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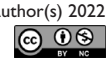

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"Put a mark on the errors": Seventeenth-century medicine and science

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Abstract

Error is a neglected epistemological category in the history of science. This neglect has been driven by the commonsense idea that its elimination is a general good, which often renders it invisible or at least not worth noticing. At the end of the sixteenth century across Europe, medicine increasingly focused on "popular errors," a genre where learned doctors addressed potential patients to disperse false belief about treatments. By the mid seventeenth century, investigations into popular error informed the working methodology of natural philosophers, rather than just physicians. In 1646, Thomas Browne published *Pseudodoxia Epidemica*, a large volume on popular error. Despite Browne's formal training as a physician, this work examined only a few medical errors and instead aspired to be an encyclopedia of error. *Pseudodoxia Epidemica* was highly popular, running to six editions, and was known by the Fellows of the Royal Society. Influenced by Browne, alongside Bacon's theory of the idols, natural philosophic practice in the late sixteenth and seventeenth century developed a focus on error that revised traditional attention to the discovery of knowledge. Fellows such as Robert Boyle and Robert Hooke proposed new ways to secure truth under the far-reaching influence of Bacon's refutations of "natural human reason" distorted by false idols, of syllogistic logic, and of "theories," his label for traditional philosophical systems that bias thought toward falsity. In three parts, this article traces the progression in early modern scientific approaches to handling error, and especially medical error – from physicians' efforts to identify and eradicate it through collaborative effort, to the striking tension in Browne's work between seeking to eliminate error while also showing a marked tolerance for it, to the Royal Society's Baconian objective of instrumentalizing error to

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find truth. Error emerges as its own epistemic category that serves as a driving force toward knowledge production.

Keywords
History of science, history of medicine, intellectual history, knowledge, truth, early modern, error, correction, Thomas Browne, Royal Society

Error is a neglected epistemological category in the history of science. This neglect has been driven by the commonsense idea that the elimination of error is a general good, which often renders it invisible or at least not worth noticing.[1] Yet error was a central preoccupation for early modern thinkers. Andreas Vesalius attempted to correct anatomical errors in Galen, Tycho Brahe aimed to eradicate errors in Ptolemaic astronomical tables, and Galileo's early work sought to correct Aristotle's various errors regarding falling bodies.[2] At the end of the sixteenth century across Europe, medicine increasingly focused on "popular errors," a genre where learned doctors wrote in vernacular languages, addressing potential patients to disperse false belief about treatments. In this genre, attitudes and anxieties toward error crystallized as university-trained physicians

1. Beyond Lorraine Daston's work, there has been no study of error in the early modern history of science. See Lorraine Daston, "Scientific Error and the Ethos of Belief," *Social Research* 72 (2005): 1–28. Other critical approaches identify a turn towards error in the early modern period, attributing it to various factors: Peter Harrison to Christian anxieties about sin, Sven Dupré to linguistic impoverishment, and Alice Leonard to literary creativity. Peter Harrison argues that there was a shift in early modern epistemology, driven by Christian-religious concerns with sin, where "the human propensity to invest false claims with the character of truth was attributed to Adam's fall." Peter Harrison, *The Fall of Man and The Foundations of Science* (Cambridge: Cambridge University Press, 1993), p.8. Sven Dupré argues that recording or archiving error in recipe books "seems to first emerge in the early modern period." Sven Dupré, "Doing It Wrong: The Translation of Artisanal Knowledge and the Codification of Error," in Matteo Valleriani (ed.), *The Structures of Practical Knowledge* (Cham: Springer International, 2017), pp.167–88, 167. Alice Leonard, *Error in Shakespeare: Shakespeare in Error* (Cham: Palgrave Macmillan, 2020). On the subject of error outside the early modern frame, see also Jed Buchwald and A. Franklin, *Wrong for the Right Reasons* (Dordrecht: Springer, 2005).
2. Throughout Daniel H. Garrison (ed.), *Vesalius: The China Root Epistle: A New Translation and Critical Edition*, trans. into English by Daniel H. Garrison (Cambridge: Cambridge University Press, 2015) and the preface to Andreas Vesalius, *On the Fabric of the Human Body, Vol. 1, Bones and Cartilages*, trans. into English by William F. Richardson and John B. Carman (San Francisco: Norman Publishing, 1998), pp.liii–liv. Tycho Brahe discovers errors in the astronomical calculations of both Ptolemy and Copernicus in Tycho Brahe, *De mundi aetherei recentioribus phaenomenis liber secundus* (1588). Discussed and partly translated in Ann Blair, "Tycho Brahe's Critique of Copernicus and the Copernican System," *Journal of the History of Ideas* 51 (1990): 355–77. Galileo Galilei, *Two New Sciences Including Centers of Gravity and Force of Percussion*, trans. into English by Stillman Drake (Toronto: Wall and Thompson, 1989), pp.61–7.

sought to establish their authority over less learned practitioners in the high stakes realm of life or death medical treatment.

By the mid-seventeenth century, investigations into popular error informed the working methods of natural philosophers, rather than just physicians. A key figure in this shift from medicine to natural philosophy is the English doctor Thomas Browne, who in 1646 published *Pseudodoxia Epidemica*, a large volume on popular error. Despite Browne's knowledge of popular errors literature and his own formal training as a physician, this work examined only a few medical errors and instead aspired to be an encyclopedia of error, covering astronomy, natural history, and religion. Furthermore, Browne's definition of popular error included error inherited from respected authorities. These same concerns for received error informed the official publications of the Royal Society. Its founding treatise called for an approach that questioned knowledge inherited from the "ancients," which it declared to be error-ridden.[3] Browne, as well as the early Royal Society, proposed new ways to secure truth under the far-reaching influence of Francis Bacon's refutations: of "natural human reason" distorted by false idols, of syllogistic logic, and of "theories," his label for traditional philosophical systems that bias thought toward falsity. The acknowledgment of error's pervasiveness was central to the manifest changes to observation and reason in the seventeenth century, and Fellows such as Robert Boyle and Robert Hooke proposed new methods in the attempt to correct it.[4] This article brings to light the ways in which early modern error, as an underestimated aspect of knowledge production, was identified, instrumentalized, corrected, and even delighted in. We trace, in three parts, the progression in early modern scientific approaches to handling error, and especially medical error – from physicians' efforts to identify and eradicate it through collaborative effort, to the striking tension in Browne's work between seeking to eliminate error while also showing a marked tolerance for it, to the Royal Society's Baconian objective of instrumentalizing error to find truth. Error emerges as its own epistemic category that serves as a driving force toward knowledge production.

Popular error in medicine

By the end of the sixteenth century, doctors across Europe began to address the errors held by their patients and their less educated medical rivals in popular errors treatises.[5] These works served to bolster the author's reputation by identifying error and locating it

3. Thomas Sprat, *The History of the Royal Society of London, For the Improving of Natural Knowledge* (London, 1667). See this article's section "The early Royal Society."
4. A significant new method was the social ratification of truth, and the Society insisted upon communal endeavor in its work to overhaul inherited knowledge. See Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England* (Chicago: Chicago University Press, 1994).
5. Popular errors literature drew on the importance of paradox to learned medicine where *paradoxa* taught students to reject popularly held but erroneous ideas about medicine. See Xavier De Saint-Aignan, "Vulgarisation médicale et mélange des genres: *Les songes de phestion* de Pierre Bailly (1634)," in Andrea Carlino and Michel Jeanneret (eds.), *Vulgarizer la médecine: du style médical en France et en Italie (XVIe et XVIIe Siècles)* (Geneva: Droz, 2009), pp. 137–148.

outside the realm of learned medicine.[6] The university-educated doctor called attention to and attempted to correct the erroneous beliefs of the average patient and unlearned medical practitioners in what Brockliss and Jones have called the "medical penumbra": "groups and individuals who, though invariably lacking formal training or corporative status, nevertheless operated either by custom or right within the medical domain."[7] The first of these works, published in 1578 by Laurent Joubert, was written in the vernacular in order to target a popular readership, and his work appeared within the context of a broader rise in vernacular medical works in the sixteenth century.[8] As William Eamon argues, physicians began to write in the vernacular both to combat the errors in the publications of their unlearned rivals and to encourage patients to pay for physicians rather than empirics.[9] The stakes of error were especially high in medicine where the decisions of patients and their caretakers were a question of life and death. Within this medical marketplace, Joubert emphasizes these risks to demonstrate his concern for the reader-patient's wellbeing and thereby establish his own trustworthiness.[10] The new editorial venture of "popular errors" is an attempt to leverage institutional authority to press his reading public into employing learned medical practitioners.

