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# Shakespeare and the Making of Early Modern Science: Resituating Prospero's Art

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Some readers may ask what it means to use the term “science” in conjunction with Shakespeare. From a modern perspective, science may not seem to be able to tell us much about Shakespeare or Shakespeare about science. Looking backwards, it is fair to say that Aristotle would probably have agreed with such a perspective: what scholasticism came to call *scientia* has nothing to do with *ars*. In between Aristotle and Einstein, though, matters stood differently. The late sixteenth and early seventeenth century saw the historic transition from Aristotelian models of *scientia* to modern “science.” Both classic and modern epistemologies of science exclude art, but the crucial transition from the first to second was itself largely achieved by art. Art unexpectedly became the mediating term that made it possible for early modern intellectual culture to abandon Aristotelian scholasticism and move toward experimentalism and fact-based knowledge models. For Aristotle, various forms of making, doing, and knowing were all means by which “the soul possesses truth,” but only scientific knowledge was certain

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and, indeed, truly scientific.<sup>1</sup> In the early modern period, though, those kinds of making and doing that Aristotle had distinguished from true knowledge came to have a new epistemological status. For a brief period in intellectual history, art was accepted as what I would like to call a knowledge practice. Aristotelian understandings of knowledge as eternal, unchanging, and “that which cannot be otherwise” involved a fundamental exclusion of the human from its categories;<sup>2</sup> the historic shift in the early modern period away from that model of knowledge thus required the interjection of the human, the introduction of various forms of human invention and intervention, that is to say, art, into what counted as knowledge. In the mechanical arts (such as surveying, architecture, metallurgy, printing, alchemy, Paracelsian medicine, and drama), the act of creation was understood to both require and express knowledge. Through a new assessment of the possibilities of invention-artificial contrivances and human interventions of the kinds proposed by Francis Bacon and others—oddities that were once classified as the domain of the theologian and the natural historian became the basis for the new science of experimentalism.

Shakespeare’s *The Tempest* both depicts and participates in this transition. Prospero’s “Art” expresses the remarkable power of this model of art as a knowledge practice; yet, as we shall see, the play also suggests reasons why the Renaissance conception of art as knowledge was ultimately displaced by a modern science of facts. This essay offers a local reading of how art functions as a form of knowledge in *The Tempest*. From a larger theoretical perspective, the lesson I would draw from *The Tempest* is that in order to understand how poetry and drama shared in the emergent scientific cultures of early modern England we must recognize that art was not separate from the practices that became science but instrumental to them.<sup>3</sup>

1. Aristotle, *Nicomachean Ethics* in Jonathan Barnes, ed., *The Complete Works of Aristotle*. 2 vols. (Princeton: Princeton University Press, 1984), VI, 3, 1039<sup>b</sup>15–17. Further references from Aristotle are from this edition.

2. Aristotle, *Nicomachean Ethics*, VI, 3, 1139<sup>b</sup>20–25.

3. This essay draws upon two important arguments that have dominated work in the history of science concerning the emergence of fact-based, experimental and mathematical sciences in the seventeenth century. The first pursues the claim that craft traditions, not university philosophy, provided the basis for the emergence of new scientific practices in the seventeenth century. See, most notably, Edgar

For Aristotle and the natural philosophers of the Renaissance who followed his model of physics, the things of art were indeed separate from those of nature. A scientific explanation, in Aristotle's terms, involved understanding the nature of things in a teleological sense (how and why they were what they were). Art and other forms of human invention could not lead to true knowledge because art was the product of a human intention rather than the expression of an essential teleology.<sup>4</sup> Through art, one could only learn about man and his ideas, not about nature or truth. At the same time, Aristotle's *Metaphysics*

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Zilsel, "The Sociological Roots of Science," *Social Studies of Science* 30.6 (2000): 935-49; rpt. from *The American Journal of Sociology* 49 (1942): 544-62; Zilsel, "The Origins of William Gilbert's Scientific Method," *Journal for the History of Ideas* 2.1 (1941): 1-32; Antonio Perez-Ramos, *Francis Bacon's Idea of Science and the Maker's Knowledge Tradition* (Oxford: Oxford University Press, 1988); and Paolo Rossi, *Philosophy, Technology, and the Arts in the Early Modern Era*, trans. Salvator Attanasio, ed. Benjamin Nelson (New York: Harper and Row, 1970). The second suggests that the epistemological significance of matters of fact and individual observations changed during this period. See, among others, Peter Dear, *Discipline and Experience: The Mathematical Way in the Scientific Revolution* (Chicago: University of Chicago Press, 1995); Charles B. Schmitt, "Experience and Experiment: A Comparison of Zabarella's View with Galileo's in *De motu*," *Studies in the Renaissance* 16 (1969): 80-138; Barbara Shapiro, *Probability and Certainty in Seventeenth Century England* (Princeton: Princeton University Press, 1993); Lorraine Daston, "Baconian Facts, Academic Civility, and the Prehistory of Objectivity," *Annals of Scholarship* 8 (1991): 337-64; Daston, "Reviews on Artifact and Experiment; the Factual Sensibility," *Isis* 79 (1988): 452-70. In their introduction to the outstanding *Cambridge History of Science*, Katharine Park and Lorraine Daston comment on the integration between natural philosophy and both art and literature: they note, "headings of the form 'Science and X,' although perhaps helpful to orient modern readers, presume autonomous fields of activity that in many cases had yet to crystallize as such [...] Some forms of early modern art and literature were also so tightly intertwined with coeval natural inquiry that it is more accurate to treat them as expressions of a common endeavor" ("The Age of the New," *The Cambridge History of Science*, vol. 3, *Early Modern Science* [Cambridge: Cambridge University Press, 2006], 12). I would simply emphasize that art was, in this period, understood to be necessary to the practices that created knowledge as well as to their representation. I am drawing here on my earlier arguments that both literature and science, as emergent fields, were practiced as arts that sought to create knowledge. See: Spiller, *Science, Reading and Renaissance Literature: The Art of Making Knowledge, 1580-1670* (Cambridge: Cambridge University Press, 2004).

