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Introduction

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The papers collected in this special issue of *Perspectives on Science* discuss the roles and notions of experience in the works of a range of early modern natural philosophers and physicians, including Galileo Galilei, Francis Bacon, the Dutch atomist David Goroelaeus, William Harvey, and Christian Wolff.

There are three reasons for considering medicine in connection with natural philosophy when studying early modern views on experience. First, influential discussions of experience since antiquity, including those of Aristotle (e.g., *Metaphysics*, 981 a 9–21) and his authoritative medieval commentators (Agrimi and Crisciani 1990, p. 24), make reference to medicine and employ medical examples. Second, early modern vocabulary relating to experience contains several terms and distinctions that emerged in medical circles following the recovery of ancient medical texts and then entered philosophical contexts. They include “observation,” “phenomenon,” and the contrast between first-hand and vicarious observation, *autopsia* and *historia* (Pomata 2011a, pp. 23–4; Pomata 2011b, pp. 65, 69). Third, looking at medical writings allows scholars to weaken or correct a number of general claims on the transformations of the notion of experience in the early modern period. Consider two examples.

The first is the shift from experiential to experimental empiricism (Koyré 1953, p. 222). It is often stated that the early modern period witnessed a shift from the reliance on mere experience to the reliance on experiment (e.g., Henry 2008, p. 34). Those who follow this narrative acknowledge that some experiments were performed in the late antiquity and Middle Ages. However, they typically add that the significance of

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experimentation only started to be acknowledged in the seventeenth century, first within mixed mathematics and then more generally (Dear 1995, 2006; Garber 2002). A recent study of sixteenth-century medical texts has shown that this reconstruction of the emergence of experimentation is incorrect (Ragland, unpublished). Decades before experimentation rose to prominence within mixed mathematics, anatomists were performing experimental trials, recognized their significance, and regarded them as being capable of proving or disproving general claims.

The second example concerns a related, but more encompassing narrative that identifies a shift from a *historical* to an *autoptic* notion (Baroncini 1992) or, as Peter Dear (1995, p. 21) puts it, from a *pre-modern* to a *modern* notion of experience.¹ According to the historical, pre-modern notion, experience is a body of self-evident, ordinary, commonly accepted knowledge of what happens “always or for the most part” (Judson 1991, pp. 82–9). Experience in this pre-modern sense is referred to in the singular form, as an *experientia longa*, formed over an extended period of time from the accumulation of numerous perceptual events in memory. It can be apprehended vicariously, through books and oral reports, and it can be relied upon without first-person verification (*autopsia*), in virtue of its being generally accepted. It does not typically serve as a testing ground for theories and hypotheses, but rather, as the basis for deriving natural-philosophical principles that are the starting point of *scientia*. By contrast, the modern notion of experience is of a singular event personally witnessed in a specific place and time, perhaps brought about as a result of experiments, and which establishes (or concurs to establish) matters of fact that can be used to infer, confirm, or refute theories and hypotheses. It is tempting to suppose, and it is sometimes claimed, that the pre-modern, historical notion of experience was distinctive of the Aristotelians, whereas the modern, autoptic notion was peculiar to the *novatores*.

A survey of medical texts is sufficient to disprove this supposition and to rule out any sharp contrast between Aristotelian and modern attitudes toward experience. On the one hand, conservative Aristotelian anatomists like Laurentius acknowledged the importance of first-person, autoptic experience (Wear 1983, pp. 227–30). On the other hand, *novatores* like Michel de Montaigne and Francis Bacon employed a rather traditional notion of experience, as being built slowly in the course of time, as the basis of their views on the preservation of health. However, they emphasized the *personal* dimension of this process, combining aspects of the historical and autoptic notions of experience (Pender 2006). More generally, an understanding of

1. What Dear calls the pre-modern notion is the prevailing notion of experience in Aristotle’s writings (Le Blond, 1973, pp. 267–8).

experience as slowly accumulated expertise was important for early modern physicians of all stripes, including learned and popular practitioners, Galenists and anti-Galenists (see e.g., Bianchi 2002; Goldberg 2016 [this issue]).

