordance with the ideals of New Atlantis, as well as with the Baconian understanding of the doctrine of *copia*, it is not the eloquence and wit as such that may pose the problem. If the author's fancy is bright enough and his writing style reflects it clearly, the figurative forms cannot inflict any harm but may only assist in purging the body of knowledge of old errors. Eloquence may only pose a danger in wrong hands, and Cowley is dedicating his ode to the audience of neither

[445] Ibid.

wrong hands, nor minds. The Society fellows' capabilities are specifically recognized in the lines: "Natures great Works no distance can obscure,/ No smallness her near Objects can secure", which must have hinted at the revelations in Robert Hooke's *Micrographia* (1665). Sprat's own introduction to the *History*, entitled *An Advertisement to the Reader*, as well as dedication to the King, is written in a clear and elevated prose style, which singles out Cowley's ode as displaying the practice within the circle of the Society members. Just as the practices of experimentation may differ from the accounts of particular experiments, published in a written form, a public account of the Royal Society's activities could differ from its actual exertions in bringing nature to speak. The Society may have formulated its goals precisely, when poetically declaring itself committed to dealing with "all the Beauties nature can impart, and all the comely Dress without the paint of Art".[446]

When knowledge is conceived of as acquired primarily in practice, its attributes undergo an alteration in meaning. The scholastic techniques of text-commenting required the clearness of structural representation and repudiated the sensuousness of epistemological expression. On the contrary, the making of "an exact Piece to the life" does not marginalize the sensuous. Even to Thomas Sprat himself the figurative "language of hands" seems well adjusted for grasping the meaning of experimental practices. Another attribute of practical knowledge may also be transformed: "plain language" and "speaking plainly" in this context do not mean the same. "Plain language" as a systematic use of concepts according to their definitions may require everything that looks suspicious of rhetoric and figurative speech to be eliminated. However, "speaking plainly" does not demand such sacrifices. The "language of hands" employs the vividness of figurative expressions if it enhances the capacity to deliver new meanings.

The emphasis on the performativity of action in the politics of the Royal Society dissolves the binary oppositions of the fanciful and the plain, the figural and the literal, the practical and the theoretical. Poesy can be "speaking plainly", even

[446] Abraham Cowley, "Ode to the Royal Society".

though it does not use “plain language”. The Renaissance axiom that the knowing of things implies an ability to imitate or reproduce them, raised the status of performative knowing in artistry. However, using “language of the hand” does not necessarily mean that the hand holds a lever. “The instrument of instruments” may hold a more sophisticated modeling device. The early Royal Society sought to bring congruence into the actions of human hand and mind. The making of things was preceded with designing, and imagining with ingenuity often made it possible to create more pointed and “plain” designs. The new science employed the sculpting capacity of poetics to produce genuine inventions.

Mimesis veterum versus *mimesis naturae* in scientific narratives

As Cowley confides in his ode, speaking in the first person, “Y’have learn’d to Read her [nature’s] smallest Hand, and well begun her deepest Sense to Understand”. This imagery of deciphering the secret character of nature could well refer to his own deciphering experience, while assisting the King and the Queen of England in their correspondence during the French exile. However, Cowley’s ode seems intended as a statement of purpose for the whole of the Royal Society. One of the roles of poetry consisted in revealing the secret meanings inscribed in natural things, which had been famously discussed by Philip Sidney in his *Defence of Poesie* (1595).

Sidney grounds his *apologia poetica* on the thesis that it is not essential for poesy to be a fictional construct. More importantly, “in Poesie, looking but for fiction”, they shall use the narration as an imaginative “groundplat of a profitable invention”.[447] Neither fiction, nor non-fiction, epitomizes the main purpose of poesy, but a “profitable invention”, the figures and imagery of which communicate some unique and individual experience. Narrative forms provide frameworks for composing such figures of poetic thinking. Sidney points out that one of the specific

[447] Philip Sidney, *Defence of Poesie* (London: Printed for William Ponsonby, 1595), p. 26.

features of poetry is that it assists the reader in creating a subtle and specific mode of representing reality, which would not be possible otherwise: "there are many misteries contained in Poetrie, which of purpose were written darkly, least by profane wits it should be abused".[448] Poetic language, as it were, distills the figures of apprehension from the "natural particulars" of experiential details, and therefore poesy is a "speaking picture, with this end to teach and delight",[449] whose lessons are more efficient than those of non-poetic philosophy. Whereas "the Philosopher bestoweth but a wordish description", poesy can "strike, pearce", or impart other experiences and feelings that "possesse the sight of the soule".[450] Poesy gives action to words and releases the persuasive power of figures to impart experience. The "learned definitions" of philosophers "lie darke before the imaginative and judging power, if they be not illuminated or figured forth by the speaking picture of Poesie."[451] In poesy, things are brought to speak and become "figured forth", i.e. the poetic figurative thinking effects a conceptual shift that leads to the possibilities of new ingenious solutions. Without poesy, the explorer of nature "should never satisfie his inward conceit, with being witnesse to it selfe of a true lively knowledge",[452] i.e. the knowledge associated with the experience of the harmonic coherence of things in nature.

In Wilkins's time, Sidney remained a relevant authority on explaining the performative power of poetic expressions, although the understanding of this power changed. According to Renaissance theorizing, the art of poesy was endowed with the capacity for *mimesis* in two ways: *mimesis naturae* as the aesthetic principle of the imitation of natural reality and *mimesis veterum* as a rhetorical technique of emulating the writings of ancient authors. By the mid-seventeenth century, both versions of *mimesis* as productive writing tools found themselves in crisis. Sidney in his *Defence of Poesie* had already criticized the practice of following too closely

448 Ibid., p. 35.
449 Ibid., p. 15.
450 Ibid., p. 17.
451 Ibid.
452 Ibid.

the rules of *mimesis veterum*, calling it a recipe for failing “the materiall point of Poesie”. Sidney’s comment appeared as a part of literary discussions, but his attitude derived from the tradition of rhetorical pedagogy, where the “material point” of effective literary composition was considered within the framework of the doctrine of *copia*.

As was mentioned in Chapter I of this study, the notion of *copia* or “the effective richness of discourse” was distinguished from the mere imitation of ancient authors.[453] Quintilian first expressed the view that imitation alone is not sufficient for producing a *copious* speech, since in that case “nothing would ever have been discovered”.[454] Later, in Erasmus’s interpretation, the key to *copia* became associated with operating the abundance of details through technically precise discursive figures, which entailed “including the essential in the fewest possible words”.[455] The quality of *copious* discourse was related to “pointed brevity”,[456] and performing with such pointed figures required ingenuity.[457] Erasmus’s prescription on rhetorical composition was reduced in theory in favor of *exercitatio* or *experientia*,[458] which was characteristic of the crisis of *mimesis veterum*. In terms of theory, Erasmus recommended employing multiple and combined patterns of *mimesis*, to ensure the diversity and ingenuity of the operative “figures of abundance”. By the end of the sixteenth century, the traces of the doctrine of *copia* could be found in statements by Sidney and Bacon, although the “primitive fathers” of English literary and scientific language created different applications for this rhetorical doctrine. Bacon was influenced more directly by Quintilian’s versions of *copia*; as was noted by A.C. Howell, the Latin edition of *De Augmentis Scientiarum* (1623) translates the phrase about the excessive hunting after words with an exact

453 The notion of *copia* is explored in more detail in Chapter I of this study.
454 Quintilian, *Institutio oratoria*, trans. Harold Edgeworth Butler (Cambridge, MA: Harvard University Press, 1922), Book X, 2:4.
455 Desiderius Erasmus, “De copia”, p. 301.
456 Ibid., p. 687.
457 Ibid., p. 580.
458 Terence Cave, *The Cornucopian Text: Problems of Writing in the French Renaissance* (Oxford: Clarendon Press, 1979), p. xi.

quote from Quintilian on the priority of things over words.[459] Bacon juxtaposed "words" and "matter" within a figure of *antithesis*, stating that "words are but images of matter", which accentuates the "matter" but also brings out the notion of "image vehicle" connecting representations in the mind. However, unlike rhetorical pedagogy, Bacon insisted that the dialectical invention should be practiced in application to material "things in the world".

Philip Sidney's above-mentioned criticism of excessive obedience to the principle of *mimesis veterum*, albeit essentially different from the Bacon's focus on the materiality of things, can be considered in parallel with the Baconian rehabilitation of Quintilian's version of rhetoric. Sidney's famous "material point" that poesy should not be deemed the "mother of all lies" can be translated in Quintilian's terms. Quintilian maintained that the key difference between the original model and its imitations lies not in the level of *mimesis*, in which they may be equal, but in the authenticity of the speaker's illocutionary standing. Quintilian believed that any imitation (not to be confused with *copia*) has "less life and vigor than actual speeches" not because of a lack of the imitator's skills but mainly because of the specific nature of their purpose that is "real" for the original and "fictitious" for any subsequent imitation.[460] Here, the distinction between the "real" and "fictitious" character of an oration is based not on the reality status of its subject matter but on its illocutionary quality. Sidney also maintains that poesy neither produces fiction, nor states anything, i.e. neither essentially operates words, nor yields specific judgments about subject matters. Similar to Bacon's view of natural studies, Sidney also views poesy as producing "profitable invention",[461] but unlike Bacon, Sidney is more interested in the inner experience which captures "the sight of the soule"[462] and constitutes the "reality" or the "material point" of poesy.

In the search for ways of expressing new notions and experiences, early science borrowed from early-modern rhetoric the idea that the subject matter of

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[459] A. C. Howell*,* "Res et Verba*:* Words and Things", p. 133.
[460] Quintilian, *Institutio oratoria*, Book X, Chapter 2:11.
[461] Philip Sidney, *Defence of Poesie*, p. 26.
[462] Ibid., p. 17.

discourse cannot be entirely reduced to words manipulated within rhetorical figures, or to things manipulated within doctrinal theorizing about nature. Following Bacon's method, the Royal Society, including Wilkins, chose a position close to the modern philosophy of mind, insisting that the quality of discourse is mostly dependent on the quality of inventions termed as "thoughts".[463] The Royal Society also inherited the Baconian view that the performative intention is included in the subject matter of discourse through maintaining the specific ethical position of ensuring the "moral certainty" of conclusions. Scientific copiousness was supposed to result from discovering the appropriate "figures of abundance" that offered strong perlocutionary potential. Mid-seventeenth-century natural philosophy exercised a lot of effort to impress the public mind by discovering such figures in experimental practices. In England, the focus on thoughts and impressions also brought discussions away from politically charged doctrines towards more flexible and instantaneous experimentation.[464]

Whereas *mimesis veterum* was in crisis as the way of coping with *copia*, *mimesis naturae* was sustaining a challenge related to its subject matter. One of the consequences of revising the worldview based on the Ptolemaic cosmology was the collapse of the notion of a finite universe.[465] Due to the multiple religious and political connotations of this idea, many prolific intellectuals perceived the sudden deterioration of the geocentric model of the cosmos not only as a curious logical problem but as a painful existential experience, which was reflected in contemporary literary output. For instance, the metaphysical poets, although they were accredited with this title only one and a half centuries later in the ironic depiction given by Samuel Johnson in *Lives of the Most Eminent English Poets* (1781), were sensitive to developments in various fields of natural studies. This was in part the ground for the irony of Johnson's characterization that in metaphysical poetry "the most heterogeneous ideas are yoked by violence together; nature and art are ransacked for

[463] See Quintilian, *Institutio oratoria*, Book XI, 1:7.
[464] Ibid., Book XII, 2:11.
[465] Robert J. Clements, "Poetry and philosophy in the Renaissance", *Comparative Literature Studies*, V. 8, No. 1, Special Issue on Literature and Philosophy (Mar., 1971), pp. 1-20, p. 4.

illustrations, comparisons, and allusions”.[466] From Johnson’s viewpoint, the metaphysical poets lost the touch with nature, indulging themselves in the cunning and violent artifice of poetic verbosity. Johnson’s criticism of the metaphysical way of *mimesis naturae* is essentially similar to Sidney’s criticism of excesses in *mimesis veterum.* Analyzing the concept of metaphysical wit, Johnson points out that wittiness should not be “abstracted from its effects upon the hearer”.[467] Wit fails to please, i.e. impart the experience of harmonious satisfaction, if the poetic piece becomes perceived not as a coherent composition but rather as “a kind of *discordia concors*; a combination of dissimilar images, or a discovery of occult resemblances in things apparently unlike”.[468] Johnson reproached metaphysical poetry for the overuse of “occult” philosophical novelties, at the same time acknowledging that they “sometimes stuck out unexpected truth”. The “unexpected truth” consisted in *discordia concors* representing a fairly accurate description of what the natural *macrocosm* looked like upon the abolition of ancient cosmology.

For instance, instead of pleasing the reader, John Donne strove to impart a certain authentic intellectual experience in his oft-quoted “An Anatomy of the World” (1611):

> And new philosophy calls all in doubt,
> She that should all parts to reunion bow,
> The element of fire is quite put out,
> The sun is lost, and th’earth, and no man’s wit
> Can well direct him where to look for it.
> And freely men confess that this world’s spent,
> When in the planets and the firmament
> They seek so many new; they see that this
> Is crumbled out again to his atomies.
> ‘Tis all in pieces, all coherence gone,
> All just supply, and all relation;
> Prince, subject, father, son, are things forgot,
> For every man alone thinks he hath got

[466] Samuel Johnson, “Lives of the English Poets”, *English Prose,* ed. Henry Craik (London: Macmillan, 1916), V. IV, “Cowley”: 8.
[467] Ibid.
[468] Ibid.

To be a phoenix, and that then can be
None of that kind, of which he is, but he.
This is the world's condition now...

Johnson criticized the metaphysical poets for failing to reproduce the values of noble poetic artistry as required by *mimesis naturae*: "these writers will, without great wrong, lose their right to the name of poets; for they cannot be said to have imitated anything".[469] But the crisis of *mimesis naturae* was not due to a loss of the secrets of *mimesis*. The metaphysical poets implemented faithfully the basic rules of the poetic guild, which created an impression that "they broke every image into fragments" and presented "laboured particularities", acting as if "dissecting a sunbeam with a prism".[470] Their imitation of the physically chaotic universe was accurate, but it could not bring about the purifying *catharsis* which neoclassicism particularly expected from poetry.

The old Renaissance understanding of poetry as *mimesis naturae* was grounded on the epistemic relationship between *macro*- and *microcosm* viewed as mediated by a certain prior design or a master *logos* in the human mind. But this disposition was challenged upon the arrival of scientific empiricism where all reliable knowledge of nature had to be derived from the accounting of sensuous experience. Revealed designs in nature could not be explained through any kind of innatism. The new experimental philosophy, as well as the experimental metaphysical poetry, were not committed to reflecting upon the harmonious pattern of mediation between the human mind and nature. They were searching for new patterns of coherence within the potential infinity of individual experiences.[471] Instead of the strategies of *mimesis* this rather required employment of the procedures of *inventio* and

[469] Ibid: 4.
[470] Ibid: 10.
[471] Meyer H. Abrams, *The Mirror and the Lamp*: *Romantic Theory and the Critical Tradition* (Oxford: Oxford University Press, 1953), p. 166.

"throwing together the mass of materials" with what Johnson calls "ingenious absurdity",[472] i.e. by composing certain pointed but communicable figures of apprehension for the abundance of new experience.

In the mid-seventeenth century, this became viewed as the main task of the poetic arts, and even Hobbes, albeit a severe critic of poesy, acknowledged the usefulness of tools that enable the patterning of multifaceted experience. In Hobbes's view, the ability of an author to capture the details allows him to achieve the harmonious quality that Johnson would later demand from poetry. The copiousness of discourse could be accomplished by pleasing the reader with an innovative construction of patterns within chaotic experience through the figures of similitude.[473] Hobbes praised the intellectual virtue of "discretion", i.e. the ability to discern "times, places and persons" in the "application of thoughts to their end", i.e. in their coherent causal representation.[474] The presence of "discretion" improves the use of author's similitudes, making them not only illustrative but genuinely persuasive and pleasing "by the rarity of their invention".[475]

Performative approaches to *res et verba*

As Meyer H. Abrams notes, the change of poetic aims "from imitation to expression, and from mirror to the fountain, the lamp" was not an isolated phenomenon but an integral part of changes in popular epistemology, more specifically, promotion of the idea of subjectivity in cognition.[476] By the end of the seventeenth century, aesthetic theory, experimental philosophy, and natural theology would all develop a fascination with an organic modeling of the universe, centered around the human

[472] Samuel Johnson, "*Lives of the English Poets",* "Cowley": 13.
[473] Ibid.
[474] Thomas Hobbes, *Leviathan* (London: Printed for Andrew Crook, 1651), Part I, Chapter VIII, "Good Wit, Or Fancy; Good Judgement; Discretion".
[475] Ibid. See also Quentin Skinner, *Reason and Rhetoric in the Philosophy of Hobbes*, p. 371.
[476] Meyer H. Abrams, *The Mirror and the Lamp*, p. 57.

mind as “sensitive matter”[477] or “universal plastic nature” that “forms a whole, coherent and proportioned in itself, with due subjection and subordinacy of constituent parts”.[478] In the late 1660s, John Wilkins also contributed to this trend in his version of natural theology grounded on the notion that the human mind possesses a natural capacity for grasping patterns within the experience of providence.[479] But even in the early seventeenth century, Donne’s “An Anatomy of the World” creates personified and subjective imagery of the “original” force that could bring coherence back into the disrupted universe:

> She that had all magnetic force alone,
> To draw, and fasten sund’red parts in one;
> She whom wise nature had invented then
> When she observ’d that every sort of men
> Did in their voyage in this world’s sea stray,
> And needed a new compass for their way;
> She that was best and first original
> Of all fair copies...

Like the other masters of the baroque Ciceronian style, such as Sir Thomas Browne and Jeremy Taylor, Donne was receptive to the *mimesis naturae* part of the Renaissance dialectical and rhetorical heritage. Donne’s poetic ingenuity allowed him to indicate the “magnetic” force that, metaphorically or literally, could be responsible for maintaining order in the natural world. Interestingly, since at that point magnetism was not yet distinguished from gravity, even here Donne’s apparent wordiness was not entirely misleading, although his use of the term “magnetism” would be more of an analogue with the spiritual realm. However, he was not spared the agitated literary polemics of those new masters who favored more practical attitudes and more transparent styles in natural philosophy. The episodes of such polemics occurred repeatedly between 1620s and 1660s, often within what became

[477] Margaret Cavendish’s treatment of the concept of “sensitive matter” is considered in Chapter IV of this study.
[478] Anthony Ashley Cooper Earl of Shaftesbury, “Soliloquy, or advice to an author”, *Characteristics of Men, Manners, Opinions, Times*, ed. Lawrence E. Klein (Cambridge: Cambridge University Press, 1999), pp. 70-162, p. 93.
[479] On this point, see Chapter V of this study.

known as “the battle of the couplets”. In 1629, Sir John Beaumont’s son[480] published a collection of his father’s poems that echoed Quintilian’s advice and formulated the model attitude for the future reformative efforts of the early Royal Society. Beaumont’s *To His Late Majesty*, *Concerning the True Form of English Poetry* praises:

> Pure phrase, fit epithets, a sober care,
> Of metaphors, descriptions clear, yet rare,
> Similitudes contracted, smooth and round,
> Not vexed by learning, but with Nature crowned:
> Strong figures drawn from deep inventions, springs,
> Consisting less in words, and more in things:
> A language not affecting ancient times,
> No Latin shreds, by which a pedant climbs.
> …
> He paints true form who with a modest heart
> Gives lustre to his work, yet covers art.
> Uneven swelling is no way to fame,
> But solid joining of the perfect frame.[481]

The mentioning of “rare but clear” metaphors, as well as “strong figures drawn from new but deep inventions” reveals the traces of Quintilian’s heritage that were also explicitly appreciated by Ben Johnson and Dryden. However, a pronounced emphasis on “things” instead of mere subject matter suggests a strong Baconian influence. As Ryan Stark remarks, Beaumont effectively reiterated his poetic argumentation from Bacon’s *Advancement of Learning*, where affected speech is taken as a sign of “Pygmalion’s frenzy”.[482] Beaumont’s poem epitomizes neatly the spirit of Restoration views of the epistemological role of language, even if Beaumont’s advice formally differs from the one given by the first historians of the Royal Society. In another of his reflexive pieces, entitled *To the Most Illustrious Prince Charles, of the Excellent Use of Poems*, Beaumont encourages poets to

[480] Sir John Beaumont was the older brother of Francis Beaumont who participated in the famous play-writing duet of Beaumont & Fletcher in 1605-1613.
[481] John Beaumont, *The Poems of Sir John Beaumont*, ed. by Alexander B. Grosart (Lancashire: C. Tiplady and son, 1869), pp. 120, 119.
[482] Ryan J. Stark, *Rhetoric, Science, and Magic in Seventeenth-century England* (Washington, DC: Catholic University of America, 2009), p. 189.

devote more attention to natural subjects and envisages the Society's linguistic interests:

> The Muses claime possession in those men,
> Who first adventure'd with a nimble pen,
> To paint their thoughts, in new invented signes,
> And spoke of Nature's workes in numbered lines.[483]

Beaumont's maxima of employing the lustre but covering the art represented a piece of rhetorical advice that was later emulated in Abraham Cowley's introductory ode as the task of presenting "all the Beauties nature can impart, and all the comely Dress without the paint of Art".[484] If we consider Cowley's statement about words being "but pictures of the thought" in the context of Quintilian's "philosophy of mind" framework, it becomes clearer why his Ode is moving so freely between the realms of words and things. The discourse of early science was operating not with truth claims but probability claims, and therefore it is not the truth-value of scientific conclusions but the strength and depth of the figures of invention that mattered most in discussions. Although formulated in aesthetic terms, the principle of employing the lustre while covering the art had a methodological impact on early science. The Baconian method often employed *antithesis* to create a plausible, systematic and apparently rhetoric-free account of experimental results. As will be shown later, John Wilkins also employed the recommendation of building "solid joining of the perfect frame" when designing his imaginary automata as models for the new plain structures of knowing.

Early experimental philosophy attempted to build figures of abundance from experiential material, performing with these figures at the scene of experiments. The new science fostered performative knowing of how to effectively present an object within a new frame of reference. Both poetry and rhetoric were promoting this skill, using Sidney's words, "doth not onely shew the way, but giveth so sweete a prospect

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[483] John Beaumont, *The Poems of Sir John Beaumont*, p. 143.
[484] Abraham Cowley, "Ode to the Royal Society".

into the way, as will entice anie man to enter into it".[485] The statements of *apologia poetica* worked not only in poetry but also for natural studies. The experimental philosophy was also fighting the prejudices that portrayed it as "the mother of lyes" or "the nurse of abuse".[486] The new experimental methods were striving to wave away such accusations of deception by working not in the modality of doctrinal propositions but in "figuring forth" new ingenious hypotheses, "not laboring to tell you what is, or is not, but what should, or should not be".[487]

Sidney mentioned that the classical art of poetry had been given the divine names of prophesying and world-making, and that "indeed the name of making is fit for him [the poet]".[488] The "making of what should be" leads poetic discourse to form hypotheses about "that second nature, which in nothing … sheweth so much as in Poetry".[489] Similar to how the poet "calleth the sweete Muses to inspire unto him a good invention",[490] the Royal Society also appreciated a good invention, or when things were "illuminated or figured forth by the speaking picture of Poesie". These views on poetics and rhetoric were influential in developing the new normativity of experimental scientific discourse. Poetics and rhetoric were embroiled with the theories of language and style, accounting for specific forms of communication in discursive situations.[491] As J.H. Newman argues, poetry "delineates that perfection that imagination suggests, and to which as limit the present system of Divine Providence actually tends".[492] Newman summarizes the attitude of Aristotle and Bacon to thinking in figures: "by confining the attention to one series of events and scene of action, it bounds and finishes off the confused luxuriance of real nature".[493] In Newman's view, the function of poetical archetypes

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485 Philip Sidney, *Defence of Poesie*, p. 20.
486 Ibid., p. 25.
487 Ibid., p. 26.
488 Ibid., p. 24.
489 Ibid., p. 14.
490 Ibid., p. 26.
491 Richard Nate, *Wissenschaft und Literatur*, p. 148.
492 John Henry Newman, "Poetry with Reference to Aristotle's *Poetics*", *Essays Critical and Historical* (London: B. M. Pickering, 1871), V. I, pp. 1-29, p. 9.
493 Ibid.

and models towards any narrative is similar to the function of the abstract mathematical formulas of science towards the factual chronicle accounts of corresponding natural phenomena.[494] Using Walter Benjamin's words, throughout the seventeenth century, early science was replacing the poetical "magical reading" of nature or "the gift which we possess of seeing similarity"[495] with what might be called the performative knowing or "the gift of framing similarity". This performative knowing sought to lose the touch with magical reading, without being engulfed in the profane, and to build artificial bridges wherever the coherence of nature appeared weakened.

Within the early Royal Society, the "understanding of the deepest sense of nature" was initiated within utopian constructs of hypotheses. In the modern words of Walter Moser, a scientific experiment has to respect the given structure of the factual world, but to freely re-combine elements of reality and form new structures, the experiment needs to be viewed as a mode of fiction.[496] The scientist first needs to imagine the natural world as if it were different, adding new features that are not immediately discernible and starting an experiment as a conjecture within the "semiotic materiality of language". Both poesy and scientific experimentation feed from the root of a language game. In Sidney's words, it is "under the vaile of Fables" that we're given "all knowledge, Logicke, Rhetoricke, Philosophie, naturall and morall".[497] The sphere of poesy is not limited by issues of literary forms, and "it is not ryming and versing that maketh Poesie: One may be a Poet without versing, and a versefier without Poetrie".[498] Poesy was distinguished from non-poesy by the presence of the performative intention to advance nature, when the poet "bringeth things foorth surpassing her [nature's] doings".[499]

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494 Ibid., p. 10.
495 Walter Benjamin, Addendum to *Doctrine of the Similar*, New German Critique No. 17, Special Walter Benjamin Issue (Spring, 1979), pp. 65-69, p. 69.
496 Walter Moser on the work of Ernst Mach, *Erkenntnis und Irrtum: Skizzen zur Psychologie der Forschung* (1916), in Walter Moser, "Experiment and Fiction", *Literature and Science as Modes of Expression* (Dordrecht: Kluwer Academic Publishers, 1989), pp. 61-80, pp. 62-63.
497 Philip Sidney, *Defence of Poesie*, p. 35.
498 Ibid., p. 25.
499 Ibid., p. 14.

Abraham Cowley in his Pindarique Ode V entitled *The Muse* (1656) presented the main character as a goddess voyaging even beyond the works of God,[500] adding a comment that "[t]he meaning is, that Poetry treats not only of all things that are, or can be, but makes Creatures of her own, … and varies all these into innumerable Systemes, or Worlds of Invention".[501] Having spent several years in French exile, Cowley might have been influenced by the rich early-modern French tradition of scientific poetry. As Dominique Bouhours (1628-1702), Cowley's French contemporary, remarked later, the poet's gift may involve lying, but lying ingeniously: "Il est permis, il est même glorieux à un Poete de mentir d'une manière si ingenieuse".[502] Both poetics and experimental science brought things to speak through the ingenuity of performative effects. As Florian Nelle notes, "Die scharfsinnige und überraschende Pointe, verlieht dem Menschen die demiurgische Fähigkeit, die Welt zum Sprechen zu bringen … Ingeniös sprechen sie mit den ingeniösen Menschen".[503] Within the framework of early-modern experimental philosophy, the concepts of prior design, divine providence, and innate ideas were slowly giving way to viewing the wonder of invention as the key epistemological reference point for scientific practices.

The seventeenth-century meaning of "ingenious", due to synonymic use, was overlapping with the meaning of "ingenuous" as "gentleman-like". Thomas Blount's *Glossographia* (London, 1656) defined "ingenuity" as "the state of a free and honest man, freedom, a liberal nature or condition".[504] Edward Phillips's *The New World of Words* (London, 1658) provided a single mixed entry for "Ingeniosity, or Ingenuity", deriving both from "ingenuousnesse", and even the edition of 1706 still recorded the double meaning of "ingenuity" as "quickness of Wit, Smartness",

500 Abraham Cowley, Pindarique Ode V "The Muse", *Poems* (London: Humphrey Moseley, 1656).
501 Meyer H. Abrams, *The Mirror and the Lamp*, p. 274.
502 Ibid., p. 269.
503 Florian Nelle, "Im Rausch der Dinge", pp. 151-152.
504 Robert A. Greene, "Whichcote, Wilkins, 'Ingenuity', and the Reasonableness of Christianity", *Journal of the History of Ideas*, V. 42, No. 2 (Apr. - Jun., 1981), pp. 227-252, p. 229.

also connecting it with "ingenuous" as "free, open, frank, sincere, plain".[505] The ingenuity of the both poetic and technical implementation of ideas was not viewed as contradictory to the "free, open, frank, sincere, plain" or "close, naked, natural way of speaking", promoted by the Royal Society of London. In Dominique Bouhours's words that reproduced a whole string of ancient views, "What is figurative is not false, and Metaphors have their Truth as well as Fictions", since "they deceive no man" and are "like transparent Veils, thro' which we see what they cover".[506]

Steven Shapin remarks that the new science faced the practical problem that its lexicon contained many outdated discursive terms which needed to be amplified to accommodate new meanings.[507] Often only a constructed metaphorical use of some established lexical item could impart an unusual experience or convey a newly acquired understanding. The artificial or metaphorical use of an existing term created a tension between the two subjects connected within the metaphor, which attracted attention to new features of the signified phenomenon, opening up new ways for its interpretation.[508] For instance, the metaphor comparing heavenly motions to a clockwork highlighted those features of the heavens that are clockwork-like, i.e. emphasizing that this object features a circular, regular, and calculable operation.

Geoffrey Cantor points out that in some contexts it is even difficult to distinguish between the metaphors and the literal scientific propositions, since the difference lies within practices of reading and specific views on language use. The constructed metaphorical reading of phenomena may also be executing a theory-generative function. In Richard Boyd's words, "any worthwhile scientific theory is continually being extended through articulation of its underlying metaphor".[509] Figurative thinking brings out particular qualities of the phenomenon, which may be helpful for modeling its causality. Metaphors may even extend their influence towards

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505 Ibid.

506 Dominique Bouhours, *The Art of Criticism*, trans. A Person of Quality (London: D. Brown, 1705), pp. 5-12.

507 Steven Shapin, "Pump and Circumstance: Robert Boyle's Literary Technology", *Social Studies of Science*, V. 14, No. 4 (Nov., 1984), pp. 481-520, p. 500.

508 Geoffrey N. Cantor, "Weighing light: the role of metaphor in 18th century optical discourse", *The Figural and the Literal: Problems of language in the history of science and philosophy, 1630-1800*, ed. Andrew E. Benjamin (Manchester: Manchester University Press, 1987), pp. 124-146, pp. 126-127.

509 Ibid., p. 127.

the material culture of science, serving as symbolic models for designing scientific instruments.[510] For instance, if our world resembles a clock, various clocklike devices should be helpful for comprehending its operation. In early-modern experimental thinking, the ingenuity of experimental designs often had to be modeled through such figurative forms.

The new science claimed a break with the previously widespread tradition of rhetoric, however, as Jeanne Fahnestock mentions, estimations of the ornamental role of rhetorical elements in early-modern discourse were partly affected by the ambiguity of the Latin term *ornamentum*, which meant "embellishment" but also "apparatus and gear".[511] Francis Bacon was opposed to rhetoric in theory but admitted that the figurative procedures of *inventio* attract our attention to certain marks or places that may excite the mind and direct inquiry.[512] The effective use of figurative techniques was also important for presenting new ideas to the "persuasive communities", which was an essential social prerequisite for making new inventions possible. The dialectical rhetoric that created new figures of contextual framing was viewed as a transferable skill regulating both phrasing and method within the practices of making knowledge.

In early-modern scientific writing, various figures of speech also corresponded to the use of specific visual figures in illustrations. The use of imagery in texts, such as tables with curly brackets and spherical projections, often indicated the presence of particular rhetorical techniques. In both speech and vision, the argumentative significance of figures consisted in allowing for a recombination of data into a more coherent and concise structure. Within the early-modern mechanical arts, visual arguments were often preferred to verbal ones, since imagery induced more of a practical involvement on the part of the apprentices.

The memoirs of John Evelyn, running from 1640 to 1706, contain an entry about his visit to Lord Berkley, Wilkins's former student. Evelyn found there John

[510] Ibid., p. 140.
[511] Jeanne Fahnestock, *Rhetorical Figures in Science*, p. 18.
[512] Francis Bacon, *Advancement of Learning*, Book II, XIII, 9.

Wilkins, astronomer Lawrence and economist William Petty, all amusing themselves with “contrivances for chariots, and for a wheel for one to run races in”.[513] As Evelyn admiringly notes, perhaps three such persons were not to be found in Europe for ingenuity. Wilkins’s involvement with the “invisible college” at Oxford had an impact on both the agenda of the early Royal Society and his own epistemological views. Within a specific cultural situation, he became interested in the performative experimental strategies embroiling the techniques of dialectical and rhetorical pedagogy. Although the Royal Society claimed to break with rhetoric, dialectical procedures were deemed suggestive for directing experimental inquiries. Wilkins’s collaborators repudiated outdated “fancies & fables” but welcomed the figurative “language of the hand”. The vividness of metaphors borrowed from the practices of artistry was employed for returning to “plain speaking” about “things themselves”. The task of “bringing things to speak” made the experimental philosophy join with poetry, as both aimed to arrive at a new vision of nature, for which natural reality had to be transformed through the procedures of invention. The elements of poetical and rhetorical discourse, such as the doctrine of *copia*, provided techniques for the reconstruction of the scientific object as a material entity within experimental action. The newly discovered “speaking instruments of science” made new properties of objects visible for phenomenological analysis, and the dialectical procedures helped distill the pointed figures of apprehension from the abundance of experimental data, which enabled the generation of new theories.

My next chapter will show how Wilkins’s method makes use of verbal and visual figurative forms as performative aids within the procedures of both rhetorical *inventio* and technical invention. In *Mathematicall Magick*, Wilkins applies the dialectical procedures of *loci communes* and *stasis*, as well as other figurative patterns of thinking, to impart the experient knowing of technical novelties and to present them in the light of new cultural references, which would advance his argument in favor of various developments in the mechanical arts.

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513 P.A. Wright Henderson, *Life and Times of John Wilkins*, p. 121.

Chapter IV

Wilkins's poetical and mathematical magic

When I first thought of this invention,
I could scarce forbear with Archimedes to cry out ἕυρηκα ἕυρηκα;

John Wilkins
Mathematicall Magick (1648)

In 1648, when John Wilkins was preparing for publication his *Mathematical Magick, or the Wonders that may be performed by Mechanical Geometry*, discussions on how to conduct experiments were in the initial stages, and the discursive space of experimental philosophy was not yet regulated by rigid paradigmal requirements. The concepts of ingenuity and *ingenuousness* as "gentleman-like" served for Wilkins as the starting point for legitimizing his narrative about mechanics. In this chapter I will focus on Wilkins's second science book, popular enough to go through several editions up until the late seventeenth century.[514] Wilkins's performative representation of the art of mechanics formed a modeling example for the new scientific knowing, which was implemented in the research program of the early Royal Society of London.

Wilkins's mechanics as a liberal art

Mathematical Magick begins with Wilkins's dedicating the book to Charles Louis, the Prince Elector Palatine, to whom at that time he was rendering services as a chaplain. The Prince had been staying in London since 1644; in 1648 the Peace of Westphalia was signed, the Rhenish Palatinate was restored to him, and he returned to Heidelberg, with Wilkins accompanying him on the way, also intending to employ his Palatinate connections in case he would need to flee the country.[515] In

[514] In *Battle of Books* by J. Swift, Wilkins is remembered as one of the chief engineers among the Moderns: "The engineers were commanded by Regiomontanus and Wilkins", whereas "Euclid was chief engineer" of the Ancients. *The Prose Works of Jonathan Swift*, ed. by Temple Scott (London, 1911), V. I, p. 173.

[515] On Wilkins's relations with the Palatinate on this occasion, see Lisa Jardine, *On a Grander Scale: the outstanding career of Sir Christopher Wren* (London: Harper Collins, 2002).

the dedication to his book, Wilkins regrets the troublesome conditions, "under which the Common-wealth of learning does now suffer",[516] which might mean not only his grieving about English calamities but also mourning the destruction of the Hortus Palatinus in Heidelberg. Between 1614 and 1619, the famous pleasure park had been built by Inigo Jones and Salomon de Caus for Charles Louis's father, Frederick V. De Caus was a Huguenot engineer who had been previously involved in commissions in England but in the Palatinate received a chance to realize his potential in full splendor. In 1618, the Thirty Years War broke out, and soon afterwards the Court was abandoned, the park was severely damaged in the Siege of Heidelberg and could not be restored with the limited financial means available to the devastated land. Before its destruction, the Hortus Palatinus had been titled the "Eighth Wonder of the World", and to the present day is deemed the greatest Renaissance pleasure park to the north of the Alps.

The park was not only famed for its exotic plants, including an orange grove, but also for Salomon de Caus' ingenious waterworks, such as a water organ, a recreation of the legendary "speaking statue" of Memnon, and a musical water clockwork that reproduced the birdsong of nightingales and cuckoos.[517] The garden was also sometimes viewed as an implementation of the Rosicrucian allegory of "botanical cosmos", as Salomon de Caus was suspected of a secret sympathy with hermetic teachings.[518] However, de Caus' overt inspirations can be traced to Bacon's *Essay of Gardens*, which at that time was often published in England as a separate gift edition.[519] Speaking of water features to be placed in the perfect garden, Bacon advises

[516] John Wilkins, *Mathematicall Magick*, the Epistle.

[517] Salomon de Caus, *Hortvs Palatinvs: A Friderico Rege Boemiae Electore Palatino Heidelbergae Exstructus* (Franckfurt: Theodor de Bry, 1620).

[518] On the connections between Rosicrucian movement and the practices of engineering in Germany in 1614-1620 see Marcus Popplow, "Court mathematicians, Rosicrucians, and engineering experts. The German translation of Guidobaldo del Monte's *Mechanicorum liber* by Daniel Mögling (1629)", *Guidobaldo del Monte (1545–1607). Theory and Practice of the Mathematical Disciplines from Urbino to Europe*, ed. Antonio Becchi, Domenico Bertoloni Meli et al. (Berlin: MPIWG, 2013).

[519] Paula Henderson, "Sir Francis Bacon's Essay 'Of Gardens' in context", *Garden History*, V. 36, No. 1 (Spring, 2008), pp. 59-84, p. 59.

that "the water [should] be in perpetual motion". Given Salomon de Caus' theoretical and practical efforts, the motion of water was one of his priorities in mechanical engineering.[520]

Wilkins must have been familiar with such contemporary technical achievements through his close association with Charles Louis, also because the engineering skills of the de Caus brothers had been recognized in England. In 1615, in Frankfurt, Salomon de Caus had published his work on automata, *Les Raisons des Forces Mouvantes avec diverses machines tant utiles que plaisantes.* In 1620, there also appeared his *Hortvs Palatinvs: A Friderico Rege Boemiae Electore Palatino Heidelbergae Exstructus.* In Wilkins's time, some twenty-five years later, both books were still unavailable in English, which confirms his complaints about gaps in the literature on mechanics in the English language. However, Isaac de Caus, Salomon's brother, had also been invited to London in 1612 to complete some of his brother's projects. In 1645, there was published *Wilton Garden*, a portfolio of Isaac de Caus' baroque garden designs. The British Museum now hosts another folio, "Hortus Penbrochianus", displaying a bird's-eye view of Wilton House gardens, marketed by a different publisher shortly after 1645. In 1644, Isaac de Caus published his own *Nouvelle invention de lever l'eau*, containing numerous plates with spectacular hydraulic mechanisms from his brother's book, some of which were designed for producing musical sounds. Wilkins mentions similar designs in his *Mathematicall Magick* while discussing mechanisms for producing artificial articulated speech. For instance, Wilkins depicts a machine contrived "to give several sounds, whether of birds, as Larks, Cuckoes, &c. or beasts, as Hares, Foxes". Wilkins insists that the voices of all these creatures were "rendered as clearly and distinctly … as they are by those naturall living bodies".[521] Although it might be difficult for us to imagine the clearly articulated voices of hares and foxes, it was widely reported that the sounds of "larks and cuckoes" were indeed emitted by several of de Caus' water-

[520] An account of the theoretical views on the motion of water by Isaac de Caus is given in the Preface to his *New and Rare Inventions of Water-Works* (London: Printed by Joseph Moxon, 1659).