4. Aristotle, *Nicomachean Ethics*, VI, 3-4, 1139<sup>b</sup>14-23.

made it clear that not all of nature realized its teleological end, and the resulting accidents, anomalies, and monstrosities could not serve as the basis for knowledge.<sup>5</sup> Challenges to these two key tenets of Aristotelian natural philosophy were at the center of a radical redefinition of knowledge, art, and science in the late Renaissance.

These challenges to once fundamental ideas about knowledge are also at the center of Shakespeare's *The Tempest*. The play develops out of an initial conjunction of art and accident. When the play opens, we find ourselves in what appears to be a moment of the ultimate expression of nature's power and man's inability to exert control over it. The boatswain recognizes that the power of nature surpasses that of man when he rebuffs Gonzalo's interference: "What cares these roarers for the name of the king? [ ... ] If you can command these elements to silence [ ... ] use your authority."<sup>6</sup> Almost immediately, though, we learn that what had appeared to be brute, unchecked nature was instead a piece of carefully contrived artifice. The "direful spectacle of the wreck" (1.2.26) was indeed a spectacle, a simulated phenomenon conjured up by Prospero's "art" that became possible because an "accident most strange" (1.2.178) brought the usurped Duke's enemies within his reach.

Prospero uses his art in both the initial shipwreck and the subsequent manipulations of the humans on the island not for revenge, retribution, or even in any simple way to enable his return to power. Rather, the end of Prospero's "art" is knowledge and, if at the close of play, Prospero suggests that what has occurred have only been "happened accidents" (5.1.250), Shakespeare may be emphasizing precisely what it means in the new knowledge culture of early modern England to deliberately and artificially create an accident to simulate reality. Throughout the play, Prospero seeks to make his enemies know what he has known. The shipwreck is a reenactment that subjects Alonso, Gonzalo, and Sebastian to experience a version of the initial marooning that Prospero and the infant Miranda had suffered through their acts: "There they hoist us / To cry to th' sea that roared to us, to sigh / To th' winds, whose pity, sighing back again, / Did us but loving

5. Aristotle, *Metaphysics*, VI, 2, 1026<sup>a</sup>34-1027<sup>a</sup>28.

6. William Shakespeare, *The Tempest*, 1.1.16-17, 21-23. All citations are from the Arden Shakespeare, edited by Virginia Mason Vaughan and Alden T. Vaughan (London, Thompson Learning, 1999).

wrong” (1.2.148–51). Prospero’s contrivances provide the mechanism by which characters reveal their true purpose and nature. We see in high relief the identities of conspirators such as Sebastian, Trinculo, Stephana, and perhaps even the boatswain, marked for hanging. Prospero’s ultimate concern is to educate a second generation into better forms of knowledge (Miranda, Ferdinand, and in a failed way, Caliban). From Prospero’s own perspective, the art that he calls up and the political ends to which he puts that art are an attempt to redress his own earlier failure to appropriately comprehend the relationship between knowledge of the “liberal arts” and the behavior of “a prince of power” (1.2.73, 54), an attempt to correct his once mistaken belief that, “my library / Was dukedom large enough” (1.2.109–110).

At the close of the first scene, Gonzalo confronts the possibility that he might drown and wishes for “an acre of barren ground” (1.1.66). *The Tempest’s* island is the acre that human imagination has called up: it and everything that happens in that space is in some way an invented construct. Like the alchemist’s crucible, William Gilbert’s magnetic terrella, or Francis Bacon’s idea for experiments that use the “vexations of art” to reveal the “secrets of nature,” the island is a small world in which Prospero seeks to use art to control nature and, in doing so, create different forms of knowledge.<sup>7</sup> Prospero is not attempting to discover the properties of magnets or transmute base elements into gold, but from a philosophical perspective his art can only be imagined to work for the same kinds of reasons that natural philosophers like Gilbert and Bacon understood their science to do so. Prospero’s art stands alongside their experiments as a refutation of Aristotle’s claim that art cannot serve as a means to understand nature and that singular events (whether those are dismissed as anomalies, monstrosities, or accidents) cannot produce universal experience or certain knowledge. His art confounds what were for Aristotle at least three philosophically distinct kinds of knowledge: *praxis* (prudential decision-making), *poesis* (mechanical construction, craft), and *scientia*

7. Francis Bacon, *Novum Organon* in Grathan Rees, ed. and trans., *The Oxford Francis Bacon: The Instauration magna Part II: Novum organum and Associated Texts* (Oxford: Clarendon Press, 2004), vol. 11, aph. 98. On the play’s depiction of early modern worldmaking, see Roland Greene, “Island Logic,” *The Tempest and Its Travels*, ed. Peter Hulme and William H. Sherman (Philadelphia: University of Pennsylvania Press, 2000), 138–47.

(certain knowledge of the teleological purposes of things).<sup>8</sup> *The Tempest* violates Aristotle's maxims and mixes his categories in a way that is not specific to Shakespeare but that is in keeping with a much larger reworking of Aristotelian physics that helped produce a distinctively early modern understanding of knowledge as a form of art.