Turning from medicine to natural philosophy, several recent studies confirm that it would be wrong to draw a clear-cut distinction between the notions of experience of traditional and innovative authors. Aristotelian philosophers are often characterized as relying at most on “bookish” experience, based on *endoxa*, textual sources, and thought experiments, as opposed to the moderns’ emphasis on first-hand, sensory experience (Schmitt 1967, p. 358; Reif 1969; Murdoch 1982; Grant 2002). However, as regards the *roles* of experience, Aristotelian naturalists and meteorologists have been found to rely largely on direct observation as the basis for their claims (Ogilvie 2006, pp. 19–22; Martin 2011, pp. 1–2). As regards *notions* of experience, there were significant disagreements among Aristotelians on the relation of experience to perception and the intellect and on the role of experience in the acquisition of scientific knowledge.² Moving from the Aristotelians to the *novatores*, a traditional notion of *experientia longa* that derives from numerous perceptual episodes can be found in the works of Campanella (Ponzio 2004, p. 183), Hobbes ([1651] 1839, p. 6), Descartes and Pascal (Dear 1990, p. 677), among others. As for Galileo, despite some historians’ eagerness to crown him as the father of modern science, his notions and uses of experience have been found to reveal a complex combination of tradition and innovation (see e.g., Baroncini 1992, pp. 63–101; Dawes 2016 [this issue]).

Recent research does not only invite us to be cautious about general claims of large-scale conceptual change and sharp distinctions between old and new philosophies. It also reminds us that any claims about the transformation or evolution of early modern understandings of experience can only be established on the basis of a broad range of detailed case studies. The six essays gathered in this issue extend the evidential basis on which we can rely to identify trends, changes and continuities in the roles and notions of experience in the period of the Scientific Revolution (see also Sargent 1989; Burnett 1999; Fattori 2000, pp. 208–16; Fattori 2002; Stabile 2002; Klestinec 2010). Besides contributing to the exegesis of a diverse range of authors, the essays shed light on two broad aspects of the roles that early modern authors assigned to experience: the longstanding influence of traditional views and the emergence of early modern experimental philosophy.

2. See Heßbrüggen-Walter (2013, 2014) and Spinoza’s (2002) distinction between Thomist and Ockhamist notions of experience.

Craig Martin's paper surveys Renaissance and early modern uses of the aeolipile to explain the generation of winds. The aeolipile is a metal water container with one or two small openings. Once it is warmed up, jets of steam and air shoot forth from the openings, creating lateral wind-like currents. This is neither the kind of familiar, everyday experience to which traditional philosophers used to refer to, nor a contrived test that could decide among competing theories or explanations. Instead, the meaning given to this experience was largely determined by a broad set of assumptions, including definitions and theories of wind, air and its weight, rarefaction and condensation, and the different ways in which the aeolipile was thought to map onto natural phenomena (for instance, does the entire atmosphere act as a single aeolipile, or do hills and clouds create numerous natural aeolipiles?) Experiences with the aeolipile were made to fit with a broad range of theories in ways that do not map onto familiar distinctions between empiricists and rationalists or Aristotelians and their critics.

Helen Hattab's paper reconstructs the theory of universals of an opponent of Aristotelian orthodoxy, the Dutch atomist David Gorlaeus, and discusses his puzzling stance on the role of experience in the attainment of general notions. Like Hobbes and others, Gorlaeus holds that the mind can attain scientific knowledge through the orderly arrangement of general notions, which derive from experience. Objects do not provide those notions, but only sensory, image-like individual representations. One would expect Gorlaeus to explain what psychological processes generate general notions from experience and to emphasize the importance of observations and experiments as the basis of cognition. Not only does he refrain from explaining this, but his arguments against universals and intelligible species appear to bar any possibility of forming general notions.

Hattab solves this difficulty by proposing that Gorlaeus, like Suárez, rejects universals *in re*, but allows for universals *in intellectu* and holds that our sensible representations "come with built-in similarities among the sensible qualities" of individuals. Our intellect picks out such mind-independent similarities and relies on them to form universals. Hattab's interpretative strategy involves ascribing a limited appropriation of Aristotelian doctrines to an anti-Aristotelian. This entails that, with regard to the role of experience in the attainment of general notions, Aristotelian views persisted among anti-Aristotelians and divisions between the two camps were not as sharp as one may believe.

Turning from natural philosophy to medicine, more specifically to anatomy, William Harvey has been often portrayed as an exemplar of the attitudes of the *novatores*: the inventor of an observational epistemology that renounced the search for causes and advocated the search for purely factual knowledge (French 1994). Benjamin Goldberg's essay shows that

Harvey's understanding of *experientia* and of its role within anatomy is strongly indebted to traditional views. According to Harvey, *experientia* derives from an extensive training aimed at building up a repertoire of observations, at developing one's manual abilities, and at teaching a specific way of seeing, a skill in pattern recognition. This is the basis for judgments on the ends or functions of bodily parts. Harvey regards first-hand observation, its interaction with reasoning and manual skill, the compilation of *historiae anatomicae* and the pursuit of comparative anatomy as means to the end of identifying final causes. This shows that Harvey was not indifferent to causal knowledge and did not invent a purely observational epistemology. His mindset and his understanding of the role of experience were deeply informed by Aristotelian and Galenic assumptions.