[521] John Wilkins, *Mathematicall Magick*, p. 176.

works.[522] However, it is hard to tell if Wilkins was referring to someone's experiential evidence or his own reading of Heron of Alexandria (c. 10−70 AD), whose designs and descriptions had been translated into Latin in the late sixteenth century and provided concrete imaginative targets for creating the Hortus Palatinus. In any case, Wilkins's connection to the royal family of the Palatinate must have greatly advanced his familiarity with mathematical wonders. Accompanying Charles Louis to Heidelberg, Wilkins visited a number of European destinations on his way back to London and fostered other connections that remained beneficial to the Royal Society long afterward. For instance, Charles Louis' younger brother, Prince Rupert of the Rhine-Palatinate, upon completing a successful military career, retired to perform various experiments in his luxury laboratory at Windsor Castle.[523] This happened two years after Wilkins's death, but Daniel Defoe in *An Essay upon Projects* (1697) values Wilkins's *Mathematical Magick* for providing theoretical background for the public fascination with scientific experimenting in the late seventeenth century.[524]

Mathematical Magick praised the Prince Elector Palatine as "a Judge in all kind of ingenuous arts and literature", which on the one hand sought to place the publication under his patronage, and on the other hand attempted to position the discourse under the disciplinary cover of *artes ingenuae*, or the noble liberal arts. Wilkins presents mechanics as an art that the author "did the rather at such times make choice of, as being for the pleasure of it, more proper for recreation",[525] in this way emphasizing that this subject is appropriate for a genteel readership. He defines the book's topic as "mixed Mathematicks", "the most easie, pleasant, useful (and yet most neglected) part of mathematics" and a powerful τέχνη for prevailing over nature.[526]

522 Isaac de Caus, *New and Rare Inventions*, pp. 26-27, Plate XIV.

523 Charles Spencer, *Prince Rupert: The Last Cavalier* (London: Phoenix, 2007), p. 331.

524 Wilhelm Hennis, a political scientist at the University of Freiburg, reproduces this position, adding Neo-Kantian associations and naming Wilkins's artificial language project "eine wahrhaft extravagante hochmütige Ambition der projektierenden Vernünft". Quoted in Stephan Schlak, *Wilhelm Hennis: Szenen einer Ideengeschichte der Bundesrepublik* (C.H. Beck, 2008), pp. 110-111.

525 John Wilkins, *Mathematicall Magick*, the Epistle.

526 Τέχνῃ κρατμενῶ ὧν φύςει νικώμεϑα. John Wilkins, *Mathematicall Magick* (London, 1648), the Epigraph.

Wilkins's book is divided into two parts: the first is entitled "Archimedes, or Mechanical Powers" and describes how to use basic mechanical instruments and appliances; the second part is named "Dedalus, or Mechanical Motions" and mostly addresses a more advanced topic of automata, depicting a diverse range of legendary ancient and existing contemporary inventions. Wilkins explains that he entitled the volume *Mathematicall Magick*[527] because mechanical inventions were too often associated with "vulgar opinion, which doth commonly attribute all such strange operations unto the power of Magick".[528] He was also pursuing a rhetorical goal, similar to the titling of his first book "the Discovery of the Moon", where the moon was in fact successfully invented as an object for observation. For Wilkins's readers, the title *Mathematicall Magick* already appeared to be an oxymoron, and he intentionally used this provocative combination to invent a new shade of meaning for the term "mathematical", on which he would ground his subsequent argument. Wilkins employs the figure of *antithesis*, juxtaposing the notion of the magical interpretation of mechanics, discredited as "vulgar opinion", with the notion of mathematical interpretation of mechanical operations, which the power of antithetical framing represents as the opposite of vulgar. This dialectical procedure invents mechanical art as a refined and reasonable field of knowing, appropriate for all strata of society. Thus Wilkins successfully transfers mechanics from the realm of the magical imitation of nature to the sphere of the new experimental philosophy and geometrical calculations.

Unlike mathematics, mechanics at the time did not by definition belong to the *artes ingenuae*, so Wilkins felt obliged to preface his main narrative with a story of Heraclitus entering a tradesman's shop, to make the point that "the gods were as well conversant in such places as in others".[529] He elucidates it by saying that although manual practices of the "common arts", such as mechanics, can be esteemed

527 Cf. "We have three [men] that collect the experiments of all mechanical arts, and also of liberal sciences, and also of practices which are not brought into arts. These we call mystery-men." Francis Bacon, *New Atlantis* (1628).
528 John Wilkins, *Mathematicall Magick* (London, 1648), To the Reader. Wilkins's distinction between mathematics, mechanics, and mechanics in the sense of magical teachings of alchemy derive from Bacon's *Advancement of Learning* (1605), Book II, VIII, 2-3.
529 Ibid.

"ignoble", yet "a divine power and wisdom might be discerned even in those common arts, which are so much despised", and "the study of their general causes and principles, cannot be prejudiciall to any other (though the most sacred) profession".[530] As will be shown further, the positioning of mechanics among the liberal arts allows Wilkins to augment the practices of mechanical design. As "mixed mathematics", mechanics could now apply geometrical calculations, just as astronomy legitimately considered the geometry of heavenly motions, and music accounted for the mathematical relations between sounds. At the same time, the status of a liberal art also presumed that mechanics may employ the pointed figures of abundance for the apprehension of experience.

Wilkins positions mechanical art within the framework of the early-modern view of the structures of knowledge as divided into three realms where "men doe busie their endevours": the divine, the natural and the artificial. Wilkins essentially lays out his epistemological program in terms of practices,[531] and not doctrines. He employs rhetorical techniques to carefully adjust the balance between the theoretical and practical aspects of "human endevours", which reveals the considerable ontological importance of practices. Wilkins points out that both natural and divine studies, some of which are perceived to be highly theorized, presume "the *practice* of those virtues, which may advantage our minds, in the inquiry after their proper happiness".[532] Therefore, mechanics is ontologically important as a branch of practical natural learning about "the frame of this great Universe, or the usual course of providence in the government of these created things".[533] This statement also correlates with Wilkins's views expressed in *Discourse Concerning the Beauty of Providence*, which would appear in 1649, the year after the publication of *Mathematicall Magick*.

530 Ibid.
531 John Wilkins, *Mathematicall Magick*, pp. 1-2.
532 Ibid., p. 2.
533 Ibid.

Mechanics, as a noble mathematical pursuit, encompasses “all those inventions, whereby nature in any way quickned or advanced in her defects”.[534] This elevates the status of mechanics, implying that it may actually succor human beings. The practice of any art helps “overcome and advance nature”,[535] including complex human nature, so that the liberal quality can be attributed to many arts by definition, since “our best and most divine knowledge is intended for action”.[536] But those arts that help human beings “restore themselves from the first generall curse” should be particularly celebrated as liberal, since “these arts alone may truly be styled liberal, *Que liberum faciunt hominem, quibus curae virtus est*”. In Wilkins’s opinion, the art of mechanics is thematically focused on this ontologically significant mission: “These artificiall experiments being (as it were) but so many Essays, whereby men doe naturally attempt to restore themselves from the first generall curse inflicted upon their labours”.[537] He modestly adds that “this following Discourse, does properly appertain to this latter kind”.[538]

Having reassigned mechanical art a higher status, Wilkins defines his topic anew and explains that mechanics consists of “Rational” and “Cheirurgicall or Manuall” parts.[539] The rational part treats of “principles and fundamental notions”, and the “cheirurgicall” part “doth refer to … the exercising of such particular experiments”.[540] Wilkins’s main interest lies with the rational part of mechanics, which “may properly be styled liberall, as justly deserving the prosecution of an ingenious mind”[541] liberated from “lusts and passions”.[542] Comparing other liberal arts, such as “disciplines of Logick, Rhetorick, & c.”, with the newly founded liberal art of mechanics, Wilkins notes that those “doe not more protect and adorn the mind, then

534 Ibid.
535 Ibid., p. 3.
536 Ibid., p. 2.
537 Ibid.
538 Ibid.
539 A similar distinction is preserved in Isaac Newton’s *Philosophiae naturalis Principia mathematica* (London: Printed by Joseph Streater, 1687), The Author’s Preface.
540 Ibid., p. 9.
541 Ibid., p. 9.
542 Ibid., p. 2.

these Mechanicall powers doe the body".[543] What makes rational mechanics equal to the noble art of rhetoric is not the similarity of subject matter but the efficacy of their performative impact. Both in poesy and mechanics, the aesthetic capacity to "adorn" emerges from the ingenuity of thinking in pointed figures. The art of mechanics is "well worthy to be entertained with greater industry and respect", since it promotes the human ingenuity or *ingenuousness* and therefore may be called a liberal art similar to astronomy, music, and rhetoric.

Eulogizing mechanics, *Mathematicall Magick* promises that the reader will experience "the great *delight and pleasure*", as well as "*real benefit* to be learned".[544] The delight and the benefit are closely related: they both consist in seeing how ingeniously human inventions may advance nature. Wilkins's interactive narrative is also supposed to offer an attractive scenario for implementing the inventions, "particularly for such Gentlemen as employ their estates", "and also for such common artificers ... who may be much advantaged by the right understanding".[545] The capacity to adorn induces the will for practicing and performing in mechanics, and in Wilkins's view, the mastering of principles of hypothetical design should make a desirable contribution to the other specifically human pleasures and faculties.

The implementation of inventions is facilitated by the availability of immediate experience of mechanical ingenuity. Next to the statement about the various benefits of his art, Wilkins quotes Peter Ramus:

> The reason why Germany hath been so eminent for Mechanicall inventions, is because there have been publike Lectures of this kind instituted amongst them, and those not only in the learned languages, but also in the vulgar tongue, for the capacity of every unlettered ingenious Artificer.[546]

In other words, like many other liberal arts at that point, mechanics had to start operating in the vernacular, and one of the reasons why Wilkins wanted to publish the

543 Ibid., p. 10.
544 Ibid., To the Reader.
545 Ibid.
546 Ibid.

"fruit of his leasure" is because of the lack of such literature in the English language.[547]

Wilkins believed that ordinary language was better attuned for the advancement of learning and criticized the "mysticall expressions" that ancient philosophers used "to conceal their learning from vulgar apprehension of use".[548] He also connected the tendency of ancient mathematicians to use "mysticall expressions" with their favoring of "abstracted speculations, refusing to debate the principles of that noble profession unto Mechanical experiments".[549] Wilkins's adherence to native discursive means in mechanics originates from the linguistic ideas of Reformed theology, where, as opposed to the Catholic liturgy, the significance of practical divinity had to be amplified with the experience of Scripture in the vernacular. For Wilkins, an art's language predetermines the pattern of its development, and the language of "abstracted speculations" causes stagnation in an art, since "when once the learned men did forbid the reducing of them to particular use, and vulgar experiment, others whereupon refuse these studies themselves, as being but empty and useless speculations".[550] Learning deprived of its power to perform also loses its power to produce concise figures of abundance together with the ability to adorn and inspire interest. Using the terms of Bertrand Russell, learning stagnates if the descriptive propositions lose the grounds of experient knowing.[551]

Wilkins also refers to mechanics as the "natural end" of mathematics,[552] since otherwise mathematics alone would be unable to fulfill the ontological mission of advancing nature. Therefore, mechanics does not occupy the margins but constitutes the epistemological core of mathematical learning. Acknowledging the significance of communication in the vernacular, Wilkins at the same time shows himself concerned about the capacity of any natural language to attain the knowing of things

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547 Ibid.
548 Ibid., p. 3.
549 Ibid., p. 4.
550 Ibid., p. 5.
551 The role of experient knowledge in performative knowing is considered in Chapter I of this study.
552 Ibid., p. 7.

themselves. As we can see from his contribution to supervising the production of *The History of the Royal Society*, he repudiates outdated fables but welcomes the new figurative language of artistry, whose frames and patterns are "like transparent Veils, thro' which we see what they cover",[553] which compensates for the imperfect ability of natural language to speak plainly with naked words.

Wilkins insists on translating mechanical discourse into a "language of the hand", because it facilitates the ingenuity or ingenuousness of inventions. Mentioning of the hand is ontologically significant, since among other "instruments of motion" of human body "the hand is the instrument of instruments". The soul bears the message of Revelation, but the hand implements the design of providence, which may be especially effective, if the "work of many hands" is augmented with competence in the mechanical arts.[554] Wilkins's theological treatment of mechanics effectively suggests a subsidiary method of salvation: apart from the "plastic nature" of the soul, divine grace can also operate through the "plastic nature" of the human hand whose power grows wondrously with practicing of the liberal mechanical art. The ingenuity of mechanical invention mediates between divine providence and its creation: the physical properties of weight and power find themselves in such a relation to each other, that the overcoming of weight requires the gaining of power through human ingenuity. The natural balance between weight and power guarantees that men "are not encouraged … to such bold designes as would not become a created being"[555] but at the same time prompted to enhance the efficacy of their invented mechanisms.

Wilkins realizes that his view of mechanics may sound unusual and clarifies that "according to the ordinary signification, the word is used in opposition to the liberall arts".[556] Contrary to this common opinion, he continues, mechanics "discov-

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[553] Domonique Bouhours, *The Art of Criticism*, trans. A Person of Quality (London: D. Brown, 1705), pp. 5-12.
[554] John Wilkins, *Mathematicall Magick*, p. 30.
[555] Ibid., p. 104.
[556] Ibid., p. 8.

ers the general causes, effects, and properties of things", and needs to "truly be esteemed as a species of Philosophy".[557] The term "mechanick", notes Wilkins, is derived from ἀπὸ τῶ μήκως κἰἄνειν, *multum ascendere and pertingere*, or παρὰ μὴ χαίνειν, *quia hiscere non finit*, which is "intimating the efficacy and force of such inventions", and also "because these arts are so full of pleasant variety, that they admit not either of sloth or wearinesse".[558] Wilkins's depiction of mechanical inventions is reminiscent of Joseph Addison's words on poetic inventions in "The Pleasures of the Imagination": "creating similitudes, metaphors, and allegories makes additions to nature, giving greater variety to God's works".[559]

For Wilkins, the copious pattern of liberal mechanics also plays the role of an interpretative historiographical style, which he would later display in his discourse on providence. Rephrasing Hayden White's argument in *Metahistory*, Wilkins's mechanistic interpretative model is integrative and "turns upon the search for the causal laws" governing divine creation "in the modality of part-part relationship".[560] However, unlike White's mechanistic interpretative model, Wilkins's narrative of mechanics does not reduce the elements of description to abstractions. His "preconceptual linguistic protocol" is not that of a grammarian, since he does not confront but welcomes a new language. Wilkins's mechanics cannot systematically fit with the abstract laws of nature, because those were not yet given in mathematical representation. In the absence of universal mathematical methods for the advancement of learning, he strives to advance the knowledge of nature through the spontaneous ingenuity of invention and the pointed copiousness of scientific narratives. Before mathematics became the comprehensive language of mechanics, which would be achieved by Newton, the advancement of mechanical art was effected through the sharpening of figures of abundance as the most sustainable of the available instruments of knowing.

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[557] Ibid., p. 9.

[558] Ibid., p. 8.

[559] Joseph Addison, *Spectator*, ed. Henry Morley (Glasgow and New York: George Routledge and Sons, 1891), in three volumes, Vol. III, Ns. 419, 421.

[560] Hayden White, *Metahistory: The Historical Imagination in Nineteenth-Century Europe* (Baltimore: The Johns Hopkins University Press (1973), pp. 17, 30.

The question arises whether Wilkins's methodology should be placed within scientific or poetic thought? Science claims to discover the truth, and poetry claims to discover the possibilities for truth. The discursive practices of early science, where Wilkins duly belongs, presumed that it was more appropriate to claim higher or lower probability, than the truth of the matter. Experimental philosophy was used to considering its propositions not in terms of "truth-value" but "probability-value". Thomas Sprat repeatedly advised that British *virtuosi*, when "conjecturing of the Causes", should not present them "as unalterable Demonstrations, but as present appearances".[561] Experimental accounts had to be formulated in "a wary and becoming language", emphasizing the hypothetical nature of claims: "'tis probable that". Discussions on probability were also a standard element of poetic theory.[562] Aristotle had set specific requirements for the probability of relations between parts of a poetic composition: the probability could assimilate empirically impossible elements, on the condition that altogether they make up a coherent narrative. British early-modern aesthetics accepted the Aristotelian approach to probability in poetic inventions: "Beyond the actual works of nature a Poet may now go; but beyond the conceived possibility of nature, never".[563] Wilkins's guidelines for mechanical design also recommended to "never so much exceed that force, which the power is naturally endowed with".[564] Wilkins's liberal mechanics employs the aesthetic principle of assimilating the improbable elements but making up an altogether coherent narrative. In Wilkins's times, "our best and most divine knowledge" intended for advancing nature appeared in the form of more or less probable hypotheses and the pointed figures of scientific narratives. Therefore, his own contribution to the advancement of learning consisted in enhancing the "pointedness" of those hypotheses and narratives or their efficacy for the apprehension of experience.

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561 Thomas Sprat, *The History of the Royal Society*, pp. 107-109. Cf. Peter Dear, "Narratives, Anecdotes and Experiments", pp. 135, 161.

562 Meyer H. Abrams, *The Mirror and the Lamp*, p. 267.

563 Thomas Hobbes, "Answer to Davenant's Preface to *Gondibert*" (1650), *Critical Essays of the Seventeenth Century*, ed. by J.E. Spingarn, V. II (1650-1685) (Oxford: Oxford University Press, 1908), p. 62.

564 John Wilkins, *Mathematicall Magick*, p. 11.

The performativity of Wilkins's mechanical art

Wilkins's discussion on mechanics employs a method similar to his so-called discovery of the moon, which he invented through a powerful instrument of poetic vision to enhance the public will for discoveries. As claimed by Abraham Cowley, "Natures great Works no distance can obscure,/ No smallness her near Objects can secure".[565] Before uncovering the truth, one needs to invent an instrument to do it with, also in the form of a linguistic protocol. Making further use of Hayden White's terms, Wilkins's liberal mechanics uses the mutually illuminating power of "narrative" and "investigative" operations[566] to transform the old chronicle of the bodily art of mechanics into a more prestigious narrative of mechanics as a liberal art of advancing nature. The point of emplotment for this storyline is located with the ingenious/ingenuous quality of both linguistic and technical innovations.

Philip Sidney in *Defence of Poesie* desired that "the highest flying wit have a Dedalus to guide him" and "three wings to beare itself up into the aire", namely, "Art, Imitation, and Exercise". But he regretted that the exercise is too often done "fore-backwardly", i.e. "where we should exercise to know, we exercise as having knowne".[567] Art should not just be practiced but needs to be taken beyond its present station. Wilkins applied poetic means as the instruments of "exercising to know", which at the same time promoted the conspicuous "plainness" of his designs. To illustrate, George Granville expressed a similar disposition in his "An Essay upon Unnatural Flights in Poetry" (1701):

> As Veils transparent cover, but not hide,
> Such metaphors appear, when right apply'd;
> When, thro' the phrase, we plainly see the sense,
> Truth, which the meaning's obvious, will dispense.[568]

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[565] Abraham Cowley, "Ode to the Royal Society".
[566] Hayden White, *Metahistory*, p. 12.
[567] Philip Sidney, *Defence of Poesie*, p. 31.
[568] George Granville, "An Essay upon Unnatural Flights in Poetry", *Critical Essays of the Seventeenth Century*, V. III, p. 293.

Wilkins had started his career by describing flights to the moon, and in *Mathematicall Magick* he proceeded to a more detailed description of flying machines, as well as the other inventions that might have nature "not only directed in her usuall course, but sometimes also commanded against her own law".[569] He notices that an acquaintance with mechanics is relatively rare outside the circle of "unlettered Artificers", so that "there be very many that pretend to be masters in all the liberall arts, who scarce understand anything in these particulars".[570] Since the knowledge of mechanics mostly circulated outside the educated milieu, the special language of the art was still under development. With a view to properly introduce the new liberal art to his genteel readership, Wilkins industriously elaborated on the vocabulary of mechanical learning. He intended not only to popularize mechanics but to standardize its professional lexicon by disseminating it among the educated gentry. Wilkins explores the *know-how* of specific bodily operations, depicting "the *manner* whereby the power is impresst upon it [an object], which is by a stroak or blow".[571] He summarizes the scattered performative knowing of mechanics as a bodily art and transforms these data into a coherent account given in legitimate philosophical terms, as befits a noble liberal art. *Mathematicall Magick* brings the "fair lady" of mechanics into the respectable society of educated communication, by giving it a presentable tongue to speak.

Wilkins's liberal mechanics "refers likewise to violent and artificial motion, as Philosophy doth to that which is natural".[572] At the start, Wilkins states that mechanics is part of philosophy, but later he arrives at the conclusion that it actually represents the most important part. Mechanics surpasses philosophy in significance, since it not only studies nature but also ventures to explore ways for commanding it "against her own law". The technical part of mechanics begins with "understanding the true difference betwixt the *weight* and the *power*, a man may adde such a fitting

569 John Wilkins, *Mathematicall Magick*, p. 10.
570 Ibid., p. 10.
571 Ibid., p. 55.
572 Ibid., p. 11.

supplement to the strength of the power, that it shall be able to move any conceivable weight".[573]

In Wilkins's times, weight was considered a quality of bodies that made them "tend downwards", which fell within the scope of competence of the practical bodily arts. In scholastic terms, the quality was regarded as an inherent, incalculable feature of an object, and therefore weight as such was deemed incalculable. But mathematics as a liberal art accounted not for qualities but for calculable quantities.[574] To legitimize the procedure of calculating weight, Wilkins reminds the reader that Aristotle himself considered it within the category of discrete quantities,[575] meaning that weight could be measured. This saves the position of mechanics as a mathematical discipline and a liberal art, allowing it to employ the methods of mathematical and, more broadly, theoretical apprehension. Furthermore, Wilkins shifts the center of conceptualization for mechanics by offering a specific interpretation of scholastic categories. He defines weight not as a simple quality but as an "affection" or the condition of being acted upon by a certain force or power. Thereby he transfers the emplotment point of his narrative from the concept of weight towards the concept of mechanical power. Since power is mainly achieved by human ingenuity, the narrative of liberal mechanics begins to represent not a story of how to overcome weight but how to acquire the power for commanding nature.

Having clarified the "subject and nature" of mechanics at the beginning of "Archimedes, or Mechanical Powers" (the first half of *Mathematicall Magick*), in his third chapter Wilkins considers basic mechanical appliances, "of which, the force of all Mechanicall inventions must necessarily be reduced".[576] He first mentions the balance, tracing its origins to mythological and social symbolism: "The first invention of the balance is commonly attributed to Astrea, who is therefore deified for the

[573] Ibid.
[574] Ibid.
[575] Ibid., p. 12.
[576] Ibid., p. 13.

goddess of justice".[577] Wilkins never forgets to underline the liberal status of mechanics, and these symbolic connections with divinity are intended to present the appliance in the light of respectable cultural references, hinting that the power of mechanical invention rivals *magia naturalis* in the amplification of human power over nature. Similarly, Wilkins presents his second instrument, the lever, as also finding its origins in the Greek mythology.[578] The lever is regarded as "the very sum and epitome of this whole art", making it "easy to conceive how a husbandman … may proportion the labour of drawing according to the several strength of his oxen".[579] Wilkins strictly repudiates any involvement of supernatural magical forces in mechanical operations but stresses that the completely natural power of ingenuity may render no less wondrous results. The motif of the "magical" amplification of power becomes more pronounced later in his storyline; in Chapter IX, Wilkins describes the screw as an instrument, "in the performance of which the strength of one man may be of greater force, then the weight of a heavy mountain".[580] As in the *Discovery of the Moon*, in *Mathematicall Magick*, the astounding historical accounts are intended to invoke a sense of wonder, at the same time creating a belief in the substantial capacity of mechanics. The same chapter convinces the reader that the instrument of the balance can be made "so exact, … as to be sensibly turned with the eightieth part of a grain: which (though it may seem very strange) is nothing to what *Capelus* relates of one at *Sedan*, that would turne with the four hundredth part of a graine".[581] These narratives support the thesis that the power of the human mind, when ingeniously applied, may generate unlimited physical power.

Wilkins then moves on to investigate more deeply the social aspects of mechanical ingenuity. He uses the figurative expression "according to the shekel of the Sanctuary" and notes that some people construe this as referring to some "weight or

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[577] Ibid., p. 14.
[578] Ibid., p. 20.
[579] Ibid., p. 27.
[580] Ibid., p. 58.
[581] Ibid., p. 19.

coin, distinct from, and more than the vulgar",[582] i.e. as if the Sanctuary had the power to choose the norms of measure. According to Wilkins's etymological explanation, on the contrary, the expression needs to be understood as "measures as were agreeable to publicke standards that were kept in the Sanctuary" for the purpose of "the preservation of commutative justice from all abuse and falsification". This interpretation stresses that mathematical normativity represents a power in itself that is even capable of rectifying imperfect social order, since the standards of measurement set the rules for quantification and comparison, which renders political power.

On another occasion Wilkins implies that the narrative of mechanics is ready to replace the Biblical narrative as the primary interpretative pattern in the study of nature. He quotes a Biblical passage on how Samson lost his strength together with his hair, noting that liberal mechanics is capable of furnishing human beings with far greater power: "But now by these Mechanicall contrivances, it were easie to have made one of Sampsons hairs that was shaved off, to have been of more strength, then all of them when they were on".[583] Mechanics renders the force more fundamental than the sacred power of sovereigns, and may help one cope with differences in human physical capacities: from studying how the lever works "it is easie to conceive, how any burden carried betwixt two persons, may be proportioned according to their different strengths".[584] So, mechanics as a liberal art may help promote the sustainability of social and religious government.

Wilkins's mechanical expertise relied on the special literature available on the continent, as his visualizations of existing mechanical devices essentially derive from *Mechanicorum Liber* (1577) by Guidobaldo del Monte who also attempted to reinterpret mechanics as a mathematical discipline. Some of the diagrams of engines with "toothed wheels" were borrowed from Marin Mersenne's *Cogitata physico-mathematica* (1644). However, Wilkins and Mersenne pursued different didactic

[582] Ibid., p. 18ff.
[583] Ibid., p. 96.
[584] Ibid., p. 23.

tasks: whereas Mersenne was more interested in building geometrical models, Wilkins sought to approximate the models to a whole range of experiences associated with mechanical art.[585] Wilkins also presents his basic mechanical appliances within the context of performative representation of the body. Although his drawings rarely exhibit the full human figure, his guidelines on the use of devices employ one of the most expressive elements of visual bodily rhetoric: the gesture of the hand. Wilkins's descriptions of devices often depict them as if operated by a remarkable hand that is disposed of a traceable social status, precision of movement, and certain conspicuity of gesticulation (see Figure 1).

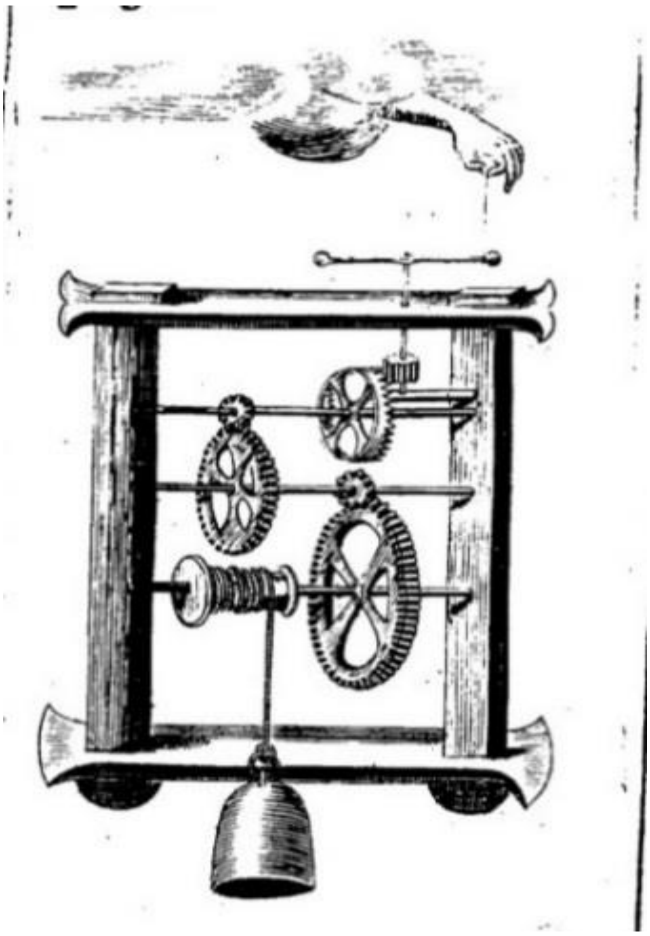

Figure 1.
A jack. John Wilkins, *Mathematical Magick* (London: Printed by M.F., 1648), p. 88.

[585] On Mersenne's views on the relationship between mathematical modelling and experience, see Peter Dear, *Discipline and Experience: the Mathematical Way in the Scientific Revolution* (University of Chicago, 1995), 133-136.

In classical rhetoric, gesture formed an integral part of the *actio* of the speech, which not only visualized the subject matter but also marked the boundary between the verbal and the experiential, as the speaker was to translate speech into bodily action, when the experience was presumably surpassing his verbal resourcefulness. In the seventeenth century, the early-modern European visual arts employed gesture not only as a conventional expression of emotion but also as an indicator of the more permanent character of a depicted personality.[586] Apart from an expression of *pathos*, gesture was the outward sign of *ethos*, achieving a persuasive effect through emphasizing the moral certainty of the depiction. In a scientific description, the author could use the gesture of the hand for delivering his point of *historia*. The hand that governs the operation of Wilkins's machine in the figure must belong to a gentleman, judging from the fashionable cut of the cloud, out of which the limb emerges.[587] In contrast with similar Mersenne's illustration, Wilkins shows not only the hand but also a thin hair that connects the living hand with the mechanical device.[588] This magical hair seems to communicate the will for motion to the machine, in the manner of the Aristotelian primary mover. The hand mediates between the realms of spirit and things, which invites parallels with preaching, and indeed the gesture is reminiscent of the recommendations from popular manuals on homiletics, one of which Wilkins crafted himself a few years afterwards.[589]

Wilkins's visual rhetoric also used the scale of the human hand to specify the approximate measurements of his contrivances and the extent of the supposed application of force. As Renaissance theorizing on visual rhetoric suggested,

> The elements of narrative paintings ought to move those who look at or contemplate them in the same way as him whom the narrative painting represents. …the minds

[586] Caroline van Eck, *Classical Rhetoric and the Visual Arts in Early Modern Europe* (Cambridge and New York: Cambridge University Press, 2007), p. 19ff.
[587] Cf. John Wilkins's portrait by Mary Beale painted after he became Bishop of Chester in 1668; available at upload.wikimedia.org/wikipedia/commons/5/53/John_Wilkins.jpeg. Retrieved 15.01.15.
[588] Cf. Marin Mersenne, "De mechanicis", *Cogitata physico-mathematica* (Parisiis, 1644), 40.
[589] See John Wilkins, *A discourse concerning the gift of prayer: shewing what it is, wherein it consists and how far it is attainable by industry* (London, 1651).

> of those who view it ought to move their limbs so that they seem to find themselves in the same situation.[590]

It was believed to be a sign of the quality of an image if it prompted the viewer to feel and act in an intended way. David Hume's theorizing of experience would later state that external objects on their own give us no idea of force, but that the idea is derived from reflection on specific operations of the mind, i.e. "we are every moment conscious of internal power; while we feel, that, by the simple command of our will, we can move the organs of our body".[591] Displaying the hand in action, Wilkins sets up the scale for the approximate force that is required to empower the depicted device, since at that time neither a mechanical measurement for that force nor proper mathematical apparatus to process such measurements was available. Wilkins employed visualization of experience in mechanics as a substitute for the absent geometrical demonstrations to explain the operation of his devices.

The sketched hand performs not only an argumentative but also a purely persuasive function in the narrative. The pictured gesture is conspicuous but not forceful, and the shape of the posed hand is relaxed, which helps Wilkins deliver the point about the easiness of operating his machine due to the almost magical power of mechanical appliances. As will be shown further, Wilkins repeatedly inserted elements of the rhetorical distribution of force in his illustrations. The "instrument of instruments", as Wilkins names the hand, plays a versatile instrumental part in his narrative.

The necessity of studying bodily mechanics is evinced by the ontology of the human body as part of divine nature and an agent of providence: "We doe not so much goe, or sit, or rise, without the use of this Mechanical Geometry".[592] Wilkins follows Descartes' mechanical interpretation of translating the will for motion into the action of the muscles in understanding the functions of living organisms. He

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590 Leonardo, *Treatise on Painting*. Quoted in Moshe Barasch, *The Language of Art: Studies in Interpretation* (New York: NYU Press, 1997), p. 317.
591 David Hume, *An Enquiry Concerning Human Understanding* (London: Printed for A. Millar, 1748), "Of the Idea of necessary Connexion", Part I:9.
592 John Wilkins, *Mathematicall Magick*, p. 36.

compares mechanical devices to “those that are natural in living bodies” and proposes to examine whether these also are not governed by “the same kinde of proportions”.[593] On securing the ontological significance of mechanics, Wilkins devotes Chapters VI to IX of *Mathematicall Magick* to the use of “wheels with teeth in them”, pulleys, wedges, and screws, thereby keeping the focus on how to amplify human force through devices employing natural weight. The technical language of geometrical demonstrations, alternating with diagrams and drawings of actual mechanisms, encourages the reader to visualize their operation. Apart from the images, Wilkins also offers textual sketches of legendary ancient inventions. Although positioned in the past, these historical narratives are intended as utopian scenarios laying out an inspiring perspective of possibilities for the future pursuits of mechanics.

Wilkins clearly selects those monumental achievements that “were of such vast labour and magnificence, and so mighty disproportionate to humane strength”.[594] Here he appeals to the reader’s technical expertise built from the previous chapters, to “conceive the truth and ground of those famous ancient monuments”. He seems most interested in stunning measurements of height and weight, especially when such structures are moved at a great distance. He first mentions the Pyramids of Egypt “of so vast a magnitude, as time itself in the space of so many hundred years hath not yet devoured”.[595] The Pyramids were so gigantic that “there was not any one stone lesse then 30 foot long, all of them being fetched from *Arabia*”, which implies that highly sophisticated engineering efforts were employed at a great scale.[596] When describing the legendary monuments of Jewish history, Wilkins notes “that ‘tis scarce imaginable by what strength so many stones of such great magnitude should be conveyed to so high a place”.[597] This supported his point that even in primitive antiquity it was already possible to apply mechanical power to amplify the human power over nature.

593 Ibid., p. 28.
594 Ibid., p. 61.
595 Ibid., p. 62.
596 Cf. John Greaves, *Pyramidographia* (London: George Badger, 1646), p. 76.
597 John Wilkins, *Mathematicall Magick*, p. 64.

As in his previous popular science writings, Wilkins's *Mathematical Magick* makes use of verbal and visual figurative forms as performative aids within the procedures of both rhetorical *inventio* and technical invention. In the *Discovery of the Moon* Wilkins had already applied the dialectical procedures of *loci communes* and *stasis* to impart the experience of travel to the moon and its observation. His narratives presented the moon's discovery in the light of new cultural references, which advanced public knowledge of the moon beyond the limits of contemporary popular science and theology. In *Mathematical Magick*, he uses similar rhetorical means of figurative thinking to impart the immediate experience of how to operate mechanical devices. Through some vivid historical excursions he engages his readers in the making of technological discoveries.

In spite of the enthusiastic disclaimers in *The History of the Royal Society*, the early-modern "persuasive communities" actively employed a rhetorical capacity for *ornamentum* in the sense of both "embellishment" and "apparatus and gear".[598] Figures of poetic depiction and rhetorical persuasion were viewed as legitimate discursive skills within the practices of making knowledge. Figures of speech often correlated with the use of particular visual figures in illustrations. The argumentative significance of such imagery consisted in allowing for a recombination of data into a more coherent and plain structure. An investigation of the role of figurative thinking in the process of mechanical invention helps reveal the specific features of the early-modern generative process of technical advancement.

Wilkins's *Mathematical Magick* contains a number of examples where such figures as *antithesis*, *incrementum*, and *gradatio* were used in their verbal and visual forms. The figure of *antithesis* usually worked as a conceptual tool for inventing the argument by shaping the language to deliver a contrast, which serves for the framing of premises built on opposed concepts. The generation of premises leads to the formulation of claims, which structures the whole program of inquiry, prompting the search for confirming data. The figure comes to be used as a structuring pattern that

598 Jeanne Fahnestock, *Rhetorical Figures in Science*, p. 18.

stimulates the discovery of specific material. Then the obtained data may be presented as texts or images, such as tables of observation or illustrations, which explicates the relationship between the antithetical terms. Most of the sixteenth century manuals of rhetoric suggested that the function of *antithesis* consists in its subsequent mediation. The polarized terms are mediated with a third term, or linked by belonging to a common larger category. The new term or category will be imprinted on the public mind as a paradoxical wonder and a basis for further conceptual and doctrinal development. The figure of *incrementum* represented an ascending conceptual series, and the figure of *gradatio* was a series where the conceptual elements were melded together into a continuum.

By way of example, Wilkins employs *antithesis* to impart the impression created by the famous Colossus of Rhodes. First, the size of the magnificent statue is indicated by mentioning that its thumb could not be grasped by a man with both his arms. Interestingly, another popular work that Wilkins later helped compose, an academic pamphlet *Vindiciae Academiarum* authored by his friend Seth Ward, mentions that "it was heretofore accounted an instance of Mathematicall skill, to give the dimensions of Hercules from the measure of his foot".[599] From this casual remark it can be supposed that Wilkins intended to induce his readers, most of whom were versed in "Mathematicall skill", to visualize the height of the Colossus or even calculate its approximate dimensions. Second, Wilkins mentions that when the statue collapsed, "the brasse of it did load 900 camels".[600] He composes an antithetical pair of the notions of "thumb, not to be grasped by man with both arms" and the "load of 900 camels". The size of a thumb and the load of nearly a thousand camels do not form a natural opposition, also because they refer to different categories of dimensions and weights, but Wilkins pairs them into an *antithesis* between their physical dimensions and the capacities of humans and draught animals. Within this *antithesis*, "one thumb" and "900 camels" are turned into end points on a scale of physical aptitude that would be necessary to handle such weights. The *antithesis* is

[599] Seth Ward, *Vindiciae Academiarum* (Oxford: Thomas Robinson, 1654), p. 27.
[600] John Wilkins, *Mathematicall Magick*, p. 64.

mediated by the concept of physical power but infers the potential power of human ingenuity. Later in his career, Wilkins would calculate the exact proportions of Noah's Ark, but in *Mathematical Magick* he usually does not reveal the total dimensions of the legendary monuments, as if feeling compelled to leave this information in the realm of marvelous infinity. However, his intention is not to superficially amuse the reader with old tales, since he ruminates various conjectures on how the ancients could erect such wondrous structures. Adhering to the poetic principle that makes it possible to imagine things "beyond the actual works of nature" but not "beyond the conceived possibility of nature", Wilkins sarcastically cites a legend about some Greek architect who proposed to Alexander carving the mountain Athos into a human statue holding a large town on its hand, and how Alexander refused to erect this "microcosm" for political and economic reasons. Admitting the limits of mechanical power, Wilkins at the same time encourages experimentation with the available mechanical devices, inquiring "both *why*, and *how*, such works should be performed in those former and ruder ages".[601] The next chapter of *Mathematical Magick* would be devoted to exploration of the motives that could inspire such outstanding enterprises.

Wilkins finds those motives in the social spheres of religion, policy, and ambition. Having presented mechanics as a liberal art operating with physical power, he seems interested in relating it to the concept of social power and political status. He notes that stately ancient monuments were often dedicated to deities, and since the extremities of religious devotion often require the extreme means of political defense, the "utmost power and estate" were employed for "any such design, which might promote or advance it".[602] On the other hand, the considerations of state policy require that people are kept occupied, for which enormous construction projects were convenient. Ambition, another motive for erecting mega-structures, drove the ancients "to leave such monuments behind … as might *continue forever*, and make

[601] Ibid., p. 68.
[602] Ibid., p. 70.

them famous unto all after ages".[603] Wilkins presents all these reasons as respectable grounds for practicing the art of mechanics at the state level. But he also recognizes the difference between ancient and modern social realities, including the relations of patronage and the impact of wars, which often make modern princes invest more prudently in architectural enterprises.