In the early modern period, the chief challenge to Aristotelian conceptions about the divide between art and nature—and the impediments that that divide posed to the development of modern forms of scientific knowledge—came from the mechanical arts and related practical craft knowledges. This challenge became possible because mechanical arts were not practiced under the terms of Aristotelian epistemology. Arts such as metallurgy, architecture, alchemy, navigation, painting, engineering, and surveying instead relied upon a very different epistemology, one that Antonio Pérez-Ramos has termed the “maker's knowledge tradition.”<sup>9</sup> This model of knowledge rejected the divide that Aristotle saw between art and practical wisdom, on the one hand, and scientific knowledge, on the other. The maker's knowledge tradition instead posited an integral relationship between “objects of cognition and objects of construction, and regard[ed] knowing as a kind of making or as a capacity to make (*verum factum*).”<sup>10</sup> From an Aristotelian perspective, this formulation is strictly incoherent: craft practices were simply that, instances of *praxis* or *poesis*, and thus, by definition, could tell one nothing about epistemological questions.<sup>11</sup> Breaking with Aristotelian knowledge categories, early modern craftsmen and artisans instead understood what they did as, in Paolo Rossi's words, “a form of cognition.”<sup>12</sup> Being able to

8. Aristotle, *Nicomachean Ethics* VI, 3, 1139<sup>b</sup> 14–18. For the argument that sixteenth-century natural philosophers were increasingly collapsing distinctions between prudential wisdom and *praxis/poesis*, see Henry S. Turner, *The English Renaissance Stage: Geometry, Poetics and the Practical Spatial Arts, 1580–1630* (Oxford: Oxford University Press, 2006), 54.

9. Pérez-Ramos, *Francis Bacon's Idea*, 48.

10. Pérez-Ramos, *Francis Bacon's Idea*, 84–85.

11. Aristotle, *Nicomachean Ethics*, VI, 4, 1140a 13–15. It is worth noting that the maker's knowledge tradition is a rejection of Aristotle but, like many other early modern moments of resistance to Aristotle, it does nonetheless have a philosophical basis in Aristotelian thought. See *Metaphysics* I (A), I, 981<sup>b</sup> 31–34 for Aristotle's comments on the degrees and kinds of knowledge that pertain to the artist and the “master-worker.”

12. Rossi, *Philosophy, Technology, and the Arts*, 10.

make something was an act of knowledge; knowing something involved knowing how to make it.

This alternative knowledge tradition flourished in guild and craft halls, artisans' studios, and other places in which various kinds of making were acquiring new cultural and social significance. In a series of groundbreaking articles, Edgar Zilsel first called attention to the importance of craft traditions for understanding the emergence of science as both a practice and an epistemological possibility in the early modern period.<sup>13</sup> He argued, for instance, that we must look for the origins of William Gilbert's attitude toward experimental trials—a key precursor to the more fully articulated experimentalism of the seventeenth century—not in books, which constituted the academic tradition of existing Aristotelian epistemology, but in smithies, mines, and instrument makers' workshops.<sup>14</sup> Pamela Smith follows Zilsel's emphasis in her definition of artisans as those who are trained by apprenticeship, rather than in schools and universities; she identifies Paracelsus's stillroom and artisanal workshop as key sites in which a new "epistemology of handwork" was being articulated.<sup>15</sup> Henry Turner likewise argues that makers' knowledge traditions underlie and interconnect what might otherwise seem to be the disparate areas of geometry, sixteenth century poetic theory, and early modern stage practice.<sup>16</sup> The maker's knowledge tradition initially arose in craft practices that were separate from university training and transmitted, from master to apprentice, largely through oral culture. By the end of the sixteenth century, and in ways that "Prospero's book" registers, these knowledge traditions entered print culture. Many of the most popular and profitable books coming off of sixteenth century printing presses—books of secrets, recipe books, and practical manuals—were dedicated to forms of knowledge associated with the mechanical arts.<sup>17</sup>

The second challenge to Aristotelian modes of knowing that is important to *The Tempest* is a related shift that bears on the question of accidents and experiments. This shift was important in four distinct

13. Zilsel, "Sociological Roots of Science."

14. Zilsel, "Origins of William Gilbert's Scientific Method," 12, 15, 24.

15. Pamela H. Smith, *The Body of the Artisan: Art and Experience in the Scientific Revolution* (Chicago: University of Chicago Press, 2004), 243–4, n. 7; 28.

16. Turner, *English Renaissance Stage*; see also, Dear, *Revolutionizing the Sciences*, 49–64.

17. William Eamon, *Science and the Secrets of Nature*, 93–120, 126–33, 234–259.



areas of inquiry: the mechanical arts traditions (which saw changes, through the sixteenth century, in the meanings associated with the terms “experiment” and “experience”); jurisprudence (which saw related developments in the concept of “matters of fact”); the intersection of natural history and theology (where the significance of miracles and marvels was important); and the mixed mathematical sciences (where, from the beginning of the seventeenth century, Jesuit mathematicians began transferring practices that had originally been seen as only appropriate to mathematics, a discipline that was not classified as a science, into inquiries that had previously been regarded as physics).<sup>18</sup> While these developments occurred across a range of largely disparate areas in the early modern intellectual landscape, they were all involved in some way with rehabilitating the particular and making it a viable component of what could be counted as knowledge. Surveying these developments, Peter Dear concludes: “Many local contexts of knowledge-making bear witness to the gradual process by which appeal to discrete experiences became culturally dominant in European philosophy of nature.”<sup>19</sup> The particular was not itself a form of knowledge, but it could in various ways be built up into one. What Lorraine Daston refers to as the “new-style scientific facts” of the seventeenth century were observations of the particular. Unlike Aristotelian experience (what happens always or most of the time), facts concerned themselves with what happens at a particular time and place, under particular circumstances.<sup>20</sup> Etymologically akin to “fabrication” and “manufacture,” facts were also understood to be something made, created out of the particular. This emphasis on the particular led to a corollary shift from the idea of science as something that is to the acceptance of knowledge as something that must be made.