Although medical publication in the vernacular had expanded significantly over the course of the sixteenth century, it remained a controversial decision for a university-educated physician to publish guarded professional secrets for an audience literate in the vernacular. In Joubert's paratextual address to the reader, he justifies this decision by emphasizing that he intends his work to benefit young physicians whose patients question their judgment. His defense of these young doctors highlights the relationship between error and authority, as he attempts to build authority by singling out specific

6. For an overview of the genre that focuses on France, see Joël Coste, *La littérature des "Erreurs Populaires": Une Ethnographie médicale à l'époque moderne* (Paris: Champion, 2002). On the relationship between learned medicine and popular publication, see also William Eamon, *Science and the Secrets of Nature: Books of Secrets in Medieval and Early Modern Culture* (Princeton: Princeton University Press, 1994); and Brian Lawn, *The Salernitan Questions: An Introduction to the History of Medieval and Renaissance Problem Literature* (Oxford: Oxford University Press, 1963). Joubert's work is considered the first in the genre, which also includes Scipio Mercurio, *De gli errori popolari d'Italia* (1603); Gaspard Bachot continued Joubert's work in publishing *Partie troisième des Erreurs populaires* (1626); James Primerose's Latin *De vulgi erroribus in medicina libri IV* (1639) translated into English (1651) and into French (1689); Thomas Browne *Pseudodoxia Epidemica, or, Enquiries into Very Many Received Tenents and Commonly Presumed Truths by Thomas Browne* (London, 1646), discussed in this article; and Labrosse, *L'Abus des urines, ou les Erreurs du peuple concernant la médecine* (1679). https://catalogue.bnf.fr/ark:/12148/cb30705598q
7. Laurence Brockliss and Colin Jones, *The Medical World of Early Modern France* (Oxford: Oxford University Press, 1997), p.14.
8. Carlino and Jeanneret (eds.), *Vulgariser la médecine* (note 5).
9. Eamon, *Science and the Secrets of Nature*, p.103 (note 6).
10. On the medical marketplace, see Mark S. R. Jenner and Patrick Wallis (eds.), *Medicine and the Market in England and Its Colonies, c. 1450–1850* (New York: Palgrave Macmillan, 2007), pp.1–23. The argument that a patient might choose a medical practitioner without regard for the official hierarchies of education and licensure held true in France.

errors in medicine and correcting them. Furthermore, he casts entire social groups as faulty, admonishing patients for trusting those he characterizes as empirics, quacks, charlatans, and midwives.[11] As many of the sick would have been attended by women who were often members of the patient's family, Joubert also attacks the ignorance of women, which gives parts of the work a misogynist tone.[12]

Joel Coste argues that popular errors literature is "*un discours sur l'autre*" because its authors are learned doctors talking about the "other," specifically unlearned practitioners.[13] Yet Joubert does not only dismiss the medical "other"; he also encourages the patient-as-reader to identify with and even participate in his arguments for learned medicine.[14] For example, Joubert contends that aristocratic women make a grave error in sending their children to wet nurses, and advocates instead for breastfeeding by the mother. He expresses the widespread belief, dating back to antiquity, that the mother's milk has an effect on the personality of the child, and seeks to convince his female reader not to surrender this central feature of child rearing.[15] He claims,

> I write for good and virtuous women who only fail in their duty through ignorance. We are not concerned about foolish and wicked ones; they no more deserve to nurse children than to have them. For we would have to fear that if they nursed their children, the children also become wicked, and the world would become still more corrupt and troubled by their pernicious kind.[16]

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11. On practitioners in the medical marketplace, see William Eamon, "Markets, Piazzas, and Villages," in Lorraine Daston and Katharine Park (eds.), *The Cambridge History of Science, Vol. 3: Early Modern Science* (Cambridge: Cambridge University Press, 2006), pp.206–23.
12. See, for example, Joubert's chapter lamenting that the women attending patients too often ignore the physician's advice about food. Laurent Joubert, *Popular Errors*, trans. into English by Gregory de Rocher, (Tuscaloosa: The University of Alabama Press, 1989), pp.80–4. For the French, see Laurent Joubert, *Erreurs populaires* (Bourdeaux, 1579), "Montaigne's Library." University of Cambridge Digital Library, pp.108–17 [https://cudl.lib.cam.ac.uk/view/PR-MONTAIGNE-00001-00007-00034/55] (14 September 2020). All translations and quotes from Joubert are drawn from these two editions. This is Joubert's most misogynist chapter, and it was excluded from later editions, possibly due to Joubert's aim to reach a female readership, see n. 14.
13. Coste, *La littérature des* "*erreurs populaires,*" p.123 (note 6).
14. The feminine pronoun is used deliberately. Joubert imagines an audience of readers that includes women. The book is dedicated to a woman, the Princess Marguerite de Valois, which sparked a scandal given its frank discussion of women's sexual and reproductive health. Though the book is often misogynistic against female practitioners, it aims to educate a reading public that includes women. On the controversy surrounding the dedication, see Valerie Worth-Stylianou, "The Definition of Obscene Material 1570–1615: Three Medical Treatises Held to Account," in Anne L.Birberick, Russell J. Ganim and Hugh G. A. Roberts (eds.), *Early Modern French Studies 14: Obscenity* (Charlottesville, VA: Rockwood Press, 2010), pp.148–67; Sarah Parker, "Reading and Viewing Sex in Early Modern French Vernacular Medicine," *Renaissance and Reformation/Renaissance et Réforme* 38 (2015): 65–88.
15. The idea that bodily fluids carried elements of a person's temperament was a feature of ancient humoral theory. See Nancy Siraisi, *Medieval and Early Renaissance Medicine: An Introduction to Knowledge and Practice* (Chicago: University of Chicago Press, 1990), pp.101–2.
16. Joubert, *Popular Errors*, trans. by De Rocher, p.195; Joubert, *Erreurs populaires*, pp.257–8 (note 12).

Despite his insistence on the importance of medical authority, represented by the learned physician, Joubert here invites the ill-informed mother to share in specialist knowledge through the eradication of error. In associating what he identifies as a medical error with a moral shortcoming, he draws on the discursive connection between error and morality that would have been familiar to his reader to convince her to breastfeed her own children. Joubert appeals to his reader's intelligence and commonsense as a way of eradicating error, even as he elsewhere excludes women and the uneducated from his definition of medical authority.