This point brings Wilkins to finally formulate the chief message of his book, and in Chapter XI he declares that "had we but the same means as the Ancients had, we might effect far greater matters than any they attempted, and that too in a shorter space, and with lesse labour".[604] In the words of Hugh Blair, there is nothing more difficult in epic poetry than to adjust properly the mixture of the marvelous with the probable, so as to gratify and muse us with one, without sacrificing the other.[605] Wilkins approaches perfection in this art with his discourse intended to propagate the widespread practice of liberal mechanics.

Wilkins's paradoxical machines

Sometimes it may appear that the laws of poetic imagination are more imperative for Wilkins than the laws of nature. This would not be too surprising, since it would correlate with his own maxima that nature ought to be commanded against her own laws. In Chapters XII−XIV, nature is challenged in accordance with Wilkins's aesthetic and engineering principles. His attitude is reminiscent of William Duff's quote on allegorical poetry: the poet "finding no objects in the visible creation sufficiently marvelous and new, or which can give full scope to the exercise of its power, naturally bursts into the ideal world," where his success "will be proportionable to the plastic power of which it is possessed".[606] Wilkins uses the "plastic power" of both poetical and mechanical ingenuity to create hypothetically possible

603 Ibid., p. 71.
604 Ibid., p. 79.
605 Hugh Blair, *Lectures of Rhetoric and Belles Lettres*, Lecture XLII. Quoted in Meyer H. Abrams, *The Mirror and the Lamp*: *Romantic Theory and the Critical Tradition* (Oxford: Oxford University Press, 1953), p. 269.
606 William Duff, *Essay on Original Genius*. Quoted in Meyer H. Abrams, *The Mirror and the Lamp*, p. 289.

models of imaginary mechanisms. His designs featuring the wondrous mechanical amplification of human power were created with figurative thinking, and the procedures of rhetorical amplification inspired him to model the methods of enhancing the power of mechanisms. Just as the artificial constructions of language help overcome the shortcomings of natural languages, so the artificial constructions of mechanics compensate for the weakness of the natural human body: "each of these Mechanick faculties are of infinite power, and may be contrived proportionable unto any conceivable weight. And that no naturall strength is any way comparable unto these artificiall inventions".[607]

After depicting the legendary mechanic achievements of the ancients, Wilkins proceeds by describing his own models of imaginary accomplishments. From the start, he acknowledges that many fabled experiments of the past were supported with the rhetorical strategies of creating belief. For instance, in a famous thought experiment, Archimedes claimed it was possible to move the globe of the earth if only he could "know where to stand and fasten his instrument", which posed a problem. However, mechanical and social power collaborated, and "the King of *Sirakuse* did enact a law whereby every man was bound to beleeve, whatever *Archimedes* would affirm".[608] This thought experiment resulted in a statement whose truth-value was confirmed through political, instead of physical, mechanisms. But for Wilkins this neither nullified the outcome, nor made the conclusion less compelling. On the contrary, he used the plot of Archimedes' imaginary test as a figurative introduction to his own narrative of the imaginary demonstrations of mechanical power. Wilkins neither claimed to have implemented his imaginary experiments, nor did he appeal to the King of England for support, which anyway would not have been possible given the historical circumstances of the year 1648 in England. At that point, the English intellectual community realized that royal power might have failed to provide a sufficient warrant for truth claims. The search for more sustainable epistemic values contributed to the development of instruments for creating a new scientific

[607] John Wilkins, *Mathematicall Magick*, p. 95.
[608] Ibid., p. 80.

outlook, including elaborated rhetorical techniques and illustrations. In spite of the high costs of production, Wilkins encloses in *Mathematical Magick* a few exquisite engravings that imparted the experience of being present at the scene of his endeavors. Whereas his previous accounts of mechanical instruments had been styled as didactics, his mechanical thought experiments employ conspicuous imagery for performing as if in front of the eyes of his readers.

The design of Wilkins's first thought experiment is based on the figure of *antithesis*. He states that the globe of the earth weighs 2 400 000 000 000 000 000 000 000 pounds, a barely readable numeral almost vanishing into infinity, and then claims that one man could move it, if only the right lever were available. As before, the weight of 2400 sextillion pounds and the power of "one man" do not represent a natural opposite, but turning them into end points on the scale of mechanical capacity creates the desired effect of wonder. Wilkins notes that the specific "magic" of mechanical design does not violate any laws of nature, since "every ordinary instrument doth include all these parts *really*, though not sensibly distinguished".[609] His thought experiments remain a variation of rhetorical figures composed on the conceptual material of mechanics. Wilkins also supported his imaginary design of moving the globe of the earth with an account of how Archimedes supposedly in the same way overturned Roman ships at the siege of Syracuse.

Wilkins's imaginary mechanics, like poetics and rhetoric, was primarily striving to create the aesthetic experience of wonder. In Chapter XIV of *Mathematicall Magick*, entitled "Concerning the infinite strength of Wheels, Pulleys, & Screws", Wilkins employed many other figurative patterns of rhetoric for the structuring of his mechanical designs. The depiction of such instruments as "The Wheel, and Pulley, and Screw, being but as so many Leavers of a circular form and motion, whose strength may therefore be continued to a greater space",[610] was meant to demonstrate mechanics' impressive capacity for the amplification of power. Other combinations with *antitheses* allowed Wilkins to create a mechanical design, about which he

609 Ibid., p. 82.
610 Ibid., p. 84.

claimed that, without taking into account the materiality of device, "it is possible by the multiplication of these [forces], … to perform the greatest labour with the least power".[611] The motto *Datum pondus cum datâ potentiâ*, the greatest conceivable weight with the least conceivable power, was viewed as a major value in both rhetorical and mechanical artistry. Earlier Wilkins had quoted Archimedes as suggesting that this represents the main challenge in the art of mechanics.[612] This fundamental principle of mechanical design was also formulated by Wilkins with the figure of *antithesis*. Together with the title of a liberal art, mechanics obtained the tools of the liberal arts, including the techniques of dialectical logic.

Various combination of *antithesis*, *incrementum* and *gradatio* helped Wilkins create other sophisticated structures that did not always comply with the laws of nature, but contradicted no law of rhetoric or poetic imagination. The figure of *incrementum* represents an ascending conceptual series used to mediate notions opposing each other within an *antithesis.* The main point of using *antithesis* consists in its mediation, and so *incrementum* was given much attention in early-modern rhetorical manuals. Henry Peacham in *The Garden of Eloquence* (1593) defines it as follows:

> … a form of speech, which by degrees ascendeth to the top of some thing or rather above the top, that is, when we make our saying grow and increase by an orderly placing of wordes making the latter word alwaies exceede the former in the force of signification, contrarie to the naturall order of thinges, for that ever putteth the worthiest, and weighiest words first.[613]

Describing further the functioning of *incrementum*, Peacham notes that it is "apt to bewtifie the speech and to amplifie the matter" with an effect similar "in force to comparison, and it as it were the Orators scaling ladder, by which he climeth to the top of high comparison".[614] In Peacham's view, as well as in the opinion of many other renowned rhetoricians, the figure of *incrementum* produces the aesthetic effect

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611 Ibid., p. 92.
612 Ibid., p. 79.
613 Henry Peacham, *Garden of Eloquence* [1593] (Gainesville, FL: Scholars' Facsimiles and Reprints, 1954), p. 169.
614 Ibid.

of wonder by reaching, or even exceeding, the top grade in the accepted hierarchy of a certain quality.

A version of *incrementum,* the figure of *gradatio* represents an ascending conceptual series where the elements distribute each other's properties, and its single parts are bridged together into an ascending continuum. The ancient rhetoricians saw *gradatio* as such a powerful tool that Quintilian recommended a sparing use of it, since otherwise it makes the style look "affected". Demetrius even attributed *gradatio* to the forceful style, but early-modern rhetoricians characterized it more technically as an amplifying pattern.[615] Interestingly, the rhetorical tradition itself invented this metaphorical association between the use of figures and the mechanical concepts of force and weight. The tools of liberal mechanics included the technique of modeling and combining of basic elements. Wilkins's more complicated imaginary mechanisms represent combinations of basic figurative devices.

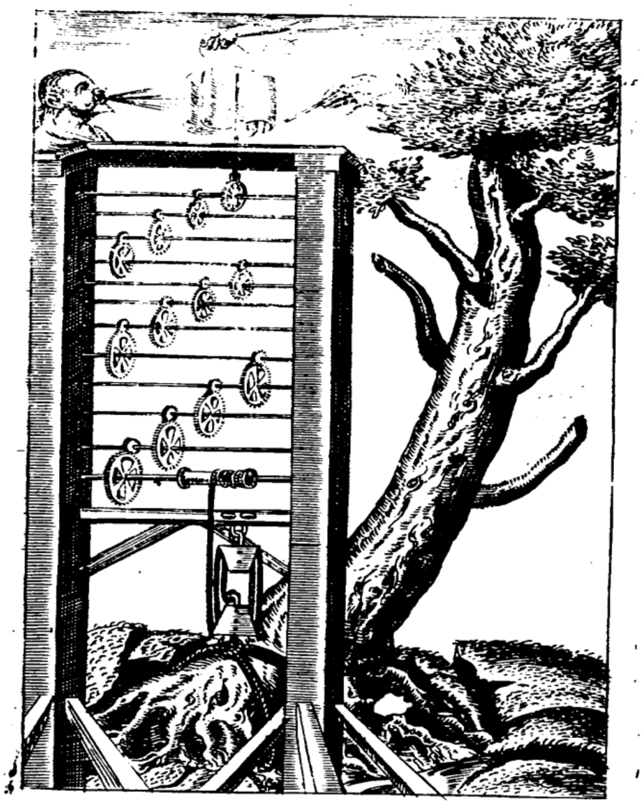

Figure 2.

An engine for pulling up trees by the roots.
John Wilkins, *Mathematical Magick* (London: Printed by M.F., 1648), p. 98.

[615] *Princeton Encyclopaedia of Poetry and Poetics* (Princeton, NJ: Princeton University Press, 2012), p. 268.

In another imaginary experiment (see Figure 2), Wilkins claims that if the work of forcing up an oak by the roots is equivalent to lifting up the weight of 4 000 000 000 pounds, an engine consisting of two double pulleys, twelve wheels, and a sail should be able to do the job, performing this great labor with very little physical power.[616] He describes and provides a drawing of an imaginary construct where a breath of air turns a cross-shaped sail, which transfers the movement through a system of toothed wheels, which supposedly amplifies the momentum and generates enough force to pull up an oak tree by the roots. Wilkins's imaginary design bears traces of the initial rhetorical figures that enthused him to shape his creation as a mediated *antithesis*. The concepts of "air" and "oak tree" are not intrinsically antithetical, but Wilkins compares the physical power that can be linked to the moving of these objects and turns these amounts of power into end-points on a uniform scale of mechanical capacity. Thus the *antithesis* is mediated through the notion of mechanical power, which highlights the wondrous power of human ingenuity.

The difference between Wilkins's imaginary and real mechanics lies in that, for instance, in actual mechanisms composed of toothed wheels, the momentum generated by some initial, often natural, force is slowly accumulated while passing through the sequence of toothed wheels. The momentum is distributed through the system, which makes the whole mechanism more powerful in performing a specific job. When designing such a machine, the engineer takes into account the materiality of all parts, considering the probable loss of momentum, depending on the weight and the friction force within the mechanism. Wilkins's mechanical imagination does not consider the materiality of the parts, also because many of the necessary calculations were not yet available, and moves in a different "magical" direction, indeed "contrarie to the naturall order of thinges", only taking into account the amplification of power, just as happens within the figure of *incrementum*. Thinking along the lines of this figure, Wilkins suggests the pattern for amplifying power via a system of toothed wheels that represents a series of interlocked elements as the overlapping

616 John Wilkins, *Mathematicall Magick*, pp. 97-99.

elements within *gradatio*. Wilkins includes a disclaimer that this particular design is not realizable, but, in any case, his ultimate task is not to build real mechanisms. The full title of his book, *Mathematicall Magick, or the Wonders that may be performed by Mechanical Geometry*, suggests that he is chiefly targeting the rhetorical task of producing wonder. These imaginary thought experiments were supposed to inspire readers to conduct or support financially their own real experiments in mechanical arts.

The imagery of Wilkins's thought experiments also influences the design of his machines. His imaginary lifting device is shaped like the frame of an abacus, which was a popular toy and a helpful gadget for calculations. Rhetorical figures provide the conceptual framework for Wilkins's imaginary mechanisms, but as for their mathematical *ornamentum*, the multiplication of power occurs in them in the same way as the multiplication of numbers is effected on an abacus, i.e. by 10 at each level of the abacus-like frame.[617] Like Archimedes' utopian lever for moving the world, Wilkins's root-puller essentially remains a figural rhetorical model, but at the same time a mathematical one. He admits the impossibility of building such a mechanism due to the material properties of parts, but avoids discussing such properties, except when drawing attention to their potentially wondrous qualities: "if the hair be but strong enough to lift 1/10000 part of a man … it may as well serve" for oak-lifting.[618] Nowadays, not a hair but perhaps a steel cable, or a carbon nanotube in the future, could be applicable for this purpose. In 1648, upon dealing with the oak, Wilkins tests his device on the legendary ancient assignment of lifting up the globe of Earth, and as we might expect, the imaginary machine lifts the imaginary globe in no time.

From Chapter XV on, *Mathematicall Magick* approaches the topic of automata. Thereby Wilkins designs various schemes of mechanical motion which "can be increased to any kind of proportion",[619] and his argument continues to be supported

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[617] Ibid., pp. 99, 101.
[618] Ibid., p. 90.
[619] Ibid., p. 116.

with the use of various rhetorical figures, including *antithesis*. He is fascinated with extremely swift and extremely slow motion, approvingly quoting an anecdote of how John Dee once saw a vastly expensive instrument that had a wheel not finishing one revolution in seven thousand years.[620] For Wilkins, extreme slow motion is "no less admirable" than extreme swift motion, since both suggest the involvement of great weight or distance. At the same time, extreme slow motion is often unavailable for sensuous observation, so theoretically its existence cannot be doubted but also cannot be observed, which turns it into an ideal object for figurative and mathematical modeling. Besides, if calculated, the extreme slow motion produces wondrously great figures. In *Discourse on the Beauty of Providence*, to be published one year later, Wilkins would use the imagery of extreme slow motion to explain how the works of providence may sometimes appear incredibly slow, especially if perceived from the perspective of a short human life. In relation to mechanics, Wilkins is also fascinated with extreme slow motion for methodological reasons. Comparing it with other phenomena that are unobservable with the naked eye, Wilkins notes that the human physical senses are "extremely disproportioned for comprehending the whole compasse and latitude of things".[621] The methods of figurative and mathematical modeling could be employed as a means of accounting for the physical reality that is not immediately available to senses. Around the mid-seventeenth century, a number of discoveries were being made thanks to the use of recently invented optical devices, which compromised the Baconian epistemological criterion of availability to the senses. But the methods of mathematical modeling remained underdeveloped in mechanics, and therefore it became necessary to acquire the "pointed copiousness" of discourse through persuasive figurative patterns.

Extreme swiftness of motion is mostly considered by Wilkins in the context of ballistics, a topic that became critically important during the Civil Wars. On this point Wilkins quotes Lucan and Ovid, as well as enumerating the ancient victories won with the help of *ballistae* and *catapultae*. Provoking curiosity and awe, Wilkins

[620] Ibid., p. 112.
[621] Ibid., p. 116.

claims that "many foreign people being so amazed at the strange Force of these Engines, that they durst not contest with those who were masters of such inventions".[622] As before, he is interested in the dimensions and weight of the bodies launched through the air, as well as in the vast destruction that they are capable of inflicting. Wilkins's narratives imply that even the primitive ballistic devices of the ancients could be extremely effective, which eventually allows him to crown mechanics with a capacity to advance nature even in its most sacred parts. The Chapters XVIII−XX of "Archimedes" conclude by discussing how the liberal art of mechanics may "contrive such an artificial motion, as shall be of greater swiftnesse, then the supposed revolution of the heavens".[623] However, when designing such artificial motion, Wilkins returns to the strategy of imaginary conjectures, with a reservation that they are "not to be understood of any reall and experimentall, but only notionall, and Geometrical contrivance".[624] Like in the *Discovery of the Moon*, whenever the rigor of mathematical demonstrations is insufficient along the lines of Wilkins's argumentation, he employs a performative representation of events. For instance, many of the problems of ballistics could not be explained through geometrical diagrams, since before the invention of calculus most calculations of curves in ballistics were not yet available.[625] So instead of using mathematical formulae, Wilkins creates an account composed of reliable evidences about the immense power of ballistic devices. Instead of impressing the reader with a number featuring a long chain of zeros, he mentions some horrifying details. First, he states how "a man of sufficient credit, affirms that he was an eye-witnesse, how one of these Bows with a little arrow did pierce through a piece of steel three fingers thick".[626] Then he describes how "a great bellied woman walking about the City in the day time, had her child struck out of her wombe, and carried half a furlong from her".[627] In each case Wilkins supports

[622] Ibid., p. 136.
[623] Ibid., p. 144.
[624] Ibid., p. 142.
[625] Ibid., p. 133.
[626] Ibid., p. 131.
[627] Ibid., p. 135.

his argument with a narrative that creates a performative illusion of the immediate presence at the scene of events, which compensates for the absence of a theoretical explanation of the phenomena. If there are no eye-witnesses, Wilkins provides an experiential historical account, and if that is not obtainable, the reconstruction of experience is effected through the performative power of poetry.

Wilkins follows the recommendation of both Baconian and rhetorical doctrines on how to create copious discourse by processing the details of observations through topical analysis. He also employs certain elements of *stasis*, which presented an object in the light of new contextual references. Although formally *stasis* was a technique of questioning, the goal of *stasis* consists not in the questions themselves but in laying out a new perspective for viewing the matter. Bacon insisted that "a faculty of wise interrogating is half a knowledge" and the discovered "places" may help attract our attention to new experience.[628] Wilkins's contextual references, expressed both verbally and visually, convey the experience of designing mechanical wonders. Before the arrival of the comprehensive mathematical tools that could impart the engineering experience through calculations, commonly accepted rhetorical figures served as conceptual rails for moving forward the discourse of mechanical engineering.

In the second part of *Mathematicall Magick*, entitled "Dedalus or Mechanical Motions", Wilkins switches his attention from basic devices to automata. His approach to this topic could be well expressed in the words of Samuel Taylor Coleridge about imagination that acts by impressing the stamp of humanity, or human feeling, over inanimate objects.[629] Analyzing the mechanical structures of wondrous machines, he admires them as an imitation of natural movements and sounds. Wilkins's notion of automata is wider than our modern concept and includes water mills, chariots, submarines, wind-guns, as well as other imaginary and existing mechanisms, "where the motion is caused either by something that belongs unto its own frame,

[628] Francis Bacon, *Advancement of Learning*, Book II, XIII, 9.
[629] Samuel Taylor Coleridge, *Shakespeare, Ben Jonson, Beaumont and Fletcher: Notes and Lectures* (Liverpool: Edward Howell, 1874), p. 46.

or else by some external inanimate agent".[630] The modern notion of automata is closer to Wilkins's "fixed automata", i.e. "such as move only according to their several parts, and not according to their whole frame".[631] These include the clockwork mechanisms representing the motions of the heavenly bodies, the statues imitating the movements and sounds of living creatures, and other engineering implementations of the principle of *mimesis naturae*.[632] Wilkins is most fascinated with those automata whose sophisticated mechanical design makes them appear animated, as thereby the mechanical artistry advances nature through its successful imitation.

The more complex a mechanism Wilkins describes, the wider the variety of rhetorical techniques that appear in the depiction. By alternating ancient historical accounts, utopian scenarios, imaginary designs, and poetic pieces, Wilkins demonstrates the infinite power of ingenious combinatorics, "for (as was said before) any constant motion being given, it is easie for an ingenious artificer to apply it unto various services".[633] His designs are only limited by the basic proportion between physical power and weight. However, as in the first part of *Mathematicall Magick*, Wilkins continues disregarding the material aspect of this proportion. His designs remain ingenious conjectures, but he assumes that all potential difficulties can be solved and the necessary technical implementations will be created in the future.

The "Dedalus" part of *Mathematicall Magick* starts with an enumeration of the labor-saving functions of watermills. Then the basic mechanism of mills is considered in a recombined form as a design for the sailing chariot: "The force of the wind in the motion of sails may be applied also to the driving of a Chariot, by which a man may sail on the land as well as by a ship on the water".[634] The sailing chariot represents a convenient case for demonstrating Wilkins's linguistic protocol of bringing engineering inventions into the world.

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630 John Wilkins, *Mathematicall Magick*, p. 145.
631 Ibid., p. 162.
632 For scholarship on early-modern types of automata and networks of communication between the artisans, see Alexander Marr, "*Gentille curiosité*: Wonder-working and the Culture of Automata in the Late Renaissance", *Curiosity and Wonder from the Renaissance to the Enlightenment*, ed. Robert John, Weston Evans, Alexander Marr (Fulham: Ashgate, 2006), pp. 149-170.
633 John Wilkins, *Mathematicall Magick*, p. 152.
634 Ibid., p. 154.

In this case, he possesses neither a working model, nor a geometrical scheme of the chariot's mechanism. Therefore, he first enumerates the ancient and contemporary traveling accounts, according to which such chariots were in a widespread use on the plains of China, Spain, and Holland. Then he quotes an eye-witness experiential account of traveling by the sailing chariot that can move "with an equal swiftness to the wind it selfe. Men that ran before it seeming to goe backwards, things which seeme at a great distance being presently overtaken and left behind".[635] To increase the credibility of this evidence, Wilkins quotes two Hugo Grotius's "copious and elegant" Latin epigrams from *Grotii Poemata* (1639) mentioning sailing chariots.[636] One of the epigrams praises an invention by Stevenius, or Simon Stevin, who worked together with Johan de Groote, Hugo Grotius's father, on the theoretical and practical issues of erecting mills. Around the year 1600, Stevin constructed two wind driven carriages that could move along the beaches in the Netherlands.[637] Wilkins adds that Grotius's account at first made him (and perhaps others) feel distrustful, "but upon farther enquiry I have heard them frequently attested from the particular eye-sight & experience of such eminent persons, whose names I dare not cite in a business of this nature".[638] Stevin's chariots served for the amusement of Prince Maurice of Orange, whose military success was partly indebted to Stevin's engineering and fortification explorations. However, like in the case with the Egyptian Pyramids, Wilkins prefers to position the authority of his witnesses beyond the reach of documentation, thereby also supporting the rhetorical weight of the testimonies.

Emulating further his design of the sailing chariot, Wilkins provides an illustration reproducing a sketchy version of Simon Stevin's *Zeilwagen*, or wind chariot, depicted in an engraving by Jacques de Gheyn around the same time as the device was constructed. De Gheyn presents a realistic scene of fashionable entertainment with two chariots of different sizes, supplied with sails but not shaped like boats,

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635 Ibid., p. 156.
636 Ibid., p. 157.
637 For a study on Simon Steven's biography and engineering achievements, see E.J. Dijksterhuis, *Simon Stevin: Science in the Netherlands around 1600* (Springer Netherlands, 1970).
638 John Wilkins, *Mathematicall Magick*, p. 157.

moving along or standing on the coastline, with several conventional boats placed in the marine background for comparison. In Wilkins's simpler illustration, several people are traveling on a wheeled boat, shaped like a vessel with a rudder which is either supplied on purpose in case the boat needs to steer in the water, or represents what Robert Hooke would later famously call "Mr. Engraver's fancy".[639]

Then Wilkins describes a modification of the boat, where the wheels would be replaced with sledges, whose main function seems to be to endow the imaginary model with additional details, as was recommended by the doctrine of pointed *copia*. Finally, Wilkins suggests his own stylish design of the sailing chariot, inserting an elaborate illustration (see Figure 3). He admits that the functionality of his invention may be questionable but at the same time regrets that none of the gentry have even attempted to develop anything in this line: "The experiments of this kind being very pleasant and not costly: what could be more delightful or better husbandry, then to

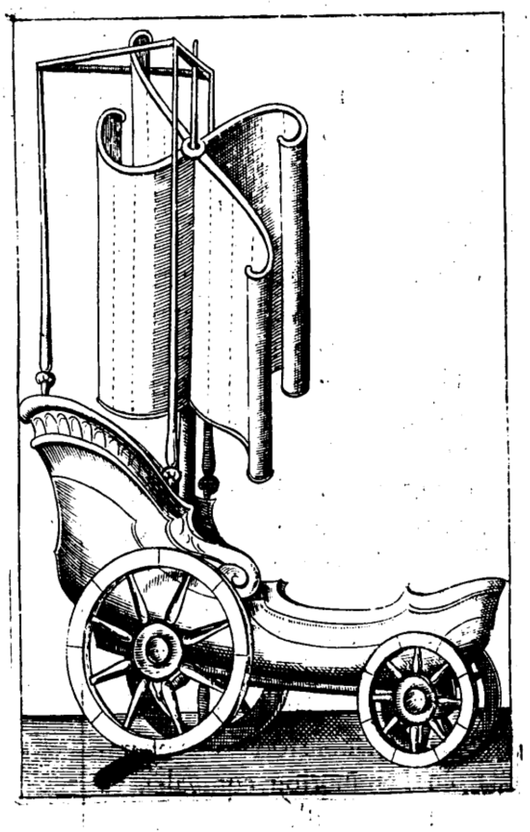

Figure 3.

A sailing chariot. John Wilkins, *Mathematical Magick* (London: Printed by M.F., 1648), p. 160.

[639] Robert Hooke, "An Instrument of Use to Take the Draught or Picture of Any Thing. Communicated by Dr. Hooke to the Royal Society, Dec. 19, 1694", *Philosophical Experiments and Observations of the late Eminent Dr. Robert Hooke* (London: Printed by W. and J. Innys, 1726), p. 292.

make use of the wind (which costs nothing, and eats nothing) instead of horses?"[640] Sailing chariots were never to become a means of transportation on European roads, but nowadays a similar logic supports the spread of wind turbines. In 1648, from the initial grapevine statement that "such Chariots are commonly used in the Champion plains of China" to the graceful landau with a lot of social appeal, Wilkins's imaginary chariot sails smoothly over all the roughness of technical background.

The liberalization of mechanics and the agenda of the new science

In the words of Johan Bodmer, the poet aims to "imitate the powers of nature in transferring the possible into the condition of reality".[641] Wilkins's mechanical designs seem to pursue a similar goal: his designs of fictional chariots and automata are not constructed through geometrical demonstrations but like pure poesy "spring from the creative impulse of a vague imaginative mass pressing for development and definition, … and this is the reason why such poems strike us as creations, not manufactures".[642] Of all the fixed automata that Wilkins mentions, including the spectacular moving statues and singing birds, he is most fascinated with an astronomical instrument invented by Archimedes, showing the diurnal and annual courses of the sun, and the changes and aspects of the moon, etc. This prime possession in Wilkins's imaginary cabinet of curiosities is first presented with a quote from the famous *Epigram of Claudian*, in Latin with an English translation:

> Jove saw the heavens framed in a little glasse,
> And laughing, to the gods these words did passe;
> Comes then the power of mortall cares so far?
> In brittle orbs my labours acted are.[643]

Further in the epigram Jove admits that Archimedes "brings hither the laws of God by art", and that "a poor hand is nature's rival grown". Wilkins considers this short

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640 John Wilkins, *Mathematicall Magick*, p. 161.
641 Johan Bodmer, *Von dem Wunderbaren in der Poesie* (Zürich: C. Orell, 1740), p. 165.
642 Andrew Bradley, *Oxford Lectures on Poetry* (London: Macmillan and Co., 1926), pp. 4-6, 23-24.
643 John Wilkins, *Mathematicall Magick*, p. 165.

piece of ancient poetic wisdom with earnest interest, and his very first remark after finishing its last line, "But that this Engine should be made of Glasse, is scarce credible",[644] sounds as if the rest of the epigram, including the scene with laughing Jove, were beyond doubt the pure historical truth. It is unlikely that one of the future masterminds behind the denouncing of "fancies and fables" was mixing up poetic and historical depiction. Wilkins's criticism about the materiality of the "brittle orbs" could be related to his life-long loyalty to Copernican cosmology and the repudiation of Ptolemaic crystal spheres.[645] But he oversees the distance between poetry and mechanics primarily because for him they both fall into the same *topos* of the liberal arts. The mythological framing does not interfere with the technical analysis of poetic imagery, since poetry creates a natural setting for mechanical ingenuity. Wilkins's narrative depicts the possible and, "transferring the possible into the condition of reality", uses the sophisticated astronomical instrument as a model for formulating a set of primary values for mechanical ingenuity. "The particular circumstances for which the Automata of this kind, are most eminent" include "the lastingesse of their motion without needing any other supply", "the art and simplicity of their composition", "the multitude and variety of those servies for which they may be usefull", and "the littleness of their frame".[646]

Wilkins needs two pages to clarify the seemingly contradictory criteria of "the art and simplicity of mechanical composition", which is almost four times longer than the rest of his comments on any other criterion of mechanical sophistication. His formula for the rules of perfect ingenuity consists in "the addition of any such unnecessary parts, as may be supplied some other way, is a sure sign of unskillfulnesse and ignorance", and "the more easie and compendious such inventions are, the more artificial should they be esteemed".[647] In other words, mechanics appreciates the pointed figures of copious design. Like the Erasmian advice on the rules of

[644] Ibid., p. 165.
[645] For a study on Wilkins's defence of Copernicanism, see John L. Russell, "The Copernican System in Great Britain", *The Reception of Copernicus' Heliocentric Theory*, ed. J. Dobrzycki (New York: Springer, 1972), pp. 189-240.
[646] John Wilkins, *Mathematicall Magick*, pp. 168-171.
[647] Ibid., p. 169.

rhetorical composition, which appreciated fresh similitudes and repudiated cumbersome allegories, Wilkins's "mechanical device of style"[648] applies the principle of composition common to all the liberal arts to the modeling of the new experimental mechanics. Wilkins's liberalization of mechanics can be interpreted as searching for symbolic forms for modeling the new learning of nature:

> Those antiquated engines that did consist of such a needlesse multitude of wheels, and springs, and screws, (like the old *hypothesis* of the heavens) may be compared to the notions of confused knowledge, which are always full of perplexity and complications, and seldome in order, whereas the inventions of art are more regular, simple, and perspicuous, like the apprehensions of a distinct and throughly informed judgement.[649]

In this context, Thomas Sprat's motto about prevailing over the "false Worlds" and "fables" of ancient superstition means that the excessive "ornaments of speaking" are "in open defiance against Reason"[650] similar to the excessive screws in mechanisms. By "preferring the language of Artizans" the Royal Society was promoting transparent coherence within the discourse of experimental philosophy, which they defined as returning to "the primitive purity, and shortness, when men deliver'd so many *things*, almost in an equal number of *words*".[651] When Sprat declared an endeavor "to separate the knowledge of Nature … from the devices of *Fancy*, or the delightful deceit of *Fables*",[652] he expressed the Society's standpoint that "fancies and fables" distorted the clear natural connections between the notions of material things. On the contrary, true poesy brings "things themselves" to speak and restores the coherence between notions, promoting the pointed copiousness of ingenious discourse.

The Royal Society intended "to promote the same rigid way of Conclusion in all other *Natural things,* which only the *Mathematics* have hitherto maintained".[653]

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648 William Wordsworth, quoted in Meyer H. Abrams, *The Mirror and the Lamp*, p. 291.
649 John Wilkins, *Mathematicall Magick*, p. 169.
650 Thomas Sprat, *The History of the Royal Society*, p. 112.
651 Ibid., p. 113.
652 Ibid., p. 62.
653 Ibid., p. 326.

Bernard de Fontelelle, a later counterpart of Thomas Sprat at *l'Académie royale des Sciences*, once mentioned that "[t]he geometrical method is not so rigidly confined to geometry itself, that it cannot be applied to other branches of knowledge as well."[654] In the political turbulences of the mid-seventeenth century, Wilkins's *Mathematical Magick* was intended to elaborate on the Renaissance ideal of the natural philosopher as a poet and a prophet. In "Dedalus", Wilkins depicts various imaginary and existing "fixed" automata in the form of doves and eagles, the automata imitating the singing of birds and human speech, as well as a diverse range of flying chariots. Possibly thanks to his family history, he was also vividly interested in the challenges of *perpetuum mobile*,[655] which he mentions at the end of *Mathematical Magick* as the ultimate wonder. In the context of this discussion, he devotes much attention to the chemistry of perpetual lamps, supposedly burning for hundreds of years, and magnetism.

Mathematical Magick was published when Wilkins had just started his career as the Warden of Wadham College, hosting the "invisible college" at Oxford. In slightly over ten years, the minutes of the first meetings of the Royal Society of London would mention two major tasks that Dr. Wilkins was desired to undertake: "the burning of lamps under water" and "the universal language".[656] Wilkins probably initiated the establishment of the Mechanical Committee of the Society, which first assembled on July 16th 1664 (Wilkins did not attend this session). Then it was "proposed by Mr. Hook, to make an instrument by which may be found a ships motion through the water".[657] It wasn't always easy for the committee to arrive at certain conclusions, as its second meeting on August 6th 1664 left an entry: "Inquiry was made, what any of the Committee had thought upon the method, formerly mentioned, and it being found, that it had not *yet* [inserted] been considered by any, the

[654] Bernard de Fontenelle, *Histoire de l'Académie royale des Sciences.* Quoted in Jackson Cope and Harold Whitmore, *The History of the Royal Society,* Introduction to the Reproduction of 1667 Edition (Washington University Studies, 1959), p. xxviii.
[655] Wilkins's father was reportedly fascinated with the idea of building a *perpetuum mobile.* See Barbara Shapiro, *John Wilkins 1614-1672*, p. 11.
[656] "Experiments recommended to Dr. Wilkins", Royal Society Archive DM/5/78C.
[657] "Transactions of the Mechanical Committee", Royal Society Archive DM/5/66, 16 July 1664.

Company was desired to take it into consideration by the next meeting".[658] The crossed out and inserted remarks in the minutes are indicative of the lively character of debates at the Society's sessions, where a few years earlier the second Duke of Buckingham had promised to present the company with a piece of unicorn's horn.[659] In this context, the notion of "unicorn" most probably refers not to the mythical creature with a spiraling horn and wild temperament, which could only be tamed by a gentle maiden. In the early seventeenth century, the translators of the King James Version of the Bible (1611) erroneously followed the Greek and Latin source texts and employed "unicorn" to translate "re'em", a wild untamable animal which is now identified with an aurochs bull. Besides, in the thirteenth century, Marco Polo had claimed to have seen a unicorn in Java, whereas his description most likely referred to a Javan rhinoceros. Therefore, in 1660, the gift promised to the Society could arouse considerable interest not only because of the unicorns as such but also in relation to the issues of animal classification. Later, the classification of plants and animals, birds and fish in particular, became one of the primary pursuits of John Ray and Francis Willughby, who collaborated with Wilkins on his language project.[660]

The entry for November 14th 1664 in "Transactions of the Mechanical Committee" mentions that "the mechanicall Authors, formerly brought in, were recommended to the perusal of the members of the Society", and members were "pleased to take" certain writings. Wilkins chose a work by Sir Hugh Plat, most probably *The Jewell House of Art and Nature* (1594) devoted to household recipes, and his own *Mathematicall Magick.*[661] Thereby Wilkins's realm of responsibility within the Committee would cover a wide range of artificial and natural objects of curiosity. The entry for August 19th 1661 depicts an experiment on the force of blowing, conducted by Dr. Wilkins. Blowing into the pipe "the Trumpet fashion" – "Io! Sound too the Trumpets here!"[662] – Wilkins made rise up a platform with "a fat boy of about

[658] Ibid., 6 August 1664.
[659] "Journal Books of the Royal Society", Royal Society Archive JBC/1, June 5th 1660.
[660] See the ongoing research project of Silvia Flubacher (University of Basel) on animal classification in early modern natural and cultural history, focused on information management in organizing the animal kingdom.
[661] "Transactions of the Mechanical Committee", Royal Society Archive DM/5/66, 14 November 1664.
[662] Abraham Cowley, "To the Royal Society".

16 or 17 y.o." sitting on it.[663] In Alberti's *De Pictura*, among recommendations on how to paint *historia* in a way that holds the eyes of the beholder, there is a remark that "the *historia* is most copious in which there are mingled together in their places old men and men in their prime, youths, boys, … and I will praise all *copia* provided that is appropriate to the event that is represented here".[664] The canons of early-modern visual rhetoric considered such copious presentation to be the most difficult but also the most effective pattern, since with the use of the right gestures and expressions it has the greatest potential for moving the viewer. The concise depiction of the minutes mentions the weight of the boy and the "trumpet fashion" of blowing, which Wilkins must have arranged as the setting for a copious and persuasive experimental performance.

When Wilkins was preparing to move from Oxford to Cambridge, he discussed yet another of his interests with John Evelyn:

> Your letter sent to Oxford, was returned back, & found me here at London. … I have here in readiness for you one part of the Bee-hive you desire, according to the same modell I have in Oxford. If you would desire to have two other like parts made to this … (which I would advise), they may be done here in London by the same man who made this."[665]

Bees were a common object of fascination for natural philosophers. The image of the bee is reminiscent of Bacon's famous metaphor in *Novum Organum* (1620) of philosophical "ants", "spiders", and "bees" choosing the *via media* in transforming empirical learning into certain knowing. In 1653, John Wilkins was experimenting on bee-hives in cooperation with Christopher Wren, creating a transparent "observation hive" that had glass windows or sides but also some architectural features to make the bees feel sufficiently dignified in their new home. In 1654, John Evelyn's *Diary* mentions "the transparent apiaries, which he had built like castles and pal-

663 "Experiments concerning the force of blowing ", Royal Society Archive RBC/1/17, pp. 63-64.
664 Leon Battista Alberti, *On Painting*, trans. Rocco Sinisgalli (Cambridge: Cambridge University Press, 2011), Section 40.
665 John Wilkins, Autograph Letter signed to John Evelyn, 2 April 1656 (copy). The British Library, Western Manuscripts RP 8606.

aces", "adorned with a variety of dials, little statues, vanes, etc." Subsequently, Wilkins presented Evelyn with a part of such a bee-hive, hence the letter quoted above. Later even the King "came on purpose" to see Wilkins's design, to his Majesty's "much satisfaction".[666] In 1655, an octagonal design of a bee-hive appeared in Samuel Hartlib's pamphlet *The Reformed Common-Wealth of Bees*. Hartlib emulated the Baconian analogy, meaning that his network of scientific informants in the "republic of letters" also collected the pollen of evidence about nature and brought it to the hive of public discourse. In 1690, William Temple also employed the analogue of the instinctive collective "art" of bees to illustrate a point about the natural grace of poetry.[667] The multi-figured and copious design of a transparent hive completed its transformation into a performative and persuasive model of ingenious, ingenuous, and productive intellectual interaction.

John Wilkins employed the techniques of figurative thinking, developed within the aesthetics of rhetorical and poetic composition, as symbolic forms for the design of paradigmatic structures of new scientific knowledge. Partly due to the specific conditions of post-war discourse, he was prone to seek epistemological solutions outside the realm of scholarly artifice and within the practices of mechanical artistry. By promoting "motoric intelligence", the new experimental learning was able to focus on those features of nature that could not be observed before. Within the new performative scientific space, nature was presented as one of the interlocutors, which made possible the contradiction of established doctrines. When the knowing is primarily viewed as a practice, a different set of epistemological values begins to prevail. As opposed to the rigidity of representation that repudiates the sensuousness of epistemological expression, the clearness of performance does not marginalize the sensuous. In this context, "speaking plainly" means adequacy in the delivery of the performative intention of the experimenter. Poesy can "speak plainly", even though it does not employ "plain language". For Wilkins, the liberal mechanics becomes equal to the other liberal arts through imagining with ingenuity.

[666] John Evelyn, *The Diary of John Evelyn,* ed. William Bray (London: M. Walter Dunne, 1901), V. I, p. 289.
[667] Meyer H. Abrams, *The Mirror and the Lamp*, p. 197.

The mechanical invention starts with the dialectical *inventio* and hypothetical design, which widens the horizon of the possible. Wilkins's writings liberalized mechanical engineering, associating "clearness" of design with pointed copiousness and the ingenuity of invention.