These reconfigurations of Aristotelian forms of knowledge touched in different ways on the mechanical and figurative arts, poetic theory and rhetoric, and the mixed mathematical sciences. Understood

18. Schmitt, “Experience and Experiment”; Michael McVaugh, “Two Montpellier Recipe Collections,” *Manuscripta* 20 (1976): 175–80; Eamon, *Science and the Secrets*; Daston, “Fear and Loathing of the Imagination in Science,” *Daedalus* 127 (1998): 73–95; Dear, *Discipline and Experience*.

19. Dear, *Discipline and Experience*, 32.

20. Daston, “Fear and Loathing,” 75–76.

collectively, these reassessments produced a distinctively early modern model of knowledge. This conception can be described as a belief that knowledge is constructed, made or created through acts of human invention, rather than found or discovered. As I have argued elsewhere, this configuration is as important for works of literature as it is for those of science since art is in the early modern period not separate from knowledge but integral to its production. Knowledge is a practice, a way of doing or making that becomes a form of knowing.<sup>21</sup>

In keeping with this early modern reconfiguration of knowledge, *The Tempest* insists that knowledge is always created, a thing made, rather than found or passively learned. Prospero is a quintessential Shakespearean artist; his art is pre-Romantic and, perhaps more importantly, pre-Newtonian. In the opening scenes, Prospero summons up knowledge through his art. This art is initially directed at Miranda, who is Prospero's defining audience. Shakespeare makes clear that Prospero's art depends on the presence of Miranda as an audience who is in some way necessary to the creation of that art. The shipwreck does not exist independently of Miranda's experience of it: "O, I have suffered / With those that I saw suffer" (1.2.5-6). As her name suggests, Miranda stands in the interval between ignorance and knowing. She represents and stages the process through which ignorance becomes knowledge, a process that defines Prospero as much as it does Miranda. Miranda has clearly been well educated by Prospero in a tradition that exemplifies traditional scholastic and emerging humanistic education. He boasts that he has been her "schoolmaster" and given her a princely education, having "made thee more profit / Than other princes can, that have more time / For vainer hours, and tutors not so careful" (1.2.172-74). Yet, while Prospero has been able to teach Miranda many things through books and tutorials, he has perhaps not been able to give her knowledge. At the start of the play, she remains "ignorant" and "naught knowing" (1.2.18) of more than just her father's identity. From this perspective, what Prospero fashions through his art is an artificial construct that will produce a new kind of experience and with it a new form of knowledge.

21. Spiller, *Science, Reading, and Renaissance Literature*, 3-4, 21-23, 139-41; see also Pamela H. Smith, "Art, Science, and Visual Culture in Early Modern Europe," *Isis* 97 (2006): 83-100.

Miranda is a figure of admiration and an embodiment of the movement toward knowledge that wonder, as the intellectual passion, represents.<sup>22</sup> Her wonder is first incited by the shipwreck and arises out of the disparity between what she sees (the wreck) and what Prospero knows (its fabrication). The consequences to the disparity in their knowledges conform to Aquinas's classic account of admiration. For Aquinas, admiration "arises when an effect is manifest, whereas its cause is hidden [...] Now the cause of a manifest effect may be known to one, but unknown to others [...] as an eclipse is to a rustic, but not to an astronomer."<sup>23</sup> Compared to Prospero, Miranda is initially in the position of Aquinas's rustic: she sees the manifest effect of the storm and wonders because she does not understand its hidden cause. Aquinas' account of admiration was part of a well-established tradition, philosophical and theological, that sought to classify and comprehend those exceptions to the ordinary workings of nature that Aristotle identified as accidents. In this tradition, the singular might be either a monster (a preternatural phenomenon that arose out of some failure in teleological purpose) or a miracle (a supernatural phenomenon produced by God). These alternatives are captured in Miranda's two choices, Caliban and Ferdinand. Caliban is for Miranda a perverse accident, an anomaly outside nature. Miranda attacks Caliban as "a thing most brutish" (1.2.60). She castigates him as a "vile race," but he remains uniquely singular because Prospero thwarted his attempt to rape Miranda, an act which would have "peopled else / This isle with Calibans" (1.2.351-52). Miranda's response to Ferdinand, by contrast, follows the distinctions that Aquinas makes between miracles and wonders. On first seeing Ferdinand, she exclaims, "I might call him a thing divine, for nothing natural / I

22. On wonder, see, among others, Lorraine Daston and Katharine Park, *Wonder and the Order of Nature, 1150-1750* (Cambridge: Zone Books, 1998); Mary Baine Campbell, *Wonder and Science: Imagining Worlds in Early Modern Europe* (Ithaca: Cornell University Press, 1999); Stephen Greenblatt, *Marvelous Possessions: The Wonder of the New World* (Chicago: University of Chicago Press, 1992); Philip Fisher, *Wonder, the Rainbow, and the Aesthetics of Rare Experiences* (Cambridge: Harvard University Press, 1998); Thomas G. Bishop, *Shakespeare and the Theatre of Wonder* (Cambridge: Cambridge University Press, 1996).