Joubert goes so far as to invite his readership into the authorial process. In his address to the reader in the 1579 edition, he encourages those who read his book to participate in the composition of future editions by sending him popular beliefs about medicine that he will incorporate into expanded publications on this topic:

> Thus, I pray you, my friendly reader (whatever your station or profession), you who are neither opinionated nor obtuse, but broad-minded, refined, and studious, to be willing to help me. Favor me by sending whatever popular sayings you are able to encounter, and I will arrange them according to categories in order to discuss them, just as I do herein. I will then know that this labor of mine has been pleasant for you, and that you, too, wish to pursue it until I finish all that I have promised you.[17]

While his work is an assertion of the authority of his elite training, Joubert's invitation nevertheless embraces an epistemology of unconventional communal learning. He perceives error not only as a problem, but also as an opportunity for knowledge production that requires group effort, extending beyond the boundaries of the university and the profession. He recognizes the importance of communal effort in addressing and eliminating common misconceptions about medicine, a practice that would characterize the later cooperative efforts of learned societies such as the Royal Society.[18]

Joubert's call for errors captured the attention of another learned physician, Scipio Mercurio (c.1540–1615), who responded with an entire publication: *De gli errori popolari d'Italia* (1603). Like Joubert, Mercurio is eager to blame error on others as a strategy for protecting the reputation of learned medicine. His tone throughout is more defensive

17. Joubert, *Popular Errors*, trans. by Du Rocher, p.25; Joubert, *Erreurs populaires*, p.51 (note 12).

18. In this way, Joubert's vision for improving medical knowledge and medical treatment for the masses can also be interpreted as a precedent to physician Théophraste Renaudot's idea to treat the rural poor through questionnaires. See Alexandre Wenger, "Rendre un grand bien communicable: La Presence des absens de Théophraste Renaudot," in Carlino and Jeanneret (eds.), *Vulgarizer la médecine*, p.244 (note 5). Renaudot also set up a Bureau d'Adresse in Paris where he held conferences "during which questions of the most diverse and encyclopedic nature were discussed with extraordinary enthusiasm by all kinds of people – it being the rule that anyone who was interested in such matters could attend." These conferences were important precedents to the foundation of the Royal Society, as Samuel Hartlib envisioned a similar project on a vaster scale. See Lawn, *The Salernitan Questions*, pp.142–3 (quotation on p.142) (note 6), and Kathleen Anne Wellman, *Making Science Social: The Conferences of Théophraste Renaudot, 1633–1642* (Norman, OK: University of Oklahoma Press, 2003).

than that of Joubert, but he nevertheless invites the reader to identify and reject errors that may infect her way of thinking. In a chapter on food and its effect on the body, for example, Mercurio appeals to his reader by depicting a scenario where the beleaguered physician takes a moment's break from the sickbed, only to return to find that a foolish housewife or child has given the sick person wine or fruit, which he claimed caused the death of the patient.[19] The exasperated narrator pleads with his audience to avoid such mistakes, which endanger the reputation of the physician but also the life of the patient. For Joubert, Mercurio, and others, publishing in the vernacular was a strategy to reach an audience of patients and their caretakers and involve that audience in their attempts to correct, or at least reduce, life-threatening errors.

Pseudodoxia Epidemica: Error everywhere

From the end of the sixteenth century, Joubert, Mercurio, and their followers established a genre that turned error into its own epistemic category, as readers and authors responded to each other's assertions on popular error. Seven decades later we see the evolution of this culture of correction with Thomas Browne's *Pseudodoxia Epidemica* (1646). Although Browne was a university-educated English physician who had trained in Montpellier, Padua, and Leiden and was familiar with this continental tradition, his work takes a very different approach. Rather than focusing exclusively on medical error, Browne begins his account with the Fall of humankind, as recounted in Genesis, and characterizes error as a testament to the fallen nature of man's knowledge of things.[20] He believes that Satan is in all of error as its "invisible Agent," and is the father of error.[21] This all-encompassing perspective is far removed from the genre's applied medical focus. Browne devotes attention to a huge diversity of objects, from mineral and magnetic worlds, insects, plants and animals, to pictures, and biblical and classical worlds. Rather than protecting the health of the patient and the reputation of the physician, the purpose of identifying error is to uphold the intention declared on the opening page: "to purchase a clear and warrantable body of Truth."[22]

Browne states that he has read both Joubert and Mercurio, in addition to other authors of popular errors treatises. Despite the work of his predecessors, he nevertheless claims, "we find no open tract, or constant manuduction in this Labyrinth; but are oft-times fain to wander in the America and untravelled parts of Truth." [23] Browne believes he is in

19. Mercurio, *De gli errori popolari d'Italia* (Venice, 1603), p.164 v (note 6).
20. Achsah Guibbory, "Thomas Browne's 'Pseudodoxia Epidemica' and the Circle of Knowledge," *Texas Studies in Literature and Language* 18 (1976): 486–99.
21. Browne, *Pseudodoxia Epidemica*, p.37 (note 6). Browne's handling of the devil in error is inconsistent. In Chapter 10, "Of the Last and Common Promoter of false Opinions, the Endeavours of Satan," Browne attributes all error to the devil. Here his tone shifts from the speculative and digressive to confidently asserting theological truth. Yet after Chapter 11, "A Further Illustration," Satan is not mentioned again, which is puzzling given the strength of Browne's attribution. This is a complex issue and is too large to address in full within the scope of this article.
22. Browne, "To the Reader," *Pseudodoxia Epidemica*, Sig. a3 r (note 6).
23. Ibid., Sig. a4 r (note 6).

uncharted territory because previous researches are too limited in their scope: "Scipio Mercurii, hath also left an excellent tract in Italian, concerning popular Errors; but confining himself only unto those in Physick, he hath little conduced unto the generality of our doctrine. Laurentius Joubertus, by the same Title, led our expectation into thoughts of great relief; whereby notwithstanding we reaped no advantage; it answering scarce at all the promise of the inscription."[24] Though Joubert and Mercurio in fact keep their promise to "extinguish and annihilate several false notions and errors . . . that have long had credence and vogue in medicine, surgery, and pharmaceutics," their sense of error is only medical.[25] Browne's approach to error is much broader because it is influenced by Baconian intellectualism concerning the "actual art of interpreting nature," which is the "truer exercise of the intellect" rather than the pragmatics of medicine.[26] Though Browne admits the qualities of his continental predecessors, he argues that popular error is a topic that extends well beyond the purview of medicine. The genre of popular error is an important starting point for Browne, but his work transforms error into a philosophical rather than practical problem, from a life-threatening matter into a curious quality that is worth exploring for its own sake.

Pseudodoxia Epidemica is a vast catalog of errors that offers a large, formalized body of false beliefs, yet their correction into truth is most often an elusive end. Where Joubert and Mercurio take on the confident tone of a physician addressing his patient, Browne insists that "wee are not Magisteriall in opinions, nor have wee Dictator-like obtruded our conceptions, but in the humility of Enquiries or disquisitions, have only proposed them unto more ocular discerners."[27] *Pseudodoxia Epidemica* does not aim to secure knowledge through the eradication of error, as Browne hesitates at the stage before correction. In *Religio Medici* (1643), a slightly earlier publication, he argues that "there are many things to be taken in a soft and flexible sense, and not to be called unto the rigid test of reason."[28] Under certain circumstances, Browne envisions truth as clear and graspable, but he more often shrinks from this confidence. He lacks the magisterial confidence of Joubert and Mercurio because of both his religious view that the world is irrecoverably fallen and the influence of a newer Baconian model of knowledge that encourages gathering observations without imposing causal reasoning that might reintroduce error.[29] Browne's work combines the continental popular errors genre with a response to Bacon's call to create a "*Kalender of popular Errors*" so "that Mans knowledge be not weakened