Wilkins was among the chief ideologists of the language reformation within the Royal Society, which like the religious Reformation was supposed to restore the coherence of a specific discourse. The scientific reformation aimed to "purify" the language, which meant turning it into a more pointed instrument of invention and discovery. The Royal Society's efforts were part of a broader movement shifting from the procedure of *inventio* as the main framework for producing knowledge within a probabilistic paradigm, to approaching the certainty of knowing by the means of mathematical demonstration. In the late seventeenth century, early science turned from a method of knowing as *mimesis naturae* which involved poesy to a method of knowing as creation of a second nature through mathematical modeling, where, in Nietzsche's words, "an imitation no longer felt to be an imitation".

Wilkins's *Mathematicall Magick* was mainly focused on the concept of power. He often implied that the generation of physical power is indicative of the potential power of the human mind to advance nature and fulfill the design of providence. The early-modern interest to "situational knowing" of the arts challenged the concept of absolute knowledge. My next chapter will be devoted to Wilkins's notions about providence, his ideas about prophesy and natural religion, and his explanations of the relationship between the human ways of advancing nature and the absolute intellect.

Chapter V

Art and nature in the contrivance of providence

Very seasonable to quiet and support the heart
in these times of publick confusion

John Wilkins
Discourse Concerning the Beauty of Providence (1649)

Unlike John Wilkins's other writings, *Discourse Concerning the Beauty of Providence*, published in London in 1649, contains no mentioning of the King of England. This does not seem surprising, if we remember the events of the fateful year in which, on 27th January, the High Court of Justice announced its verdict on Charles I. The King was found guilty because, while "being admitted King of England, and therein trusted with a limited power to govern", he "out of a wicked design" usurped "an unlimited and tyrannical power to rule according to his will",[668] whereby "infinite mischiefs"[669] were committed. Many a sovereign in Europe, even a few centuries afterward, would perceive the intention to "rule according to his will" as their sacred royal prerogative. However, Charles was executed for it "in behalf of the people of England", although during the announcement of the sentence in Westminster Hall, some people from the gallery declared Oliver Cromwell a traitor. The last tribute that the King paid to himself was a short speech where he presented himself as a martyr for the cause of preserving the natural order of things. In Charles's view, English people ought to have realized that their life and goods may be "most their own", but it is not for them to have a share in the government.[670] The people, however, condemned Charles's ways of government as decidedly "wicked", the term being mentioned several times in the verdict. In this chapter, I will consider

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668 "January 27, 1648-9. The Sentence of the High Court of Justice upon the King". *The Constitutional Documents of the Puritan Revolution 1625-1660*, ed. Samuel R. Gardiner (Oxford: Clarendon Press, 1906), p. 377.

669 "January 1649: an Act of the Commons of England Assembled in Parliament, for Erecting of a High Court of Justice, for the Trying and Judging of Charles Stuart, King of England", *Acts and Ordinances of the Interregnum, 1642-1660,* ed. C.H. Firth, R.S. Rait (London: HMSO, 1911), pp. 1253-1255.

670 "An account of the execution of Charles I", *Readings in European History*, ed. James H. Robinson, (Boston & New York: Ginn & Company, 1904), V. II, p. 243.

Wilkins's treatment of the notion of providence and the doctrine of natural theology, which were intended to repair the gap between the government of turbulent individual affairs and the universal harmony of divine nature.

The mechanics of divine providence

In 1649, John Wilkins already occupied the position of Warden of Wadham College at Oxford, appointed to the post as a Puritan protégé. In a few years' time he would marry Oliver Cromwell's youngest sister, which would secure for him the patronage of the Lord Protector. At Wilkins's Oxford lodgings, a group of intellectuals was gathering on a weekly basis, constituting the devoted core of the "invisible college" which in ten years' time would germinate into the Royal Society of London. While Wilkins's *Discourse Concerning the Beauty of Providence* was composed, his position as a Puritan educator in the former Royalist capital placed him at the very center of religious and social polemics. The dramatic events surrounding the execution of Charles I stirred a lot of ecclesiastical, theological, and moral issues, which at times must have felt overwhelming. The founder members of "invisible college" were willing to escape into the world of natural experiments, but Wilkins kept addressing painful contemporary issues in his sermons. Charles's verdict, his scaffold speech, and the questions raised in them were still fresh in the public memory; questions about the rightful form of the relationship between the governing body and its subjects, as well as the understanding of "good" and "wicked", must have been discussed by a Puritan warden at Oxford on multiple occasions.

Wilkins declares that the immediate reason that prompted him to publish his *Discourse Concerning the Beauty of Providence* was that he preached it before different persons, among whom some individuals "of eminent quality" often "solicited [him] for a Copie".[671] He admits writing the discourse based on his "own experience concerning the efficacie of this Doctrine against those damps and dejections of

[671] John Wilkins, *A Discourse Concerning the Beauty of Providence* (London: Printed for Sa. Gellibrand, 1649), To the Reader.

minde, unto which, such times as these, will expose a man".[672] Possibly, he meant to commemorate the fate of King Charles when quoting from Daniel 2:21 of the Bible, where the prophet is interpreting Nebuchadnezzar's dream. Divine providence "changeth the times and the seasons", "removeth kings, and setteth up kings", as well as "giveth wisdom unto the wise, and knowledge to them that know understanding".[673] Taking into account the political context, Wilkins's discourse on providence represented an attempt to renegotiate the understanding of divine government in a state in which the sacred royal power has perished. Wilkins solved this task by applying dialectical and rhetorical techniques to redistribute the ecclesiastical balance between the divine and human responsibilities concerning the natural order within creation. His inquiry into the role of providence contributed to filling the ideological vacuum that emerged upon the elimination of Royalty. Similar to his conduct in scientific endeavors, he tackled the problem by shifting the focus of attention from the doctrinal subtlety to sustainable practice, which enabled him to avoid sharp debate. In the context of the probabilistic paradigm, viewing knowledge primarily as a system of arts and practices also allowed Wilkins and his contemporaries to soften the binary oppositions of human and divine, artificial and natural, and chaotic and providential, which served as fulcrums for existing positions in disputations.

For Wilkins, any discussions on the governing authority of providence should have duly belonged to the discipline of natural theology and were considered as yet another human art to be studied "in the practical application of it, to particular times and conditions".[674] Considering the categories of theology from the perspective of contemporary social experience, Wilkins supplies himself with an abundance of fresh contextual references. Juxtaposing his theological constructs with new contexts, Wilkins processes them through the procedures of *stasis*, where they acquire a new set of references.[675] The new relationships between the presented concepts

[672] Ibid.
[673] Ibid., p. 19.
[674] Ibid.
[675] For a more detailed analysis of these terms, see Chapter I of this study.

and other discursive terms were meant to serve as "hinges" for more positive narratives which could guide human behavior. Ultimately, Wilkins's "chief aime and businesse of this Discourse" was "to convince and quicken men under this dutie"[676] of coping with new political and cultural reality.

The category of God's providence was mainly employed by Wilkins in the sense of "friendly providence", i.e. as the beneficial care and wise governance over the totality of nature, including human beings. Initially, the term "providence" had been derived from the Latin *providentia*, or "foresight", and helped support associations between historical narratives and Christian doctrine. The idea of providence had been promoted in St. Augustine's neo-Platonic writings explicating the interplay of knowledge and inner experience in the exercising of right judgment. For St. Augustine, the natural judgment pertaining to the human being improves when the human mind disciplines itself to desire objects of proper interest. The virtue of "practical rationality" enhances one's perceptiveness to the underlying principle of harmony and justice that permeates the abundance of historical events. The disciplined mind also becomes more perceptive in noticing the works of particular providence, which account for causation in nature.[677] The Reformed theology of Luther, a former member of the Augustinian brotherhood, retained and elaborated the notion of providential government. Many branches of Protestantism, including Calvinism and its English interpretations, cultivated the doctrine of special or particular providence, associating it with the "culture of accidents": in all occurrences in which some are punished and others rewarded, one might discern the signs from which the individuals should gain certain experient knowledge of rational divine principles.[678] Michael Witmore notes that in the England of the late sixteenth century, the providential deciphering of everyday experience was raised to the level of a "mode of civic

[676] Ibid.
[677] St. Augustine, *Confessions,* ed. James J. O'Donnell (Oxford: Clarendon Press, 1992), Book III, 13-15.
[678] Michael Witmore, *Culture of Accidents: Unexpected Knowledges in Early Modern Europe* (Stanford, CA: Stanford University Press, 2001), p. 44.

consciousness" and became widespread as a method for interpreting English history.[679]

Providential ideas also resurfaced in early-modern Dutch and English popular travel and historical writings, but became much expounded in English Puritan theology, developing into a system of notions that spread across religious thinking, politics, ethics, and other thematic fields. Throughout the seventeenth century, Puritan providentialism served as a source of ideological support for various religious groups and undertakings. Social upheavals created a particular demand for the teachings that might account for accidents or sudden changes in the fates of individuals. The interpretation of events as signs given by "particular providence" formed part of Puritan practical divinity. The career of Oliver Cromwell, to whom Wilkins had family ties, provided a number of examples on how providentialism may have inspired political actions. As Michael Russell mentioned in his two-volume *Life of Oliver Cromwell* (1829), the religious temperament of the age taught Cromwell to ascribe his abrupt political success to the involvement of particular providence, which induced him to view himself as an instrument of divine will.[680] Cromwell's fascination with experimental providentialism was in keeping with a more general tendency to popularize various explications on how to figure out providence, which involved the discourse published by Cromwell's brother-in-law, John Wilkins.

In the late seventeenth century, divine providence was presumed to retain its function of governing social affairs, but its role in the minute government of nature was reconsidered. Robert Boyle, when he was still one of Wilkins's young associates, presented a series of arguments elaborating on the Paracelsan conviction that "special providence" bestows knowledge about nature upon Christian philosophers. At the same time, the Hartlib Circle was considering ways for determining whether a certain occurrence was an incident of special providence, or whether the matter should be accounted for otherwise. Boyle also speculated on how to reliably read

679 Ibid.
680 Michael Russell, *Life of Oliver Cromwell* (Edinburgh: Printed for Constable and Co., 1829), p. 40.

providential decrees,[681] however, later, in *A Disquisition about the Final Causes of Natural Things* (1688), he doubted that "particular providence" was a helpful analytic concept in the study of nature. In Proposition IV of the *Disquisition*, Boyle notes that it is presumptuous to suppose that the welfare of any particular part of nature, such as a specific animal, could be ensured in a better way than it would be anyway if provided within the framework of general providence, to which particular providence "ought, in reason, to be subordinate".[682] Proposition IV was entitled "We ought not to be hasty in concluding upon a particular use of a thing, or the motive which induced the author of nature to frame it in a peculiar manner".[683] By the end of the seventeenth century, it became clear that the notion of particular providence only showed some explanatory potential in application to social relations within "cultures of accidents" where it created a framework for communication between the human and divine intellect. As soon as early science started to systematize causality in nature, especially concerning the things that have no access to divine communication, such as animals and plants, particular providence became viewed as a cumbersome and unnecessary category. Later, Isaac Newton transferred emphasis toward the mathematical methods of explicating causality in the physical reality of nature. Finally, David Hume in *Enquiry Concerning Human Understanding* (1748), in Section 11 entitled "A particular providence and a future state", criticized the notion of contrivance or design of providence. Hume pointed out that it seems reasonable to derive the understanding of all causes and effects from our experience, but the works of particular providence cannot be perceived as incidents given in human experience, which means that the conclusions about providence cannot be based on any reasonable grounds. Thus, the empirical agenda propagated by the Royal Society eventually ruled out scientific interest in providentialism.

[681] John T. Harwood, Introduction to *The Early Essays and Ethics of Robert Boyle* (Edwardsville, IL: Southern Illinois University Press, 1991), p. xxxvi.
[682] Robert Boyle, "A disquisition about the final causes of natural things", *The Philosophical Works of the Honourable Robert Boyle*, ed. Peter Shaw (London: W. and J. Innys, 1725), in three volumes, Vol. II, p. 191.
[683] Ibid.

About one hundred years before the publication of Hume's *Enquiry*, and over a decade before the proper establishment of the Royal Society of London, John Wilkins was approaching the issue of providence not from an empirical but from a dialectical perspective. The category of particular providence had been long since introduced into Puritan providentialism, representing a branch of general divine providence that puts "the *general* kinds of things into a regular way of working".[684] During the "times of publick confusion" in England around 1649, the "rugged passages of Providence which seem to be performed with the greatest negligence and deformity" were provoking questions, especially about the guidance of individual human actions. Wilkins's *Discourse Concerning the Beauty of Providence* was meant to save appearances for the "rugged" notions about providence through the dialectical rearrangement of factual historical material. He reinvented and revitalized the concept of particular providence by defining it as the main part of the providential works on which he focused his argument.

From the start, the figure of *antithesis* lays out the topical perspective for Wilkins's discourse. The use of several antithetical pairs for prompting the invention of an argument was a well-known dialectical procedure. Even Bacon employed it in his *Novum Organum*, turning the technique of topical invention into a legitimate method for guiding empirical investigations.[685] Wilkins's central line of argumentation in *Discourse Concerning the Beauty of Providence* concerns the functions and properties of particular providence. Following the dialectical logic of places, he persuades the reader to accept the existence of this mode of providential care which regulates individual human actions and lives. Using the terminology of Bertrand Russell, Wilkins strives to reinforce the experient knowledge of the phenomenon of particular providence.

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[684] John Wilkins, *A Discourse Concerning the Beauty of Providence*, p. 22ff.

[685] In Jeanne Fahnenstock's words, "the importance of antithesis and of antithetical reasoning to the entire project of the *Novum Organum* can hardly be exaggerated". J. Fahnenstock, *Rhetorical Figures in Science*, p. 60.

Another dialectical technique implicitly employed at the starting point of Wilkins's argument consists in compartmentalizing the continuum of "absolute" providence into a structure of *genera* and *species*. This procedure originated in the tradition of the humanist commonplace books where the continuum of random facts was distributed across various rubrics, which enabled the writer to assess a wide range of phenomena at a glance and make conclusions about their *historia* and causality. Reaffirming the division of providence into "general" and "particular" kinds, Wilkins's argument gains a logical possibility for considering the "particular" part of providence as a phenomenon intended for human understanding. Similar to the case of mechanics, Wilkins effectively develops another liberal art of communicating and interacting with providence, which then only waited to be cultivated and given a language to speak.

Wilkins accepts the Anglican version of providentialism, inventing his argument by endowing providence with specific attributes, for instance, the title of his discourse already characterized providence as beautiful. Further Wilkins turns the well-established category of providence into "a Universal providence", which does not seem provocative, since what else should divine providence be but universal? However, instead of considering "universal providence" as an established theological category expressed through an undivisible semantic unit, Wilkins views it in more disputable terms as a combination of an object and an attribute, and therefore his formula "a Universal providence" contains an indefinite article. If "universal" is an attribute, the human mind trained in dialectics cannot deny itself the possibility of thinking about the opposite of a certain property. The compelling power of antithetical pairing, once a term is positioned within an antithetical setting, consists in invoking its opposite as a legitimate logical option. Wilkins's argument takes this turn, qualifying providence as "a Universal", which suggests that this is not the only way to approach the concept, and then inventing the opposite notion of "particular" providence:

> The very Heathen have acknowledged not onely a Universal providence of God, which puts the *general* kinds of things into a regular way of working, but his particular providence likewise, which takes care of *individuall* persons and actions.[686]

Wilkins remarks that what seems peculiar about particular providence is that its works may arouse conflicting emotions and thoughts: "men have been much startled in their judgments, by that unequal dispensation which seems to be in these outward things".[687] In Wilkins's depiction, the events of the year 1649 in England appear as if the whole cosmos plunged into primaeval chaos, and "those many strange revolutions and changes in the world"[688] so perplexed the thoughts of many men that it "puts him to his wits end, transports him with wilde imaginations".[689] But Wilkins's discourse also offers dialectical means for coping with this confusion by weighing the staggering features of particular providence within the framework of yet another *antithesis*. He counterbalances the wildness of perplexed imaginations with the idea of "wise contrivance" and argues that this is the most essential characteristic of particular providence. The rest of his discourse is devoted to bringing out this regulating capacity of special providence, which should effectively dissolve the "wild imaginations". Wilkins discounts as superficial the association of particular providence with bewildering emotions, and the concept of the "wise contrivance" of providence becomes the central dialectical weight, around which Wilkins's discourse and the new social cosmos is revolving.

In Wilkins's time, the meaning of "contrivance" already included the idea of mechanical design, as in a clockwork, but was not limited to purely mundane interpretations. Robert Boyle also named the notion of contrivance as one of the central pieces in the conceptual framework of his natural theology. Boyle expressed similar methodological concerns as Wilkins, as well as John Ray and other members of the early Royal Society, who viewed the principal challenge in the understanding of nature as the failure of the human mind to grasp the infinity of natural forms and

[686] John Wilkins, *A Discourse Concerning the Beauty of Providence*, To the Reader.
[687] Ibid., A5.
[688] Ibid., A4.
[689] Ibid., A6-A7.

qualities. Therefore, human cognition has to rely upon a certain dividing pattern to account for the attributes of God and divine creation. In Boyle's words, "we are reduced to present him [God], as it were, in parts; contemplating him sometimes as omnipotent, and sometimes as wise, and sometimes as just, and etc."[690] Boyle was familiar with the hermetic views of Renaissance Platonism which maintained that the infinity of God's intellectual perfection was "infigurable", i.e. no image could be formed from it,[691] but that human memory and imagination could be aided in grasping it through artificial geometrical figures. Boyle noted that such figures, like any other product of the human mind, may indicate the causality of things in ways more or less erroneous, but through them "God may have given peculiar and admirable instances of His inexhausted Wisedom in the Contrivance and Government of Systemes".[692] In other words, God's contrivance could be discerned through the figures of divine providence, "into which the Omniscient Architect at first contriv'd the parts"[693] of natural creation. Boyle admits that natural phenomena may appear to us differently from how they were "at first contriv'd". The realm of the attributes accessible to human knowing represents a hypothetical universe which only forms a part of the real universe. By the end of the seventeenth century, John Locke would argue more radically that the human figures used for "sorting things" are arbitrary: "Our Faculties carry us no farther towards the knowledge and distinction of Substances, than a Collection of those sensible *Ideas*, which we observe in them".[694] Consequently, the human knowledge of substances can be more remote from "their true internal Constitution" than "a Countryman's *Idea* is from the inward contrivance of that famous Clock at *Strasburg*, whereof he only sees the outward Figure and Motions".[695] Wilkins presents the "wise contrivance" of providence as the figure

[690] Robert Boyle, "Appendix to the First Part of the Christian Virtuoso" [1690], *The Works of the Honourable Robert Boyle,* ed. Thomas Birch (London: Rivingtons, 1772), 2nd edition, in six volumes, Vol. VI, p. 694.
[691] Frances A. Yates, *Giordano Bruno and the Hermetic Tradition* (Chicago, IL: University of Chicago Press, 1964), p. 309.
[692] Robert Boyle, "Of the High Veneration Man's Intellect Owes to God peculiarly for his Wisdom and Power" [1685], *The Works of the Honourable Robert Boyle,* ed. Thomas Birch (London: Printed for A. Millar, 1744), Vol. V, pp. 138-139.
[693] Ibid.
[694] John Locke, *Essay Concerning Humane Understanding* (London, 1690), III.vi.9.
[695] Ibid.

of "sorting things" by God's will, albeit he admits that the outward appearance of providence may seem confusing. The contrivance of providential design became the core concept of his natural theology.

The Renaissance tradition of *magia naturalis* presumed that the accessing of information about providence means mastering the infinite powers of nature, but Wilkins did not subscribe to this agenda. By the mid-seventeenth century, Wilkins's contemporaries noticed that bursts of mystical enthusiasm more often blew the flames of discord than facilitated the soothing of "wild imaginations". Wilkins's scheme of dividing providence into *genera* and *species* presented it "in parts", i.e. in a less mystical and more comprehensible way. The infinite continuum of providence needed to be distributed into a series of "common places", to make the abundance of providential works available for consideration in various combinations and from different angles. Processing "providence" through a series of dialectical topics, Wilkins implied that any legitimate method of human interaction with particular providence can only be developed through comprehending the figures of its contrivance.

The notion of "wise contrivance" of providence worked as a symbolic form aiding the human mind in understanding the meaning of providential works. Another *antithesis* prompts Wilkins's argument, while he is building up the rhetorical weight of the concept of contrivance. The idea of "wise contrivance" mediates the antithetical pair of human reason and divine intelligence, so that the *topos* of "particular providence" turns into the space where the human and divine reason interact. Unlike Renaissance magical teachings, Wilkins does not view this space as a common ground where the human and the divine merge into a universal continuum of power. Wilkins fosters a dialogical relationship between them. The specific conversational link between the realms of the absolute divine and situational human knowledge will be elaborated in Wilkins's discourses on homiletics.

"Particular providence" displays a certain pedagogical paternalism, acting in what it perceives to be the best interests of humans, regardless of how the humans themselves feel about the matter. Wilkins argues that "[t]hough the potion be bitter and displeasing, yet so long as it comes from a loving and careful Father, we have no reason to fear any hurt by it".[696] Since the soothing of emotions is one of the tasks he is pursuing in his discourse, he takes into account the human sensibilities that should not be "transported with wonder or impatience, or unbelief, as if the providence of God were regardless or negligent".[697] The antithetical dichotomy of the infallible divine and the vulnerable human intelligence emphasizes their infinite dissimilarity: "God best understands the fittest order and reason for all things," even in cases where "they do crosse our private hopes and desires".[698] Contrary to the paternalistic attitude but in congruence with Puritan experimental providentialism, particular providence encourages the human mind to gain more experience and learn from coping with divine dispensations.

Wilkins's scientific narratives, as well as his theological writings and the project of artificial philosophical language, always appreciated first-hand knowing gained in practice. He does not abandon this principle in the analysis of "providence", although the topic may seem a feeble stimulus for elaborating on free-thinking. Wilkins's version of particular providence differs considerably from the Calvinist doctrine of predestination, which stresses the absolute governance of Divine Will. Wilkins's discourse seeks to readjust the politics of heaven, so that human beings could collaborate with providence in a variety of ways, and any proper interaction with it could be primarily perceived as a cognitive experience. "It is the glorie of God to conceal a matter",[699] and many divine works are ordered so as to make men "labour to seek them out". But a considerate man should not give up trying to figure out "many observable passages" in current affairs.[700] The human task within creation consists in serving providence, but Wilkins does not condemn the human being to servitude. More likely, he proposes rules of fair conduct in the distribution

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696 John Wilkins, *A Discourse Concerning the Beauty of Providence*, To the Reader.
697 Ibid.
698 Ibid., p. 4.
699 Ibid., To the Reader.
700 Ibid., p. 64.

of power and responsibility: “To serve providence is the usuall *means*, that is our work; but the *issue* and *event* of things that’s God’s work, we have nothing to do in it. That which is not under our *power*, should not be under out *care*.”[701] Thus the relationship between divine and human reason within the realm of particular providence is approaching collaborative pedagogy.

The main service that a human being may render to particular providence consists in controlling the emotions and maintaining the right behavior “with chearfulnesse and contentment” during “the present times under which we are fallen”.[702] Those who “repine at the works of Providence” and “take upon them the magisterial judgement of events; as if they could tell, how to frame things much better” demonstrate “especiall manner appropriated to wicked men”.[703] The question of what constitutes wickedness was a serious issue, especially as it was cited as a ground for executing the King of England. Wilkins defines “wickedness” as looking no further than the “second causes” of things, while believing them to be the primary causes.[704] One may notice the traces of the concept of “right reason” and the influence of Renaissance Platonism in this approach where morality is associated with sufficiently deep thinking.[705] In Wilkins’s intellectual interpretation, the fulfillment of Christian duty means employing the analytic skill of discerning the red thread of providential causality amidst the teeming chaos of surface occurrences: “If all the events of Providence, be so wisely contrived, ‘tis certainly then our duty to consider and to take notice of them”.[706] Wickedness as the inclination to oversee the primary causes of things tends to spread in “these later ages, wherein there have been many new, unusual emergencies, such as our forefathers have not known”,[707] i.e. when the human mind is confronted with many unfamiliar experiences. However, Puritan doctrine

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701 Ibid., p. 100.
702 Ibid., p. 66.
703 Ibid., p. 76.
704 Ibid., p. 77.
705 Cf. “Man is but a reed, the most feeble thing in nature; but he is a thinking reed. … All our dignity consists, then, in thought. … Let us endeavour, then, to think well; this is the principle of morality.” Blaise Pascal, *Pensées* [1670], trans. W.F. Trotter, Introduction by T.S. Eliot (London: Dent, 1931), Section VI “The Philosophers”, p. 347.
706 Ibid., p. 58.
707 Ibid., pp. 63-64.

supposes that "the times that are full of change and vicissitude are best for the writer, the Historian that writes of them", since they may "teach us our duty to take notice of and observe the works of Providence".[708] So, Wilkins views the ability to grasp the true contrivance of providence as a profound Christian virtue.

Wilkins's propaedeutic message on how to serve providence does not aim to promote mystical devotion but rather to enhance the capacities of Christian "right reason". In mid-seventeenth century England, this position was in keeping with that of the Latitudinarians, including the Cambridge Platonists,[709] who argued in favor of moderating ardent spirituality through intellectual effort. Latitudinarians were known to disapprove of the excessive manifestations of religious enthusiasm, which they justly associated with the dangers of political atrocities. Wilkins also must have witnessed many times how the pathos of providentialism could be employed for the justification of selfish political acts. He makes a point of elucidating that Christians should serve providence not by immersing themselves in spiritual devotion but by keeping up their own subjectivity and improving their skills of recognizing the subject matter in the contrivance of "divine things", which in the early-modern context also includes "the knowing of nature". The works of providence represent the true order of things, and serving providence means grasping the meaning of divine dispensations. Here, Wilkins advocates the contemplative attitude of rational theology but also emulates the Puritan notion of "experimental providence", suggesting that active cognitive zeal might be a better remedy against wickedness:

> If a man were but well-read in the story and various passages of his life, he might be able to make an experimental divinity of his own. He that is observant of Gods former dealings and dispensations towards him, may be thence furnished with a rich treasury of experience against all future conditions.[710]

[708] Ibid., p. 58.
[709] On collaboration between John Wilkins and Benjamin Whichcote, the founding father of the Platonic School of Cambridge, see Robert A. Green, "Whichcote, Wilkins, 'Ingenuity', and the Reasonableness of Christianity", *Journal of the History of Ideas*, Vol. 42, No. 2 (Apr. - Jun., 1981), pp. 227-252.
[710] John Wilkins, *A Discourse Concerning the Beauty of Providence*, p. 61.

The collecting of "a rich treasury of experiences" in figuring out providence is supported with essentially the same dialectical skills, as those employed in the collecting of natural curiosities or composing the pointed figures of copious discourse.

Wilkins's contemporaries gave due credit to his outstanding ability for considering things in their multifaceted complexity. In his discourse on providence, after setting up the configuration of his argument, he employs various narrative techniques to display in more detail the puzzling variety of divine dispensations. His idea that divine intelligence means to inspire human intellect with the riddles of nature is rooted in early Renaissance humanism, but Wilkins's providentialism also shows a masterful command of more mature dialectical tools in delivering his pedagogical message.

Wilkins unfolds his argument by mediating various antithetical pairs, which imparts a certain vividness to his dialectical demonstrations. On denouncing wickedness as a lack of capacity for figuring out the primary causality of things, he transforms the scholastic dichotomy of secondary and primary causes into a set of more illustrative opposites. Employing more visual analogues of outward and inward relations, as well as those of darker and brighter sides, he maintains that the contrivance of providence may seem particularly perplexing "if a man in these times shall with his reason consult onely the outward face of things".[711] In this case, "they must needs seem full of irregularitie & disorder", "and yet even in all this, there may be a designe of providence for our good".[712] Wilkins could have been thinking along the lines of 1 Corinthians 13:12 KJV: "Now we see through a glass, darkly; but then face to face", while composing his own line "We do in this world (for the most part) see onely the *dark side* of Providence".[713] The motif of darkened or blurred vision was a popular one in mid-seventeenth century British theology. For instance, Nathanael Culverwell derived the whole narrative of his *Spiritual Optics or a Glass Discovering the weaknesse and imperfection of a Christians knowledge in this life*

711 Ibid., p. 69.
712 Ibid., p. 70.
713 Ibid., p. 72.

(1651) from this quote from 1 Corinthians. Culverwell's *Spiritual Optics* employed the same principle of the figural and visualized interpretation of history, which helped establish certain patterns of causality between events. However, Wilkins's argument does not peak with the visual analogues, as they only help him prepare the ground for depicting providence in more abstract terms, approaching the methods of mathematical modeling.

Dialectical and mathematical approaches to providence

When clarifying the reason why God reserves to himself the prerogative of apprehending the true meaning of his design, Wilkins initially mentions the natural "obscurity of things", the precious secrets of knowing them, which cannot be revealed freely due to the limits of fallen human intelligence.[714] But then he switches from explaining these reasons in qualitative moral terms to modeling them in quantitative mathematical analogues. The "inward" work of providence is bound to remain clandestine to the human mind because "those concealed providences, we do not discern the reason of, are of much greater proportion then those that appear".[715] Mathematically, the inward moves of providence are of no proportion at all to its outward moves visible for human intelligence, since divine providence arranges things on "infinite occasions", and the human mind only disposes of "finite abilities".[716] Wilkins is very much at home with the mathematical concepts of infinity and proportion but he expects his readers to be less so and therefore elucidates: "there is the same proportion of infinite to infinite, as of one to one".[717] The infinity of providential works, such as "the distinctions of seasons, the growth of several plants, its various influence upon Minerals, the cherishing of living creatures, with sundrie other such variety of employments, which we are not able so much as to

[714] Ibid., p. 48.
[715] Ibid.
[716] Ibid., pp. 44, 42.
[717] Ibid., p. 44.

notice of",[718] equals as "one to one" to the infinity of divine capabilities, but in calculable terms, the limited human mind is infinitely remote from divine intellectual power.

The mathematical relationship between divine providence and divine creation needs to be understood in the context of the basic theological assumption, according to which human nature, as a consequence of the Fall, was deemed infinitely distant from its creator.[719] The connection between the absolute and the non-absolute by definition represented a difficult logical problem which had to be solved through sophisticated discursive means. The awareness of the infinite qualitative and quantitative distance between the perfection of divinity and the imperfection of the sublunar world manifested itself on many levels, including mathematical, moral, and mythopoetic understanding.[720] In mythological terms, the cosmic connection or *copula mundi* was often portrayed as the "chain of being". Arthur Lovejoy observed that the widespread imagery of the great chain represented a visualized gradation of species, which consisted of the links ranging in hierarchical order. The symbolism of the chain was intended to balance "the principle of plenitude" and "the principle of continuity", which can be also interpreted as the principle of copiousness and that of coherence in nature.[721] The idea of the hierarchical ladder originated from Homer's "golden chain", by which the irritated Jove wanted to hang the earth and leave it "dangling in the mid firmament".[722] Later, it turned into the concept of Jacob's Ladder which in Jacob's dream was "set up on the earth, and the top of it reached to heaven", with "the angels of God ascending and descending on it".[723] In manifold variations, these narratives of universal connection became part of the philosophical, theological, and literary arsenal of early-modern *loci communes*.

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718 Ibid., p. 43.
719 For a summary of the origins of early-modern views on this point, including Platonic and Aristotelian influences, see Edward P. Mahoney, "Metaphysical Foundations of the Hierarchy of Being According to some Late Medieval and Renaissance Philosophers", *Philosophies of Existence, Ancient and Medieval*, ed. Parviz Morewedge (New York: Fordham University Press, 1982), pp. 165-257.
720 For a recent study of this tendency in the 17th century England, see Rhodri Lewis, *William Petty on the Order of Nature: an Unpublished Manuscript Treatise* (Tempe, AR: ACMRS, 2012), esp. pp. 22-28.
721 Arthur O. Lovejoy, *The Great Chain of Being* (Cambridge, MA: Harvard University Press, 1936), p. 59ff.
722 Homer, *The Iliad*, trans. Samuel Butler (London: Longmans, Green, & Co., 1898), Book VIII, 18-27.
723 The Bible (KJV, 1607), The Book of Genesis 28:10-19, 12.

In the England of the early seventeenth century, both narratives were reflected in Bacon's influential writings. Concerning the golden chain narrative, Bacon remarks that upon "the entrance of Philosophy", it is usually easier to notice the second causes of things, which are "next to our senses" and "offer themselves to the mind of men". If the mind dwells on them too long, "it may induce some oblivion of the highest cause", but more advanced studies will inevitably lead the mind to noticing "the dependence of causes, and the works of Providence", or in the allegorical words of the poets, that "the highest link of nature's chain must needs be tied to the foot of Jupiter's chair".[724] Book II of *Advancement of Learning* continues giving advice about natural studies in terms of "moral certainty", noting that "in that excellent and divine fable of the golden chain", no one could draw Jupiter down to the earth, but he was able to draw them all up to heaven, which means that men cannot submit the mysteries of God to their reason, but should raise their reason to divine truth.[725] However, further Bacon turns to the narrative of the ladder for a more technical clarification on how to raise the reason, noting that all causes and effects "have a great connection between themselves", and therefore all true natural philosophy "hath a double scale or ladder, ascendant and descendent; ascending from experiments to the invention of causes, and descending from causes to the invention of new experiments."[726] In Bacon's view, the human mind does not climb the golden chain but calmly ascends the ladder, and that is because the "chain" signifies the natural causal connections, and the "ladder" stands for the methodology of "raising the mind" for their understanding. In Bacon's description cited above, the "ascending" and the "descending" of the ladder are not meant as allegories but as direct methodological guidance which is repeated in *The Novum Organum*. There the experimenter is advised to start with "setting forth Solitary Instances" or particular narratives of behaviour and design in nature, and then proceed by way of "the Ascending and Descending Ladder of Axioms", where the diverse "histories" can be

[724] Francis Bacon, *Advancement of Learning*, Book I, III, 1.
[725] Ibid., Book II, VI, 1.
[726] Ibid., Book II, VII, 1.

processed into "well ordered and digested experience", and prepared for "presentation to the intellect", which is how "a true philosophy regarding the laws of nature − divine, human, and natural − can be derived".[727] It is notable how the initial "fable" gave rise to a new scientific method by capturing a specific scenario for the apprehension of scientific experience.

Although John Wilkins and the Royal Society did not in principle approve of "fancies and fables", the most "excellent and divine" of them permeated their statements. For instance, Wilkins's *Of the Principles and Duties of Natural Religion* reproduced Bacon's argument and mentioned that "the highest link of Natures Chain is fastened to Jupiter's Chair."[728] Wilkins's interpretation of providence also reproduces Bacon's argument on the primary and secondary causes, associating the works of providence with the internal and clandestine primary causality, which by the mid-seventeenth century represented another theological commonplace.[729] However, as for the treatment of the concept of universal *copula* in Thomas Sprat's *History of the Royal Society*, it seems characteristic of another contemporary tendency. It consisted in referring neither specifically to the mythological chain, nor to the metaphorical ladder, but to a combined and more terminologically accurate version of them both, which many sources termed as *scala naturae*. Young Thomas Sprat provides a sample thereof, demonstrating such deep reflection and stylistic clarity, which invites speculations about the authorship of the following passage:

> There is nothing of all the works of Nature, so inconsiderable, so remote, or so fully known; but, by being made to reflect on other things, it will at once enlighten them, and shew it self the clearer. Such is the dependence amongst all the orders of creatures; the inanimate, the sensitive, the rational, the natural, the artificial: that the apprehension of one of them, is a good step towards the understanding of the rest: And this is the highest pitch of humane reason; to follow all the links of this chain, till all their secrets are open to our minds; and their works advanced, or imitated by our hands. This is truly to command the world; to rank all the varieties, and degrees of things, so orderly one upon another; that standing on the top of them, we may

[727] Francis Bacon, *The Novum Organon: Or a True Guide to the Interpretation*, trans. G. W. Kitchen, (Oxford: Oxford University Press, 1855), pp. 164-165.
[728] John Wilkins, *Of the Principles and Duties of Natural Religion* (London: Archive, 1675), p. 237.
[728] John Wilkins, *A Discourse Concerning the Beauty of Providence* (London: Printed for Gellibrand, 1649), p. 69.
[729] Ibid., pp. 63-69.

perfectly behold all that are below, and make them all serviceable to the quiet, and peace, and plenty of Man's life.[730]

This description preserves the idea of connection, as was previously expressed by the chain, and the notion of a vertical ascent, as earlier captured in the imagery of the ladder, so that the combined figure of "degrees of things" or *scala naturae* invokes both the method and its object, in this way allowing for a closer examination of the "things themselves". Under the influence of the Renaissance dialectical and rhetorical strategy for visualizing an argument, *scala naturae* became a performative utility for displaying knowledge and making it part of individual experience. For instance, Jean Bodin's *Universae naturae theatrum* (1596), as well as numerous other similar treatises, employs the figure of the scale as a pre-encyclopedic pattern of knowledge representation.[731]

The figure of *scala naturae* allowed for displaying the connections between things with experiential vividness, but they also had to be attested through the means of logical or mathematical certainty. The explanation of how *scala naturae* was supposed to function in the operations of divine providence often involved the terms of "harmony" and "proportion". For instance, Thomas Browne's *Religio Medici* (1643), and Ralph Cudworth's *True Intellectual System of the Universe* (1678) both employ the notion of "proportion" that keeps nature in order.[732] Although otherwise Browne's discourse focused on the materiality of things, and Cudworth's neo-Platonic treatise abundant in theological reminiscences do not share much common material. However, the translation of "proportion" in mathematical terms posed a problem. As effectively acknowledged by Browne, no quantitative analysis of that "pro-

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[730] Thomas Sprat, *The History of the Royal Society*, p. 108. Cf. Pico della Mirandola, *The Oration on the Dignity of Man* [1486], ed. Francesco Borghesi et al. (New York: Cambridge University Press, 2012). See also John Wilkins, *Essay towards a Real Character and a Philosophical Language* (London: Printed for Sa. Gellibrand, and for John Martyn, 1668), the Epistle Dedicatory and the General Scheme, p. 23.

[731] See, among others, Markus Friedrich, "Das Buch als Theater. Überlegungen zu Signifikanz und Dimensionen der Theatrum-Metapher als frühneuzeitlichem Buchtitel", *Wissenssicherung, Wissensordnung und Wissensverarbeitung. Das europäische Modell der Enzyklopädien*, ed. Theo Stammen, Wolfgang Weber et al. (Berlin, Colloquia Augustana. Bd. 18, 2004), pp. 205-232.

[732] See also William Petty's unpublished manuscript *Of the Scale of Creatures*, ed. Rhodri Lewis in *William Petty on the Order of Nature: an Unpublished Manuscript Treatise* (Tempe, AR: ACMRS, 2012).

portion" could be conclusive, as between plants and animals there was "wider difference", between them and man "a farre greater", and between man and Angels "there should be yet a greater",[733] which places the quantification of the proportion into the realm of incalculable infinity.

Wilkins follows the tendency to view divine providence as mainly occupied with the "natural employments" of preserving the order in nature. Wilkins's discussion on the infinite multitude of divine works in nature introduces in his writings the problem of the apperception of experience of natural phenomena. Since the "highest pitch of humane reason" consists in "following all the links" in the infinite chain of being, and situational human knowing is striving to approach the ideal of absolute divine knowledge, it makes the human experience of natural forms and qualities potentially infinite. From the perspective of divine intelligence, the infinity of things is "*inter numerata*", since God "takes an exact account" of natural phenomena, for instance, counting every barely observable hair on a human head.[734] But Wilkins realizes very clearly that infinity is a special kind of mathematical object that cannot be equalized to any finite number: "we measure God by our own *finite abilities*, whereas we should consider, that that which is *infinite* cannot be confined by time, or number, or place."[735] The infinite divine capabilities are not proportional to the limited capacities of humans. In mathematical terms, human knowing will never catch up with divine knowledge for the same reason that Achilles can never overtake the tortoise in the famous Zeno's paradox.