23. Aquinas, *Summa contra gentiles*, trans. English Dominican Fathers, 4 vols. (London, 1928), vol. 3, part 2, 60-61. Cited in Lorraine Daston, "Marvelous Facts and Miraculous Evidence in Early Modern Europe," *Critical Inquiry* 18 (1991), 96. For Aquinas's source in Aristotle, see *Metaphysics* I (A). 2, 982<sup>b</sup>12-17, 983<sup>a</sup> 14-18.

ever saw so noble" (21). Unsure of what he is, she intuitively transposes Ferdinand from the natural world to the divine. If Caliban is a monster, Ferdinand is a miracle.

What is most important about Miranda's responses to Caliban and Ferdinand is not how closely she follows Aquinas but how radically she takes us away from him. To understand Shakespeare's attitude toward knowledge in *The Tempest*, we must recognize that Miranda does not live in a world that Aquinas or Aristotle imagined. She experiences life as an inversion of the usual scholastic understanding of the balance between the universal and the accidental. For Aristotle, most of life is lived within a consistent and undifferentiated realm of universals (those things which happen always or for the most part), but Miranda's experience of the island is so emptied out that she lives almost entirely in a world comprised of singularities.<sup>24</sup> This feature of the island, I would argue, identifies *The Tempest* as distinctively early modern in its epistemological assumptions. Returning to Aquinas may make this distinction clear. As Lorraine Daston demonstrates, Aquinas used the example of eclipses to distinguish supernatural miracles (which came from God and which produced universal wonder) from preternatural wonders (singularities which might be remarkable but which stood outside of natural philosophy and did not constitute a basis for knowledge). His arguments were a key instance of how Aristotelian claims about the universal and the accidental were subsumed into medieval theology. By the early modern period, though, miracles and wonders acquire a new status. They provide the basis for a radical inversion of scholastic epistemology. The monsters and marvels that had once stood outside the boundaries of knowledge in the Aristotelian universe now become "the first scientific facts." As Daston explains: "The very traits that had previously unfitted them for use in natural philosophy, and which had then disqualified them from use in theology, made this new role possible."<sup>25</sup>

24. Aristotle, *Metaphysics*. VI, 3, 1027<sup>a</sup> 23.

25. Daston, "Marvelous Facts and Miraculous Evidence," 109. Daston sees the movement of preternatural things from natural history to natural philosophy a key development in the late sixteenth century. Bacon and other philosophers of the preternatural "shifted the marvels of nature from the periphery to the center of their philosophy, and attempted explanations of even the most singular phenomena" ("Preternatural Philosophy," *Biographies of Scientific Objects*, ed. Lorraine Daston [Chicago: University of Chicago Press, 2000], 18).

Miranda lives not in the world of nature imagined by Aristotle but in the space of experiment most fully articulated by Bacon. Her world, bounded and contrived as it is, is a place in which the singular is not excluded from knowledge but instead forms the basis for it. In the late sixteenth century and early seventeenth century, a traditional Aristotelian epistemology, which relied on experience, was replaced with a new proto-experimental epistemology, which instead depended on “singular experiences made using contrived apparatus.”<sup>26</sup> This intellectual context provides a key to understanding Prospero’s staged illusions. For Aristotle, “all science is either of that which always is or that which is for the most part” and thus “there is no science of the accidental.”<sup>27</sup> In the knowledge culture of early modern Europe, though, a science of the accidental did emerge. As Michael Witmore argues, questions about the epistemological status of accidents were not simply arcane philosophical or theological speculation, but were instead part of a “widespread early modern interest in the unexpected and unforeseen.”<sup>28</sup> Under this new epistemology, anomalous events—precisely those things that did not happen all or most of the time—became the basis for investigation, examination, and experimentation. Sebastian, Gonzalo, and the other European courtiers speculate about the kinds of monsters that live at the limits of imagination and philosophy (3.3). More so than unicorns or men with heads in their breasts, Miranda is a true wonder in that she is confined to a world of carefully circumscribed particulars. Prior to the arrival of the Europeans, Miranda’s world was not full enough to give her experience of the ordinary course of nature:

I do not know  
 One of my sex, no woman’s face remember—  
 Save, from my glass, mine own. Nor have I seen  
 More that I may call men than you, good friend,  
 And my dear father. How features are abroad

26. Dear, *Discipline and Experience*, 32.

27. Aristotle, *Metaphysics* V1.2, 1026<sup>b</sup>20–21 .

28. Michael Witmore, *Culture of Accidents: Unexpected Knowledges in Early Modern England* (Palo Alto: Stanford University Press, 2001), 18. Witmore also provides a useful account of how Bacon rehabilitated the “accidental” into a fundamental source of philosophical knowledge (*Culture of Accidents*, 111–29).

I am skillless of, but by my modesty  
 (The jewel in my dower), I would not wish  
 Any companion in the world but you,  
 Nor can imagination form a shape,  
 Besides yourself, to like of. (3.1.48–58)

Miranda cannot imagine an alternative to Ferdinand and in a way everything for her has the epistemological status of a unicorn. She has never experienced the multiplicity that could constitute kind and that would enable her to give meaning to “man” himself.