24. Browne, "To the Reader", Sig. a4 r.
25. Joubert, *Popular Errors*, trans. by De Rocher, p.28 (note 12).
26. Francis Bacon, *The Oxford Francis Bacon, Vol. 11: The Instauratio Magna Part II: Novum Organum and Associated Texts*, Graham Rees and Maria Wakely (eds.) (Oxford: Oxford University Press, 2000), p.49.
27. Browne, "To the Reader," *Pseudodoxia Epidemica*, Sig. a6 r (note 6).
28. Thomas Browne, "To the Reader," *Religio Medici* (London, 1643), Sig. a2 v.
29. On Bacon's resistance to causal explanation, see Margaret L. Wiley, "Francis Bacon: Induction and/or Rhetoric," *Studies in the Literary Imagination* 4 (1971): 65–80; Sara Miglietti, "New Worlds, Ancient Theories: Reshaping Climate Theory in the Early Colonial Atlantic," in James Marroquín Arredondo and Ralph Bauer (eds.), *Translating Nature: Cross-Cultural Histories of Early Modern Science* (Philadelphia: University of Pennsylvania Press, 2019), pp.214–20.

nor imbased by such drosse and vanitie."[30] Yet Browne's interest in the opinions of "ancient" authors often distracts him from pursuing them for truth. Whereas Bacon is clearer on the need to jettison the accumulation of faulty knowledge from the past, Browne is more tolerant of existing textual traditions. He often treats a question in scholastic fashion, citing the various authorities on either side.[31] As Robin Robbins argues, many of the chapters are not accounts of particular experiments, "rather they synthesize ancient and modern opinions . . . clearing the path for subsequent investigators."[32] Browne's method and his own claims about it, however, are inconsistent, as he collects "ancient" sources from his reading while at the same time arguing that "knowledge is made by oblivion," asserting the need not to revise but to reset.[33]

Browne gathers knowledge, weighs and doubts it, refusing to give "assent" to "popular affirmations." Skepticism is his useful tool and his method allows for the possibility of truth to be apprehended, even if its arrival is deferred.[34] Browne, like Bacon, wishes to marshal doubt. Bacon expresses the fear that he may be mistaken for a skeptic and draws attention to his desire to arrive at certain knowledge by this means:

> People will also think, because I have sought to restrain peremptory opinions and the laying down of fixed principles until one duly arrives at the most general ones by way of intermediate steps, that I am advocating suspension of judgement and bringing everything down to *Acatalepsy*. But what I have in mind and recommend is not *Acatalepsy* (that knowledge is unattainable) but *Eucatalepsy* (that is attainable by the right route). For I do not undermine the sense but minister to it; nor do I despise the intellect but regulate it.[35]

The "restraint" of fixed principles until the "right route" is arrived at is coherent with Browne's hesitancy. Bacon and Browne are not Pyrrhonian skeptics; knowledge is possible through Eucatalepsy, yet it is difficult to achieve and certainty is fraught. It is for these reasons that Browne frequently declares pieces of knowledge to be held erroneously but does not correct these beliefs or offer any suggestion of how this might be done.

For example, in his chapter "Of Swimming," Browne raises a set of difficulties in knowing whether certain things are true. He casts doubt on the popular beliefs that

30. Francis Bacon, *The Oxford Francis Bacon, Vol. 4: The Advancement of Learning*, Michael Kiernan (ed.) (Oxford: Oxford University Press, 2000), p.91.
31. Robin Robbins (ed.), *Sir Thomas Browne's Pseudodoxia Epidemica*, Vol. 2 (Oxford: Oxford University Press, 1981), p.xxxvii.
32. Ibid., p. xxxvii (note 31).
33. Browne, "To the Reader," *Pseudodoxia Epidemica*, Sig. a3 r (note 6).
34. Brian Cummings describes Browne's approach in *Pseudodoxia Epidemica* as one of "rough skepticism." Brian Cummings, "Pliny's Literate Elephant and the Idea of Animal Language in Renaissance Thought," in Erica Fudge (ed.), *Renaissance Beasts: Of Animals, Humans, and Other Wonderful Creatures* (Champaign: University of Illinois press), pp.164–85, 164. See also Andrew Cunningham's account of Browne's skepticism in Andrew Cunningham, "*Religio Medici*: Sir Thomas Browne and his *Religio Medici*: Reason, Nature and Religion," in Ole Peter Grell and Andrew Cunningham (eds.), *"Religio Medici": Medicine and Religion in Seventeenth Century England* (Aldershot: Ashgate, 1996), pp.12–61.
35. Bacon, *The Oxford Francis Bacon*, vol. 11 pp.190–1 (note 26).

drowned men float on the ninth day "when their gall breaketh," that drowned women float face down, and drowned men face up.[36] Here and throughout *Pseudodoxia Epidemica*, Browne is unafraid to raise problems that he cannot solve. He cites one explanation for why women float downwards, caused by the weight of their breasts, yet this "take not away the doubt," because he claims that girls (without breasts) also float face down when drowned.[37] Although Browne describes these as "popular affirmations, whereto we cannot assent," by the end of the chapter he self-consciously stops himself from providing further explanation or correction: "hereof we cease to discourse lest we undertake to afford a reason of the golden tooth,* that is to invent or assigne a cause, when we remain unsatisfied or unassured of the effect."[38] The "golden tooth" is alleged to have been grown by a seven-year-old Flemish boy.[39] Browne uses this image to reject faulty reasoning, that to assert knowledge of the cause or effect of something when we are unsure is a "reason of the golden tooth" – curious, exceptional, spectacular, baffling, attractive because it is potentially spurious, but also doubtful. Browne senses that, in fact, common error should not be corrected, because in attempting to correct it, we risk introducing further errors. Instead, he calls attention to error in a way that disparages popular credulity.

Browne prefers to end the discussion rather than create faulty belief by asserting false truth, and in the first edition this is where the chapter ends. Yet subsequent editions suggest Browne's dissatisfaction with this limit of knowledge. *Pseudodoxia Epidemica* was a highly popular work that saw six editions across Browne's lifetime. He corrected and revised each edition in preparation for the next, drawing on his latest reading and experiment, and the second (1650), third (1658), and sixth (1672) editions contain substantial changes. In this chapter, Browne appends a paragraph where his refusal to let the subject rest is driven by his desire to move toward more certain knowledge. Bacon asserts that the purpose of proposing doubts is that they "are so many Sponges which continually suck and draw in unto them an increase and improvement of Knowledge."[40] As Browne gets drawn back to this chapter after its publication, we can see both his attempts to "improve" knowledge and his inability to do so. He adds another example of a related common error, that mares drown more quickly than horses, but this only serves to raise more questions.[41] "Experience" and its synonym "experiment" are positioned as a means to secure knowledge, yet their inaccessibility prevents him from closing the chapter with more certainty. The "authority" of previous authors also provides him with no further clues, as it does in other chapters.[42] The hesitant style of *Pseudodoxia Epidemica* is

36. Browne, *Pseudodoxia Epidemica*, p.193 (note 6).
37. Ibid., p.195.
38. Ibid., p.193, 195.
39. See Robbins (ed.), *Sir Thomas Browne's Pseudodoxia Epidemica*, p.916 (note 31).
40. Bacon, *The Advancement of Learning*, p.91 (note 30).
41. Thomas Browne, *Pseudodoxia Epidemica, or, Enquiries into Very Many Received Tenents and Commonly Presumed Truths by Thomas Browne* (London, 1672), p.230.
42. Browne identified three "determinators" of Truth: "Sense, Authority and Reason." The "authority" of previous authors was a significant source of information when reasoning error. Yet Browne is highly contradictory on this point of authority, arguing that "the mortallest enemy unto Knowledge, and that which hath done the greatest execution upon truth, hath been a peremptory adhesion unto Authority, and more especially, the establishing of our belief upon the dictates of Antiquity." Browne, *Pseudodoxia Epidemica*, p.20 (note 6).