However, according to Renaissance Platonic geometry, although infinity cannot be quantified, it can be apprehended through the figures of thinking. Wilkins effectively attempts to interpret the human experience of natural phenomena not as a simple multiplicity but as a consistent multiplicity, i.e. a finite set of figures, where each figure encompasses a potentially infinite number of natural features. Although this methodology comes to be best described in the modern language of set theory,

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733 Thomas Browne, *Religio Medici* (London: Printed for Andrew Crooks, 1643), pp. 73-74.
734 John Wilkins, *A Discourse Concerning the Beauty of Providence*, p. 36.
735 Ibid., p. 42.

its basic principle originates from the technique of *loci communes*, the doctrine of *copia*, and the Ramist version of dialectical rhetoric, all of which represented the early-modern instruments of coping with the abundance of experience in oratory. Wilkins's approach to infinity was essentially dialectical, as he endeavored to make infinity comprehensible "in parts" through exploring its composition. Later, in *Essay Towards a Real Character and a Philosophical Language* (1668), he would attempt to solve the problem of the infinity of experience through analyzing the composition of the potential infinity of species and simple apprehensions in the mind.

The main mission of providence consists in maintaining coherence within the domain that in the modern language of Alain Badiou can be called "being-in-totality, the complete domain of experience".[736] Wilkins provides a view of this domain from two sides: the divine/infinite/absolute and the human/finite/probabilistic apprehension. He explains that infinity is a legitimate working material for God, but humans perceive it as an unimaginable greatness beyond their capacity of understanding, which confuses them and instigates the "wild imaginations". Wilkins suggests that the human mind may account for the infinite phenomenology of nature by applying topical operators, i.e. a finite number of *genera* containing a potentially infinite number of *species*. The experience of natural forms and qualities should be thus processed through a series of *loci communes*, which also opens up ways for the observing and recognizing the works of divine providence.

In Wilkins's time, early-modern astronomy and physics began to abandon the scholastic qualitative vision of nature, where the apprehension of experience was effected through the categories of Aristotelian scholastics. However, Newtonian quantitative accounting of observational experience was not yet available. The properties of many natural phenomena were only starting to be assessed in measurements, for instance, in the case of mechanics, as described in my previous chapter. Wherever some quantitative analysis was obtainable, the mathematical relationships between the quantities often did not yet exist as part of a coherent framework for the

[736] Alain Badiou, *Being and Event* (London: Continuum, 2007), p. 76.

interpretation of specific phenomena. The language of mathematical formulae would assume this role later, but to the present day mathematics has not completed its development as the exhaustive modeling methodology within the exact sciences. In the mid-seventeenth century, dialectics was the method of apprehension of observational experience, which proved to be the most reliable technique for coping with the growing abundance of experimental data. The acute awareness of this growth necessitated the use of topical operators and figurative forms for maintaining the coherence of scientific representation.

Wilkins's notion of providence in theological context

Wilkins employed the notion of the contrivance of providence to mediate the *antithesis* between the infinity of potential human experience and the finiteness of the human mind. More radical Puritan theology provided a qualitative interpretation of the limits of human understanding, construing it in terms of moral and intellectual weakness. Wilkins viewed this weakness more moderately and at the same time in quantitative terms: the limits of cognition are not due to fallen human nature but mainly because of the temporally confined existence of individual consciousness. The category of temporality helps draw the borderline between the general or "common" and the particular or "special" providence. Divine providence cannot be temporal as such, but Wilkins considers the notion of providence from different points of view. The rhetorical technique of *stasis* allows him to shift the perspective of vision and consider his object from the standpoint of divine and human knowing, to change the contextual references and arrive at a new meaning for "particular providence". Divine providence is not temporal from its own point of view, but from the point of finite human beings, general providence operates the eternal laws of nature, whereas special providence deals within the experimental theater of social "temporal matters" and individual human actions. In historical terms, we might compare general and particular providence with the modern notions of the macro- and the microscale of historical apprehension.[737] The "temporal matters" pertaining to special or particular providence are related to the human "desires for any particular success" and must be handled "with a tacit submission to the will of God, who knows better what is fit for us, then we our selves",[738] since divine intellect operates the infinity of potential historical possibilities.

Wilkins steers a moderate course between the extremes of his contemporary theological convictions. Unlike the radical Puritans, he does not disparage the human intellect but, on the contrary, makes an appeal to it by suggesting a rational, almost mathematical reason, why it makes perfect sense to accept the works of divine providence. Absolute intellect is infinitely more competent in operating all manner of issues than the individual human mind with its limited situational understanding conditioned by temporal existence. But unlike the Latitudinarian rational theology, Wilkins does not endow human reason with the capacity for spiritual *mimesis* of the intellectual glory of God. A characteristic example may illustrate Wilkins's views. Around the same time when he published his discourse on providence, the founder of the Platonic School of Cambridge, Benjamin Whichcote, was debating with the Puritans how to interpret Proverbs xx. 27 KJV "The human spirit is the candle of the Lord that sheds light on one's inmost". The metaphor of "candle of the Lord" that compared the candle of human reason with the sun of divine intellect was a popular one among both the Puritans and the Platonists, and the latter could see their interpretation supported in Bacon's legacy, in spite of his criticism targeting occult Platonic teachings.[739] The Puritans insisted that human reason is weak as a candle, whereas the Platonists argued that even if weak, this candle is proportional in power to the sun. Wilkins, had he wished to use this comparison, would not have regarded the candle as mathematically proportional to the sun of divine intelligence,

[737] In the classical interpretations of Carlo Ginzburg and Michel de Certeau, the relationship between the micro- and macro-levels of phenomena can be defined in terms of exceptionality and typicality. For critical analyses of this approach, see Matti Peltonen, "Clues, Margins, and Monads: The micro-macro link in historical research," *History and Theory*, Volume 40, Issue 3 (October 2001), pp. 347-359.
[738] John Wilkins, *A Discourse Concerning the Beauty of Providence*, p. 110.
[739] Cf. Francis Bacon, *Essays* (London: Printed by John Halivand, 1625), "On truth".

and would also repudiate the widespread Platonist belief that the spiritual concentration may considerably improve the quality of human reasoning. Wilkins's doctrine of providence encourages contemplation and profoundness in the study of divinity, but his model was meant to appeal to ordinary people and to employ ordinary language. However, if he had used the comparison of the candle, he would also not have joined the Puritans in their negative assessment of the fallen quality of the light of human intellect. Wilkins would have been chiefly interested not in the quality but in the duration of this light, i.e. considering it not in qualitative but in quantitative terms. In reality, he never used the metaphor of the candle, but in twenty years' time his version of natural theology would feature a more abstract but similar notion of "private natural light", signifying the ordinary human capacity for reasoning.[740]

Wilkins's theological standing has been a matter of some discussion. He was born into a family with connections to renowned Puritan authors,[741] received a Puritan upbringing, and in 1637 succeeded at Fawsley his grandfather John Dod, a Puritan Church of England clergyman and a popular preacher. Wilkins's subsequent career was much advanced by his close collaboration with the Puritan political leadership. However, in the England of the mid-seventeenth century, the political turbulences widened the range of accepted Puritan views in comparison to the sixteenth-century Puritanism. Barbara Shapiro in her comprehensive analysis of Wilkins's Puritan leanings noted that, in spite of his ecclesiastical duties, his own views were closer to the "broad middle ground in which it is difficult to clearly differentiate between moderate Puritan and moderate Anglican".[742] Wilkins's position lacked the rigidness and the sense of rightness pertaining the authoritarian Puritan faith. Politically, he most often opted for solutions based on discussions and compromises. Therefore, Shapiro concludes, instead of ascribing him to moderate Anglicans or moderate Puritans, it is better to place him among the Latitudinarians, where the Platonic School of Cambridge also duly belonged.

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740 John Wilkins, *Of the Principles and Duties of Natural Religion*, pp. 51, 54, 60.

741 Nicholas Bownd (died 1613) and Richard Greenham (1535-1594), both known for their Christian Sabbatarian writings, were among Wilkins's ancestors.

742 Barbara Shapiro, *John Wilkins 1614-1672: An Intellectual Biography*, pp. 61, 66-68

According to some investigations,[743] the careers of Wilkins and Benjamin Whichcote, the founder of the Platonic School, intersected at a number of points. In 1659−1660, while Wilkins was on a brief mission at Cambridge, he arranged Whichcote's appointment as his own successor in the vicarage of St. Lawrence, Jewry. There is a noticeable similarity between Whichcote's and Wilkins's specific use of the term "ingenuity" that was essential for the theological dispositions of both authors.[744] For Whichcote, ingenuity is the most distinct human feature and the natural foundation of religion. The evidence for the rationality of humans is to be found in their capacity to bear "truths of first inscription" that "the Reason of a Man's Mind doth determine".[745] Whichcote expounded "truths of first inscription" within the framework of the argument on "innate ideas" which were deemed imprinted upon the souls of men to allow true ingenuity to render judgment through the processing of inner experience. By the end of the 1640s, when Wilkins was composing his discourse on providence, Platonic innatism was widely perceived as obsolete, for many philosophical and social reasons. Like the Platonists, Wilkins attempted to revive the bleached optimism of humanistic theology, suggesting a way for promoting the "truths of first inscription" as the teleological principle of providence. Instead of being imprinted in the soul, the patterns of how to figure experience now had to be acquired from the things themselves, which was mediated by the presumably graceful help of providence.

In this context, when Wilkins quotes 1 Corinthians 4:5 KJV "But man cannot find out the work of God from the beginning to end",[746] he is actually making a positive and sanguine statement. He maintains that the "inward face of things" or "the contrivance of special providence" is barely visible to humans not due to their intrinsic wickedness but primarily because of the temporal limits of human judgment. Wilkins takes note of the role of sinful actions in dimming the light of reason.

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743 Robert A. Green, "Whichcote, Wilkins, 'Ingenuity'", p. 245.

744 Robert Green also offered a hypothesis that Wilkins's typical use of "ingenuity" can be traced to the influence of Whichcote who had been an advocate of "ingenuity" since 1650. In my opinion, this argument is somewhat undermined by that Wilkins already uses the term extensively in his *Mathematicall Magick* published in 1648.

745 Ibid., p. 239.

746 John Wilkins, *A Discourse Concerning the Beauty of Providence*, p. 32.

But mainly he advocates the point that "God doth reveal unto mens hearts the work which he makes, from the beginning to the end, excepting onely some things unto which man cannot attain".[747] In other words, God reveals everything except what cannot possibly be attained, simply because "some things" within the operative theater of "temporal matters" are part of the patterns that exceed the temporal limits of individual human existence in this world. Nevertheless, Wilkins's statement asserts the capability and necessity for the human mind to attain knowing of whatever can be discovered within an observable timescale.

Similar to his aesthetics of technical invention, Wilkins's interpretation of providence invokes contemporary aesthetic values. Like the immense mass of legendary Egyptian statues, the true scale of providential contrivance almost vanishes into infinity, promoting a sense of wonder. This positive rhetorical effect is induced further through an appeal to the aesthetics supported by Biblical authority: "Every thing has its time. Every thing in its time is beautiful. That is the proper season for all things which God appoints".[748] The human mind is bright enough to appreciate the beauty and comeliness of the figures of providence as a whole, although there are particulars that humans cannot grasp because of having no means of coping with infinite timelines. Although all Christians are supposed to be "conscious of their own immortality", human thinking "is confined with the narrow bonds of life".[749] However, humans may serve particular providence by grasping the pleasing harmony and aesthetic integrity of providential contrivance, a reliable signal of which comes as the experience of wonder. The individual human lifetime is short, but "posterity perhaps may see the end of it, when all these confused preparations shall be made into a beautiful structure".[750] Like the ancients who "did set forth their Gods with Harps in their hands, to shew the harmony they observed in the government of the

[747] Ibid., p. 6.
[748] Ibid., p. 7.
[749] Ibid., p. 95.
[750] Ibid., p. 74.

world",[751] a good Christian fulfills his or her duty by reproducing the harmony and explicating the "truths of first inscription".

Wilkins's approach borrows a part of its argument from the English neo-Platonic version of rational theology, on the one side acknowledging the limits of human intellect in finding out the factual contents of infinity, on the other side, outlining a legitimate ground for figuring the patterns in which this infinity is operated. But unlike the Renaissance intellect, the early-modern mind needed to generate those patterns or the "first inscriptions of truth" immediately from the sensuous experience of "things themselves". Starting from Bacon, many seventeenth-century experimental philosophers, including Wilkins, believed that this problem should be solved through a radical improvement of language as the primary means of reading the book of nature.

Wilkins's theology also names prophesy as one of the ways of expressing "how all events in the world are wisely disposed of, by the care and government of Providence".[752] Within the realm of prophesy, the human and the divine responsibilities concerning providence can be distinguished even more clearly, than in ordinary communication: "there is nothing more in our command, then our thoughts and words, and yet both *the preparation of the heart, and the answer of the tongue is from the Lord*". Wilkins quotes Proverbs 16:1 KJV to discriminate between the sphere of "thoughts and words" that falls under the human care, and the realm of the "preparation of the heart" and the "answer of the tongue" (actual prophetic speech) that fall under the care of divine providence. Prophesy reveals "positive truth" about providential dispensations, but prophetic speech contains no direct statements. Prophetic communication does not reveal the contents of the infinity of providential works, as it indicates their patterns only. Therefore, prophesy has to unfold itself in narrative forms, challenging the human capacity to figure out the contrivance of divine schemes. The "preparation of the heart" and the "answer of the tongue" come as a gift of Grace, but the "words and thoughts" fall under human care where "truth

[751] Ibid., p. 20.
[752] Ibid., p. 18.

of first inscription" should be discovered and formulated in analogues. Later, in his writings on natural religion, Wilkins would prefer the abstract laws of nature over prophesy as a source of information about particular providence. He would also focus on the "thoughts and words" in *Essay towards a Real Character and a Philosophical Language* (1668), seeking to approach the contrivance of natural providential works via an improved non-prophetic scientific communication.

In his discourse on providence, Wilkins neither yet formulates his ideas concerning artificial tongues, nor elaborates further on what happens in the act of prophesy. However, in his view, the most spontaneous and unexpected occurrences in the course of ordinary events are likely to be the signs indicating the greatest works of providence. This idea is reminiscent of a more detailed and explicit account by John Smith, another Cambridge Platonist, who around 1650 composed his discourse *On Prophesy* (published posthumously in 1660).[753] Discriminating between the truly prophetic visionaries and common dreams, Smith noted that true prophesy should be accompanied by specific inner experience. The prophetic message is formulated within the realm of "thoughts and words" which must be the prophet's own, but emerges as if at "the Prophetical scene or Stage upon which all apparitions were made to the Prophet".[754] The authenticity of this experience, and of the prophesy itself, is dependent on the unexpectedness of suggestions within the dialogue on the stage, where all interlocutors appear to speak their mind freely. The more spontaneous this "stage-experience" seems to the prophet, the more authentic should be the prophesy: "Exits and Intrats upon this Prophetical stage being made as it were in an invisible manner, … and Transitions from the voice of one person to another".[755]

[753] John Smith, a Cambridge Platonist, died in August 1652, presumably of tuberculosis. His writings were edited and published by John Worthington, his close friend and colleague, in 1660. Smith's papers were not dated, however, his discourses must have been composed within the few years of his lectureship at Cambridge before 1651 when his health began deteriorating, i.e. around the same time as Wilkins was composing his discourse on providence. There is no indication of their collaboration, however, John Smith's enormous personal library, presently in custody of Queen's College, Cambridge, contains an copy of Wilkins's "Mathematicall Magick" printed in 1648 in octavo format, among several other publications on "mixed mathematics".

[754] John Smith, "On prophesy", *Select Discourses* (London: F. Flesher, for W. Morden, 1660), p. 222.

[755] John Smith, "Some rules and observations concerning prophetical writ in general", *Select Discourses* (London, 1660), p. 278.

The prophetic communication occurs within the "inward man"[756] where the prophet "according to the exigencie of this Dramatical apparatus, must, as the other Actors, perform his part, sometimes by speaking and reciting things done, propounding questions".[757] In Wilkins's view, the prophetic message should, on the one hand, amplify the coherence of experience and reveal the figures of deep correlations between historical events; on the other hand, it should emerge as "the first inscription of truth", i.e. as the prophet's spontaneous impression. In Wilkins's opinion, the same applies to the discerning of providential gestures outside prophesy.

It may seem a paradox that the least expected elements within a certain scheme should be suggestive of its deepest structures. Wilkins presents this paradoxical wonder by mediating the antithetical pair of the spontaneous and the regular. The "thoughts and words" belong to the sphere of the humans' concern about the course of regular events. But the "preparation of the heart" is a matter of divine providence, the patterns of which are not obvious to limited human consciousness. Therefore, what it perceives to be a spontaneous move of the heart, in reality represents the most immediate expression of God's will: "Those actions and events that seem unto us most free, casual, inconsiderable, are all of them ordered by his providence".[758] Providence manifests itself in the spontaneous "moves of the heart", actions, and via the practice of praying, which Wilkins addressed in other writings.

Particular providence regulates social interactions, but because of the immense timescale of the figures of providential contrivance, the meaning of its individual steps may appear obscure. Therefore, one may sometimes notice that God can "manage the worst action of man to the best advantage of man".[759] Even the most sinful actions can be "wisely contrived to the promoting of God's decrees and glory",[760] which is the main reason why the sinful actions are permitted to occur "in

[756] John Smith, "The Shortneß of a Pharisaick Rightneousneß, or An account of mens mistakes about religion", *Select Discourses* (London, 1660), p. 358.
[757] John Smith, "On Prophesy", *Select Discourses* (London, 1660), p. 222.
[758] John Wilkins, *A Discourse Concerning the Beauty of Providence*, p. 34.
[759] Ibid., p. 58.
[760] Ibid., p. 55.

the revolution of time". Wilkins believes that for an inquisitive mind, the most spontaneous and unforeseen events should indicate the most promising paths towards grasping the meaning of the works of providence. This point emulated the Puritan doctrine of "experimental divinity", as well as Bacon's advice about paying attention to experimental anomalies. Wilkins combines them in his own recommendations for discerning providential works. To illustrate the difference between the human and the divine vision of nature, he uses a famous analogue of Bacon's: "If there be a commonwealth amongst Ants and Bees … 'twoud make a man smile to think, that they should take upon them the censure of State matters amongst us, men".[761] Wilkins's discourses on providence, as well as his experimental endeavors, encourage his fellow human beings to take the position of a scientific observer of the beehive of social interactions, to improve his or her performative knowing of how to reconstruct and consciously participate in the contrivance of providence.

Wilkins's scientific interpretation of "experimental divinity" considers it to be a Christian duty to be able to decipher the providential intentions to some extent. This entails reflections upon the problem of the relationship between the historical vision and its expression, as well as the issue of interpretation of historical narratives. His discourse on providence appeared almost twenty years before the publication of *The History of the Royal Society* where the attitude to narrative techniques was revised under Wilkins's close supervision. The *History* would promulgate the plain description, not "over-pressed by a confusing Heap of vain and useless Particulars, or from being streightened and bound too much up by general Doctrines".[762] But in 1649, Wilkins was pressing for a doctrine that could help interpret the tempestuous stream of historical particulars. Speaking of providence within the tradition of Biblical exegesis, Wilkins praises the use of figurative expressions on the grounds that "a phrase signifies much more than the naked words do import".[763] He gives his own reasons why "the naked words", as well as "the naked eye", sometimes fail to

[761] Ibid., p. 78.
[762] Thomas Sprat, *The History of the Royal Society*, p. 62.
[763] Ibid., p. 83.

discern the true patterns among the infinite variability of providential history. Wilkins's explanation is based on dialectical and rhetorical theorizing from the standpoint of philosophy of mind, i.e. his explications are neither formulated in the categories of the realm of words, nor of things themselves. The human "naked mind" tends to "look only upon some *particulars*, without the consideration of their *proper ends*, or *general frame*", and "'tis true indeed that some particular events, *singly* looked upon, may seem very prejudiciall; but the whole *contexture* of affairs in their *cooperation* shall prove for the best".[764] The "naked eye" tends to look "singly" upon things themselves, whereas their true meanings within the scheme of providence can only be discerned through their relational causality spread along the infinite timeline. Similarly, the "naked word" conveys the focused "single" meaning of things, whereas "a phrase signifies much more", i.e. conveys a figure for grasping the connections within a wider context. The framing of a phrase or a topical operator creates, as it were, a magnifying window on a massive contrivance of things on the infinite scale of providence.

The human mind requires "phrases" and figures composed of "naked words" to cope with the infinity of experience. Divine intelligence may view the true meaning and causality of things with a "naked eye", but humans need to employ topical procedures, such as the optics of figurative vision, to grasp the extended patterns of history. Wilkins's subsequent work on linguistics, *Essay towards a Real Character and a Philosophical Language* (1668), would bring this discussion further, elaborating on the relationship between "plain language" and the figures of thinking, composed of "naked words". Wilkins would on the one hand encourage "plain speaking" for solving immediate scientific tasks, but on the other hand propose a method for the apprehension of potentially infinite experience through the figures of natural and artificial connections between things themselves.

Using the words of Nicholas of Cusa, Wilkins effectively distinguishes between human knowing as "mere reason" capable of the situational knowing of the

[764] Ibid., p. 85.

arts, which should be focused on solving "singly" the "temporal matters", and divine knowledge as "vision of the intellect". To illustrate this point, he gives a popular example: God's infinite capabilities allow divine intellect to look into all the details of "the contrivance of every the least particular thing, as he would be, if he had nothing but that to look after",[765] not losing sight of the integrity of creation. This argument had been used by theologians since much earlier times, but Wilkins attributes an experimental touch to it, writing that divine intellect sees such things that the human eye would only be able to recognize through an infinitely powerful microscope or telescope. Wilkins maintains that in the providential works of nature "there are common things of excellent beauty, which for their *littlenesse* do not fall under our sense",[766] adding a piece of experiential evidence: those who "have experimented the use of *Microscopes*, can tell, how in the parts of the most minute creatures, there may be discerned such gildings and embroderies, and such curious varietie as another would scarce believe".[767] At the same time, divine intellect can naturally perceive all those things that the human eye would only be able to notice through an infinitely powerful telescope, since God contemplates heaven, while at the same time directing the body in its sundry motions.[768]

Following the logic of negative theology, Wilkins primarily sees the reason for the obscurity of things neither in their material opaqueness, nor in the minute size of their primary constituents, but in the "unmeasurablenesse" of their sides and connections.[769] The discussion of the infinity of the sides of geometrical objects had been a popular topic in the early-modern mathematics since the fifteenth century, when Nicholas of Cusa suggested a method for squaring the circle by presenting the circumference as an infinite-sided polygon. In this context, mathematical connotations permeate Wilkins's advice to focus on the humanly accessible "temporal" and

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765 Ibid., p. 40.
766 Ibid., p. 49.
767 Ibid.
768 Ibid., 43.
769 Ibid., p. 90.

calculable matters, instead of feeling perplexed in the face of the eternal and infinite works of providence.

Wilkins was familiar with these contemporary mathematical debates, also because his friend and collaborator John Wallis was thematically interested in the geometrical representations of infinity. In fact, Wallis made a considerable contribution to the development of infinitesimal calculus by introducing the symbol "∞" for "infinity" and the fraction "1/∞" for "infinitesimal", i.e. infinitely small but not equal to zero size of geometrical objects. Debates on the invention of new mathematical methods would have been of great interest to Wilkins whose mathematical skills had been appraised since the early stages of his career.[770] Speaking of the "unmeasurablenesse" of the sides and connections between things, Wilkins indirectly alluded to mathematical analogues of infinitesimal calculus.

Within the framework of Nicholas of Cusa's teaching on the relationship between the absolute minimum and the absolute maximum, a method was also developed for handling infinitely large numbers. The most famous of Cusanus' geometrical models demonstrated that what human "situational" reason takes for a straight line, from the standpoint of the "vision of the intellect" may represent a section of an infinitely large circumference. Cusanus entitled his argument in *De Docta Ignorantia* "instruction in ignorance as it regards the nature of Absolute Maximum",[771] asserting that the human mind can only approach the ultimate "unqualifiedly Maximum" through the figures of geometry and figurative speech. Wilkins also composed his discourse on providence as "instruction in ignorance", but in comparison with Cusanus' approach, Wilkins's argument features more of the early-modern appreciation for immediate sensuous experience, offering a piece of positive advice on how to apply the human ability to observe and to experiment in exploring the infinite combinations of "temporal matters".

[770] See also Chapter III of this study, exploring Wilkins's connections with the Royal family of the Palatinate.
[771] Nicholas of Cusa, *De Docta Ignorantia*, trans. J. Hopkins (Minneapolis: The Arthur J. Banning Press, 1981), Book II, Prologue.

Wilkins's discourse on providence admits that providential operations cannot be grasped at once by the finite human mind, offering to display these operations "in parts", processing them through different *topoi*, and giving illustrative examples. Having mentioned that divine providence dismisses kings, he continues with another social pattern, that of the ranks of an army, which would be equally familiar to the generation of the Civil War survivors. Wilkins observes that everyone would perhaps like to climb onto a higher level of the civil or military hierarchy, but "how could this consist with the exigencies of a commonwealth, or an Army, where there must be degrees, and disproportion of places according to the necessitie of several employments".[772] This analogy emphasizes that the figures of providence function on different levels, which would be later reflected in the multilevel structure of Wilkins's scheme of artificial philosophical language. With another popular analogy of his time, that of the clockwork, Wilkins introduces aesthetic parameters for the contrivance of providence, which are similar to his criteria for the ingenuity of mechanical inventions. Providence is a multifunctional structural frame operating at extremely small and extremely large scales, and disposing of a concise mechanism with no "excessive screws".[773] In Wilkins's own words, anyone "who can discern onely two or three wheels in a Clock, how they move one against another, would presently think, that there were contrariety and confusion in the work", but when he "beholds *the whole frame*", he will "acknowledge a wise order in the contrivance".[774]

In *Discourse Concerning the Beauty of Providence*, Wilkins sometimes attempts to present providence not as a mechanical contrivance but as a piece of living nature, comparable with a natural body or a bee-hive.[775] Such natural analogies would later play an important role in his *Of the Principles and Duties of Natural Religion*, but in 1649, he does not reveal any specifically natural features in God's contrivance. Wilkins describes the beauty of providence mainly as the perfection of

[772] John Wilkins, *A Discourse Concerning the Beauty of Providence*, p. 88.
[773] For an interpretation of Wilkins's use of this expression in *Mathematicall Magick*, see Chapter II of this study.
[774] John Wilkins, *A Discourse Concerning the Beauty of Providence*, pp. 52-53.
[775] Ibid., pp. 86, 78.

a mechanical model, where the seemingly irregular operation of parts nevertheless makes up a coherent framework. However, occasionally relating the figures of providence to natural forms, he seems interested in experimenting with the narrative perspectives of depiction. Analogies comparing providence to the hierarchical structures of a state, an army, and a clockwork all display the contrivance of providence from the outside, looking into all its levels down to the minute details. When considering the natural side of providence, Wilkins takes a note, not of the levels, but of the specific shapes of natural bodies, which might not be necessary for producing an adequate structural example. Instead of the structure, here he admires "the roundness of the head, the length of the arm, the flatness of the hand".[776] Later in his project on artificial language, Wilkins would face the challenge of how to group notions into the coherent series of *genera* and *species*. He would pursue the time-consuming task of drawing up hundreds of pages of classification tables, sometimes offering sheer surprises as to which particular elements end up within which *genera*. Wilkins had to find the perspective of vision that would allow him to group things, and his writings on providence seem to bear the traces of such dialectical experimentation.

It is not live nature but mechanical contrivance that mostly serves as a model for Wilkins's appreciation of the beauty of providence. However, although the providential "matters might seem to run upon wheels", i.e. to go at random, "yet these wheels have eyes in them".[777] In 1649, the imagery of "wheels with eyes" encompassed Wilkins's specific understanding of providential operations. In his later writings on theology and linguistics, he would become more intrigued with those "eyes of providence" and what might possibly be visible to them. But in 1649, his discourse represents an attempt to translate a familiar system of theological categories into the framework of a new experimental and mechanistic worldview centered on God as the infinitely capable and sophisticated artificer. The success of Wilkins's rhetorical mission is testified by the popularity of his writings on "how the wisdome

[776] Ibid., p. 86.
[777] Ibid., p. 19.

of the Artificer hath contrived those motions unto *useful ends*".[778] The masterful use of dialectical techniques allowed him to perform a shift in doctrinal categories, revising Puritan providentialism. In his posthumously published writings on natural theology, Wilkins would consider providence through the laws of living nature.

Natural providence

The collection of discourses *Of the Principles and Duties of Natural Religion* (1675) was prepared for publication by John Tillotson three years after Wilkins supposedly succumbed to kidney stones, surrounded by his grieving friends and family.[779] Some of his last words were that he was prepared for the great experiment. Tillotson was one of Wilkins's young colleagues, who was impressed with his powerful but unaffected preaching style, and may have possessed similar talents, since almost twenty years after Wilkins's death he would become Archbishop of Canterbury. In the Preface to Wilkins's volume, Tillotson mentions that only about twelve chapters out of twenty six sections in two books of the treatise were prepared for print by Wilkins himself, "the Remainder hath been gather'd and made up out of his Papers, as well as the Materials left for that purpose".[780] It is indeed regrettable that Wilkins did not live to complete his most substantial theological compendium, but it provides us with a hole-in-the-wall on his methods of composition.

The late Lord Bishop of Chester must have kept his papers in excellent order at all times, since at no point within the four hundred pages of the discourse is the reader faced with any irregularities of either style or reasoning. The difference between the finished and the unfinished parts lies more with the topical organization

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[778] Ibid., p. 51.

[779] In November 1672 Wilkins died from a stoppage of the urinary tract, after having presumably suffered from the "stone". However, a partial dissection, which was performed by way of post mortem by his medical friends, discovered no stone whatsoever. This has led some biographers to speculate whether the death might have been brought about by the toxicity or incompatibility of medical prescriptions. Indeed, it was documented that during his illness Wilkins was flooded with a variety of healing recipes, many of which would nowadays be regarded as at least unhelpful, such as oyster shells quenched in cider or blisters of cantharides applied to the neck. Another hypothesis has been that Wilkins could have been suffering from a kind of prostate tumour, which was a pathology entirely unfamiliar to the physicians of his day. See Alan Chapman, "Warden Wilkins of Wadham".

[780] John Wilkins, *Of the Principles and Duties of Natural Religion*, the Preface.

and the argumentative techniques. Where Wilkins's editing of the volume ceases, i.e. starting from Chapter XIII, most of the titles stop representing the usual brief summary of the theological argument of the chapter and instead tend to look like rubrics in a preacher's book of common places: "Of Faith or Affiance", "Of Love", "Of Reverence and Fear".[781] The manner of presenting these topics also very much resembles the graphic argumentative style of Wilkins's several published sermons. All this makes it plausible to conjecture that these fragments may have been initially composed as notes for preaching on practical morality. On the contrary, the previous Chapters I−XII are styled similarly to Wilkins's published treatises, i.e. written in "plain and unaffected" language but featuring a more refined argument and referring more often to the academic background of contemporary natural philosophy. This difference in argumentative stylistics would not be very remarkable, as Wilkins's writing appears polished everywhere, except that it throws suggestive light on the extent, to which his practice of preaching provided the material for his theological publications. Maarten Van Dyck and Koen Vermeir note that, judging from the references Wilkins made to recent literature published during his university years, such as to works by Mersenne, Gassendi, and Kircher, his *Mathematical Magick* had been written in several stages and intended for different audiences, adapting previous notes and ideas.[782] This remark also falls in line with the appearance of Wilkins's text *Of the Principles and Duties of Natural Religion.*

Wilkins's writing methods are reminiscent of the popular Erasmian guidelines on composition: the theoretical part of his argument emerges as a product of an extensive practice of preaching and sermon-writing. The Erasmian tradition, as well as experimental philosophy, undermined the strictness of categorical division between theory and practice, and focused on convincing argumentative performance.[783] Wilkins's argumentative stylistics was influenced by the dominant hu-

781 Ibid., The Contents.
782 Maarten Van Dyck, Koen Vermeir, "Varieties of Wonder. John Wilkins' *Mathematical Magic* and the perpetuity of invention", *Historia Mathematica*, Volume 41, Issue 4 (November 2014), pp. 463-489, p. 465.
783 Terence Cave, *The Cornucopian Text*, pp. x, xiv.

manist techniques, and certain ways of diagrammatic representation, such as the Ramist brackets, would even become instrumental in Wilkins's artificial language project. The discourse *Of the Principles and Duties of Natural Religion* contains textual evidence that Wilkins was developing his theorizing by elaborating on "common places" in preaching and practical divinity. This circumstance explains why Wilkins's most voluminous theological collection, the greater part of which represented an assemblage not prepared for publication by himself, displays a lower density of theorizing than was usual in his previous works published under his own supervision.

Some of the theoretical points in *Of the Principles and Duties of Natural Religion* concerning questions of the certainty of knowing will be considered in the last chapter of this study, which is devoted to Wilkins's linguistic epistemology. As for divine providence, Wilkins's posthumous collection is more deeply rooted in the main background of natural theology: "men come to the knowledge or belief of anything without immediate Revelation" but through specific "Evidence of things".[784] This statement by the Reverend John Wilkins was not meant to undermine the importance of fulfilling divine will. On the contrary, this discourse was promoting the "Reasonableness and the Credibility of the Principles of Natural Religion in opposition to that Humour of Scepticism and Infidelity".[785]

The humanist studies of history gave mid-seventeenth-century intellectuals reasons to avow that the obligations of moral duty were not entirely dependent upon the Revelation of God's will as given in Holy Scripture, since the primary lessons of piety and virtue had been already present in ancient philosophy.[786] Due to ongoing political turmoil in England, by the late 1660s, it was also becoming increasingly clear that Revelation does not always render sufficient elucidating power to "save appearances" for the stormy course of history, even with the help of the most so-

[784] John Wilkins, *Of the Principles and Duties of Natural Religion*, p. 2.
[785] Ibid., p. 1.
[786] Ibid., p. 395. Cf. John Tillotson, the Preface to John Wilkins, *Of the Principles and Duties of Natural Religion*.

phisticated techniques of textual commentary. At the same time, experimental philosophy succeeded in gaining more argumentative weight in "saving appearances" and explaining the causality of various natural phenomena.

The methods of the natural studies were overlapping with the new methods for the study of human society, although this intersection did not always happen on the common ground of humanistic ideals. For instance, Hobbes's *Leviathan* (1651), although positively appraised for its reflection on questions of the social contract between a sovereign and his subjects, was severely criticized for Hobbes's direct extrapolation of the laws of physical nature onto the functions of society. Hobbes acknowledged the hostility of social conflicts as a natural phenomenon, providing great explanatory potential in contemporary historical conditions. His position appeared convincing, whereas many of his opponents, such as the Cambridge Platonists, or representatives of the early Royal Society, often failed to defend their alternative accounts and frequently disagreed with each other on important points. Nevertheless, they managed to come to an agreement that accepting "war of all against all" as the natural state for the most excellent of divine creatures posed difficult questions about divinity. In this context, the doctrines of natural theology attempted to give a fresh stimulus to the humanistic interpretations of natural and political history, for combating the tendencies of disintegration in the apprehension of social life and promoting a sense of congruity in the understanding of divine and human nature.

As Barbara Shapiro shows, by the mid-seventeenth century, British natural theology correlated closely with combined natural history studies.[787] The term "natural history" represented more than just a linguistic accident and reflected an existing overlap between the subject matters and the methods of early-modern investigations on history and nature. The authors of both kinds of accounts were prone to use historical testimonies as evidences for truth, pursuing similar goals of eliminating

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[787] Barbara J. Shapiro, "English scientific virtuosi in the 16th and 17th centuries", *Papers Read at a Clark Library Seminar, 5 February 1977*, ed. Barbara J. Shapiro, Robert Gregg Frank (Los Angeles: University of California Press, 1979).

fiction and arriving at a coherent and probable explanation of events. The term "history" or *historia* signified a method for composing plausible narratives of causality for a set of particular natural and historical phenomena. For instance, in 1621, Peter Heylyn published his *Microcosmos* and soon after his *Cosmographie*, which together covered the history of the world's creation, where geography, heraldry, and theology were closely interconnected.[788] By the mid-seventeenth century, popular thinking placed natural, historical, and religious knowing into a uniform framework of probable knowledge.[789] John Tillotson, who compiled the posthumous edition of Wilkins's writings on natural theology, was also known as an upholder of eclectic theories on probability. Within natural theology, the notion of providence served as a modeling framework for both historical and natural studies.

As for Wilkins's views, twenty years after the publication of his first discourse on providence, his argumentation on natural religion underwent a change. Discussing providence in 1649, Wilkins essentially used the mechanical contrivance as a model for providential works, only occasionally taking note of living nature. Discussing providence within the framework of natural theology in the late 1660s, he is more focused on living nature as the agent that warrants the causality of events. John Wilkins, as the founder member of the "invisible college", was developing an expedient instrumental pattern for bringing "things themselves" to speak. John Wilkins, as Bishop of Chester, employed the created pattern for viewing things themselves more closely.

Wilkins's change of heart appears to have been caused by the experience of observing things through the microscope, an instrument of close vision, as well as in the discussions that followed the publication of Robert Hooke's *Micrographia* (1665). Wilkins shares with readers his astonishment at the discovery of a profound difference "betwixt natural and artificial things", "made in these later times, since we have had the use and improvement of the Microscope".[790] On the object-glass of

788 Ibid., p. 12.
789 Ibid., p. 25.
790 John Wilkins, *Of the Principles and Duties of Natural Religion*, p. 80.

the microscope, “things themselves” started to reveal previously hidden sides: either “[t]he most curious works of Art, the sharpest finest Needle, doth appear as a blunt rough bar of iron, coming from the furnace of the forge”, or, on the contrary, “whatever is Natural doth by that appear, adorned with all imaginable Elegance and Beauty”.[791] Even in a common fly there is “such accurate order and symmetry in the frame of the most minute creature” as “no man were able to conceive without seeing of them”.[792] The motif of the aesthetic appreciation of the works of nature was a common one in early scientific literature, but Wilkins draws an epistemological conclusion about the infinite “skills of nature”. Any product of human art appears rough and ugly when compared to natural “things themselves”, which makes it clear that the project of understanding nature via its successful imitation or modeling through the art of mechanics was a utopian pursuit.

In the natural philosophy of the mid-seventeenth century, there was a vivid discussion of the relationship between the mechanical and vitalistic aspects of nature. In the famous debate between Descartes and Henry More, the Cartesian rationalist depicted the universe as a mechanically construed clockwork-like machine which its creator abandoned in a state of infinite perfection. Henry More, a Cambridge Platonist, doubted such a restrained attitude on the part of the divine spirit, and his associate Ralph Cudworth was additionally concerned about the status of the soul within the mechanical cosmos. The Platonist opponents of Hobbes and Descartes suspected that a reevaluation of the role of the divine spirit within nature would open the door to atheism. Wilkins’s doctrine of natural theology employed the antithetical opposition of artificial imperfection and natural perfection to support his thesis about the supremacy of divine nature over mechanical human art. Within contemporary polemics, he primarily argued against the rigidity of rational and empirical mechanism.

[791] Ibid.
[792] Ibid.

“Natures great Works no distance can obscure,/ No smallness her near Objects can secure”, or so it was claimed in the *Ode to the Royal Society* by Abraham Cowley. The first optical experiments of the early 1660s revealed previously unseen natural forms, and it was deemed probable that a mechanically advanced vision may eventually render a true understanding of “things themselves”. However, along with mechanistic conceptions of vision, there soon emerged various alternative theories of perception. Some of them combined the new knowledge of optics with the vitalist views that were applicable to the doctrines of natural theology. Margaret Cavendish, in *The Philosophical and Physical Opinions* (1664), challenged Hobbes’s mechanistic notion of “pressing” or “striking” perception with a vitalist conception that emphasized “sensitive patterning” and “corporeal, patterning self-motions” in the living matter.[793] In spite of Cavendish’s skepticism toward the practices of the Royal Society, her treatment of the concept of “sensitive matter”[794] was characteristic for the revival of interest to vitalism in the natural philosophy of mid-seventeenth century. In the course of the eighteenth century, discussions within natural theology about animate, inanimate, rational, and sensitive kinds of matter were to influence the programs of specific life sciences.