The degree to which what Shakespeare imagines is in keeping with the larger intellectual shift that took early modern culture from scholastic experience to early modern experiment can also be seen in the transformation of Ferdinand by Prospero’s “trials” (4.1.6). Ferdinand’s life has been precisely the opposite of Miranda’s: he has lived in the world and may indeed have had the occasion to know too much of that world (“Full many a lady / I have eyed,” he admits [3.1.39]). The illusions that Prospero creates—the seeming death of Ferdinand’s father and loss of all his companions—abstract Ferdinand from that larger world. When Prospero asks, “What were thou if the King of Naples heard thee” (1.2.429), Ferdinand’s response suggests his sense of what, not who, he is now: “A single thing, as I am now, that wonders / To hear thee speak of Naples” (1.2.433–34). Ferdinand begins to experience wonder at the moment that he understands himself to be alone, “a single thing,” and more like Miranda in his relationship to the world. In Bacon’s experiments, singularity did not remain a wonder but became a tool for producing knowledge about nature and the world.<sup>29</sup> By the end of *The Tempest*, Miranda still experiences wonder when she sees that Ferdinand is only one among many, but her response is emotionally and philosophically different. Fulfilling the kinds of hopes that led philosophers to imagine that oddities of nature could be made meaningful, Miranda’s new sense of wonder transcends the particular to arrive at a universal of a species and a world: “O, wonder! / How many goodly creatures are there here! / How beauteous mankind is! O brave new world” (5.1.181–83).

While Miranda and Ferdinand are brought from a kind of Aquinian wonder to a Baconian knowledge, Caliban stands outside this new

29. Bacon, *Novum organum*, aph. 29.

knowledge universe. The drunk Trinculo tries to determine what kind of monster Caliban is: “a very shallow monster” (2.2.141–2), “a very weak monster” (2.2.142), “a most poor credulous monster” (2.2.143), “a most scurvy monster” (2.2.152), and “a most ridiculous monster” (2.2.160). Stephano ultimately settles on “monster” as a form of appellation, if not a classification (3.2.106, 119, 134, 151). *The Tempest* does not encourage us to take Trinculo and Stephano seriously, but they are right here: Caliban is, in a philosophical sense at least, a monster. He is emphatically singular and stands outside the laws of nature and the predictions of man. Miranda imagines that Ferdinand must be a supernatural being (a “thing divine, / Nothing natural”), but Stephano initially assumes that Caliban, bundled together with Trinculo, must be a preternatural one. He asks, “Have we devils here?” and concludes, “this is some monster of the isle with four legs ... a most delicate monster” (2.2.62–63, 85). Caliban does not entirely belong to the world of nature that is the island, but he also refuses the kind of transformation that Miranda and Ferdinand are imagined to undergo. He cannot be educated and his philosophical singularity is expressed in the thwarting of his desire to reproduce (1.2.344–61). Singular and apparently unredeemable, Caliban belongs in a world of Aristotelian universals but does so as a kind of monstrous accident that cannot be accommodated into the new world of Baconian particulars.<sup>30</sup> As recent scholarship has made clear, Caliban is imagined as a barbaric other, but his relationship to the Europeans as the holders of knowledge and power is complicated by the fact that that alterity is also expressed in the way that he stands in for an older knowledge order.<sup>31</sup>

30. My concern here is with what I take to be the intellectual singularity of Caliban and the way in which he stands in for a model of knowledge that also implies a certain understanding of human potential and power. This assessment does not touch directly on the racial and colonial questions surrounding Caliban’s identity, but it is also not entirely separate from those questions. Emily Bartels has astutely argued that Caliban appears within the play as both a collective type, a race, and yet also as an isolated and persistently singular subject, “the only one of his kind” (“Forms of Race: Strachey and Shakespeare,” *Shakespeare Association of America*, April 2008, 2). The dynamic that Bartels identifies in which Caliban seems to resist and demand categorization also carries over to the philosophical issues in the play.

31. Readers of *The Tempest* have had different assessments of Caliban depending on whether they take a universalist perspective (usually humanist or psychoanalytic) or a particularizing one (culturalist or post-colonial). For accounts of this

The extent to which Caliban remains fixed in an older knowledge order can be seen in his relationship to the island. Caliban is impassioned and eloquent in his descriptions of the island:

Be not afeard. The isle is full of noises,  
 Sounds and sweet airs that give delight and hurt not.  
 Sometimes a thousand twanging instruments  
 Will hum about mine ears; and sometimes voices,  
 That if I then had waked after long sleep,  
 Will make me sleep again; and then in dreaming,  
 The clouds, me thought, would open and show riches  
 Ready to drop upon me, that when I waked  
 I cried to dream again. (3.3.135-43)

His service to first Prospero and then Stephano and Trinculo expresses itself as devotion to the land. He showed Prospero “all the qualities o’ th’ isle, / The fresh springs, brine-pits, barren place and fertile” (1.2.337-39). To Stephano and Trinculo, he offers to “bring thee where crabs grow, / And I with my long nails will dig thee pignuts, / Show thee a jay’s nest, and instruct thee how / To snare the nimble marmoset” (2.2.164-67). Caliban’s description of the island is a kind of poetry, but it is one that differs fundamentally from Prospero’s art. Caliban describes nature, whereas Prospero masters and commands it. The details and particularities of nature that Caliban enumerates

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dynamic, see Marjorie Garber, *Shakespeare After All* (New York: Anchor Books, 2004), 852-57 and Julia Reinhard Lupton, “Creature Caliban,” *Shakespeare Quarterly* 51 (2000), 1-4. As early as 1996 Denise Albanese identified critical attention to colonialist implications of the play as “nearly an orthodoxy in itself” (*New Science, New World* [Durham: Duke University Press, 1996], 71) and pointed to the role that science and nature played in this critical shift from universalist to particularist readings of the play. Accounts that emphasize the racial and colonialist implications to the play include, among others, Paul Brown, “‘This Thing of Darkness I Acknowledge Mine’: *The Tempest* and the Discourse of Colonialism” in Jonathan Dollimore and Alan Sinfield, eds., *Political Shakespeare: New essays in cultural materialism* (London: Manchester University Press, 1985), 48-71; Barbara Fuchs, “Conquering Islands: Contextualizing *The Tempest*,” *Shakespeare Quarterly* 48 (1997): 45-62; and Meredith Anne Skura, “Discourse and the Individual: the case of colonialism in *The Tempest*,” *Shakespeare Quarterly* 40 (1989): 42-69. My assessment of Caliban is consistent with Lupton’s argument that “Caliban’s creatureliness precedes secular humanism” (“Creature Caliban,” 4).