yoked to Browne's hesitant empiricism, as he is unable to conduct tests that enable him to draw conclusions with certainty. For example, on the subject of how drowned people without legs float, he admits "we have not made experiment."[43] This question is illuminated by a gory parallel to nonhuman animals, that their drowning is "observable [...] when the hinder legges are cut off."[44] The revision suggests his desire to improve knowledge, or his familiarity with this methodology through revision, yet the printed work demonstrates the difficulties in doing so. Nevertheless, this does not prevent Browne from pondering error even when it cannot be identified with any certainty because, following Bacon's imperative to gather, these speculations are inherently valuable.[45]

We can see elsewhere in Browne's work that empiricism or observation is a useful method in identifying error. His extensive notebooks detail his own observations, especially in the natural world, some of which he transfers into his printed works as an addition of knowledge, or its correction. For example, he records an experiment concerning moles:

> Wee intred a moll, a toade, & a viper in one glasse, within half an hour the moll eate up half the viper leaving the tayle and harder parts, destroyed the toad, eat part of the entralls, dyed the next day . . . wh. I imputed not unto soe . . . or large a meale for they will not commonly live above a day or 2 out of earth.[46]

Browne uses this observation to expand his chapter "Of Moles, or Molls" in the sixth and final edition (1672):

> though they be contented with Roots, and stringy parts of Plants, or Wormes under ground, yet when they are above it, will sometimes tear and eat one another, and in a large glass wherein a Moll, a Toad, and a Viper were inclosed, we have known the Moll to dispatch them and to devour a good part of them both.[47]

Comparison between the notebook entry and Browne's revision of it for *Pseudodoxia Epidemica* shows the details of the event as they were observed being edited out for print. In the notebook, for example, we have precise testimony about what Browne (and

43. Browne, *Pseudodoxia Epidemica*, p. 230 (note 41).
44. Ibid., p. 230 (note 41).
45. In this way, Browne's style could be described as Baconian. Scholarship on the connection between Bacon's accumulative style and his belief that knowledge was disassembled is vast. See in particular Vera Keller's work on Baconian desiderata, which, she argues, "made failure the key to . . . future success." Vera Keller, *Knowledge and the Public Interest, 1575–1725* (Cambridge: Cambridge University Press, 2015), p.128. Bacon uses aphorism similarly. See Stephen Clucas, "'A Knowledge Broken': Francis Bacon's Aphoristic Style and the Crisis of Scholastic and Humanist Knowledge-Systems," in Neil Rhodes (ed.), *English Renaissance Prose: History, Language, and Politics* (Tempe: University of Arizona Press, 1997), pp.147–72. Aphorism, like paradox, is also an important stylistic influence on the popular errors genre.
46. Geoffrey Keynes (ed.), *The Works of Sir Thomas Browne*, 4 Vols. (London: Faber & Faber, 1964), Vol. 3, p.366.
47. Browne, *Pseudodoxia Epidemica*, p.169 (note 41).

possibly others) did, what they observed, and over what time scale. We learn that the mole ate the viper within half an hour, leaving the tail and "harder parts" behind, then killed the toad and ate its insides, before dying the next day. In *Pseudodoxia Epidemica*, however, Browne reduces this to the fact that the mole "dispatched" the viper and toad. From notes to print, the rhetoric of the testimony changes. In *Pseudodoxia Epidemica*, the outcome of this animal battle is something that "we have known," an imprecise description of the number of times this occurred or the likelihood of the same result being observed if it were repeated. The more detailed version of the experiment as it appears in the notebook provides a more compelling and reliable contribution to knowledge than Browne chooses to represent in the much more widely accessible printed form in *Pseudodoxia Epidemica*. This suggests his intention in publication is to exemplify and display error rather than to convince the audience of its correction.

Browne's stated intention at the beginning of *Pseudodoxia Epidemica* is to "purchase a clear and warrantable body of Truth" by identifying error and casting doubt upon belief.[48] Yet once he has laid out these primary intentions, we see in the body of the work that this is complicated and difficult to achieve. For example, he examines the belief that the heart sits in the left-hand side of the chest, which he claims "is refutable by inspection."[49] Yet he also notes "wee shall not quarrel if any affirme it is seated toward the left."[50] In Baconian fashion, Browne fails to mark one belief as erroneous and the other correct, despite his medical training. According to Sharon Cadman Seelig, Browne's method of argumentation often "occupies the skeptical posture of not *yet* believing."[51] The cumulative effect of his work is to draw attention to error, highlight it and its grave epistemological dangers, and incite the reader to take action against it with confirmed moral endeavor. He refers cynically to the "exacter performances" of the "learned Philosophers and criticall Philologers" who claim to hold the truth.[52] Rather than profess to hold truth, Browne's skepticism makes error into an object to hunt and know.[53]

In reflecting on the status of his book, Browne is "humbly acknowledging a worke of such concernment unto truth, and difficulty in its selfe, did well deserve the conjunction of many heads."[54] For Browne as well as Bacon and, in a different epistemological model, Joubert and Mercurio, the identification of error is the necessary precursor to truth because it stimulates the activity of thought. Yet Browne's reluctance to exit this mode of negative searching means that *Pseudodoxia Epidemica* remains an account of error that can only hope for the "conjunction of many heads," where a society of thinkers may advance this

48. Browne, *Pseudodoxia Epidemica*, Sig. a3 r (note 6).
49. Browne, *Pseudodoxia Epidemica*, p.213 (note 41).
50. Ibid. (note 41).
51. Sharon Cadman Seelig, "'Speake that I may see thee': The Styles of Sir Thomas Browne," in Reid Barbour and Claire Preston (eds.), *Sir Thomas Browne: The World Proposed* (Oxford: Oxford University Press, 2008), pp.13–35, 26. On the many variations of Browne's method across his publications, see Cadman Seelig.
52. Browne, *Pseudodoxia Epidemica*, p.320 (note 41).
53. William N. West, "Brownean Motion: Conversation Within *Pseudodoxia Epidemica*'s 'Sober Circumference of Knowledge'," in Reid Barbour and Claire Preston (eds.), *Sir Thomas Browne: The World Proposed* (Oxford: Oxford University Press, 2009), pp.168–87, 174.
54. Browne, *Pseudodoxia Epidemica*, Sig. a4 v (note 6).

initial, somewhat tentative investigation. Given Browne's Norfolk location, far from London society, he may have been especially aware of the drawbacks of his solitary intellectual endeavor. In a similarly skeptical vein, where Joubert and Mercurio are optimistic about their works' ability to correct popular error, Browne believes that "Books do not redress" the common people.[55] The explicit agenda of correction pursued by previous authors of popular errors is absent with Browne. He distances himself from the imperious tone of his predecessors because of his belief that, while an author can attempt the encyclopedic task of enumerating error, replacing error with truth is beyond the capacity of any fallen individual and risks reintroducing error through faulty causal logic.