In the late 1660s, Wilkins positioned not the mechanical but the “natural principle” at the core of his theological reasoning on providence, as sensitive nature represented a more auspicious symbolic form for interpreting divine dispensations:

> Every thing is endowed with such a natural Principle, whereby it is necessary inclined to promote its own preservation and well-being. That which hath in it a fitness to promote this end is called Good. And on the contrary that which is apt to hinder it is called Evil.[795]

All natural things, such as minerals, plants, and beasts, are “endowed with such principles as are most fit to promote the perfection of their natures”. The human being is “the most excellent of all other Creatures in this visible world”, as many things

[793] Elizabeth Spiller, *Science, Reading and Renaissance Literature*, p. 148.
[794] Lisa T. Sarasohn, *Natural Philosophy of Margaret Cavendish* (Baltimore: The John Hopkins University Press, 2010), p. 72.
[795] John Wilkins, *Of the Principles and Duties of Natural Religion*, pp. 12, 82.

seem to be designed for his service, and therefore he "should have such kind of principles interwoven in his very nature".[796]

Unlike Hobbes who was focused on the mechanism of the outward senses, Wilkins emulated the neo-Platonic argument on "innate ideas" and explored the nature of "Inward Sensation, whereby we can discern the impressions of our own minds".[797] Human beings have "written in their hearts" all the necessary "natural notions" and "sense of Law" for distinguishing between good and evil. However, Wilkins strove for pointed plainness in his epistemological designs, and multiple "natural notions" seemed to complicate the structures of reason. Wilkins subscribed to the view of ancient heathen philosophers that the only positive attribute that can be given to Spirit is its absolute simplicity. Like many others authors, he compared this simple being with the light that is "amongst all visible things the most pure and simple".[798] God represents the absolutely uniform being, and divine nature should feature an underlying principle of such ultimate simplicity that is "not to be represented by any kind of sensible Image".[799] Therefore, the enlightenment of human nature cannot be dependable on multiple "innate ideas" but should be based on the cultivation of a uniform "sense of Law", which can also be translated as the enhancement of the ability to discern the patterns of providence.

Wilkins's earlier taste for mechanics made him appreciate the pointed copiousness of all artificial contrivances, including Biblical narratives. For that reason, heathen multiple deities seemed to him like "excessive screws" in the world design, i.e. technically unnecessary elements whose presence "doth imply in it many inconsistencies, and therefore is impossible".[800] He deemed a plain and coherent storyline to be the main criterion for attaining true providential patterns. But by the late 1660s, doctrines on prophetic communication became viewed as "excessive screws" in at-

796 Ibid., p. 156.
797 Ibid., p. 92.
798 Ibid., p. 104.
799 Ibid., p. 106.
800 Ibid., p. 113.

taining knowledge of nature. The hermeneutic practices of deciphering the narratives of Revelation retained an immense moral authority and answered the needs of the popular discourse on natural history, but these methods of revealing providential intentions were losing their explanatory potential due to the beginning secularization of science. Wilkins's natural theology maintained that instead of "signal prophesies", the congruence of things is communicated more immediately through the "Law of nature" which is also the "natural notion of God". This uniform law represented the basic mode of perception available to the human being as "sensitive matter", and it is fixed "in the hearts of men" as the ability to sense the coherence of things.

The contemporary doctrines on natural theology, including Wilkins's writings, were meant to promote another step in the course of the Reformation, through peaceful intellectual means. Early-modern physico-theology was redefining religion, as Wilkins expressed with this point: "By Religion, I mean that general habit of Reverence towards the Divine nature".[801] Reintroducing the views of Christian Platonism, from the two books of humanist learning, the book of Scripture and the book of nature, natural theology recombined the book of divine nature as a new object of interest. The agenda of natural theology presumed an inquiry into the attributes of God without appealing to divine Revelation. Wilkins's concept of nature was far from secular, as for him nature was divine and the main purpose of studying it consisted in understanding God's "communicable perfections".[802] But his version of natural theology emphasized the immediate experience of belief induced by admiring the coherence of "things themselves": "There must be a firm belief of the Divine nature and Existence. … That excellent contrivance which is in all natural things … the Works of providence in the Government of the World".[803] For Wilkins, the primary sacred text is "the Law of Nature; this being every whit as much the Law of God, as the Revelation of his Will in his Word".[804] Accordingly, the method

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801 Ibid., p. 39.
802 Ibid., p. 189.
803 Ibid., pp. 40-41.
804 John Tillotson, the Preface to John Wilkins, *Of the Principles and Duties of Natural Religion*.

for approaching divine providence is changing: instead of subtlety in interpreting the prophetic word, natural religion highlights the performativity of the mind in processing experience. Wilkins underlines that discerning the coherence of things in nature is a skill that demands no doctrinal sophistication but necessitates the practice of Christian life, "an ordinary capacity, and an honest mind; which are no other qualifications than what we are required to the institutions of men, in all kinds of Arts and Sciences whatsoever".[805]

Within natural theology, the works of providence begin to manifest themselves through the "evidence of things". Wilkins divides them into several kinds: the evidence related to inward and outward senses, the understanding of things through their nature and the testimony of others, as well as "mixed" evidence related to both senses and understanding.[806] In all cases, this democratic version of theology presumes that the book of divine nature is written in ordinary language and intended for ordinary people. Characteristically, Wilkins frequently mentions the "natural light" of reason, but he does not use this term in the sense of a spiritual emanation from divine grace, as was customary in many branches of Renaissance and early-modern theology. Instead, he speaks of "the improvement of natural light",[807] as if this feature were controlled from within by the self-enlightening reason. Wilkins's "individual natural light" works somewhat like a candle or a pocket light, singling out groups of things within particular providence and revealing the divine pattern of their congruence. In his view, this "private enlightenment" can be enhanced via the practices of fair Christian conduct but not through any occult manipulations.

Early modern rationalism viewed the evidence of "natural light" or "simple intuition" as a warranty against the deception of the outward senses. At the same time, it equaled rationality with computationality, since the universality of measurements and procedures of computations presented an evidence that was not dependent on sensuous observation. The Cartesian method was developed with the intention of

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805 John Wilkins, *Of the Principles and Duties of Natural Religion*, p. 2.
806 Ibid., p. 3.
807 Ibid., p. 51.

polishing the prism of reason, so that patches of error would not prevent the mathematically certain truths from shining through the layers of human assumptions based on sense-data. On the contrary, experimental philosophy pursued a different agenda of employing primarily observation by the senses as a source of epistemological confidence. It was acknowledged that virtually no observation is free of error, so that a theory of error must be included in a legitimate paradigm of science. The highest authority on experimental theory, Baconian methodology, sought to dethrone the scholastic natural philosophy where secure knowledge was to be derived from Aristotelian "first principles". But the systematic apprehension of experiential particulars became possible only after many years of institutionalized experimental practices. Experimental theoreticians, such as Robert Boyle and John Ray, both Wilkins's close associates, were much concerned with the "messiness of the real world" that was manifest in conducting experiments. Various kinds of impurities, coincidences, accidents, and miscalculations were deemed unavoidable, and Ray even criticized Wilkins's philosophical language project on the grounds that an ultimate rationalization of cognitive occurrences should be impossible. Interestingly, these contingencies were also deemed ineliminable in the mathematical methods of natural studies, since those were dependent on imperfect scales and instruments of measurement.

Wilkins's natural theology originates in the seventeenth-century approach to "natural history" and considers human affairs as part of the development of divine nature, striving to employ contemporary experimental methods to account for the seeming impurities and accidents in the dispensations of providence. Rationalism sought to eliminate the possibility of mistake, and experimental discourse admitted its unavoidability, but Wilkins's natural theology steers a productive middle course, introducing error as a legitimate part of the interaction between divine providence and "sensitive matter". Wilkins's private natural light aims not at the certainty but the probability of knowing. On the one hand, mathematical certainty "would not be consistent with our dependent conditions".[808] On the other hand, Wilkins states that the virtue of all actions proceeds from the liberty of them, and so the mind's actions should not be guided "by a kind of natural necessity".[809] The human mind should examine various possibilities for truth and make a choice based not on corruptible mathematical certainty but on the suggestions of "improved natural light" about the congruence of things.

Introducing elements of social theory into the doctrine, Wilkins's discussion on providence employs the term "ingenuous" in a sense that is close to "ingenious", although it also bears the connotations of "gentlemanlike". Unlike his earlier discourse on providence, Wilkins's natural theology uses "ingenuous" to signify not only moral but also intellectual faculties.[810] The highest attainable certainty is moral certainty, since "the more just and honest any man is, the more willing and careful he is to walk up to the dictates of his natural light".[811] However, unlike earlier theological thinking, natural theology does not view morality as a means of purifying the mind for receiving the specific grace of Revelation. Wilkins sees morals as a means to, as it were, polish the lens of human understanding, to make it less "naked" and more instrumental for the immediate observance of the contrivance of things. For Wilkins, individual natural light is an ordinary intellectual faculty based on "consideration and experience" and not dependent on institutions, although the light can be enhanced "with the common help of mutual Society".[812] This statement eliminates the chances of any institution usurping the "dictate of natural light" but at the same time retains room for collaborative effort within scientific community.

Wilkins repeats his earlier writings on many occasions in his *Of the Principles and Duties of Natural Religion*, which makes him appear conservative, but his initial suggestions on "performing an experimental divinity" achieve logical advancement and completion in his last theological works. The summarizing piece of advice that

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808 Ibid., p. 86.
809 Ibid., p. 87.
810 Ibid., p. 216. Wilkins's specific use of "ingenious" and "ingenuous" is analyzed in Chapter II of this study.
811 Ibid., p. 54.
812 Ibid., p. 60.

he leaves to the reader on how to interact with providence is formulated with a rhetorical question about divine conduct: “Did not he [God] appoint the time, and place, and part you are to act upon the Theater of this world? And this is properly your business, to apply yourself to the fittest means of representing the part allotted to you”.[813] Wilkins’s statement may sound similar to the one made by the unfortunate King Charles I of England in January 1649. In his opinion, English people had the right for arranging their own private affairs but should have entertained no aspirations to participate in the general government. However, in the contemporary context, Wilkins’s message in fact expresses an opposite view: whereas the King meant himself as the chief executor of God’s will, Wilkins proposes that it is properly the business of private persons to fulfill the immediate guidance of providence. In mid-seventeenth-century England, the removal of absolute royal power as a sacred governmental institution mediating between the realms of divine and private affairs prompted the creation of theological doctrines that would rearrange the configuration of providential rule. The gap between the divine and the private was repaired by conceiving them as parts of the same contrivance of providence. But the traces of the repair remained visible in the divide between the *genera* and the *species* of providence, which also allowed for its humanization, i.e. making particular providence legitimately accessible for human understanding.

In 1649, Wilkins’s *Discourse on the Beauty of Providence* departed from the experience of bewilderment and the suspicion that humans cannot ever comprehend the entanglements of providence. The conclusion he arrives at in his *Of the Principles and Duties of Natural Religion* twenty years later is that humans fail only to grasp the entirety of general providence that can be identified with the laws of nature. The human mind has limited access to the certainty of theorizing about natural phenomena, but it has a natural capability to interact with the particular providence that accounts for human affairs. This statement of Wilkins’s may sound as if he dis-

[813] Ibid., p. 251.

believed the human power of *ingenuousness*, since when we approach his proposition from a modern perspective of widespread appreciation for the infinity of human potential, the notion of human ineptness appears eye-catching. However, the idea that human faculties were limited could not have arrested the attention of Wilkins's contemporaries, since for them it was part of theological common sense and by no means a novelty. In the context of other religious and social debates that were carried out in mid-seventeenth-century England, Wilkins's readers would rather have noticed a more innovative and comforting point about the capacity of humans to cope and collaborate with providence. Judging from the popularity of Wilkins's writings, which went through several editions within a few decades, the public appreciated his celebration of the human capacity for restoring the coherence of epistemic order.

Wilkins applied topical dialectical procedures to bridge the human situational knowing of the arts with absolute divine knowledge. As in early-modern politics, where a crisis of absolute power was resolved through a redistribution of responsibilities, Wilkins attempted to resolve a crisis in the idea of absolute providence by renegotiating divine and human duties, so that humans could acquire a sphere of experimental but legitimate interaction with providence. The notion of particular providence would gain more weight in the discussions of Wilkins's younger contemporaries. In the course of the seventeenth century, the distinction between general providence as the realm of natural law and particular providence as the realm of human law would become one of the driving forces behind the proverbial division between the "two cultures" of the sciences and the humanities.

Wilkins's *Discourse on the Beauty of Providence* first chose the imagery of mechanical contrivance as a symbolic form for overcoming the perplexity due to "infinite mischief" within the civil society. Later, he readjusted this position, since the elucidating potential of mechanism as a symbolic figure was on the decrease. In *Of the Principles and Duties of Natural Religion* he elaborated on vitalist views within natural theology. Wilkins's "mechanical device of style",[814] as it appeared in

[814] William Wordsworth, quoted in Meyer H. Abrams, *The Mirror and the Lamp*, p. 291.

Mathematicall Magick, developed into "the natural device of style" in his later writings. When considering "natural" providence, Wilkins became more interested not in the shape of providence itself but in the mode of perception of a "sensitive agent". This interest motivated his unprecedented effort of creating the most complete project of artificial language in the century. His language scheme was meant to enhance the capacity of the sensitive agent for discerning coherent patterns in the potentially infinite scientific experience.

Wilkins's treatment of natural theology finds itself within the trend of exploring the capabilities of the "sensitive subject", which would be formative for the programs of European philosophy in the eighteenth and nineteenth centuries. In Wilkins's work, the repair of a gap between general and particular providence is effected through communication between the human being and divine nature. Later, Wilkins would offer his project of artificial language as a means of enhancing this communication by improving the performative knowing of grasping correlations between the "things themselves" that stand behind names and definitions,[815] which will be considered in the next chapter.

[815] Wilhelm Schmidt-Biggemann, "Christian Kabbala", *The Language of Adam*, Series "Wolfenbütteler Forschungen", Band 84 (Wiesbaden, 1999), p. 81.

Chapter VI

Wilkins's impossible invention

The impossibility of penetrating the divine pattern of the universe
cannot stop us from planning human patterns,
even though we are conscious they are not definitive.
The analytic language of Wilkins is not the least admirable of such schemes.

Jorge Luis Borges
The Analytical Language of John Wilkins (1952)

It was mentioned by Isaac Barrow in his *Of Industry* (1712) that no one can become a good scholar before becoming a general one, seeing that "there is such a connection of things, and dependence of notions, that one part of learning confers light to another, that a man can hardly well understand any [individual] thing, without knowing diverse other things".[816] The ideal of universal learning has been part of the European scholarly agenda at least since the beginning of Western philosophy. But in the England of the seventeenth century, the goal of attaining universal knowledge came to be construed as a language problem. In particular, Baconian experimental philosophy required a new language of science as an instrument that would facilitate the apprehension of the experience of the materiality of things. John Wilkins promoted multiple innovations in understanding the functions of scientific description, as both an experimentalist and one of the secretaries of the Royal Society of London, a post he shared with Henry Oldenburg. As was clearly stated in Thomas Sprat's *History of the Royal Society* (1667), composed under Wilkins's close supervision, the integration of new experimental evidence with existing forms of verbal representation was a practical issue at the core of the Society's agenda. Sprat might have exclaimed together with Crites, a character from John Dryden's *Essay of Dramatic Poesy* (1667), "Is it not evident, in these last hundred years …

[816] Isaac Barrow, *The Duty and Rewards of Industry Considered* [1712] (London: Printed for Wetton and Jarvis, 1819), p. 152.

that almost a new Nature has been revealed to us?"[817] An acute awareness of the new tasks of science and scientific language induced critical reflections about the capacity of natural languages to make "things themselves" speak, contributing to a general interest in linguistic issues, for historical and theological reasons.

The last chapter of my thesis will focus on the rhetorical and dialectical roots of Wilkins's artificial philosophical language project. Since Wilkins's linguistic thought represents the best-known part of his legacy, my study will have to refrain from repeating a large number of historical details and parallels, which can be found in the history of the artificial language movement. Substantial publications covering the history of Wilkins's language quest include Lia Formigari's account of the seventeenth-century British philosophy of language; Rhodri Lewis's comprehensive account of the network of communications behind Wilkins's project; Joseph Subbiondo's edited publications exploring the diverse context of Wilkins's linguistics; Vivian Salmon's surveys of the universal language movement; Fredric Dolezal's analysis of Wilkins's lexicography; and a recently published sourcebook collection of earlier studies, edited by Tina Skouen and Ryan J. Stark, devoted to the rhetorical techniques employed by the Royal Society.[818]

This chapter will first provide a brief introduction to the artificial language movement and the main typology of artificial language projects, identifying Wilkins's intentions within this historical context; then I will consider Wilkins's views on "philosophical" communication between the human mind and divine nature in the context of his providentialism; I will analyze the dialectical and rhetorical features of Wilkins's "darling" project, and finally formulate the conclusions of my study concerning Wilkins's most significant and wondrous invention, his design of an artificial philosophical language, which was intended to serve as an instrument for enhancing the scientific performativity of the human mind.

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817 John Dryden, "Essay of dramatic poesy", *Essays of John Dryden*, ed. W. P. Ker (Oxford: Clarendon press, 1900), in two volumes, vol. I, p. 36.

818 See the Bibliography for the full citation data of the works listed below.

Universal artificial and philosophical languages

In the early seventeenth century, British language philosophy still followed the popular teaching of Renaissance logocentrism, according to which *logos* (a Greek term standing for speech, thought, image, and the form of the cosmos) was the central principle mediating between the *micro-* and *macrocosm*, and was instrumental for discovering the features of nature. The attitude of Renaissance logocentrism, or in the apt modern expression of Jean-François Vallée, the attitude of "dialogocentrism", [819] presumed the primacy of speech over written language and proposed the simulation of spoken interaction through writing. Renaissance dialogocentrism asserted the exteriority of written signs to the signified reality of thoughts in the mind. This attitude was also supported by ideas on *lingua Adamica*, which stimulated a search for the mythic original signs of the universal language that mankind possessed before the biblical Fall from grace. Many mystical and semi-scientific authors, including radical physicians, the Paracelsians, the kabbalistic, alchemic, neo-Platonic, and other adepts of Renaissance *logomysticism*, participated in the quest for a language that would not only be interior to the reality of thoughts, but also admit no separation between thinking and its objects.[820]

The British mid-seventeenth-century version of Renaissance dialogocentrism was influenced by the lessons learned from Baconian experimental practices, which confirmed that the notion of *lingua Adamica* could stand for an epistemic ideal, rather than a concrete goal to be achieved. Baconian experimentalism tipped the balance of epistemic attention from the doctrinal and the symbolic towards the concrete material properties of objects. The challenges in the apprehension of the experience of the materiality of things brought about critical reflection of the natural connection

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[819] Jean-François Vallée, "The Fellowship of the Book: Printed Voices and Written Friendships in More's *Utopia*", *Printed Voices: The Renaissance Culture of Dialogue*, ed. Dorothea B. Heitsch, Jean-François Vallée (Toronto: University of Toronto Press, 2004), pp. 42-62, p. 43. The term "dialogocentrism" is derived from the tradition of semiotic studies of the Renaissance, involving Russian formalists, such as Mikhail Bakhtin and Yuri Lotman.

[820] See Wilhelm Schmidt-Biggemann, "Christian Kabbala", *The Language of Adam*, Series "Wolfenbütteler Forschungen", Band 84 (Wiesbaden, 1999), pp. 81-121, esp. pp. 81-108; Joscelyn Godwin, *Athanasius Kircher. A Renaissance Man and the Quest for Lost Language* (London: Thames & Hundson, 1979).

between "things themselves" and the units of human communication. In the Baconian view, language was a translational tool that transformed trains of thoughts into the sets of arbitrary sounds forming trains of words, signified with written signs.[821] But after Bacon's experiments, it became clear that both written signs and the language of thoughts are fraught with "Idols", which, among their many flaws, make the human mind disconnected from the nature and reality of "things themselves".

The experimentalism of the Royal Society of London, which was based on Bacon's programmatic studies and departed from Renaissance dialogocentrism, extended the focus of linguistic reflection from the opposition between words and objects to a more conspicuous *antithesis* between written signs and material things. Language now was meant to serve as a translational tool between written signs and "things themselves". This new disposition placed thoughts in the middle space between signs and things, which partly deprived thoughts of the status of ultimate reality and turned them into an instrument of mediation between words and things. Therefore, language as a translational tool mediating between written signs and things became primarily construed as a specific organization of thoughts in the mind. Using the terms of analytic philosophy, the function of language as a cognitive instrument was viewed as consisting in translating the experient knowledge of nature into its descriptive knowledge through the mastery of vivid representation. The role of language consisted in strengthening "the chain of being" and displaying the epistemic connection between signs and things, which was effected by exercising the performative knowing of how the signs for the specific organization of thoughts can be employed as topical operators for a multitude of particular "things themselves".[822]

Therefore, many early-modern British authors saw the primary task of philosophy in developing an artificial universal language which would facilitate the communication and apprehension of experience. As a result, the second half of the seventeenth century witnessed the emergence of a wealth of artificial language

[821] See Lia Formigari, *Language and Experience*, p. 12.
[822] See also Jacques Derrida's *Of Grammatology* (1967) which argues that the interplay between speech and writing can be construed in terms of presence and absence as the different modes of conveying experience. Jacques Derrida, *Of Grammatology*, trans. Gayatri Chakravorty Spivak (Baltimore: The Johns Hopkins University Press, 1974), p. 143.

schemes, which can be divided into projects intended to improve specific fields of human affairs by enhancing communication between individual human beings, and linguistic inventions intended to enhance philosophical communication between mankind and divine nature. Hence the early-modern distinction between artificial languages and artificial philosophical languages, most of which were termed "universal", meaning that they were also intended to expedite cross-cultural exchange.

To give an example of the first group, Cave Beck's *The Universal Character* (1657) was primarily meant to simplify intercultural communication, which was particularly apposite at the time of establishing the future British Empire. William Faithorne's engraving on the frontispiece of *The Universal Character* depicts a conversation between three figures representing the English overseas possessions in India, Africa, and the Americas, as well as, in all probability, Cave Beck himself as their European language tutor.[823] The frontispiece is accompanied by verses, according to which the figures are greeting each other with "dumb Signes". However, instead of expressing himself with bodily gestures, the figure representing Europe holds a roll of paper with a specimen of Beck's language. In the preface, Beck places his publication among the attempts to "advantage mankind in their civil commerce, and be a singular means of propagating all sorts of Learning and true Religion in the world".[824] Beck expresses hope that his language would allow travelers to "save the Charges of hiring Interpreters" and to "avoid the danger of being misunderstood, or betrayed by Truch-men".[825] At the frontispiece, he also advertises the marvelous easiness of learning the character, "An Invention of General Use, the Practise whereof may be Attained in two Hours' space". However, inside the book, more realistic guidance is provided: the character was not meant to be "imprinted in the

[823] William Faithorne (1616 – 1691) was a famous London engraver, who was especially well-recognized as a portrait-maker, and depicted many celebrated personalities, from Thomas Hobbes to John Milton, from Charles I to Oliver Cromwell. Therefore, the conspicuous individual features of the European face on Beck's frontispiece, which are more detailed than the generalized, non-individual features of the other members of the conversing group, are probable to bear likeness to some specific European, most likely, Cave Beck himself, the author of the treatise.
[824] Cave Beck, *The Universal Character* (London: Printed by Tho. Maxey, 1657), To the Reader.
[825] Ibid. Apparently, by "Truch-men" Beck means dragomans, local guides and interpreters in countries where Arabic, Turkish, or Persian was spoken. The biography of Cave Beck, a son of a baker from Clerkenwell (now the Metropolitan Borough of Finsbury, London) educated at Cambridge and Oxford, who finally became a headmaster of several schools in Ipswich, does not indicate that he himself undertook any extensive trips to exotic lands.

Memory" but needed to be practiced with a dictionary, which should guarantee that in around two months' time, sufficient mastery of it could be gained from exercises.[826] Like other artificial language schemes, Cave Beck's project was based on the semantic principle that we now might associate with basic English, as his language vocabulary only comprised 3996 notions of general use. The character itself was composed of the ten Arabic numerals, from 1 to 0, which could also be vocalized, with individual letters added as the signs for basic grammatical features.[827] For instance, "q317" meant "bold", where "317" signified the semantic unit, and "q" stood for the grammatical category of "nouns capable of degrees of comparison", which nowadays would be referred to as adjectives. Accordingly, "qq317" meant "bolder", and "qqq317" signified "the boldest", the repetition of letters reflecting a change in degree.[828] Although Beck seems to follow Baconian guidelines on finding inspiration in Egyptian and Chinese hieroglyphic systems, as well as possibly in the kabbalistic techniques concerning the permutations and combinations of numerical signs,[829] his scheme was most immediately influenced by the deciphering practices widespread in England during the Civil Wars. The numerical fastidiousness of Beck's scheme, which could be a proper advantage in a cipher, was deemed a nuisance in a proposed means of live communication. Primarily, it was difficult to retrieve the meaning of a particular numerical group, since the lists of them were organized alphabetically, which made it an unsurmountable difficulty to memorize them. Additionally, it was hard to distinguish between the numbers and the modifying appendices by hearing, as well as to process the information conveyed by grammatical modifiers, which required profound skills of linguistic analysis. Finally, Beck's system could only serve as a means of communication, if some foreign enthusiasts were to reproduce a similar system in their native tongues, which Beck rightly considered possible in the future. Beck's language never acquired its initially

[826] Ibid.
[827] Ibid., p. 9.
[828] Ibid., p. 13.
[829] See, among others, Wilhelm Schmidt-Biggemann, "Christian Kabbala", p. 101.

planned "philosophical" component, i.e. something in the line of a Baconian "philosophical grammar" or Comenius's *Janua linguarum reserata* (1631), a thesaurus of the natural world, organized with the purpose of restoring the analogy between words and things. In the 1650s, Beck shared his ideas with Wilkins, whom he quoted alongside Bacon, but the product of the Ipswich schoolmaster was deemed too primitive by George Dalgarno, Wilkins's collaborator at the time.[830]

Similar artificial language designs were implemented on the continent. Cave Beck's aspiration to use a numerical character to mediate between languages was nearly fulfilled in *Character pro notitia linguarum universali* (1661) by Johann Joachim Becher, a physician from Mainz. Becher numbered the words in a conventional Latin dictionary, and then created dictionaries in other languages, where the words were arranged not in alphabetical order but according to their number in his Latin lexicon. Becher's system represented not a universal language as such but rather an early instrument for automatic written translation, where a text in Latin could be translated into numbers and then into other languages. A similar but more sophisticated attempt was made by Athanasius Kircher in Book I of his *Polygraphia nova et universalis, ex combinatoria arte detecta* (1663), which contained a two-part dictionary of five languages, Latin, Italian, French, Spanish, and German. Kircher's "polygraphy" also represented an instrument of translation from one language to another, and his project also bore traces of early-modern deciphering technologies, in this case, originating from Kircher's attempts at deciphering Egyptian hieroglyphics. In the *Polygraphia*, in the first "ciphering" dictionary, intended for composition, the words were arranged in five language columns, each organized in alphabetical order, and assigned a digit which combined a page number (in Roman numerals) and a line number (in Arabic numerals). For example, in the German column under the heading "D", we find the word "der Papst" and its number: XVII 25.[831] In the

[830] See Vivian Salmon, *The Study of Language in 17th-Century England* (Amsterdam, PH: John Benjamins Publishing Company, 1988), pp. 176-190; Mary M. Slaughter, *Universal Languages and Scientific Taxonomy in the Seventeenth Century* (Cambridge: Cambridge University Press, 1982), pp. 120-121.

[831] Athanasius Kircher, *Polygraphia nova et universalis, ex combinatorial arte detecta* (Romae: Ex typographia Varesij, 1663), p. 20.

second dictionary, which served for translation or "deciphering" of texts, the words of the same meaning in each language were arranged in a line in alphabetical order and assigned a number that combined the number of the page (clearly marked at the top) and the number of the line. These numbers could be then transferred back into words in the five languages, for instance, on page XVI, line 23, we find the word *pater* and its contemporary equivalents: *padre*, *pere*, *padre*, and *vatter*.[832] The system also admitted inflections signified by capital letters. Kircher was viewed as an embodiment of early-modern learning, and had similar interests to Wilkins; apart from artificial languages, both enjoyed designing pneumatic, hydraulic, and magnetic machines.

Another specimen of a universal but technical language intended for facilitating specialized communication was envisaged by mathematician John Pell, whose interests were also remarkably close to those of Wilkins. In the 1630s, Pell worked under the influence of Samuel Hartlib on a variety of topics in encyclopedism and combinatorics, and participated in the geometrical debate between Hobbes and Wallis,[833] as well as being interested in mechanics. Pell's multivolume archive contains several drawings of mechanical experiments on "the Art of Motion", depicting toothed wheels, a lever, and a balance.[834] In 1638, Pell proposed his "Philosophical language of places", aiming to create:

> … a Philosophicall Language by which hearing ye names of all places in ye Earth you should know their place by longitude or latitude, for names are arbitrary & but fewe places being named by us as natives doe, we may better so name ym. This were a thing of excellent use & without doubt, possible to be effected. The use would be diverse, ye maps might be filled with townes & not one name.[835]

Pell never fulfilled his plan, and although his project was titled a philosophical language, its philosophical functions remained underdeveloped. But his notes contain

[832] Ibid., p. 62.
[833] See also Chapter I of this study.
[834] John Pell, Personal papers, The British Library Ms. Add. 4423, fol. 14v-16r.
[835] Ibid., fol. 376v.

designs for the language signs, indicating that he meant to create a universal reference system for professional communication in the early-modern earth sciences.[836] Interestingly, in 1638, John Wilkins's *The Discovery of a World in the Moone* also for the first time mentions "the universal character that may be legible to all nations and languages", which was inspired by Francis Godwin's work on codes entitled *Nuntius Inanimatus* (1629). In this way, even those artificial language projects that did not aim to provide patterns for deciphering the secrets of nature contributed to the development of artificial philosophical languages, which aimed to restore congruity in the representation of "things themselves".

The seventeenth-century artificial philosophical languages represented linguistic inventions designed not for enhancing collaboration between nations, but for augmenting the coherence between the disciplines of knowing. The difference between "philosophical" schemes and the other artificial languages consisted in their instrumental function. Philosophical language projects were based on the achievements of dialectical and rhetorical pedagogy, and usually targeted not only the effective storage and retrieval of information, but also the translation of the experience of "things themselves" into a coherent and communicable representation. The translating effect was grounded in the dialectical method of *topoi*, and was to be achieved through a taxonomical artificial vocabulary, independent of natural roots, and arranged into a system of hierarchical classification. Various taxonomies determined the distinctive features of such projects, and their tables of notions were supplemented with the systems of written signs, sometimes also specifying the rules for vocalization. The pedagogical effect of such schemes was grounded in the classical construal of *topoi* as a memory system, whose impact can be defined in terms of modulating human thinking: philosophical language projects aimed to reduce the redundant aspects of grammar and vocabulary, such as exceptions and synonyms, in favor of an encyclopedic unequivocal representation of the tree of knowledge in the human mind.

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[836] See Rhodri Lewis, *Language, Mind and Nature*, p. 32-33.

Philosophical language projects were in the vogue, and many early-modern intellectuals nurtured such plans. For instance, Descartes, in his famous letter to Mersenne, discussed a project for a new artificial language. Cartesian verdict on the scheme was severe: “I do not see that all this has much use”.[837] However, Descartes expressed interest in the possibility of creating a different, philosophical language scheme which would discipline the mind: “Order is what is needed: all the thoughts which can come into the human mind must be arranged in an order like the natural order of the numbers”.[838] Descartes points out that such a linguistic undertaking inevitably involves philosophy, and “without that philosophy it is impossible to number and order all the thoughts of men or even to separate them out into clear and simple thoughts”.[839] The task of creating a philosophical language should be “to explain correctly, what are the simple ideas in the human imagination out of which all human thoughts are compounded”, which would enhance “men's judgement” in representing matters so clearly that it would be almost impossible to go wrong”.[840] Even though Descartes believed this design “too much to suggest outside of fairyland”, his advice was well-received, and Mersenne’s own later scheme represented a philosophical language based on a combined model of music and mathematics, which was reflected in Francis Godwin’s *The Man in the Moone*, which, in its turn, inspired both the cosmological and linguistic explorations of John Wilkins.[841] Popular types of sign for use in artificial philosophical languages included letters, numbers, musical notes, and even the signs of the zodiac.

[837] Descartes to Mersenne, 20 November 1629, *Descartes: Philosophical Letters*, trans. Anthony Kenny (Oxford: Clarendon Press, 1970), pp. 3-6.
[838] Ibid.
[839] Ibid.
[840] Ibid.
[841] Margreta de Grazia, “The Secularization of Language in the Seventeenth Century”, *Language and the History of Thought*, ed. Nancy S. Struever (Rochester, NY: University of Rochester Press, 1995), p. 18.
For an analysis of the Descartes–Mersenne conversation on language, see James Joseph Bono, *The Word of God and the Languages of Man: Interpreting Nature in Early Modern Science and Medicine*, Volume I (Madison: University of Wisconsin Press, 1995), pp. 247-271.

Interestingly, initiatives of this kind continued well into the twentieth century,[842] although in the early eighteenth century, Gottfried Leibniz voiced skepticism concerning the epistemic feasibility of composing philosophical languages. In 1676, Leibniz's *characteristica universalis* targeted primarily a specific mode of symbolic and diagrammatic representation of knowledge, based on Lullist techniques of memory aiding. But in 1679, in a letter to Duke Johann Friedrich von Braunschweig, he reformulated his task as the invention of the "calculus of reasoning":

> My invention uses reason in its entirety and is, in addition, a judge of controversies, an interpreter of notions, a balance of probabilities, a compass which will guide us over the ocean of experiences, an inventory of all things, a table of thoughts, a microscope for scrutinizing present things, a telescope for predicting distant things, a general calculus, an innocent magic, a non-chimerical Kabbala, a script which all will read in their own language; and even a language which one will be able to learn in a few weeks, and which will soon be accepted amidst the world.[843]

This passionate statement shows that Leibniz intended to create a system of ideography that would not consist of a numerical cipher standing for words, but could serve as an instrument for discovering the true relations between objects. This epistemic invention should have been helpful in the apprehension of the experience of "things themselves", as well as producing probable knowledge.[844] Leibniz's program for the formalization of scientific experience included three main steps: compiling a complete encyclopedia of terms; developing a *lingua universalis* as the system of codification for these terms; and creating a *calculus ratiocinator* enabling connections between the codified terms through logical operations, the possibilities of which would become visible from the combinatorics of the signs. Leibniz by no means envisaged his *calculus ratiocinator* as a tool for intercultural communication,

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[842] One of the last of such endeavors, Ro language, was developed by Edward Forster in 1904, aiming to combine a taxonomic hierarchy with easily recognizable signs. However, the roots of Ro were difficult to discern by hearing, as they failed to form a meaningful context, which was the problem already faced by Cave Beck in the 17th century. See Edward Foster, *Dictionary of Ro, the World Language* (Marietta, OH: World Speech Press, 1919), pp. 3-4.

[843] Quoted in Umberto Eco, *The Search for the Perfect Language* (Hoboken, NJ: Wiley, 1995), p. xii.

[844] Louis Couturat, *The Logic of Leibniz. In Accordance with Unpublished Documents*, trans. by Donald Rutherford and R. Timothy Monroe (2012), Chapter 3, http://philosophyfaculty.ucsd.edu/faculty/rutherford/Leibniz/Couturat. Retrieved 15.02.15.

and criticized the linguistic systems of George Dalgarno and John Wilkins for not being philosophical enough, i.e. for underrepresenting the logical properties of concepts. Leibniz imagined a language that would reveal the dialectical network and the minute composition of concepts, which would be reflected in the combinations of signs, signifying individual conceptual elements. This was supposed to ensure a natural correspondence between composite ideas and signs, and to provide a universal instrument for the operation of human thoughts "in an order like the natural order of the numbers".[845] However, in 1706, Leibniz admitted the challenges of creating his general algebra, mainly on organizational grounds, as the project "required more than one hand".[846] Gradually, methodological issues also emerged: Leibniz aimed to create "a new way of calculating, suitable for matters which have nothing in common with mathematics". His scheme struggled with mediating "the data and reason", i.e. mathematical and non-mathematical ways of description, and with attributing mathematical certainty to the probabilistic knowledge of natural philosophy.

In England, the first project of philosophical language was published by Francis Lodwick in his *A Common Writing* (1647), followed by *The Groundwork or Foundation Laid (or So Intended) for the Framing of a New Perfect Language and a Universal Common Writing* (1652). Lodwick's scheme "whereby two, although not understanding one the others language, yet by the helpe thereof, may communicate their minds one to another"[847] represented a solution half-way between cipher-based systems and philosophical languages. Lodwick defined his character as "a kind of hieroglyphical representation of words, by so many severall Characters, for each word a Character".[848] However, his language featured grammatical flexibility, which allowed for easy word formation within a lexicon of carefully chosen roots.

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[845] For a comprehensive study of the relations between the three projects, see Jaap Maat, *Philosophical Languages in the Seventeenth Century: Dalgarno, Wilkins, Leibniz* (New York: Springer, 2012).
[846] Leibniz to the Electress Sophia of Hanover, March 1706. Quoted in Lloyd Strickland, *Leibniz and the two Sophies: the philosophical correspondence* (Toronto: Centre for Reformation and Renaissance Studies, 2011), p. 355ff.
[847] Francis Lodwick, *A Common Writing* (London: Printed for the author, 1647), Frontispiece.
[848] Ibid., To the Reader.

Lodwick's proposal left more questions than answers about the functioning of philosophical languages.[849] For instance, which roots needed to be included in the scheme, and what paradigm of analysis should be employed for their selection? Lodwick's project was published by Samuel Hartlib, who had earlier supported many similar initiatives, including the pedagogical treatise *Janua linguarum* (1631) by Jan Comenius, which did not propose any new artificial character but displayed an elaborate philosophical classification of *topoi* for the existing European languages.

George Dalgarno's *Ars Signorum* (1661) represented a scheme that was the most similar to Wilkins's in *Essay on the Real Character and a Philosophical Language* (1668). Initially, Dalgarno and Wilkins worked on their common project in close collaboration, but later they disagreed about the philosophical background for constructing their languages. Dalgarno's project was based on a set of 1068 monosyllabic roots or "Radicals", which signified the concepts derived from a taxonomy of 20 "transcendentals" or semantic categories, such as being, substance, accident, body, spirit, composite of body and spirit (person), soul, angel, etc. The rest of the notions had to be formed through combinatorics, and by comparison with Cave Beck's nearly 4000 numerical roots, Dalgarno's system, arranged on two levels, was indeed easier to operate. However, his project, published in Latin, would be more suitable for disputations than for describing experimental trials. Dalgarno never claimed that his language expressed knowledge about "things themselves", which he did not believe possible, and the validity of his scheme was grounded on the universal structure of categories, as this is how, he assumed, nature presented itself to the mind.[850] As a result, Dalgarno's proposed taxonomy could pinpoint the categorical placement but not the material properties of objects. In contrast, John Wilkins chose an encyclopedic pattern, ultimately covering every species of animal, plant, mineral, etc., ordered into a four-level taxonomical structure. Wilkins's project was intended to replace the "messiness of things", and the messiness of

[849] For a more detailed account of these questions, see Francis Lodwick, *On Language, Theology, and Utopia*, ed. Felicity Henderson, William Poole (Oxford: Oxford University Press, 2011), General Introduction.
[850] See Rhodri Lewis, *Language, Mind and Nature*, p. 223.

thoughts, with organizational clarity, which was intended to facilitate pedagogical and experimental practices.[851]

On the whole, all designers of philosophical languages were engaged in the search for the right proportion between the number of artificial roots or radicals, and the complexity of a structural framework. Many early-modern analysts believed that an artificial language based on 3000 radicals had a structural advantage, since a smaller number of radicals would require a more complicated hierarchy of categories, which might leave "too large a liberty for composition".[852] However, whether the language was based on 3000 radicals, or on only 500, as was proposed in some other philosophical schemes, the main difficulty consisted in "resolving a whole discourse into Transcendental principles"[853] in such a way that could highlight and not obscure the natural properties and the order of "things themselves". The organization of semantic units within the language, its graphic character, and, most importantly, the mode of the apprehension of scientific experience, which it could supposedly promote, all these issues remained vividly discussed among the seventeenth-century language philosophers.

