The Problem of Nothingness:

Early Modern Literature, Science, and the Vacuum

by

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Duke University

Date: November 7, 2017
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Dissertation submitted in partial fulfillment of
the requirements for the degree of Doctor
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ABSTRACT

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Abstract

My dissertation explores literature's participation in 17th-century cross-disciplinary debates over nothingness; I argue that literary forms create the possibilities of scientific discourse later in the century. To fully understand the complex network of relationships that formed early modern science as well as, in consequence, our own experimental philosophy requires examining the challenges that literature issues to science. To demonstrate the mutually productive relationship between the literature and science of the period, my dissertation charts the seventeenth century's different literary conceptions of nothingness, and the contributions of writers such as John Donne, William Shakespeare, John Milton, and Margaret Cavendish to these debates over both the nature of nothingness and, more broadly, how we come to know anything at all. The project specifically focuses on how literary texts by these authors – in the form of sonnets, tragicomedies, and even proto-science fiction – produce knowledge in ways that anticipate and subtly revise scientific processes.

The first chapter, "Encompassing Nothingness in Donne's Poetry," evaluates two of John Donne's poems from *Songs and Sonnets* alongside the introduction of the symbol of zero into Western systems of calculation and the invention of the microscope. I argue for a re-reading of poems such as "A Valediction: Forbidding Mourning" and "The Flea" that accounts for their seemingly paradoxical representation of absence and presence by

considering Donne's thought alongside mathematical developments as well as developing literary technologies. This culminates in the poem's well-known image of the compass, where it inscribes a circle centered on a point (coincidentally, also the Arabic symbol for zero); the poem thus participates in the broader project of transforming nothingness into an appropriate object for scientific inquiry. Donne's poetry anticipates scientific method by forming imagined communities of observers whom he addresses and leads through a process of witnessing nothingness, thus revealing its status as an object of scientific inquiry, and consequently, as something after all.

Chapter 2, "Playing at Nothing in *The Winter's Tale*," looks at the treatment of nothingness in this play as a model for literature's production of experimental science in the seventeenth century. In *The Winter's Tale*, Leontes's solipsistic assurance of his wife's infidelity and the infallibility of his own senses gives way to knowledge formed collectively by a performance that reforms and reconciles the community. This performance suggests that the community, rather than the solitary individual, is the basis for building knowledge. Through analyzing Leontes's method of knowledge production versus the communal models that close the play, I argue that *The Winter's Tale* preemptively figures the shift from a patronage-based court philosophy to an experimental philosophy. In doing so, *The Winter's Tale* helps to revise the dominant

narrative about when the idea of communal witnessing begins by emphasizing the importance of literary contributions to the history of science.

Chapter 3, "Experience in *Paradise Lost*," pays particular attention to the shift from observation to experience as represented in Milton's poetry. Engaging with critical debates over Milton's materialism, I read Milton's epic as it rejects the idea of creation ex nihilo and instead focuses on creation out of Chaos. Just as Boyle justified his explorations into atomistic philosophy and rejected the idea of a universe created by random atomic interactions, Milton's universe, too, is established and ordered by a divine Creator. Unlike Boyle, however, Milton rejects the experiment, which he identifies with a fallen world, in favor of experience – described in *Paradise Lost* as wisely used, individually mediated reason.

Chapter 4, "'To Make Your World of Nothing': Nothingness in Margaret Cavendish's *The Blazing World*," examines Cavendish's 1666 utopian proto-science fiction romance in conjunction with Robert Hooke's 1665 *Micrographia*, a text that explores the minute worlds opened to human observation with the microscope's invention. Cavendish's text envisions a world-building that is entirely the result of individual human invention – in her words, one made of "Nothing but Wit." Cavendish focuses on the imaginative possibilities opened by a creation focused on seeming nothingness; her text fantasizes about a world in which this act of creation forces multiple boundaries to break down (human / animal, scientist / experiment). *The Blazing*

World challenges the rules for scientific practice enshrined by the Royal Society by imagining experiments that create hybrids that test the seemingly objective stance of the scientific observer as well as the facts produced in the laboratory itself.

Dedication

For my family.

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Introduction

In *The Winter's Tale,* after Hermione has persuaded Polixenes to stay and Leontes praises her, saying she never spoke as well "but once before," she jests with Leontes, asking him to "cram's with praise, and make's / As fat as tame things" (I.ii.162-164). She finishes by stating, "My last good deed was to entreat his stay / What was my first? it has an elder sister, / Or I mistake you: O, would her name were Grace!" (I.ii.169-170). Being crammed full with praise is a reward for her persuasion of Polixenes: her "last good deed," as it turns out, before Leontes will say, "my wife is nothing" (I.ii.398). Both speeches incite the dramatic action in the play by calling into question Hermione's fidelity.

What does it mean for Hermione to speak at all in this context? She is silent during her trial, absent from the play for several acts while presumed dead, and almost silent after her reintroduction into the community through an "art as lawful as eating" but for the words she speaks to her daughter (V.iii.3423-4). If you are rewarded for speaking by being crammed with praise, what happens when you stay silent, when you say nothing?