Yet Browne does not entirely dispense with the search for truth. Instead, he defers it to "the correction of future discovery."[56] Crucial to this is his strategy of publication. Browne was not a member of the Royal Society, perhaps simply because of his Norwich location, yet he had links with members and was interested in much the same material.[57] Especially after the publication of the hugely successful *Pseudodoxia Epidemica* (1646), Browne was celebrated by many of the leading scientists of the day, with whom he corresponded.[58] Rather than the physical, communal witnessing of the Society, which has received much recent scholarly attention, Browne instead imagines a paper network of engagement, response, and correction: "And we shall so far encourage contradiction, as to promise no disturbance, or re-oppose any Pen, that shall fallaciously or captiously refute us."[59] He claims that his work is "Ready to be swallowed in any worthy enlarger," a reader who will "add and ampliate," who will take further his various investigations.[60] Browne's work on error makes it, in turn, a magnet for correction. As Harriet Phillips argues, *Pseudodoxia Epidemica* receives above-average frequency of annotation in comparison with contemporary printed books, some featuring an extreme amount.[61]

Browne finds his ideal reader in an anonymous responder who takes great care to attend and correct even the smallest of Browne's claims. In an edition of *Pseudodoxia Epidemica* now in the Wellcome Trust Library, a near-contemporary reader seeks to correct Browne's claim in Book Two, Chapter Five, that "such lightnings do seldom any harm."[62] The corrector asserts instead the "Vile Effect of Lightning," as they write in the

55. Ibid., Sig. a5 v.
56. Ibid., p.20.
57. As Claire Preston claims, "physical proximity to scientific fashion is only one measure of civil involvement." Claire Preston, *Sir Thomas Browne and the Writing of Early Modern Science* (Cambridge: Cambridge University Press, 2005), p.33.
58. Kathryn Murphy, "'The Best Pillar Of The Order Of Sir Francis': Thomas Browne, Samuel Hartlib and Communities of Learning," in Richard Todd and Kathryn Murphy (eds.), *"A Man Very Well Study": New Contexts for Thomas Browne* (Leiden: Brill, 2008), pp.273–94.
59. Browne, *Pseudodoxia Epidemica*, Sig. a6 r (note 6). On the role of publication in the Royal Society, see Adrian Johns, "Reading and Experiment in the Royal Society," in Kevin Sharpe and Steven N. Zwicker (eds.), *Reading, Society and Politics in Early Modern England* (Cambridge: Cambridge University Press, 2003), pp.244–72.
60. Browne, *Pseudodoxia Epidemica*, Sigs. a6r-b1v (note 6).
61. Harriet Phillips, "Common Errors, Common Readers: Thomas Browne's *Pseudodoxia Epidemica* and the Scientific Public, 1646–c.1800," *Studies in Philology* 117 (2020): 151–200, 154.

margin, and interleaves a page to expand upon this counterclaim. The addition contains a report from "24 of Jan. 166$^{5/6}$" of "mr Brooks of Hampshire," traveling to his house at Andover "in a very bad weather." Brooks was struck by lightning, killing him and his horse. He "was found wth his face beaten into y^{e} Ground," "his Cloaths all burnd," and "his saddle torn in little pieces" (see Figure 1).[63]

The report details the way Brooks was found and how exactly the scene appeared, with "y^{e} Leg in y^{e} Stirrup, y^{e} other in y^{e} Horses Mane." This is a spectacular way to disprove Browne's claim, leaning on sensational details to add weight to their correction. Interleaving a page with this detailed anecdote provides both the justification as to why Browne is wrong and acts as a repository for the corrected information. Rather than drawing on his own experience, this reader copies the story from the *Philosophical Transactions of the Royal Society* (1666). This incident illustrates the importance of print and the early network of scientific readership to both Browne and the early Royal Society. When Browne states, "Many more there are whose serious enquiries we must request of others, and shall only awake considerations," this is exactly the response he would have imagined, and it is significant that his community is a textual one.[64]

On the eve of its foundation, one of the Royal Society's prime movers, John Evelyn, wrote to Browne on 28 January 1659/60 wishing for "a society of Learned and ingenuous men, such as Dr. Browne, . . . by whome we might hope to redeeme the tyme that has bin lost, in pursuing vulgar errours, and still propagating them, as so many bold men do yet presume to do."[65] Evelyn solicits Browne's attention to error in order to "redeeme the tyme that has bin lost," by inheriting faulty belief. Browne's universalizing approach to error as a philosophical tool is called upon to advance knowledge for the new gathering of "ingenuous men." He was, in turn, responding to Bacon's warnings about the "idols" of the mind that are certain routes to errors of thought. These include the idols of the Tribe, of the Cave, of the Market and of the Theater.[66] For Bacon, thought is dangerously misled by human nature, inherited notions, language, and dogmatic philosophy, respectively. He argues that these "*Idols* and false notions . . . garrison the human intellect."[67] As has been extensively covered, the works of Francis Bacon had a profound impact on the establishment of the Royal Society.[68] They presented themselves as embodying "Solomon's House," a group of experimental philosophers Bacon described in his scientific utopia, *New Atlantis* (1626).[69] A significant part of the Society's Baconian

62. This 1669 edition of *Pseudodoxia Epidemica* is held by the Wellcome Trust Library, 15731/B, (leaf inserted pp.90–1).
63. Full transcription available from Thomas Neale, "*A Relation of a Sad Effect of Thunder and Lightning*," in *Philosophical Transactions*, Vol. 1, no. 14, pp. 247–248.
64. Browne, *Pseudodoxia Epidemica*, p.208 (note 41).
65. John Evelyn quoted from Robbins (ed.), *Sir Thomas Browne's Pseudodoxia Epidemica*, p.xlvi (note 31).
66. Bacon, *The Oxford Francis Bacon, Vol. 11*, p.79 (note 26).
67. Ibid., p.79, 55.
68. See Marie Boas Hall, *Promoting Experimental Learning: Experiment and the Royal Society, 1660-1727* (Cambridge: Cambridge University Press, 1991); and William T. Lynch, "A Society of Baconians?: The Collective Development of Bacon's Method in the Royal Society of London," in J. R. Solomon and C. G. Martin (eds.), *Francis Bacon and the Refiguring of Early Modern Thought: Essays to Commemorate The Advancement of Learning (1605–2005)* (London: Routledge, 2005), pp.173–202.