entered early modern science out of the domains of history: “Baconian facts were new not because they were particulars, nor even because they were preternatural. Particulars were the stuff of history, natural and civil, and expressly preternatural particulars had been a staple of both sorts of history since Herodotus and Pliny. They were new because they now belonged to natural philosophy, expanding its realm beyond the universal and commonplace.”<sup>32</sup> Under Aristotle, the particular was confined to natural history; with Bacon, it became the basis for natural philosophy. Unlike Miranda and Ferdinand, Caliban remains resolutely Aristotelian in his relationship to the island that he so lovingly rehearses: collecting, itemizing, detailing the physical features of his isle, Caliban is its natural historian. Caliban in his relationship to the island looks back to Aristotelian categories that were being displaced throughout early modern culture. Prospero’s art seeks a new order of knowledge, but whatever Caliban knows, he cannot translate his knowledge of the island into either knowledge or power. His curses fall on stony ground, and he creates nothing of his own.

*The Tempest’s* break with Aristotelian scholasticism and the knowledge traditions it represented is also captured in Prospero’s changing relationship to knowledge. In his former life, Prospero was a scholar. He did not study Zinsel’s mechanical arts, the arts of the hand, but instead immersed himself in the “liberal arts,” “those being all my study” (1.2.74,75). In a manner that followed from the kind of divergence between knowledge and practice that scholasticism assumed, Prospero gives up the world for knowledge. “Transported / And rapt in secret studies,” Prospero finds that he is “neglecting worldly ends, all dedicated / To closeness and the bettering of my mind” (1.2.89–90). Ultimately, like the deposed Richard II, Prospero concludes that his library was “dukedom large enough” (1.2.11–11). What might this library kingdom have contained? It is tempting to imagine for Prospero a library akin to the fabled medieval libraries of Cordoba, Toledo, or Paris that were the conduit by which the texts and intellectual traditions that led to the New Science traveled across the Mediterranean from Claribel’s Tunis to Western Europe. It is also possible to construct for Prospero a Milanese version of John Dee’s library or Rudolph II’s laboratory, fabled sites that mixed traditional philosophy, arcane arts, and the new knowledge traditions of the mechanical

32. Daston, “Facts and Evidence,” 111.

arts.<sup>33</sup> My own shelflist for Prospero, less elegant than Peter Greenaway's *Prospero's Books*, would begin with Peter Apian's *Cosmography*, Pico della Mirandola's "Oration on the Dignity of Man," Giambattista della Porta's *Natural Magic*, Marsilio Ficino's *Three Books on Life*, the Geneva Bible, Thomas More's *Utopia*, the Aldine Press editions that Raphael Hythloday brought to Utopia, Edward Topsell's *History of four-footed beasts*, Alexis of Piedmont's *Secreti*, Richard Hooker's *Of the Lawes of Ecclesiastical Politie*, Machiavelli's *The Prince*, John Dee's "Mathematical Preface," and Montaigne's *Essays*.

Perhaps this list is wrong in its emphasis, though, insofar as such texts collectively express an attitude toward the relationship between knowledge and power that Prospero only acquires after he has lost his dukedom. Prospero had understood knowledge as its own realm, apart from the world; once he finds himself truly outside that world and indeed only when he must in turn dispossess someone else to regain a place even at the margins of the world, he learns the lesson that knowledge must be used if it is to exist because knowledge cannot be abstracted from the human world. The knowledge of nature is primarily valuable as it provides a power over man. This conclusion, adopted by Prospero in an exile that has taken him furthest from man and closest to nature, is one that Bacon had in mind when he insisted that science may be of nature but must pertain to man: "human knowledge and human power meet in one."<sup>34</sup>

The idea that princes could use art to master nature and, in doing so, create not so much knowledge as power is also at the heart of a tradition that feeds into Bacon's arguments on this subject. This tradition is best exemplified by the pseudo-Aristotelian *Secretum Secretorum* (*Kitāb Sirr al-Asrār*) Prospero's book—which never appears in the play and is not mentioned by Prospero until the closing moments when Prospero revokes his "rough magic" (5.1.57)—stands as a version of the *Secretum Secretorum*.<sup>35</sup> This pseudo-Aristotelian compendium

33. William Sherman, *John Dee: The Politics of Reading and Writing in the English Renaissance* (Amherst: University of Massachusetts Press, 1995).

34. Bacon, *Novum organum*, aph. 3.

35. My assessment of the emergence of early modern knowledge arts focuses on the role of print culture. Magic, though, was a part of both early modern print and manuscript culture. Prospero's book thus also stands suggestively within this manuscript tradition: see Barbara A. Mowat, "Prospero's Book," *Shakespeare Quarterly* 52 (2001): 1–33.

of secrets was a work of moral and political philosophy (a mirror for princes, containing supposed letters of instruction from Aristotle to Alexander the Great). The many sixteenth century descendants of the *Secretum Secretorum* included the German craft and recipe booklets known as the *Kunstbüchlein* (1530s), Alexis of Piedmont's influential *Secreti* (Venice, 1555), Giambattista della Porta's *Magiae naturalis* (1588), and other collections of recipes, formulas, and "experiments." Bacon's *Novum organon*, and the model of science it proposes, emerges strongly out of this tradition. The different versions of the *Secretum Secretorum* were committed to the idea that knowledge was a form of power and, as a result, many versions of this popular compendium were overlaid with recipes and experiments in alchemy, astrology, physic and sustenance, magic and numerology.<sup>36</sup> Purportedly Aristotle's secret revision to his own philosophy, this pseudo-Aristotelian text exemplified the challenges that the maker's knowledge tradition posed to traditional scholastic epistemology. As William Eamon explains, the *Secretum Secretorum* became influential because it offered what appeared to be a remarkable key by which the abstract knowledge of Aristotle's philosophy could be put into practical and material use.<sup>37</sup> The *Secretum Secretorum* seemed to offer the whispered revelation that art and science were not, in fact, distinct; its secret recipes would make it possible to use art to control nature and create power.