The philosophical language of John Wilkins

John Wilkins's project of artificial philosophical language represented by far the most elaborate scheme of its kind. Jorge Luis Borges in his critical essay in *Otras Inquisiciones* (1952), as well as Michel Foucault in *The Order of Things* (1966), both placed Wilkins's project among the most important schemes to remedy the failings of natural scientific languages. In the seventeenth century, the grounds for linguistic scientific skepticism, apart from biblical exegesis and the quest for the lost

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851 For a book-length study of Dalgarno's project, see David Cram, Jaap Maat, *George Dalgarno on Universal Language: 'The Art of Signs' (1661), 'The Deaf and Dumb Man's Tutor'* (1680*), and the Unpublished Papers* (Oxford: Oxford University Press, 2001). See also Vivien Salmon, "The evolution of Dalgarno's *Ars signorum* (1661)", *The Study of Language in 17th Century England* (Amsterdam, PH: John Benjamins B.V., 1988), pp. 157-177.

852 At least this was the opinion of Thomas Pigot, who conducted experiments on acoustics and was a member of the committee for the universal language project, established at the Royal Society. See Thomas Pigot, Letter to John Aubrey, 25 February 1677, The Bodleian Library Ms Aubrey 13, fol. 16r.

853 Ibid.

lingua Adamica, included the rise of vernacular languages over Latin and the consequent difficulties of scientific translation.[854] These issues were in the public mind, reflected in popular contemporary imagery, such as in the drawings and prints of the Tower of Babel, as well as in satire, for instance, with hindsight in Gulliver's visit to a grand Academy in Lagado, depicted by Swift. In England, these ideas were additionally supported by criticism from Baconians and experimentalists.

In the minutes of the first Royal Society meetings listing "the experiments recommended to Dr. Wilkins", the "universal language" was mentioned between experiments on "the burning of lamps under water" and "the dog skin cut off at his house".[855] This research statement shows very clearly that the new science was not about "delicacies and affectations".[856] Experimental discourse repudiated the methods of scholastic "delicacies" and their pertaining "fancies and fables". For instance, Bacon criticized the method of deriving knowledge immediately from traditional narratives, such as biblical stories and Aesop's fables.[857] However, targeting subjects outside familiar narrative frameworks created *lacunae* in the method of science. Methodologically, experimentalists often had to start from scratch, which was reflected in Henry Power's *Experimental Philosophy* (1664): "'Tis a Noble resolution to begin there where all the world has ended; and an heroick attempt to salve those difficulties (which former Philosophers accounted impossibilities) though but in an ingenious Hypothesis."[858] The language of the new science also had to begin where all previous languages ended. Dealing with the experience that preceded verbaliza-

854 On the challenges faced by the Royal Society in terms of scientific translation, see Felicity Henderson, "Making 'the Good Old Man' speak English: The reception of Antoni van Leeuwenhoek's Letter at the Royal Society, 1673-1723" in *Translating Knowledge in the Early Modern Low Countries*, ed. Harold J. Cook, Sven Dupré (Berlin: Lit. Verlag Dr. W. Hopf, 2012), pp. 243-268. For a more general study on early-modern scientific translation, see Peter Burke, R. Po-chia Hsia (eds.), *Cultural Translation in Early Modern Europe* (Cambridge: Cambridge University Press, 2007).

855 "Experiments recommended to Dr. Wilkins", Royal Society Archive DM/5/78C. Cf. A much longer and detailed list of experiments on "burning lamps" appears six years later in Thomas Sprat's *History*, p. 216.

856 Francis Bacon, *Advancement of Learning* (London, 1605), Book I, IV:4.

857 For a comparative study on the visual representation of "fables" in early-modern natural history and experimental practices, see Katherine Acheson, "The Picture of Nature: Seventeenth-Century English Aesop's Fables", *The Journal for Early Modern Cultural Studies*, V. 9, No. 2 (Fall/Winter 2009), pp. 25-49.

858 Henry Power, *Experimental Philosophy* [1664] (London: Marie Boas Hall, 1966), p. 189.

tion and often hesitating to assign a terminological status to a newly invented vocabulary, experimental philosophy frequently needed to express its findings in "experimental language".[859] Even though the Royal Society sought to diminish the role of *persuasio* within *scientia*, it was not possible to avoid rhetoric when introducing a new conjecture or "an ingenious hypothesis", since, as shown in previous chapters, the very notion of ingenuity presumed following the aesthetic principles of rhetorical composition.

Experimental method promoted the apprehension of experience and the understanding of the operative laws of nature. These laws were also viewed as the physical forms of things, termed as "simple natures", or "simples" in a later alchemical version. These "simples" were also perceived as a natural alphabet, and all bodies were considered as compounds made up of "simples", in the same way as words are composed of letters. Baconian experimentalism did not seek for the true definitions of "simple natures". The "discovery of forms" could not be attained even through their most precise definitions, since any definitions are made of words, and "words beget words".[860] Therefore, Bacon's advice was to break through the linear structures of natural languages into the diagrammatic space of narrative, visual, and performative experimental representation.

The Baconian method was focused on discovering non-verbalized operative forms, because "from the discovery of forms flows truthful speculation and unrestricted operation".[861] The development of axioms via induction was intended to invoke not the definitive *what* of logical objects but the operative *how* of the relations between "things themselves". In Bacon's view, the failings of natural languages could be remedied through the right kind of operative and experimental practices, and many people became convinced that some artificial language could be invented to capture the true and precise operative order of both things themselves and reasoning in mind. The mid-seventeenth century urge to invent artificial

[859] Michel de Certeau, "Mysticism", *Diacritics*, Vol. 22, No. 2 (Summer, 1992), pp. 11-25, p. 22.
[860] Francis Bacon, *The New Organon,* Book I, LIX.
[861] Ibid., Book II, III.

philosophical languages sought not to restore the lost natural connection between words and things, which was deemed arbitrary, but to reveal and explicate the true operative scenarios of causality among "things themselves" through artificial and carefully constructed figures of language.

Wilkins's *Essay Towards a Real Character and a Philosophical Language* represents the most accomplished of such attempts. Since at least 1662, the Royal Society urged Wilkins to proceed with his project as part of its general reform of scientific language and method. From collaboration with Seth Ward and the Hartlib circle, Wilkins was familiar with other artificial language schemes, such as the *Janua linguarum* (1631) of Jan Comenius, which inspired Wilkins's encyclopedism.[862] Robert Boyle witnessed Wilkins completing his scheme as early as 1657, but then the tumults of the Restoration, which made Wilkins leave Oxford, the Plague, and then the Great Fire of London in 1666, which destroyed not only the project manuscript left inside a print-house in central London but also Wilkins's personal archive and his collection of scientific curiosities, all slowed down the publication of the *Essay* till 1668. However, Wilkins showed himself happy to modify his tables after the misfortune. The printed marginalia reveal to whom Wilkins felt indebted in completing his scheme: he was collaborating with John Ray and Francis Willughby on composing the tables of flora and fauna, and with Francis Lodwick − on discussing phonetics, etc. Wilkins acknowledged his study to be a work of "as many hands as can be found",[863] quite in congruence with the Royal Society's motto. As for his personal attitude, he felt that the language was his "darling" pursuit, and mentioned it on his deathbed as his main achievement, although unfinished. The project was also esteemed among Wilkins's peers: on Monday, 13th April 1668, at a meeting of the Council of the Royal Society, it was ordered that the *Essay* should be printed by the Society's printer. However, after

[862] See Benjamin DeMott, "Comenius and the Real Character in England", *John Wilkins and 17th Century British Linguistics*, ed. Joseph L. Subbiondo (Amsterdam, PH: John Benjamins Publishing Company, 1992), pp. 155-168.

[863] Thomas Sprat, *The History of the Royal Society*, p. 20. For a concise account of the collaboration behind Wilkins's project, see Benjamin DeMott, "The Sources and Development of John Wilkins's Philosophical Language" in *John Wilkins and 17th Century British Linguistics*, pp. 170-189.

Wilkins's death four years later, the Society records no evidence of promoting the use of the language for practical communication.

The *Essay* is divided into four sections; the first introductory part reviews the evolution of natural human tongues, and expresses Wilkins's opinion on why and how artificial languages could be employed as useful means of communication. The second, most voluminous section comprises the "Universal Philosophy" tables of species. The third section describes the *modus operandi* of Wilkins's language, and the fourth section demonstrates how it might be practiced.

In the first part, Wilkins gives his reasons for the linguistic deterioration which was thought to infest his time. In his view, natural languages have decayed, because they have never been invented according to the rules of art, and "the Art was suited to Language, and not Language to the Art".[864] As a remedy, Wilkins proposes a system of writing that employed the principles of Renaissance dialogocentrism and relied on the Aristotelian order of precedence between spoken and written language. Concerning written and spoken words, Aristotle's *De Interpretatione* states:

> Spoken words are symbols of affections in the soul, and written words are symbols of spoken words. And just as written letters are not the same for all humans, neither are spoken words. But what these primarily are signs of, the affections of the soul, are the same for all, as also are those things of which our affections are likeness.[865]

Wilkins translates this Aristotelian view in terms of the paradigm of post-Baconian experimental discourse, confirming that "Writing being the Picture or Image of Speech, ought to be adapted into all the material circumstances of it".[866] Wilkins also subscribes to the Baconian view about the functioning of language and signs in transferring knowledge:

> … it is either speech or writing; for Aristotle saith well, "Words are the images of cogitations, and letters are the images of words." But yet it is not of necessity that cogitations be expressed by the medium of words. For whatsoever is capable of

[864] John Wilkins, *Essay Towards a Real Character and a Philosophical Language* (London, 1668), pp. 19-20.
[865] Aristotle, *De Interpretatione*, trans. F.W. Zimmerman (London: Oxford University Press, 1981), Section I, 1. Cf. Aristotle, *De Anima*, Book III, 3-8. For a recent comprehensive study of Aristotelian language philosophy, see Deborah Modrak, *Aristotle's Theory of Language and Meaning* (New York: Cambridge University Press, 2001).
[866] John Wilkins, *Essay*, p. 355.

> sufficient differences, and those perceptible by the sense, is in nature competent to express cogitations.[867]

The concept of "difference" appears as one of the categories in Wilkins's language, and his scheme targets the discerning and systematizing of "whatsoever is capable of sufficient differences perceptible by the sense". But his language aims to transfer this knowledge of differences not through words, but through arbitrary signs. The philosophical language was meant to assist the mind in discoursing about the reality of material things, which happens in a certain order: "The particulars are first in the Order of Being, yet Generals are first on the order of knowing".[868] The *Essay* views knowledge not as an amount of information, but as a scenario of *différance*, specifying the path of scientific thinking about objects, which could shape narrative grids for performing common discourse.

Wilkins's artificial language is neither hieroglyphic, nor is it a form of shorthand, since in his view both types of coded writing might occlude, rather than facilitate, the transparency of representation. Wilkins's characters pinpoint not the words expressed in written signs but the immediate half-spoken forms of thoughts in the mind, the Aristotelian cognitive "affections of the soul", capturing the relational definitions of things within the scheme. He departs from Renaissance *logomysticism* and follows Bacon in viewing the relationship between thinking and things as natural, but the relationship between mind and language as arbitrary. This permits him to modify language structures and, instead of conventional semantics, to map new, carefully constructed, relations between objects, which was intended to give rise to new scenarios for reasoning, and create new patterns of knowing.

The second part of the *Essay* gives an example of what this mapping might look like, and the third section elucidates how to employ the system of signification. Wilkins's language operates on three levels plus the logically necessary level of "transcendentals", technical medieval categories that do not immediately participate in word formation. On the lowest level, the Aristotelian simple apprehensions of

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867 Francis Bacon, *Advancement of Learning*, Book II, 1-2.
868 John Wilkins, *Essay*, p. 24.

reality, as the first operations of understanding, are displayed in tables of species grouped into "differences", also a category derived from medieval logic. These "differences" are assembled by six into forty classes or "Genus's" representing general notions, which correlated with the medieval category of "transcendentals".

It needs to be noted that many artificial language schemes of the mid-seventeenth century were based on Aristotelian universals, i.e. common types, "transcendentals", and their derivatives. George Dalgarno's project, mentioned above, can serve as a prominent example of this approach. In contrast, Wilkins's project was based not on the Aristotelian categories but on Aristotelian "simple apprehensions", i.e. the most basic apprehensions of experience, which translated "the sufficient differences perceptible by the sense" into thoughts through the operation of species.[869] Aristotle implied that simple apprehensions participated in concept formation, and should lead to making true statements about things.[870] In any case, doctrinally, simple apprehensions could not be false, since a simple apprehension of X immediately derives from X, which means that X must be a true apprehension. Wilkins could safely rely on this reasoning, as it was part of the core scholastic methods which, for instance, explained why the human idea of God, though never adequate, cannot be radically false.[871]

The difference between seventeenth-century artificial philosophical languages primarily consisted in their "philosophical" structure. As opposed to the artificial language considerations of Hobbes and Dalgarno, Wilkins's project was grounded on the Aristotelian simple apprehensions, pinpointed through the species of "things themselves". Wilkins composed hundreds of pages of tables, which list neither numbers, nor the words of his language, but the names of species of things.[872] The *Essay* presents Wilkins's four-level scheme of "Analysis" starting from the nouns representing universal notions, i.e. most general categories, and then going

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869 Rhodri Lewis, *Language, Mind and Nature,* p. 199. See also Chapter I of this study.

870 Deborah K. Modrak, *Aristotle's Theory of Language and Meaning* (New York: Cambridge University Press, 2001), p. 65.

871 Daniel Garber and Michael Ayers (eds.), *The Cambridge History of 17th Century Philosophy* (Cambridge: Cambridge University Press, 1998), V. 2, pp. 1069-1070.

872 John Wilkins, *Essay*, pp. 23-289.

down to "classes", "differences", and species.[873] This is how Wilkins's project has often been sketched, for instance, by Jorge Luis Borges in *The Analytical Language of John Wilkins* (1952). However, this is not how "the Analysis" was composed, as we know from Wilkins's correspondence with John Ray, who helped him draft the tables of species,[874] as well as from his own statements in the *Essay*. For instance, when Wilkins determines that there should be six "differences" in each "class", his reservation is "unless it be in those numerous Tribes, of Herbs, Trees, Exanguious Animals, Fishes, and Birds; which are of too great variety to be comprehended in so narrow a compass".[875] Wilkins's project seeks to capture the ultimate variety of species in pursuing the goal of combining the dialectical clearness of structure with the copious fullness of encyclopedic representation.

As for the words of Wilkins's artificial language, each of them represents an encoded relational definition of a particular species, based on the placement of this species within the scheme. Like in Cabbalistic teachings, in Wilkins's system, each word consists of letters signifying the position of the species, represented by the word, in the universal classification. Each "class" or "Genus" of the "Analysis" is assigned a monosyllable of two letters, each difference is assigned a consonant, and each species is assigned a vowel. Altogether these letters compose the individual words of Wilkins's language, and each of them simultaneously serves as the definition of itself. For example, in Wilkins's scheme, "de" means an element (one of the "classes"), "de" plus "b" means one particular element of "fire" (one of the "differences"), and "deb" plus "a" gives "deba", which signifies a part of the element of fire, "a flame" (one of the species). As Borges noted in his essay on Wilkins's *Essay*, this system of signification allows the language user to highlight and convey the most important aspects of the immediate experience of a particular species. For instance, in comparison with English as an ordinary language, the word "salmon" does not convey any knowledge about the salmon species, unless the speaker has

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873 Ibid., p. 23.
874 See Rhodri Lewis, *Language, Mind and Nature*, pp. 198-199.
875 John Wilkins, *Essay*, p. 22.

had an immediate experience of salmon, i.e. has seen the fish. In contrast, the word "zana" in Wilkins's language, meaning "salmon", through its very composition conveys the experient knowledge of a squamous river fish with ruddy meat.[876] Wilkins's scheme clearly sought to communicate not only the names of things but also their "Natures", i.e. the immediate experient knowledge of them as a species.[877]

Of course, this knowledge could only be communicated to someone who has digested the system of forty "classes", each containing at least six "differences", and the species in them. The third part of Wilkins's *Essay* is devoted to how the system of signification for his language should be practiced. Apart from the "philosophical" part, the language incorporated options for inflections, vocalization, and expressing attitudes. The species are signified through combinations of syllables, which can be read and pronounced like ordinary words. But none of them stands for any precise definition, except for the ciphered path of their placement in the operative order of categories. Wilkins's language conveys the experience of species by capturing the route by which they are placed in the scheme, or the scenario of reasoning about them in mind.

Although Wilkins installed some memory aids for his language learners, for instance, by pairing the species that "naturally" or "commonly" belonged together or are opposed to each other,[878] the obvious technical and pedagogical difficulties of using the scheme were evident and criticized as such. Wilkins's work on the language started to be discussed long before the appearance of the *Essay* in 1668. In 1663, the *Ballad of Gresham College* already pictured:

> A Doctor counted very able
> Designes that all Mankynd converse shall,
> Spite o'th' confusion made att Babell,
> By Character call'd Universall.
> How long this Character will be learning,

[876] Cf. John Wilkins, *Essay*, p. 142.
[877] Ibid., p. 21.
[878] John Wilkins, *Essay*, p. 22.

That truly passeth my discerning.[879]

The *Ballad* composed "In Praise of that choice Company of Witts and Philosophers who meet on Wednesdays weekly at Gresham College" is full of friendly banter about the initiating procedures of the Royal Society. The ballad's authors were also informed enough to point out the chief problem in implementing all such language schemes: the learning of a universal language requires time and industry. After the *Essay's* publication, critics also questioned its methodology and particular rubrics. For instance, John Ray doubted Wilkins's way of arranging botanical tables, which in his view, instead of following nature's lead, "strain[ed] Things to serve a Design, according to the Exigency of the Character".[880] Wilkins himself admitted that he sometimes had to place species in wrong categories, for the sake of maintaining his rationalistic pattern of "differences".[881] Besides, Ray remarked, to "[t]o make exact Philosophical tables … is a Matter very difficult, not to say impossible", and here any design aiming to achieve universality is almost doomed to failure.[882]

Whereas the discussions on practicing Wilkins's language started even before its publication, an earnest estimation of its instrumental epistemic value only began in 1676–78, several years after Wilkins's death. The Royal Society established a committee involving Seth Ward, Wilkins's close friend and co-author of *Vindiciae academiarum* (1654), to determine ways in which the scheme could be practically used. The committee appreciated the fact that Wilkins based his language on about 3000 "radicals", which was deemed a balanced decision, since a smaller number of radicals would require a more intricate system of derivatives, and a larger number of them might necessitate a more complex structure.[883] However, Thomas Pigot

879 *The Ballad of Gresham College* (1663), 28 stanzas, stanza 21. Quoted in Dorothy Stimson, "The Ballad of Gresham College," *Isis* 18 (1), 1932, pp. 103-117.

880 Letter from John Ray to Martin Lister, 28 April 1670, *Philosophical Letters between the Late Learned Mr. Wray and Several of his Ingenious Correspondents*, ed. W. Derham (London: Printed by William and John Innys, 1718), p. 62.

881 For a study on the structural compromises within Wilkins's scheme, see Francis Christensen, "John Wilkins and the Royal Society's Reform of Prose Style", *John Wilkins and 17th Century British Linguistics*, ed. Joseph L. Subiondo (Amsterdam, PH: John Benjamins Publishing Company, 1992), pp. 133-154, p. 142-146.

882 See also Rhodri Lewis, *Language, Mind and Nature*, pp. 198-199.

883 Letter from Tomas Pigot to John Aubrey, 25 February 1677, The Bodleian Library Ms Aubrey Correspondence, 13, fol. 16r.

pointed out the difficulty of running "over whole concatenation of thoughts to express or apprehend one single Species of Animals".[884] Eventually, the committee concluded that, having to install the contradictory philosophical principles of clarity and fullness into his scheme, Wilkins did not leave sufficient guidance on how the proportion between them reflected the order within nature, which raised questions about whether his language could be properly employed in its philosophical function. As some commentators have supposed, Wilkins may indeed have sought a theological and pedagogical victory, and not an inquiry into philosophical truth.[885] Characteristically, his language does not distinguish between philosophical and theological calling, and considers the notions of "philosopher" and "divine" together under the heading "Liberal Professions, Sacred; as discovered by revelation: or as the knowledge of them is, attainable by nature".[886] Thomas Pigot remarked that Wilkins's language might perhaps be spoken by Angels, whose knowledge is close to absolute, but its use by ordinary people would be similar to the confusion of Babel.[887] In 1678, Seth Ward revised Wilkins's project and advised that its improvement should start with a profound study of Ramon Llull's *ars combinatoria*, a recommendation that the Royal Society politely declined.[888]

As opposed to some other philosophical language schemes, Wilkins's project represents an approach to the concept of meaning that is based on relationships with other meanings within a topical order. Wilkins essentially created a pedagogical tool promoting the topical pattern as a set of rules for performing a scientific language game. Unlike the game of natural language, where the meaning of words is stabilized through both the individual definitions and the context, Wilkins's language game ensures the stability of its rules through combinatorics, since the use of each word invokes the whole system of categories in the classification. Wilkins's language follows the Ramist dialectical principle in the sense that the scheme is

[884] Ibid.
[885] Rhodri Lewis, *Language, Mind and Nature*, p. 183.
[886] John Wilkins, *Essay*, p. 265.
[887] Ibid.
[888] Rhodri Lewis, *Language, Mind and Nature*, p. 209.

grounded on the simple apprehensions which come before judgment, so that the scenario of thinking within his language would not be prejudiced. In terms of analytic philosophy, Wilkins's language project relies on the experient knowledge of species as concepts (although not individual material things), derived from their relations to each other within the scheme. The experient knowledge of species had to precede their descriptive knowledge, so that the discourse grounded on simple apprehensions could acquire a certain discipline of mind, as well as "commensurability, comparability, and communicability",[889] i.e. the homology of experience and coherence of the narrative grids of scientific description. But at the same time, the discourse based on simple apprehensions could also retain more freedom of categorizing than the schemes based on Aristotelian categories. Besides, Wilkins never insisted that his language system was final; it was merely meant to fulfill the Cartesian task of arranging the encyclopedia of thoughts about nature into a natural order, without specifying the content of these thoughts. In Descartes' terms, Wilkins attempted to explain correctly the simple ideas of which human thoughts are composed, and his scheme promoted the performative knowing of scientific discourse. The dialectical pattern attributed formalization, and the hundreds of pages of species tables, which Wilkins never considered completed, were meant to preserve the copiousness of philosophical description.

The rhetoric and dialectic of philosophical communication

It might seem provocative to associate John Wilkins with embedding rhetorical strategies into his "darling" project, since he was one of the supervisors responsible for the composition of *The History of the Royal Society*, which is supposed to have denounced the use of any rhetorical techniques for the advancement of learning. However, as several recent studies have shown, the Royal Society's repudiation of rhetorical extravagances was largely itself motivated by rhetorical purposes.[890]

[889] Thomas S. Kuhn, "Commensurability, Comparability, Communicability", p. 669.
[890] Tina Skouen and Ryan J. Stark (eds.), *Rhetoric and the Early Royal Society: A Sourcebook* (Leiden: Brill, 2014).

The claims for plainness of scientific language often were meant to disqualify polemical opponents, and in any case, targeted not the rhetoric itself but its conscious abuse and the resulting obscurity in the doctrines of knowledge.

Like other contemporary artificial language schemes, Wilkins's project employed some techniques of Cabbalistic combinatorics in word formation, but he does not anywhere imply that his scheme breaks the code of the sacred language of Adam, which, unlike the words of Wilkins' scheme, was commonly conceived of as iconic. In spite of obvious technical difficulties in memorizing the tables of species, Wilkins strives to emphasize the accessibility of his plan as a pedagogical tool for improving any ordinary mind. Wilkins's language did not aim to re-establish the immediate magical connection between mind and nature, but to enhance the capacity of language as a universal, conceptual, and human-created tool for scientific discovery. This approach is exemplified in his studies on the measurements of Noah's Ark. The *Essay* lists the details of construction and the estimation of supplies required for the animals deployed on the biblical vessel. The numerals were derived from Wilkins's taxonomy featuring such practical parameters as "useful both by labour and flesh" and "esteemed for the tusks".[891] Reflecting on Johannes Buteo's list of species,[892] Wilkins noted that several of them were "fabulous", with some "true species being left out", but his own classification was also not intended as a final judgement. The *Essay* encourages the assimilation of new experience, as changes may occur in species "by several countries, diets, and other accidents", and new species may also be located "in the undiscovered parts of the world".[893] Although disputed, Wilkins's project encouraged Royal Society associates, such as Robert Hooke and Martin Lister, to extend the visual representation of biodiversity.

[891] John Wilkins, *Essay*, p. 156. See also Jim Bennet and Scott Mandelbrote, *The Garden, the Ark, the Tower, the Temple* (Oxford: Museum of the History of Science, 1998); Clark Emery, "John Wilkins and Noah's Ark", *John Wilkins and 17th Century British Linguistics*, ed. Joseph L. Subbiondo (Amsterdam, PH: John Benjamins Publishing Company, 1992), pp. 279-284.

[892] Johannes Buteo, better known as Jean Borrel (1492-1572), was a French mathematician, the author of *Opera geometrica* (Lyon, 1554) containing fifteen articles on mechanical, arithmetical and geometrical problems. In 1559, his *De quadraturi circuli* disproved several solutions for the squaring of the circle. See "Archimedes" online project, Max-Planck Institute for the History of Science, http://archimedes2.mpiwg-berlin.mpg.de/archimedes_templates/biography.html?-table=archimedes_authors&author=Buteo,%20Johannes&-find. Retrieved on 02.02.15.

[893] John Wilkins, *Essay*, p. 156.

Unlike Jacob Böhme's teaching, in which the power of the word is the power of defining and becoming, in Wilkins's tables, the constructed names of species do not operate natural reality. His language represents a modeling device, serving to reproduce the coherence of discourse, and claiming potential as a strategy for scientific argumentation. The semantic relations within the language derive from the fact that each word refers to the simple apprehensions of things, which should make the reference naturally evident and demonstrable, but Wilkins stresses that the principle of the composition of words is conventional. When appointing various syllables to be the signs for particular categories, Wilkins notes: "That which at present seems most convenient to me, is this".[894] He sounds more determined when discussing the specific parameters of "philosophical" structure, based on Aristotelian metaphysics, which were deemed fixed and universal,[895] or when giving the rules for writing particular signs, which were deemed entirely arbitrary.[896] The philosophical structure of Wilkins's language promoted the apprehension of immediate experience, but at the same time, it had to comply with a conventional discourse based on categories, and therefore Wilkins views his task as an experiment on balancing the familiar dialectical structures of knowledge and the innovative copious experient vision of nature. In this sense, the artificial philosophical language project was provisional and interactive: its users were invited to continue elaborating the Ramist map of *topoi* and the resources of language. The *Essay* turned the space of artificial language into a "site of discovery",[897] and the language itself into an instrument of justification.

The fact that Wilkins's project was influenced by Ramism,[898] which would have been difficult to escape in his day, is evident from even a cursory glance at the pages of the *Essay*. Wilkins uses the Ramist pattern of curly brackets as the visual

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894 Ibid., p. 415.
895 Ibid., p. 298. For analysis of the presence of Aristotelian and medieval logical notions in Wilkins's project, see Vivian Salmon, "Philosophical grammar in Wilkins's *Essay*", *John Wilkins and 17th Century British Linguistics*, ed. Joseph L. Subbiondo (Amsterdam, PH: John Benjamins Publishing Company, 1992), pp. 207-236.
896 Ibid., p. 387.
897 Carolyn R. Miller, "The Aristotelian Topos: Hunting for Novelty", *Re-Reading Aristotle's Rhetoric*, ed. by Alan G. Gross and Alan E. Walzer (Carbondale, IL: Southern Illinois University, 2000), pp. 130-148, p. 141.
898 The Ramist reform of dialectical logic is considered in more detail in Chapter I of this study.

frame for his language project, which was usually employed by schemes implementing Ramist dialectical and rhetorical techniques. This is just one instance of Wilkins's dependence on print, but the very idea behind the invention of artificial languages relied on the principles of Ramist dialectical reform, which primarily consisted in reducing certain analytical parameters within discourse and the "tree of knowledge", for the sake of acquiring a more comprehensible model for conducting specific discursive operations. In particular, the artificial philosophical languages reduced the variability of phonemes, semantic units, and inflections to achieve the categorical or encyclopedic clarity of the structural representation of knowledge. Language was viewed as a translational tool between the realms of things in the world and words in discourse, and the authors of philosophical languages were striving to polish the lens of language, to create an epistemic instrument that would be transparent, but at the same time would so organize thoughts in the mind, as to magnify and bring out the specific desired properties of "things themselves". Earlier, Wilkins employed language in this function of a magnifying glass to show the remote moon and ancient mechanical wonders at closer range. Wilkins's artificial language project aimed to display in the same way the Baconian "operative laws of nature", and was intended as a Ramist pedagogical tool for promoting the performative knowing of the apprehension of experience and knowledge-making.

As Raphael Hallett mentions in "Ramus, Printed *Loci*, and the Re-invention of Knowledge", the visual form for displaying topology in Ramism was crucial in making it a popular technique for the apprehension of personal, cultural, and scientific experience. In classical rhetoric, the *topoi* unfolded themselves together with the linear progress of a spoken narrative. The Ramist visualization of taxonomy allowed the orator, and later the scientific writer, to spot *lacunae* in the structures of discourse at a glance, which encouraged the inventive combinatorial use of topical assets. Classical rhetoric explored the productive potential of topics, but Ramist textual *loci communes* figured it immediately.[899] Hallett agrees with Philippe Desan that Ramist dialectic becomes a "mirroring site", which was freed from any imposed definitions, but offered possibilities to present "things themselves" in the light of new references. For instance, in mathematics, the "performative display of geometry" helped develop the concept of abstract operable space.[900] In Wilkins's language project, the geometrical display of Noah's Ark helps to turn the biblical narrative into a three-dimensional projection of collected and classified species, placed within the calculable and abstract space of the mythic vessel.[901] The visualized pattern of Ramist topology allowed Wilkins to highlight the scientific experience of species, without distorting the framework of adopted metaphysical categories. Furthermore, accessible Ramist black-and-white graphics induced a wide ordinary readership, in the terms of Wilkins's discourse on providence, to be observant of natural dispensations and to perform "an experimental divinity of his own",[902] i.e. to participate in developing the structural patterns for the natural world.

Unlike the Ramist techniques of dialectical rhetoric, which encouraged clarity of apprehension and ease in transferring scientific experience, Lullist combinatorics was prone to entertain much more hermetic styles.[903] The pedagogical technique attributed to Ramon Llull (1232−1315) claimed to enhance memory, a faculty which was deemed a prerequisite for any kind of learning. The improvement of memory almost equalled the improvement of intellect itself, which made this rarely effective but often expensive learning highly popular. Lullist memory aids were based on the imagery of ancient astrological signs, music, art, and architecture. In contrast with

[899] Raphael Hallett, "Ramus, printed *loci*, and the re-invention of knowledge", *Ramus, Pedagogy, and the Liberal Arts: Ramism in Britain and the Wider World*, ed. by Steven J. Reid and Emma Annette Wilson (Farnham: Ashgate, 2011), pp. 89-112, pp. 100-102.

[900] Ibid., p. 109.

[901] John Wilkins, *Essay*, pp. 162-168.

[902] John Wilkins, *A Discourse Concerning the Beauty of Providence*, p. 61.

[903] Anita Traninger, "The Secret of Success: Ramism and Lullism as Contending Methods", *Ramus, Pedagogy, and the Liberal Arts: Ramism in Britain and the Wider World*, ed. by Steven J. Reid and Emma Annette Wilson (Farnham: Ashgate, 2011), pp. 113-131, p. 127.

the standard medieval guidelines on enhancing memory, which emphasized the logical analysis of information, Lullism sought to activate the faculty of imagination, and compared memory to an imaginary storage space, bearing specific architectural and theatrical features, where the items of information could be encoded in letters of the alphabet, visualized, enriched with sensuous features, and arranged in meaningful combinations, which was supposed not only to help memorize the items but also amounted to an infallible art of thinking.[904] Lullist pedagogy came to be a useful supplement to scholastic methods of text commentary, as the technique answered the needs of those who found it difficult to process long disputations and texts full of syllogisms. Lullist method relied on the pedagogy of contemplation in introspection, mostly developing in the immediate experience of individual practice with a master. It is not surprising that the teaching of Lullist techniques was often exercised by the marginal members of the university community, and soon began to cultivate a specific type of teaching *personae*: esoteric sages promising universal knowledge.[905] This frequently drew them closer to the courts of princes, whereby Lullism's lucrative prestige increased.

Lullism soon developed its own philosophical background, distancing itself from the Aristotelian thinking of the schools. The mnemonic claims were supported by the understanding that the technique allowed those who have mastered the skill to connect with divine powers and providence, and partake of information about the universal principles of being. During the Renaissance, Lullism adopted many hermetic ideas, including the concept of *logoi spermatikoi*.[906] In the course of the centuries, the doctrine became more associated with *magia naturalis*, supposedly invoking esoteric ancient wisdom through specific divine signs or "signatures" carried

904 Francis Yates, *Lull and Bruno* [1982] (New York: Routledge, 2013), pp. 10-12.

905 Ian Hunter, "The University Philosopher in Early Modern Germany", *The Philosopher in Early Modern Europe: The Nature of a Contested Identity.* Edited by Conal Condren, Stephen Gaukroger, Ian Hunter (Cambridge: Cambridge University Press, 2006), pp. 35-65, p. 41.

906 See Wilhelm Schmidt-Biggemann, *Topica universalis*. *Eine Modellgeschichte Humanistischer und Barocker Wissenschaft* (Hamburg: Felix Meiner Verlag, 1983), pp. 155-207.

by things.[907] Presumably, these signs could be combined in different ways to affect magically the physical properties of various objects.

Noting points of similarity and difference between the two most popular early-modern pedagogical doctrines helps us understand the extent of Ramist and Lullist influences on the artificial language movement, and the nature of their impact on Wilkins's project. In the sixteenth century, Lullism merged with Ramist dialectical rhetoric, and after assimilating Ramism, the mnemotechnical exercises were transformed into a more encyclopedic view of knowledge. Lullism incorporated the rhetorical procedures of composition, translating them as practicing of the principles of the new science.[908] Both Ramism and Lullism sought to ensure the easy retrieval and processing of knowledge stored in memory. However, Lullism construed the operated knowledge as referring to the copious universal theater of nature itself, whereas Ramism viewed it as referring to a universally structured "commonplace" book about nature. Lullism claimed to achieve the operability of knowledge via the sophisticated techniques of contemplation, and Ramism tried to attain this operability through plain dialectical exercises. Another difference concerned their attitude to visualization for the apprehension of experience. Ramist techniques could be easily and successfully communicated through printed books, which was appreciated in the mainstream of university education, in spite of all the criticism that targeted Ramist pedagogical reforms. Although Ramon Llull left numerous treatises on theology, astrology, rhetoric, and logic, the Lullist essential expertise of attributing names to things however needed to be communicated "from ear to ear", which remained universally exciting, but marginal in formal education.[909] The Lullist emblematic patterns of arranging various signs on a circle became immensely popular,

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[907] See Thomas Browne on the "signatures" of things in *The Garden of Cyrus*, or *The Quincuncial Lozenge, or Network Plantations of the Ancients, Naturally, Artificially, Mystically Considered* (London: Printed for Hen. Brome at the Signe of the Gun in Ivy-lane, 1658).

[908] For an account of Jesuit encyclopedism and the "mathematising" of Lullism by Athanasius Kircher, see Paolo Rossi, *Logic and the Art of Memory*: *The Quest for a Universal Language*, trans. Stephen Clucas (Chicago: University of Chicago Press, 2000), pp. 194-196.

[909] For a sample of Lullist rhetorical ideas, see *Ramon Llull's New Rhetoric*, trans. Mark D. Johnston (Davis, CA: Hermagoras Press, 1994).

but the authentic Lullist techniques themselves, which made free use of specific intuitions concerning the relations between forms, colors, and sounds, were difficult to disseminate through print circulation. Lullist representations could perhaps have looked more convincing in 4D cinema projections, but early-modern performative mystical devices, such as *Quarta figura*, intended to be cut out and moved, stayed silent on the black-and-white pages of printed manuals. In contrast, the Ramist designs of curly brackets looked appealing and perfectly accessible in print. Eventually, although the practices were often intertwined, Lullism became identified with semi-mystical magical teachings, attempting to affect material things, and Ramism developed into a tool for the dialectical modeling of nature.

Wilkins's philosophical language scheme reproduced the basic combinatorial patterns of Lullism, but did not subscribe to the Lullist principle of sacred secrecy. Wilkins acknowledges following the natural lead in composing his "classes" and "differences", but stresses that his proposed philosophical structures are arbitrary and provisional. Furthermore, he specifically states that his language is meant to serve as a plain and transparent projection of nature. The *Essay* offers a key, not for manipulating the natural alphabet, but for opening the multi-dimensional space for modeling and conceptualization of experience in natural studies. Wilkins elucidates this point, discussing the measurements of Noah's Ark, and also by employing a similitude with starry skies divided into constellations:

> He that looks upon the Starrs, as they confusedly scattered up and down in the Firmament, will think them to be (as they are sometimes styled) innumerable, of so vast a multitude, as not to be determined to any set number: but when all these Starrs are distinctly reduced into particular constellations, and described by their several places, magnitudes and names, it appears that of those that are visible to the naked eye, there are but few more than a thousand in the whole Firmament; … It is so likewise in other things: He that should put the Question, how many sorts of beasts, or birds, etc. there are in the world, would be answered even by such as are otherwise knowing and learned men, there are so many hundreds of them, as could not be enumerated; whereas upon a distinct inquiry into all such as are yet known, and have been described by credible Authors, it will appear that there are much fewer

than is commonly imagined, not a hundred sorts of beasts, not two hundred of birds.[910]

The idea of Ramist dialectical procedures, which formed the core of Wilkins's system, presumed that his language was supposed to be a dynamic invention. Wilkins's scheme laid out a field for a discursive game, as it was intended to build common preconceptions, and to mark the potential topical locations for more specific discoveries. The combinatorial signs of the language were meant as the milestones on the path to the heuristic solutions concerning "things themselves".

Both Lullist and Ramist teachings sought to explore a pattern for the operative knowledge of nature. However, following different historical routes, they developed into a method for using signs to operate nature (Lullism), and a method for using signs to operate knowledge (Ramism). Wilkins's project certainly aimed to operate knowledge, employing Lullist and Cabbalistic teachings as part of early-modern cultural background, and a combinatorial means of encompassing the variety of experient knowledge of species.

Unlike Lullism, Wilkins's project specialized in the art of scientific memory, where meaningful combinations of signs were meant to capture and store experience. This aspect of his language project was appreciated within the Hartlib Circle, the members of which, although advocating different methods for overcoming the "messiness of things", endorsed the systematic ordering of empirical "particulars" in the service of both scientific memory and imagination. [911] Many Hartlib scholars helped Wilkins in composing his "tables".[912] In particular, Cyprian Kinner, in a letter to Wilkins, dated June 27, 1647, shared a draft of his philosophical language, which was essentially similar to the plan followed in the *Essay*. Kinner proposed that every letter or syllable in the words of the language should have a meaning denoting the

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910 John Wilkins, *Essay*, p. 162.

911 For a recent study on Hartlib Circle's views on memory and storage of scientific knowledge, see Richard Yeo, "Memory and Empirical Information: Samuel Hartlib, John Beale and Robert Boyle", *The Body as Object and Instrument of Knowledge: Embodied Empiricism in Early Modern Science*, ed. Charles Wolfe and Ofer Gal, (New York: Springer, 2010), pp. 185-210.

912 For instance, see *The Diary of Samuel Pepys*, ed. H.B. Wheatley (London: G. Bell & Sons, 1928), vol. V – 1664, p. 292.

object's primary and secondary qualities, and the vowels should indicate their degrees. Kinner's scheme was themed on botany and suggested that one of the syllables should express the specific medical powers of the plant, and another one should encode the practical knowledge of how it can be recognized and gathered. Kinner observed that learning the words of such a language would mean storing a whole compendium of botanical and medical knowledge in the memory.[913] Wilkins's scheme clearly adopted not only the dialectical structure of Kinner's plan but also its pragmatic purpose of memorizing the combinations of qualities for building a comprehensive competence in natural studies. Although, Wilkins admits the difficulty of fitting the full list of the species of plants into his language, not only due to his doubts that "there be any determinate number" of them, but primarily because of "the want of proper words to express the more minute differences betwixt them, in respect to shape, colour, taste, smell, etc., to which instituted languages have not assigned particular names".[914] For this Wilkins proposes an encyclopedic dialectical solution: the descriptions in the language refer only to "the chief and most common Plants of that name".[915] However, by combining this Ramist principle with the Lullist techniques of memorizing experience, the language could capture not only the names but also the clusters of practical knowledge. Ramism ensures the clarity of the philosophical structure of Wilkins's language, and the impact of Lullism enables it to preserve the copiousness of referential operations in the mind. By balancing these functions, the scheme was intended as a proper artificial instrument of discourse, thus promoting the performative knowing of making knowledge.