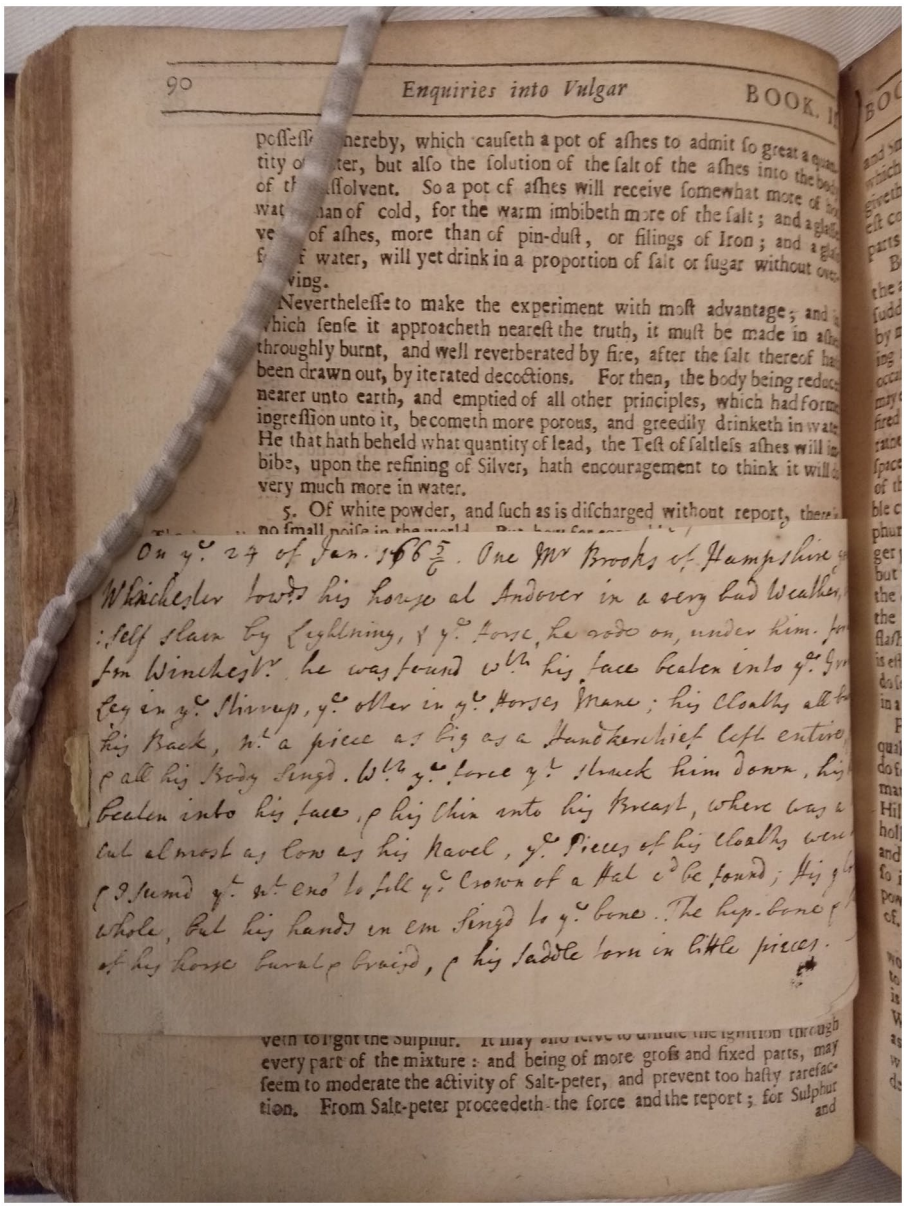

Figure 1. Thomas Browne, *Pseudodoxia Epidemica* (1669), leaf inserted pp. 90–1. Wellcome Trust Library, UK, 15731/B.

inheritance was the search for error, attention to misleading "idols" of belief, and overhauling faulty or flawed knowledge using new methods of investigation. Browne brought Baconian thought to the attention of the Royal Society in new ways, shifting focus from the treacherous processes of thought to their faulty consequences. His highly popular *Pseudodoxia Epidemica* was clearly read by the Fellows, and compounded the importance of error for the Royal Society, as Evelyn suggests. Under the influence of Bacon and Browne, the search for error became a novel method within the new experimental philosophy.

The early Royal Society

In his *History of the Royal Society* (1667), the Society's chief apologist, Thomas Sprat, consistently asserts that the spirit of correction is essential to the Society's professed methodology.[70] He defines their mission as follows:

> Their purpose is, in short, to make faithful Records, of all the Works of Nature, or Art, which can come within their reach: that so the present Age, and posterity, may be able to put a mark on the Errors, which have been strengthned by long prescription: to restore the Truths, that have lain neglected: to push on those, which are already known, to more various uses: and to make the way more passable, to what remains unreveal'd.[71]

Sprat argues that the Fellows must "put a mark on the Errors," to identify and even emphasize them so they can be corrected. Sprat, following Bacon and Browne, advocates sustained attention to error, collecting and marking it. He describes not only the Society's purpose but its method as having error at its center: "The *Truths*, which he learns this way, will be his Pattern; the *Errors* will be his Seamarks, to teach to avoid the same dangers; the very falshoods themselves will serve to enlarge."[72] Errors are conspicuous objects that warn navigating sailors: when surveying a landscape, they shape understanding. Errors will "serve to enlarge," that is, to "ampliate" and increase knowledge. Sprat asserts a working method for the Royal Society, where errors are instrumentalized because they guide against repeating mistakes and in themselves can expand understanding.

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69. On the 'community' of the Royal Society, see Anne Goldgar, *Impolite Learning: Conduct and Community in the Republic of Letters, 1680–1750* (New Haven: Yale University Press, 1995), pp.12–53; and Peter Dear, "'Totius in verba': Rhetoric and Authority in the Early Royal Society," *Isis* 76 (1985): 144–61.
70. Sprat was an elected Fellow of the Royal Society (FRS), but Society records do not indicate that he participated actively in meetings. In fact, Sprat may have been elected FRS so that he could write *The History of the Royal Society of London* to protect the Society from accusations of inutility and rejection of all ancient learning. P. B. Wood, "Methodology and Apologetics: Thomas Sprat's 'History of the Royal Society'," *The British Journal for the History of Science* 13 (1980): 1–26; Boas Hall, *Promoting Experimental Learning*, p.12 (note 68).
71. Sprat, *The History of the Royal Society*, p.61 (note 3).
72. Ibid., p.98.

This idea of the instrumentalization of error is most visible in the writings of Robert Boyle (1627–91), one of the Society's founding members. Boyle perceives error to be a productive force, arguing that "truth does more easily emerge out of error than confusion."[73] Simultaneously, Boyle is sensitive to the risk of magnifying error, for slips in interpretation to become biases and untruths as ideas move and circulate. Boyle argues that the details of an observation or experiment should be provided so readers can evaluate the information provided for themselves. He discusses the faithful representation of experiment as its ability to control error:

> when a writer acquaints me only with his own thoughts or conjectures, without inriching his discourses with any real experiment or observation, if he be mistaken in his ratiocination, I am in some danger of erring with him.[74]

He argues that providing only the reasoning of an event without the causes of those beliefs leaves the reader in much greater risk of error. For Boyle, the "truth" of the experiment, if properly reported, leaves him "at liberty to benefit myself by [it]."[75] Boyle is looking for the opportunity to understand what has been observed rather than being given only a writer's interpretation or inference, which he perceives as vulnerable to mistake.[76]

Boyle believes that unsuccessful experiments should be reported and in 1669 published two essays on the subject. His acute awareness of error is driven by its intimate relation to the experimental method; he recommends "Watchfulness in observing Experiments, and Wariness in relying on them."[77] He acknowledges that experimental information is often unreliable, and even well-substantiated theories or "Superstructures" built on them might be "confuted" by new experimental data.[78] He is careful to describe leaks, explosions, and other apparatus failures with the same attention to detail as his successful experiments, frequently encouraging the reader to repeat his failed experiments with better equipment or under more favorable conditions because of "constitutions of the Weather, times of the Day, &c."[79] Boyle asserts that experiments are unpredictably variable, and "will sometimes answer, and sometimes disappoint our expectations."[80] He refers to "sophisticated" or adulterated materials, that may lead an

73. Robert Boyle, *The Works of the Honourable Robert Boyle*, Vol. 1, Thomas Birch (ed.) (University of California, 1772), p.303. This is a repetition of Bacon's "truth comes more quickly from error than confusion." Bacon, *The Oxford Francis Bacon*, Vol. 11, p.261 (note 26).
74. Boyle, *The Works*, pp.303–4, (note 73).
75. Ibid., pp.303–4.
76. Boyle advocates here what Shapin describes as "virtual witnessing." Steven Shapin, "Pump and Circumstance: Robert Boyle's Literary Technology," *Social Studies of Science* 14 (1984): 481–520, 491.
77. Robert Boyle, *Certain Physiological Essays and Other Tracts Written at Distant Times, and on Several Occasions by The Honourable Robert Boyle; Wherein Some of the Tracts are Enlarged by Experiments and the Work is Increased by the Addition of a Discourse About the Absolute Rest in Bodies* (London, 1669), p.113.
78. Ibid., p.106, 19.
79. Robert Boyle, *New Experiments Physico-Mechanical, Touching the Air* (London, 1682), p.155.

experiment astray, and in discussing their dangers, recounts his own flawed trial.[81] He tries to make a "Menstruum" or solution to dissolve tin.[82] In combining these two materials, he unexpectedly creates "crystals," and believes he has created silver.[83] When attempting to replicate this experiment, he uses the same solution but has "casually lost" the tin, and can only conclude that the anomalous results are due to "having lighted upon a lump of Tin that was of a peculiar Nature."[84] Boyle reveals that he failed to create a solution to dissolve tin, and despite his exhortations elsewhere to replicate experiments, he had failed to procure enough of the same material to do so. His use of error is ethical, as the purpose of his honesty is to encourage "thinking men" not to "assert more than they can prove."[85]