The secrets that the *Secretum Secretorum* and other Books of Secrets offered readers are the ones that the play invites us to imagine in Prospero's book. The play consciously does not open Prospero's book to us. We cannot read in Prospero's book but we can see its consequences. The book and the kind of knowledge that it represents give Prospero the ability to control nature—or at least human perceptions and experiences of nature. Prospero regains control over his life because he abandons the philosophy of the liberal arts that Aristotle represented and embraces a new maker's knowledge tradition exemplified by this pseudo-Aristotle. In his own shifting attitudes toward the relationship between art and science, nature and man, and power and knowledge, Prospero gives us a history in small of the larger cultural transformation by which Aristotelian philosophy would become Baconian science.

36. Eamon, *Science and the Secrets*, 45-50.

37. Eamon, *Science and the Secrets*, 46-47.

*The Tempest* is finally a play not an experiment. Natural philosophers whose work followed most closely from the maker's knowledge tradition tended to emphasize the need to make knowledge and to do so through the evidence of the senses. While Bacon felt that "by far the greatest hindrance and aberration of the human understanding proceeds from the dullness, incompetency, and deceptions of the senses,"<sup>38</sup> he also insisted the any new science must nonetheless begin in sense perception. *The Tempest* counters such a model in that whatever knowledge Prospero is able to create through his art does not rely on using the senses but in deceiving them. Prospero has crucially worked his art on the faulty senses of his captive audience, rather than on nature itself. The reconciliations and resolutions of Act 5 are achieved through a protracted restoration of everyone to his and her senses: "their rising senses / Begin to chase the ignorant fumes that mantle / Their clearer reason" (5.1.66-68). The senses are not the way to knowledge, as they would be in Bacon, but a chief impediment to it: Prospero thus explains to the doubting Gonzalo, "You do yet taste / Some subtleties o' th' isle that will not let you! Believe things certain" (5.1.123-25). Natural philosophers such as Bacon and Gilbert insisted, or at least hoped, that knowledge begins with sense experience, but Shakespeare's repeated emphasis in the closing scene on "the dullness, incompetency, and deceptions of the senses" suggests that very little may have been learned by Alonso, Gonzalo, Sebastian, or Antonio. The play appeals to the idea that Alonso and his courtiers return to their "reason" through and out of what Prospero has done, but Alonso may also be right, in a philosophical sense, to conclude that "these are not natural events" (5.1.227) and Prospero to characterize them as "happened accidents" (5.1.250). Has Prospero created knowledge in Alonso, Sebastian, Gonzalo, and Ferdinand, let alone in Antonio? Or, looking back to Aristotle, has he just created a "happened accident," an anomaly that may not be replicated, whose lessons may well not apply elsewhere? Our need to ask such questions at the close leaves us uncertain about the kind of knowledge that Prospero has produced and about any future that might be created out of that knowledge.

While the play remains vexed about the quality of whatever knowledge can have been produced through Prospero's art and thus about

38. Bacon, *Novum organum*. aph. 10, 49.

any moral lessons that may have been learned by those that Prospero has directed his art against in this final scene, the only redemptive hope for knowledge is necessarily in the next generation. What we can see in the final scene of the outcome for Ferdinand and Miranda is more than just a sense of what might be possible for them personally. In their fates, only hinted at, we should also see Shakespeare's most direct assessment of whether art can ultimately produce knowledge and what kind of knowledge that is. The reconciliation of Prospero with his former adversaries is only achieved by the discovery of Miranda and Ferdinand together in Prospero's cell, a space presumably filled with his library of books. In a final gesture, Prospero contrives one more spectacle, offering Alonso "a wonder to content ye / As much as me my dukedom" (5.1.169–70). The connection between art and power, between the technologies of wonder and the facts of dynastic control are, as Prospero's comment suggests, now aligned. The two young lovers are playing chess and, when Prospero reveals them, the two young lovers "wrangle" over the kingdoms on the chessboard and Miranda reproaches Ferdinand, "you play me false" (5.1.172). Prospero had once been willing to give up his kingdom for the small world of his library. Miranda is willing to give up a "score of kingdoms" (5.1.173), but she does so only in an engagement that involves holding the world more firmly rather than renouncing it. Prospero's art has again created this new small world, but it is one that involves precisely the integration of the prudential and the political in whatever knowledge it creates. Over the course of the play, Shakespeare rejects a series of competing contemporary models for knowledge and science: knowledge as the private secrets of the mage, natural philosophy as a finding of facts and collecting of observations, utopian thought experiments, and science as a God-like control over the world. As Ferdinand and Miranda play, *The Tempest* instead embraces knowledge as a collaborative practice that depends on the presence of an audience and thus uses art to transform nature within a social, human world. Situating *The Tempest* in discussions of early modern arts of knowledge allows us not so much to choose between transcendent art and postcolonial power but to see how the two are integrally connected. In the knowledge culture that this play portrays, art is the way to power.