The performativity of scientific language and mind

In my view, Wilkins's project strove to achieve the performative pedagogical victory of preconditioning scientific persuasion, to use the apt expression of Rhodri

[913] Benjamin DeMott, "Wilkins' Philosophical Language", *John Wilkins and 17th Century British Linguistics*, ed. Joseph L. Subbiondo (Amsterdam, PH: John Benjamins Publishing Company, 1992), pp. 169-181, p. 174.
[914] John Wilkins, *Essay*, p. 67.
[915] Ibid.

Lewis.[916] Like Wilkins's *Discovery of a World in the Moone* and *Mathematical Magick*, the *Essay* makes no secret of its ultimate purpose, and admits that the signs of the language:

> … could be so contrived, as to have such a *dependence* upon, or relation to, one another, as might be suitable to the nature of the things and notions which they represented … This would yet be a farther advantage superadded: by which, besides the best way of helping the Memory by natural Method, the Understanding likewise would be highly improved; and we should, by learning the Character and the Names of things, be instructed likewise in their Natures, the knowledge of both which ought to be conjoyned.[917]

There is no Lullist allegorical sense associated with the combinatorics of Wilkins's character, however, the structure of its forty genera relies on the harmonious stability of divine natural order. Criticism on the limitations of human languages, which nurtured the artificial language movement, stressed the shortcomings of human verbal communication. The imperfection of human languages was attributed to the consequences of the Fall, causing discrepancies between the spiritual and corporeal aspects of human nature. John Wilkins's *Mercury* (1641), which was thematically devoted to various means of secret communication, states that the communication between humans is flawed primarily due to their corporeal existence and the necessity to use bodily organs. In contrast, the angels, being immaterial, communicate through their whole being, which makes the transfer of experience much more accurate. Communication is not natural in humans; they first used gestures, then spoken words, then written words, and all that has always been limited in space and time, except for the writing that extends human communication and collective memory, as well as the languages of chemistry, music, and mathematics, which are also capable of expressing things directly.[918]

In the course of Wilkins's productive life, he often exercised his passion for ingenuity by advancing various liberal arts, such as the art of mechanics and the art

[916] Rhodri Lewis, *Language, Mind and Nature*, p. 183.
[917] John Wilkins, *Essay*, p. 21.
[918] John Wilkins, *Mercury* (London: I. Norton for John Maynard and Timothy Wilkins, 1641), To the Reader.

of prayer as a way of communicating with "special providence".[919] The reform of language, initiated by Wilkins within the Royal Society, was meant to accommodate experimental needs, but Wilkins had to advance the art of scientific communication, primarily conveying the experience of the senses in the contemporary context of a profound distrust of the communicative capabilities of the human body. The seventeenth-century artificial languages were based on the ideas of universal grammar, and they were appreciated as the instruments of reversing the implications of the Fall, i.e. overcoming the limitations of sensuous perception. For instance, in the preface to Cave Beck's *Universal Character*, Joseph Waite praised the scheme for its supposed capacity to extend the spheres of knowledge that were accessible to the human mind:

> The Index of Speech, the dumb Interpreter,
> The Iliads in a Nut-shell; Tongues in Brief;
> Babel revers'd; The traveller's Relief; …
> They all now know my Sense, or here's the key:
> The Chart of Dialects, right Cosmographie.
> The Heavenly Orbs and we commune just so,
> We all their matters by Learn'd Figures know.[920]

However popular, this view concerning the mission of artificial languages provoked some revealing controversies. For instance, Thomas Traherne, an English neo-Platonic theologian and mystical poet, although concerned about the misapplication of words in the vernacular, dismissed the idea of Cave Beck's scheme on the grounds that the confusion of languages was a part of providential government.[921] But most authors of the philosophical universal languages intended their schemes to display the principles of providential operations: Wilkins's project places "the order of common Providence" within the category of the efficient causes of "differences" in things.[922] Through introductory procedures and the material of

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[919] See Chapters IV and V of this study.

[920] Joseph Waite, "To my intimate and ingenious Friend, Mr. Beck, upon his Universal Character, serving for all Languages", in Cave Beck, *The Universal Character* (London: Printed by Tho. Maxey, 1657).

[921] See Jan Ross (ed.), *The Works of Thomas Traherne: Commentaries of heaven, Part 1* (Cambridge: D.S. Brewer, 2007), pp. xxxv-xxxvii.

[922] John Wilkins, *Essay*, p. 28.

the tables, Wilkins constructs an idealized mode of scientific experience, which does not need to cope with the imperfections of natural languages and bodies.

Like other philosophical languages, Wilkins's *Essay* propagated an art of communication meant to improve the imperfect situational knowledge of the human arts, which posed the question of how this knowledge might relate to the absolute knowledge and concept of truth? The *Essay* employs "transcendentals" as the doctrinal logical categories connecting the primary properties of being and the notions of language. But the relations between the species remained subject to the early-modern attitude to all knowledge derived from the senses, which was probable knowledge. Barbara Shapiro notes that as soon as the natural sciences grew more empirical, knowledge started to be viewed as a pyramid with several levels of certainty: fiction, opinion, conjecture, probable, and morally certain knowledge, which necessitated developing new standards of proof, evidence, and practices for creating belief. The humanist art of discourse, of which Ramist and Lullist techniques were part, recombined the elements of logic and rhetoric but at the same time confused the standards for probability. Barbara Shapiro challenges the view that the scientific revolution created the modern dichotomy between the humanities and the sciences, and emphasizes that the overlap between the plausible and the empirically probable redefined the notions of proof, probability, and certainty.[923]

Wilkins explains his views on scientific truth, probability, and certainty in *Of the Principles and Duties of Natural Religion* (1675). He subscribes to the view that "Mathematicks, by reason of the abstracted nature of those Sciences, may be demonstrated by the clearest and most unquestionable way of Probation to our reason".[924] However, he adds somewhat by way of apology that "it is not rational to expect the like proof, in such other matters as are not of the like nature".[925] Unlike abstract notions, the matters "depending upon mixed circumstances", i.e. "matters

[923] See Barbara Shapiro, *Probability and Certainty in Seventeenth-Century England* (New Jersey: Princeton University Press, 1983), pp. 4-13.
[924] John Wilkins, *Of the Principles and Duties of Natural Religion*, p. 24. See also Barbara Shapiro, *Probability and Certainty*, pp. 25-34.
[925] Ibid.

of Fact, concerning Times, Places, Persons, Actions, which depend upon the story", rely on the immediate perception of the internal and external senses, and require a different kind of evidence and proof, which was often termed as "moral certainty". In early-modern experimental practices, moral certitude was dependent on the number and "quality" of witnesses at the operative theater. Wilkins's project of philosophical language was intended as a cabinet of curiosities and an operative theater. The avid learners of Wilkins's language would join the numerous witnesses to the ordered vision of "things themselves". The language itself, as a well-calibrated scientific instrument, would have the persuasive power to support the moral certainty of propositions.

Modern historians have singled out several ideological aspects in Wilkins's linguistic undertaking. Robert Markley has stated that:

> The language schemes published in the decades after the Civil War testify to the ideological urgency motivating their authors … to control the dialogical and subversive tendencies of language by offering an authoritative ground for judging the theological and political efficacy of utterances, for establishing a monological means of signification.[926]

Robert Stillman has argued that the language project was not intended to designate a specific cognitive practice, but was meant to invoke specific political implications and support the idealistic propaganda of the early Royal Society.[927] Peter Dear has noted that the ideological aspect of the Royal Society's enterprise predetermined the later turn to the "mathematical" philosophy of Isaac Newton.[928] However, rather than construing Wilkins's project as a linguistic ritual invoking ideological power, my study prefers to highlight the performativity of scientific experience, which Wilkins's "darling" project was intended to impart. According to Wilkins, sufficient moral certainty about the "matters of fact" which are "dependent upon mixed

[926] Robert Markley, *Fallen Languages: Crises of Representation in Newtonian England, 1660-1740* (Ithaca, NY: Cornell University Press, 1993), p. 72.
[927] See Robert E. Stillman, "Invitation and Engagement: Ideology and Wilkins's Philosophical Language", *Rhetoric and The Early Royal Society: A Sourcebook*, ed. Tina Skouen, Ryan J. Stark (Leiden: Brill, 2014), pp. 161-184.
[928] Peter Dear, *Discipline and Experience: the Mathematical Way in the Scientific Revolution* (Chicago and London: University of Chicago, 1995), p. 2.

circumstances" needs to be attained through "concerning Times, Places, Persons, Actions", which altogether form "a story" in the mind.[929] Wilkins's project was supposed to yield the plausible forms for that story as a scenario for the guided thought experiment, which might result in what Andrew Pickering calls "the message that emanates from the constructivist cybernetic paradigm as a shift from the traditional scientific analytical approach to nature towards what may be called 'designing truth'".[930] Pickering also juxtaposes the modern and the "non-modern" perspectives of science, concluding that the non-modern ontology is more grounded on the live performance of knowledge, than its fixed representation.[931] In paving his "non-modern" path, Wilkins's chief concern seems to be not about the placement of specific milestones at certain precise points, but about ensuring that the journey itself actually takes place. Using the words of Michel Foucault, the pedagogical significance of Wilkins's project consists in invoking the experience of "the wonderment of this taxonomy, the thing we apprehend in one great leap, the thing that, by means of the fable, is demonstrated as the exotic charm of another system of thought".[932] In my view, the argumentative style of Wilkins's discourses on Copernican cosmology, "liberal mechanics", and divine providence, indicate that his method for attaining probable knowledge was grounded not on the forcefulness of ideological constructs, but on the performativity of an aesthetic appeal.

Wilkins's project fulfills Bacon's advice in the *Advancement of Learning*:

> The custody or retaining of knowledge is either in writing or memoir; whereof writing hath two parts, the nature of the character, and the order of the entry; … for the disposition and collocation of that knowledge which we preserve in writing, it consisteth in a good digest of common-places; … I hold the entry of commonplaces to be a matter of great use and essence in studying, as that which assureth copie of invention, and contracteth judgment to a strength.[933]

[929] John Wilkins, *Of the Principles and Duties of Natural Religion*, p. 25.
[930] Quoted in Hans Diebner, "Introduction", *Performative Science - Reconciliation of Science and Humanities or the End of Philosophy?* ed. Hans Diebner, David Turnbull, et al. *Studia UBB. Philosophia*, V. 57 (2012), № 1, p. 4.
[931] Ibid.
[932] Michel Foucault, *The Order of Things* (New York: Pantheon, 1970), p. xv.
[933] Francis Bacon, *Advancement of Learning*, Book II, XV, 1.

Wilkins's scheme propagates the "good digest of common-places", for balancing the copiousness of invention with the strengthening of judgment, but he also takes into account the Baconian dissatisfaction that the existing dialectical and rhetorical patterns of commonplaces are "none of any sufficient worth; all of them carrying merely the face of a school, and not of a world; … without all life or respect to action".[934] Therefore, Wilkins avoids grounding word formation in his language scheme on "transcendentals" or on the abstract categories that would most conspicuously "carry the face of the school", and contrives his system so as to induce more performative action displaying "the face of the world" through running over the rubrics of species in the mind.

Like the other Lullist combinatorial schemes, Wilkins's language can be considered not as a set of vocabulary, since its words refer to no conventional definitions, but as an artificial scenario for Baconian operations of mind, i.e. memorizing, imagining, and reasoning.[935] What could best describe the constitutive elements of Wilkins's language project is not the concept of a word but the notion of a linguistic value, i.e. in Saussure's terms, the content attributed to a word by virtue of its use in the communally established language game.[936] Then, what best describes the whole of Wilkins's scheme is de Saussure's idea of *langue* as the value-conferring "system of interdependent terms".[937] Saussure places value as the constitutive element of *langue* within his framework of relational semantics, where the value determines the word's reference and signification. In other words, the meaning of a word is preconditioned by the practice of its use within the system of interconnected relations. This approach would be developed later by Wittgenstein as a focal point for the program of analytic philosophy. Wittgenstein stated that language represents not a system of

[934] Ibid.

[935] Cf. "The parts of human learning have reference to the three parts of man's understanding, which is the seat of learning: history to his memory, poesy to his imagination, and philosophy to his reason". Francis Bacon, *Advancement of Learning*, Book II, I, 1.

[936] Ferdinand de Saussure, *Course in General Linguistics*, ed. Charles Bally and Albert Reidlinger, trans. Wade Baskin (New York: McGraw-Hill, 1959), pp. 90-91. Saussure does not mention specifically the concept of a language game, which is more pertinent to Ludwig Wittgenstein's way of thinking, but he draws illustrative parallels between speech and a game of chess.

[937] Ibid.

references between fixed semantic units and their definitions, but a "language game" that maps the semantic boundaries of intelligible reality. However, de Saussure's notion of *langue* does not go together with *performance* or *performativity*, its opposite, *parole*, though does.

According to Richard Waswo, the shift from referential to relational semantics, i.e. from regarding the meaning as a given object of reference to considering it as a dynamic function of use, was initiated as part of the Renaissance remapping of the linguistic picture of the world.[938] William Haas in "The Theory of Translation" uses the terms of analytic philosophy to pinpoint the essence of relational semantics: the meaning is not an entity that corresponds to the expression as another entity. The category of meaning pinpoints the use of expressions or "the work expressions do", which specifies the scenarios for both imagination and memory.[939] Following the path of Renaissance remapping, in the seventeenth century England, early artificial languages attempted to invent the ideographic signs which supposedly linked things with their accurate representations. Later, the inventors of more mature artificial language schemes discovered that the proper linguistic representation of nature depended on an accurate account of nature, which at the time was supposed to be composed from collecting facts about things within the disciplinary framework of "natural history". Therefore, Wilkins's project of artificial language was intended as guidelines on how to "collect" the accidents of things into an accurate description, which could precondition the understanding of phenomena. In the words of Mary Slaughter, the method of universal languages functioned as a guarantee of order, if in no other way than psychologically, i.e. as a set of directions on controlling the infinite chaos of perceptions, and "[i]n this sense science gives the same satisfaction as plays, dances, games".[940] Later, mathematical order turned out to be the more

938 Richard Waswo, *Language and Meaning in the Renaissance* (Princeton: Princeton University Press, 1987), p. 11.
939 William Haas, "The Theory of Translation", *Philosophy*, Vol. 37, No. 141 (1962), pp. 208-228, pp. 212-215.
940 Mary M. Slaughter, *Universal Languages and Scientific Taxonomy in the Seventeenth Century* (Cambridge: Cambridge University Press, 1982), p. 7.

powerful instrument, but in the seventeenth century, linguistic classifications assisted in the formalization and universalization of scientific knowledge.

In the terms of analytic philosophy, Wilkins's language incorporates the principles of relational semantics, as it conveys the experient knowledge of a certain species through performing an act of reference, informed through the philosophical language scheme, which specified the functions of use for a particular term. The language outlines a scenario for operations of the mind, which preconditions the parameters of common discourse about the phenomenon. In this way, Wilkins's linguistic invention propagates the performative knowing of knowledge making. His scheme strives to capture a specific art of thinking and to answer the question about the relationship between words and things, not through a theoretical definition, but through an operative pattern of cognitive practice. He approaches this issue, not in terms of *what*, but in terms of *how*, to bring together the contexts of discovery and justification. Rephrasing John Austin, Wilkins tackles the problem of *res et verba* by inducing the questioning about how to discover things with words?

Seth Ward may have been right in indicating the direction of Wilkins's thinking, when he advised the Royal Society to improve the language scheme through Llull's *ars combinatoria*. The assumption that "helping the Memory by natural Method, the Understanding likewise would be highly improved"[941] was at the core of both early-modern dialectical-rhetorical practices and the practicing of Wilkins's artificial language, where the precise organization of the natural world had to be remembered. However, many years before and after the publication of the *Essay*, this was viewed as an insurmountable difficulty for the human memory. What Wilkins perceived as one of the main pedagogical benefits of his project happened to be its main impediment. Wilkins himself considered his project incomplete, and indeed it does not appear to be successful as a practical means of communication. Although the King expressed a wish to learn the language, and several of Wilkins's colleagues attempted to write sections of letters in it, the scheme remained more of a speculative

[941] John Wilkins, *Essay*, p. 21.

device.[942] However, if we consider Wilkins's endeavor in the wider perspective of the seventeenth-century artificial language movement, we may notice two curious features about this development: on the one hand, ideas on creating artificial languages fascinated the best philosophical minds of the century, including Descartes, Kircher, Hobbes, and Leibniz, some of whom spent decades nurturing their linguistic plans; on the other hand, none of these schemes have ever been considered a success in practical terms. This leads one to think that the epistemic impact of the seventeenth-century artificial language movement should be estimated not from the point of achieving (or, rather, not achieving) its self-imposed tasks, but from the viewpoint of its contribution to the progress of the philosophy of mind and language. To be practically successful, all artificial language projects of the time would have required the operations of artificial intelligence, an idea which could not be implemented until centuries afterwards. Umberto Eco argues that Wilkins's scheme anticipates the notion of hypertext, because it proposes a framework for displaying the connections between topics through symbolic links. [943] Along with Wilkins's pioneering writings on cosmology, mechanics, and cryptology, his philosophical language project can be considered as a pioneering achievement in the flexible and multiple organization of complex data.[944] The significance of Wilkins's writings can be seen by understanding that, starting from the procedures of rhetorical *inventio*, he accomplished the invention of a scientific database, and approached the idea of how to program an artificial scientific mind.

Conclusion

The last chapter of this study, entitled "Wilkins's impossible invention", was epigraphed with a quote from the essay *The Analytical Language of John Wilkins* by

[942] Letter from Andrew Paschal to John Aubrey, 13 February 1677, The Bodleian Library Ms Aubrey Correspondence, 13, fol. 15r.
[943] See Umberto Eco, *The Search for the Perfect Language* (Hoboken, NJ: Wiley, 1995), pp. 38-59.
[944] See Judith Kaplan, "Linguistic Universals from Wilkins to the GOLD Ontology" presentation at "The Total Archive: Dreams of Universal Knowledge from the Encyclopaedia to Big Data", CRASSH, University of Cambridge, 19-20 March 2015.

Jorge Luis Borges, who stated that Wilkins's attempt to penetrate the divine pattern of the universe, albeit not definitive, must nevertheless be appreciated for its bold design of scientific rationality. Wilkins and Borges both held in high esteem the utopian aesthetics of the impossible. Wilkins applied this interest to unachievable tasks through the engineering of chariots to fly to the moon, paradoxical machines, and even a *perpetuum mobile*. Later, he also wrote an account of the secret means of long-distance communication, followed by discourses on how the finite human mind could relate itself to the infinite perfection of divine reason and providence.

The universal language project continued this line of encounters. In the context of early-seventeenth-century natural history, the claim for the universality of any human pursuit was mainly to be perceived as a rhetorical statement, since real universality only pertained to divine intelligence. However, as Michael Hunter has noted, the setting up of the Royal Society was marked by a striking universality of their plans and goals. The Society targeted "completeness" as an epistemic task, aiming to account for all the phenomena in nature, to review all books, and to conduct all thinkable experiments.[945] Hence, the magnificent projects for data collection and the necessity for making sense of the accumulated data, which inspired Wilkins's efforts to catalogue knowledge. Wilkins defined his universal language encyclopedia as neither provisional nor completed, as his project represented a design not only for a language but also for the human mind aiming to reach out to the impossible, like the projects of the younger Wilkins which aimed at the utopian colonization of the moon. As Lisa Jardine has remarked, "the whole of Wilkins's English scientific writings are suffused with a sense of divine wonder".[946]

Concerning Borges' utopian pursuits, another of his essays, *The Library of Babel*, describes a project towards a universal library displaying the "indefinite and perhaps infinite" combinatorics of what can be composed from "twenty-five natural symbols" making up all imaginable texts, including those that have been written and

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[945] Michael Hunter, "The Setting up of the Royal Society" lecture, Wadham College, Oxford, 25.11. 2010, http://www.gresham.ac.uk/lectures-and-events/part-four-the-setting-up-of-the-royal-society. Retrieved 18.02.2015.

[946] Lisa Jardine, "The 2003 Wilkins Lecture: Dr Wilkins's Boy Wonders", *Notes and Records of the Royal Society of London*, Vol. 58, No. 1 (Jan., 2004), pp. 107-129, p. 108.

those that will be written, those that make sense and those consisting of randomly compiled letters bearing no recognizable meaning.[947] Borges' librarians wandered in the search of a very special book, "the catalogue of catalogues", as the very universality of their library entailed the possibility of finding a key to epistemic justification, since "[t]here was no personal or world problem whose eloquent solution did not exist", although hidden in one of the hexagonal halls within the infinite beehive of combinatorial nonsense. This much sought-for catalogue was deemed virtually inaccessible, since the probability of finding it was infinitesimal. However, since the library was supposed to contain all imaginable books, a catalogue which would describe their contents must have existed somewhere, as well as the catalogue that would describe that catalogue etc. The logically justifiable existence of the catalogue added to the library universe "unlimited dimensions of hope" and allowed for certain linkage with providence. Presently the links could only be perceived through logical categories, but "if the language of philosophers is not sufficient, the multiform Library will have produced the unprecedented language required, with its vocabularies and grammars".[948] As Borges asserted, the analytical language of John Wilkins was not the least admirable of such attempts.[949] Starting with procedures of dialectical *inventio* in his early scientific narratives, Wilkins completed his career with an attempt to invent an unprecedented language, the "catalogue of catalogues", a key to epistemic justification, allowing for linkage with providence, and containing its own vocabularies and grammar structures. Like his chariots for flying to the moon, Wilkins's language sought to reach out towards the infinity of universal knowledge and to suggest certain architectonic forms for the potentially infinite beehive of human intellectual interactions. Within seventeenth-century science, Wilkins's language can be viewed as a climactic attempt to achieve universality of knowing through the performative power of dialectical rhetoric.

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947 Jorge Luis Borges, "The Library of Babel" [1941], *Collected Fictions*, trans. Andrew Hurley (New York: Penguin, 1998), pp. 112-118.
948 Ibid.
949 Jorge Luis Borges, "The Analytical Language of John Wilkins", *Other Inquisitions, 1937–1952*, trans. Ruth L. C. Simms, (Austin: University of Texas Press, 1984).

Borges defined his project for a universal library as strictly impossible. Even though some librarians may "suffer dangerous illusions of what is knowable", the narrator describes the course of his own life as a limited route among the hexagonal cells. In Borges' ironic depiction, science will never be able to answer all questions, since the questioning mind itself is part of the riddle. Wilkins's project targeted the questioning of the human mind, seeking to formalize and collectivize its operations. His remarkable optimism concerning collaborative scientific efforts propelled the Royal Society's institutional activities, as all its members, including the famously reclusive Newton, shared in data-collection and hands-on involvement, which served as a catalyst for originality in theoretical and technological discovery.[950] The Royal Society replaced the mode of scholarship featuring the drawing of logical deductions by an isolated scholar with "horizontal collaboration", which required sociability and "fluency of codes" in data processing.[951]

The study of these collaborative ways of early science highlights the importance of dialogue, discussion, debate, and persuasion in the practices of making knowledge. Although the Royal Society vigorously denied any use of rhetorical techniques in their manner of discourse, historians of science might inquire if there could have been any reason why such noticeable denouncement was necessary? Albeit in a different historical context, this constant disowning of the use of any human figures of thinking is reminiscent of medieval attempts to claim that prophetic narratives emerged as if dictated immediately by divine intelligence. The medieval manuscript author sought to gain authority by claiming that he added nothing coming from his own imperfect soul to the communication of the divine spirit. The early-modern scientific *virtuoso* defended his narratives by claiming that his vision was not distorted by tricks of the fallen human mind but occurred to him as if revealed immediately by divine nature itself. The acknowledgement of the fact that rhetoric was used as an early-modern instrument of persuasion, collaboration, and discovery is a methodological matter. Wherever science is considered as a

950 Lisa Jardine, "The 2003 Wilkins Lecture: Dr Wilkins's Boy Wonders", p. 110.
951 Matthew Hunter, *Wicked Intelligence* (Chicago and London: University of Chicago Press, 2013), p. 7.

practice, the sharing of experience comes to be viewed as an essential prerequisite for breakthroughs, entailing the use of dialectical and rhetorical techniques which had been well-recognized as means of transmitting experience since the times of classical antiquity.

The study of texts originating from the early Royal Society, e.g. journal books, proceedings of council meetings, and *Philosophical Transactions*, has shown that, although the Society repudiated the "Idols" of verbal language, a "rhetoric of presence" provided a framework for elements of spectacle and display in their essential practices. Even their favourite form of argument, experimental testimony, which was claimed to represent nature immediately, in fact represented the part of rhetoric and dialectic that considered argumentative invention. As Richard Serjeantson confirms, "[a]ll agreed that, in technical terms, testimony was one of the 'topics', or 'common places' (*loci communes*) of argumentative invention".[952] Like in judicial rhetoric, in scientific rhetoric, testimonies were an important means of imparting credit to the argument. In scientific rhetoric, testimonies served this purpose particularly well, since the proof that they provided was regarded as "artless", i.e. not contaminated with "the paint of art" and rhetorical effects. When Bacon in *The Advancement of Learning* promoted the method of explaining nature through "testimonies and arguments", the term was not cleared from rhetorical connotations. Although natural philosophy sought to isolate argument from historical testimony, the argument from all kinds of testimonies was used widely, of which Wilkins's writings provide multiple instances.

Summing up my argument, this study employs the concept of performative knowing to pinpoint a specific form of competence in early-modern knowledge-making, which was characterized by relational apprehension and conceptualization of experience, to open up new hypothetical perspectives. In the early-modern argumentative style, the contingent character of this knowing, which is not a body of information but rather a skill to be acquired in practice, activated the heuristic

[952] Richard Serjeantson, "Testimony: the artless proof", *Renaissance Figures of Speech*, ed. Sylvia Adamson, Gavin Alexander, et al. (Cambridge: Cambridge University Press, 2007), pp. 181-194, p. 182ff.

functions of dialectical and rhetorical devices.

Using the terms of analytic philosophy, Wilkins's language project can be described as grounded on the experience of species derived from a construal of their relations adopted in contemporary natural philosophy. The performative knowing of species as interrelated parts of a specific classification preceded their descriptive knowledge as individual items and provided the "principle of meaning" for the interpretation of descriptive data. Wilkins's artificial philosophical language project was to promote this performative mode of knowing via practicing the operations of species in the mind. Ramist dialectical patterns allowed for the schematization and formalization of this knowing, and the hundreds of pages of tables, which Wilkins never believed were completed, were to preserve the copiousness and enable the extension of philosophical description. Wilkins's project was intended to reveal the ingenious "figures of abundance" for a certain scope of experience, as well as to balance the structural clarity of *inventio* with the fullness of *copia*.

Wilkins's heuristic accomplishments resulted from his elaboration on the knowing-how of rhetorical and mathematical methods of creating probabilistic hypotheses. His hypothetical *inventio* helped him promote specific inventions and explore the material properties and relations of "things themselves". Wilkins employed this knowing-how as a "spiritual optic" for displaying phenomena at a closer intellectual distance and "making things to speak", which became one of the primary goals not only for him but also for the Royal Society of London. Although the Royal Society claimed to break with rhetoric, dialectical procedures were considered necessary for directing experimental inquiries. Wilkins's collaborators repudiated outdated "fancies & fables" but welcomed the figural "language of the hand" which for them attained the role of the language of ingenuity. They employed the vividness of metaphors borrowed from the practices of artistry for building the patterns of plain speaking about "things themselves". The task of "bringing things to speak" made the experimental philosophy join with poetry, as both aimed to arrive at a new vision of nature, for which natural reality had to be transformed through the procedures of *inventio*. The elements of poetical and rhetorical discourse, such as the doctrine of *copia*, provided techniques for the reconstruction of scientific objects as material entities within experimental action. These speaking instruments of science made new properties of nature visible for phenomenological analysis and helped distill the figures of apprehension from the abundance of experimental data, which enabled the generation of new theories.

In early-modern scientific writing, various figures of speech corresponded to the use of specific visual figures in illustrations. The use of imagery in texts, such as tables with curly brackets and spherical projections, often indicated the presence of particular rhetorical techniques. In both speech and vision, the argumentative significance of figures consisted in allowing for a recombination of data into a more coherent and concise structural pattern. For instance, within the early-modern mechanical arts, visual arguments were often preferred to verbal ones, since imagery induced more of a practical involvement on the part of the apprentices. Verbal and visual figurative forms were used as performative aids within the procedures of both rhetorical *inventio* and technical invention. Wilkins applied the dialectical procedures of *loci communes* and *stasis*, as well as other figurative patterns, to impart the experient knowing of technical novelties and to present them in the light of new cultural references, thus promoting various developments in mechanical arts.

The techniques of figurative thinking, developed within the aesthetics of rhetorical and poetic composition, were employed by Wilkins and the Royal Society as symbolic forms for designing the paradigmatic structures of new scientific knowledge. Partly due to the specific conditions of discourse after the English Civil War, Wilkins tended to find epistemic solutions outside the realm of scholarly artifice and within the practices of artistry. Within the new performative scientific space, nature was presented as one of the interlocutors, which made it possible to contradict the established doctrines. When the knowing is primarily viewed as a practice, a different set of epistemic values begins to prevail. As opposed to the rigidity of representation that repudiates the sensuousness of epistemic expression, the clearness of performance does not marginalize the sensuous. In this context, "speaking plainly" means adequacy in the delivery of the performative intention of the experimenter. Poesy can "speak plainly" by imagining with ingenuity, even though it does not employ "plain language". The concept of performative knowing assists in defining the early-modern mode of scientific constructive imagination which operated through dialectical and rhetorical forms, bearing similarities with poetic imagination but allowing for a material implementation of the procedures of invention. The performative mode of knowing also does not exclude the ingenuity of building material relations between objects through bodily dexterity. Many early-modern technological inventions started with dialectical *inventio* and a hypothetical design, which widened the horizon of the possible. Wilkins's writings contributed to the liberalization of scientific language and practices by associating the ingenuity of dialectical *inventio* and engineering invention.

Wilkins was among the chief ideologists of the language reformation within the Royal Society, which, like the religious Reformation, aimed to purify the language to turn it into a more pointed instrument of invention and communication. The Royal Society's efforts were part of a broader movement shifting from the procedure of *inventio* as the main framework for producing knowledge within a providential probabilistic paradigm, to approaching the certainty of knowing by the means of mathematical demonstration. In the late seventeenth century, early science turned from a method of knowing as *mimesis naturae*, which involved ethical and aesthetical evaluation as the essential procedures of proof, to a method of attaining verification via the creation of a second nature through mathematical modeling, where, in Nietzsche's words, "an imitation no longer felt to be an imitation".

The early-modern interest to "situational knowing" of the arts challenged the concepts of absolute knowledge and divine dispensations. Wilkins applied topical dialectical techniques to bridge the human knowing of the arts with absolute divine knowledge. In mid-seventeenth-century, the British crisis of absolute power was resolved through a redistribution of responsibilities. Wilkins attempted to resolve the crisis of the idea of providence by renegotiating divine and human duties, so that humans could dispose of the domain of particular providence for experimental but legitimate interaction with divine dispensations. The figures which helped Wilkins divide providence also allowed for a division in argumentative style. “According to the diverse nature of things”, abstract issues could be solved via mathematical demonstrations, whereas those dependent upon “mixed circumstances” or “story and the relations of others” still needed to be argued through eloquence. Moral and aesthetical principles continued supporting the truth of such scientific narratives in a similar way as mathematical and statistical methods supported more abstract arguments. In the course of the seventeenth century, the distinction between general providence as the realm of abstract natural laws and particular providence as the realm of narrative human laws became one of the driving forces behind the division between the two cultures of the sciences and the humanities.

Wilkins’s *Discourse on the Beauty of Providence* first chose the imagery of mechanical contrivance as a symbolic form for overcoming the epistemic perplexity due to “infinite mischief” within the civil society. Later, he readjusted this position, since the elucidating potential of mechanism as a symbolic figure was on the wane, and explored the mode of perception of a “sensitive agent”. This interest motivated his unprecedented effort to create the most complete artificial language of the century. His language scheme was intended as an instrument for enhancing the performative knowing of the sensitive agent in discerning ingenious argumentative patterns among the potentially infinite scientific and social experience.

Although Wilkins’s philosophical language does not appear to be successful as a practical means of communication, if we consider his endeavor in the wider perspective of the seventeenth-century artificial language movement, we may conclude that his undertaking was successful in its own right as a development in the philosophy of mind and language. Along with Wilkins’s pioneering writings on cosmology, mechanics, and cryptology, his language project can be considered as an advancement in the organization of complex data. Starting from the procedures of rhetorical *inventio*, Wilkins accomplished the invention of a database, approached the idea of programming artificial intelligence, and left us the legacy of future experimenting.

The use of rhetoric in the early Royal Society, including the commitment to performance and display through the witnessing of live demonstrations and testimony, has been studied in several publications reconstructing the techniques of producing *enargeia* as an instrumental extension in the experimental activities of John Wilkins, Robert Hooke, Robert Boyle and their fellows. However, in spite of recent consideration of rhetorical techniques in the literary genres related to natural history, the instrumental and heuristic role of specific rhetorical and dialectical devices in the structuring of experience has received much less attention. My study contributes to the understanding of how the concrete figures of dialectical rhetoric were employed as patterns for constructive imagination and processing experience in early-modern argumentative style. Considering this question through the lens of John Wilkins's writings enables a focus on a comprehensive range of scientific themes and activities. The concept of performative knowing provides a framework for understanding how experience is apprehended through the figural structures of scientific imagination and the intelligent enactment of experimental practices. Dialectical and rhetorical techniques may attract more interest from scholars not only as means of persuasion but also as patterns for processing scientific experience.

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Abstracts

How to discover things with words? John Wilkins: from *inventio* to invention

My doctoral thesis explores the functions of rhetorical and dialectical devices in the argumentative style of John Wilkins (1614−1672). My study traces the development of his discursive techniques in scientific narratives, theological writings, and linguistic treatises, with the aim to examine how the interplay between cognitive and performative language enhanced early-modern practices of knowledge-making. I argue that the procedures of dialectical rhetoric, apart from being popular perlocutionary tools, were effective as heuristic instruments. Language was one of the important agents in the performing of science, and my study employs the concept of "performative knowing" as a key to Wilkins's dialectical and scientific inventions. The idea of performative knowing straddles several constituents derived from the analytic philosophy and speech act theory. From this perspective, Wilkins's undertakings appear as a coherent exercise in the art of making knowledge through persuasive communication. My thesis explores how Wilkins's argumentative method departs from baroque rhetorical flair of *The Discovery of a World in the Moone* (1638), explores the capacity of rhetoric to impart scientific experience in *Mathematical Magick* (1648), copes with the challenges of the social and empirical quests of science in *Discourse on the Beauty of Providence* (1649) and *Of the Principles and Duties of Natural Religion* (1675), and arrives at an elaboration of instruments for codification and formalization of knowledge in *An Essay towards a Real Character, and a Philosophical Language* (1668). Wilkins's humanist scholarship and involvement in semiotic debates made him appreciate the heuristic potential of dialectical rhetoric, despite his criticism of the abuse of outdated figural language in scientific debates. Wilkins's method benefited from the visualization of experience using the procedures of both rhetorical *inventio* and technical invention.

Wie die Dinge mit Worten zu entdecken? John Wilkins: von *Inventio* zu Invention

Meine Doktorarbeit untersucht die Funktionen der rhetorischen und dialektischen Argumentationsstrategien von John Wilkins (1614–1672). Meine Studie zeichnet die Entfaltung seiner diskursiven Methoden in den wissenschaftlichen Erzählungen, theologischen Schriften und sprachlichen Abhandlungen nach, um zu prüfen, wie das Zusammenspiel von kognitiver und performativer Rede die frühneuzeitlichen Praktiken der Wissensproduktion beeinflusst. Ich behaupte, dass die Verfahren der dialektischen Rhetorik nicht nur als populäre perlokutionäre, sondern vor allem auch als heuristische Instrumente wirksam waren. In diesem Zusammenhang erweist sich das Konzept des „performativen Wissens" als entscheidender Schlüssel für Wilkins dialektische und wissenschaftliche Erfindungen. Die Idee des performativen Wissens geht auf die analytische Philosophie und die Sprechakttheorie zurück. Aus dieser Perspektive erscheinen Wilkins' vielfältige Projekte als kohärente Beiträge zur Kunst der Wissensproduktion durch sprachliche Überzeugungskraft. Meine Doktorarbeit zeichnet die Entwicklung von Wilkins' argumentativem Verfahren nach: von der Rhetorik des Barock in *The Discovery of a World in the Moone* (1638), über das Durchspielen der Möglichkeiten der Rhetorik zur Vermittlung wissenschaftlicher Erkenntnisse in *Mathematical Magick* (1648) und die Auseinandersetzung mit gesellschaftlichen und empirischen Herausforderungen an die Wissenschaft im *Discourse on the Beauty of Providence* (1649) und *Of the Principles and Duties of Natural Religion* (1675), bis hin zur Entwicklung von Methoden für die Kodifizierung und Formalisierung des Wissens in *An Essay towards a Real Character, and a Philosophical Language* (1668). Wilkins' humanistische Gelehrsamkeit ließ ihn das heuristische Potential der dialektischen Rhetorik schätzen, auch wenn er den Missbrauch von figurativer Sprache kritisierte. Wilkins' Methode profitierte von der Visualisierung von Erfahrung sowohl in der rhetorischen *inventio* wie auch der technischen Entdeckung (*invention)*.

Jak objevovat věci pomocí slov?
Cesta Johna Wilkinse od *inventio* k vynalézání

Práce zkoumá funkce rétorických a dialektických prostředků v argumentačním stylu Johna Wilkinse (1614−1672). Sleduje vývoj diskurzivních technik v jeho vědeckých a teologických spisech i jazykových pojednáních. Má za cíl zkoumat, jak interakce mezi kognitivním a performativním jazykem zlepšila raně moderní poznávací metody. Vychází z předpokladu, že postupy dialektické rétoriky nebyly pouze oblíbenými přesvědčovacími prostředky, ale daly se uplatnit také jako účinné nástroje v rámci heuristiky. Protože jazyk byl jedním z důležitých nástrojů poznání v raně novověké vědě, práce využívá koncept „performativního vědění" jako klíče k Wilkinsovým dialektickým a vědeckým objevům. Myšlenka performativního vědění pochází z analytické filozofie a teorie řečových aktů. Z tohoto pohledu se Wilkinsovy různorodé projekty jeví jako koherentní uplatňování umění vytvářet znalosti prostřednictvím přesvědčivé komunikace. Práce se snaží ukázat, jak se Wilkinsova argumentační metoda vymezila v kontrastu s barokní rétorikou obsaženou v raném spisu *The Discovery of a World in the Moone* (Objevení světa na Měsíci, 1638), jak se dále rozvíjela využíváním rétoriky pro sdělování vědeckých zkušeností v pojednání *Mathematical Magick* (Matematická magie, 1648) a řešením společenských a empirických problémů v dílech *Discourse on the Beauty of Providence* (Rozprava o kráse Prozřetelnosti, 1649) a *Of the Principles and Duties of Natural Religion* (O základech a úkolech přirozeného náboženství, 1675), až dospěla k vypracování nástrojů pro kodifikaci a formalizaci poznatků v díle *An Essay towards a Real Character, and a Philosophical Language* (Pokus o objasnění skutečného charakteru a filozofického jazyka, 1668). Díky svému humanistickému vzdělání oceňoval Wilkins heuristický potenciál dialektické rétoriky, třebaže kritizoval zneužívání zastaralého figurativního jazyka. Wilkinsova metoda těží z vizualizace zkušeností nejen prostřednictvím rétorických postupů označovaných jako *inventio*, ale i technických vynálezů.

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