A central development for the transformation of the notion of experience is the rise of experimental philosophy in England during the 1660s. The emphasis of experimental philosophers on experience in the new, autoptic sense, as opposed to what Dear calls the pre-modern notion, has been well documented (e.g., Anstey and Vanzo forthcoming). The essays in this collection focus on two unresolved issues concerning experimental philosophy. The first issue concerns the methodology of experiment, which was developed by Francis Bacon, the "Patriark of Experimental Philosophy" (Power 1664, p. 82). Although, as was noted above, experimental trials were performed in antiquity, the Middle Ages, and Renaissance, it is only in the works of Bacon that we find an articulate methodology for the performance of experiments. Dana Jalobeanu's paper discusses the relation between this methodology and Bacon's notion of *experientia literata*. The second issue concerns the geographical and chronological reach of the experimental philosophy movement. This is tackled in Gregory Dawes' and Matteo Favaretti Camposampiero's essays on Galileo and Wolff.

Scholars have often been puzzled by the seemingly contradictory aspects of Bacon's notion of *experientia literata* and by its eight modes, which are enumerated in *De augmentis scientiarum* (Bacon 1857–1874, vol. 4, pp. 413–21). Jalobeanu's paper interprets them as attempts to formalize the patterns of "good and exact inquiry," that Bacon follows in his experimental series, and to generalize them into a methodology of experimentation. Experimental series are methodically organized recordings of experiments. These may be grouped cursorily, on the basis of their common topic, or systematically, in virtue of their role within a structured research program. The more systematic series of experiments exemplify procedures like the controlled variation of parameters, generalization, analogical thinking and modeling, which are the modes of literate experience of the *De augmentis*.

Experimental series provide the organizing principle of Bacon's natural histories. They perform a heuristic and pedagogical role, for they direct experimental practice and teach the neophyte how to become a Baconian experimenter. They provide the model for the experimental natural histories of Robert Boyle and the early Royal Society and they are one of Bacon's main contributions to the emergence of experimental philosophy.

Dawes' paper discusses what role experience plays in Galileo's preferred style of natural-philosophical reasoning, in order to establish if Galileo can be classified as an experimental philosopher. According to Dawes, Galileo favors a non-syllogistic, geometrical style of demonstrative reasoning. In this context, the primary role that Galileo assigns to experience lies in establishing geometrical principles and their applicability to the world. This may seem similar to the experimentalists' view that natural philosophers must start by gathering empirical information which will eventually allow them to establish principles. However, Galileo regards the establishment of principles on the basis of experience as a prelude to geometrical demonstration. It is the latter that occupies center stage and possesses the probative force that makes natural philosophy a *scientia*, a demonstrative science in the traditional sense. Galileo's preferred style of reasoning, unlike that of experimental philosophers, does not mainly focus on experience, but on the mathematical certainty of demonstrations. Dawes concludes that Galileo's natural philosophy cannot be assimilated to experimental (or speculative) natural philosophy.

Turning from seventeenth-century Italy to early eighteenth-century Germany, recent studies have highlighted the empiricist aspects of Christian Wolff's epistemology (e.g., Paccioni 2004) and have identified affinities between his natural philosophical methodology and the views of experimental philosophers (Vanzo forthcoming). Favaretti Camposampiero's essay discusses whether Wolff's affinities with experimental philosophers extend to his views on medicine. Wolff follows experimental philosophers in stressing the importance of autoptic experience for establishing the matters of fact that justify medical claims. Yet, he opposes the anti-hypothetical rhetoric of experimental philosophers and physicians. In his view, hypotheses play an indispensable heuristic role and they are used as premises in medical reasoning. Other premises are borrowed from more basic parts of the system of the sciences, such as anatomy, chemistry, and teleology (the part of physics that studies natural ends). Central concepts of medicine, like the concept of symptom, derive their heuristic value from assumptions on causality that pertain to metaphysics. Wolff's defense of the usefulness of hypotheses and his emphasis on the reliance of medicine on disciplines like teleology and metaphysics are foreign to the outlook of experimental philosophers and complement his emphasis on autoptic experience. As in the cases of

Gorlaeus and Harvey, so too in Wolff's philosophy received notions of experience are combined with original views.

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