Although Boyle's writings are perhaps not as unvarnished as he encourages in others, this method of presenting failures alongside successes permeates his other works. In *New Experiments Physico-Mechanical* (1682) he states, "To these Experiments concerning Fire we added another, which though it succeeded not, may perhaps without impertinency be recorded: partly, because that (as we have in another Treatise amply declar'd) it is usefull to recite what Experiments miscarry as well as succeed."[86] Boyle writes in a new mode, drawing attention to what might otherwise be shameful or taken as the mark of a poor investigator. He uses the recounting of failure to invite "Your Lordship, or some other *Vertuoso*" to replicate the work with "more Sunny days than the present Winter allows."[87] Bacon had lamented the desire of investigators to declare their conclusions rather than to invite correction, referring to a "kinde of Contract of Errour, betweene the Deliuerer, and the Receiuer."[88] Boyle seeks to break this contract of error, presenting information for it to be examined and corrected for the benefit of the reader under the agenda of truth.

Robert Hooke, who served as curator of experiments to the Royal Society, also demonstrates an acute sensitivity to error. He argues that "For the Members of the Assembly having before their eys so many *fatal* Instances of the errors and falshoods, in which the greatest part of mankind has so long wandred, because they rely'd upon the strength of humane Reason alone, have begun anew to correct all Hypotheses by sense."[89] We can sense in Hooke the excitement at this new revolutionary endeavor, how the Assembly will revise and correct all human knowledge on an almost biblical scale, especially with the aids of new inventions like the microscope. Hooke continues his initial admittance of error into protoscientific practice in the later years of his work at the Royal Society.

80. Ibid., p.155.
81. Boyle, *Certain Physiological Essays*, p.54 (note 77).
82. Ibid., p.54.
83. Ibid., p.54.
84. Ibid., p.54.
85. Ibid., p.5.
86. Boyle, *New Experiments*, p.49 (note 79).
87. Ibid., p.49.
88. Bacon, *The Advancement of Learning*, p.123 (note 30).
89. Robert Hooke, "Preface," *Micrographia, or, Some Physiological Descriptions Of Minute Bodies Made by Magnifying Glasses with Observations and Inquiries Thereupon* (London, 1665), Sig. g r.

Between 1679 and 1682, Hooke edited *Philosophical Collections*, which temporarily replaced *Philosophical Transactions*. In the "Preface" to the first *Philosophical Collections*, Hooke argues that the publication "may inform all, and excite some to prosecute and perfect what they find here in *Embrio*, first thoughts or tryals, Some are only good at Hints and the first conceptions of Inventions."[90] Although the "Discovery of useful Truths in Nature and Art is aimed at," the route to truth begins with thoroughly imperfect knowledge, in some instances only a "hint" of truth, which is put through a collective process of repeating study and observation to advance to something more certain.[91] The importance of identifying error and collectively dispelling it was strongly asserted by early members of the Royal Society. This established a lineage of error in later decades, propounded as both a useful method and a warning to temper the certainty with which knowledge is reported and discussed. Whereas physicians who produced works of "popular error" asserted their authority by using their expertise to identify error and correct it with certainty and confidence, the mode of the early Royal Society was more tentative. Rather than framing ideas as new discoveries of knowledge, they encouraged natural philosophers to present rather than conceal the flaws in their work, and to participate in a culture of incremental communal improvement based on the inclusion of error.[92]

Conclusion

At the end of the sixteenth century, a new publishing phenomenon sprang up across Europe, where doctors began to attack erroneous beliefs about health. Authors such as Laurent Joubert (1578) and Scipio Mercurio (1603) made sustained efforts to record the beliefs they wished to extirpate, in a way that had no earlier precedent.[93] This impetus first emerged in medicine where the stakes of negligence and harm brought error to the door of the doctor in urgent ways. Browne drew attention to error, as a method of thought and observation, to all philosophical inquiry. Influenced by Browne, alongside Bacon's theory of the idols, natural philosophic practice in the late sixteenth and seventeenth century developed a focus on error that revised traditional attention to the discovery of knowledge. Rather than contributing to the storehouse of knowledge, proposed opinion and belief were increasingly presented as provisional and liable to mistake. "Noting"

90. Robert Hooke (ed.), *Philosophical Collections*, 1 August 1679, Vol. 1 Issue 1, p.2.
91. Ibid., p.2.
92. In practice, the Royal Society did not always present failed experiments and flawed methods. Boas Hall describes a shift in the 1670s away from the risk of "*investigative* experiment" and toward delivering information as "*demonstrative* experiment" in Society meetings. Wood and Hunter similarly describe a move toward presenting experiments as successes delivered with "inscrutable consensus." Boas Hall, *Promoting Experimental Learning*, pp.16–17 (note 68); Michael Hunter and Paul Wood, "Towards Solomon's House: Rival Strategies for Reforming the Early Royal Society," *History of Science* xxiv (1986): 49–108, 50.
93. Natalie Zemon Davis, *Society and Culture in Early Modern France* (Stanford: Stanford University Press, 1975), p.258.

error and promoting future endeavors by others to eradicate it became part of the search after knowledge.

As Lorraine Daston argues, "since the early seventeenth century, scientific inquiry has been inseparable from reflections on scientific error."[94] Error was less an invisible force to be opposed by confident assertion, and instead became instrumentalized as a method to gain truth. Boyle, especially, advocated publicizing potentially shameful faults or misdirections as a way of guiding other natural philosophers to a less certain but more realistic picture of their claims, even when that strategy undermined the usefulness of their conclusions. H. Floris Cohen argues that "[w]ithin decades of the onset of the Scientific Revolution correction of oneself and/or others was built into regular procedure and subsequently enshrined in the first institutions of science."[95] By the mid seventeenth century, searching after error had become common practice for members of the Royal Society as well as a widespread method in natural philosophy. This increased sensitivity to error reflects its status, not as a waste element but as an influential epistemological category. Error acted as a center around which scientific inquiry could be organized, as a starting point for experiment or observation, as a way of highlighting mistaken information requiring correction, and as the justification for new scientific publications. Bacon argued that our innate focus on truth in the form of positive contributions to knowledge in fact impedes understanding: "the human intellect would still suffer from the peculiar and permanent error of being moved and excited more by affirmatives than negatives, when it ought to pay heed in a proper and systematic way to both equally; indeed in the true setting up of every axiom, the power of the negative instance is actually greater."[96] Discovering "negatives," pointing out errors and eradicating the "idols" of the mind, are in fact the most useful methods to arrive at knowledge. R. W. Serjeantson argues that the "sixteenth and seventeenth centuries saw more self-conscious theoretical reflection on how to discover and confirm the truths of nature than any period before or since."[97] This narrative of progress that privileges the discovery of affirmative information, however, has occluded truth's obverse, error, which was a significant aspect of knowledge in the development of early scientific thought.

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94. Daston, "Scientific Error and the Ethos of Belief," p.5 (note 1).
95. H. Floris Cohen, *How Modern Science Came into the World: Four Civilizations, One 17th-Century Breakthrough* (Amsterdam: Amsterdam University Press, 2011), p.721.
96. Bacon, *The Oxford Francis Bacon*, Vol. 11, p.85 (note 26).
97. R. W. Serjeantson, "Proof and Persuasion," in Daston and Park (eds.), *The Cambridge History of Science*, pp.132–76, 132 (note 11).

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