One of the most important aspects of *The Winter's Tale* is how it speaks about the repair and reformation of a community after rupture. Mamillius is dead and his death cannot be recuperated; the players come to piece together their stories where "each one [may] demand an answer to his part / Perform'd in this wide gap of time since first / We

were dissever'd" (V.iii.3471-3473). Even in a moment of reunion at the close of the play, the existence of a break, or absence – some loss – still remains. *The Winter's Tale* draws attention to profound loss – to absence, to a "wide gap" – even at the moment of seeming recovery.

Early modern literature worried about the anxiety and uncertainty caused by the concept of nothingness at a time when other disciplines were equally invested in knowing and naming nothingness in a variety of different forms. For example, a renewed interest in atomism brought texts by authors such as Lucretius to the forefront, with his famous claim that nothing comes from nothing. A result of this revival of interest in atomism simultaneously sparked anxieties about atheism. As historian John Henry explains,

> There were good reasons, as far as the orthodox were concerned, for implicating the new philosophies in the promotion of atheism. For example, the dominant matter theory of the new philosophies developed by Descartes, Pierre Gassendi (1592-1655), Thomas Hobbes (1588-1679), Robert Boyle (1627-91) and others was essentially atomistic, which was the matter theory favoured by the newly rediscovered ancient atheists (supposedly), Epicurus (c. 341-270 BC) and Lucretius (c. 99-55 BC). (Henry 43-44)

Despite the fact that atomists such as Gassendi and Thomas Harriot attempted to reconcile their atomistic beliefs with their devotion to Christianity, the new philosophy was tinged with atheism (Henry 272). Lucretius's philosophy posited the existence of atoms and the void and theorized that the first organisms emerged because of disorderly random encounters between atoms and not at the certain hands of a Creator God;

indeed, he believed that no such gods existed (Goodrun 208-210). During the latter half of the seventeenth century, when thinkers such as Thomas Hobbes and Margaret Cavendish explored the materialist implications of atomism, atomism became even more widely distrusted: "the materialism and unorthodoxy found in Hobbes and Cavendish prompted numerous responses in the latter half of the seventeenth century that reflect a widespread concern with the impact that Epicureanism and atomism might have" (Goodrun 212).

The fear of atheism corresponded with the fear that there might be spaces where there was no matter at all; we might term this the fear of the void or the fear of nothingness. While different experiments within the seventeenth century focused on the production of void space, writers also troubled themselves about the concept of nothingness: Leontes' fear that his wife is nothing leads to the play's complex meditation on the proper production of knowledge: authority or observation; Donne's famous use of the new numeral zero, the number of nothing, enables one of his most famous "metaphysical conceits," the twin compasses which inscribe the Arabic form of the cypher. Milton rejected both the concept of creation ex nihilo in *Paradise Lost* and the scientific experiment in favor of well-reasoned experience, while Margaret Cavendish satirized institutionalized scientific authority, their tools, and their experiments through her depiction of animal-human hybrids, and instead posited absolute female authority in *The Blazing World*.

In order to understand the cross-fertilization between literature and natural philosophy at this time of epistemological change, it is necessary to pay close attention to the details of the new methods of inquiry that were shared by poets and natural philosophers alike. It is not so much that science influenced literature or that literature influenced science but that both realms were invested in understanding the troubling new importance of nothingness that had come upon the scene of human endeavor. It will be necessary to pay close attention to the specific details of both experiments and poems in order to assess the surprising shared methods between them, which have been less appreciated than they should be.

Experiments with the barometer, which involved partially filling a barometer with mercury and testing the effect of atmospheric pressure on the mercury within the barometer, proved the existence of a vacuum within the tube. In the 1630s and 1640s, Galileo and Toricelli experimented with creating a vacuum in a barometer, experiments that were later repeated by Pascal and also by Gassendi. While Otto von Guericke made the first vacuum pump around 1650, in 1660, after hearing of Guericke's design, Robert Hooke would make one for Robert Boyle, allowing Hooke and Boyle to create a partial vacuum (Andrade 41).

In his *New Experiments*, Boyle described his experiments with the air pump. As historian Luciano Boschiero summarizes,

> In this experiment, the liquid in the barometer maintained its height until air was extracted from the receiver, at which time the liquid descended.

> The curiosity of such an observation was based on the hypothesis that air atoms possess weight and thus exert pressure on the atoms and objects below them. This means that the barometer, when placed inside a sealed container, theoretically no longer has the full weight of the atmospheric air pressing upon it. Nevertheless, Boyle showed that when the barometer was placed inside the air pump before the extraction of air, the mercury … remained at its usual height. …. Only when air, with its elasticity and weight, is evacuated from the receiver does the liquid in the barometer descend. (Boschiero 70)

Boyle's experimentations with partial vacuums were numerous. They included experimenting with the pull of magnetic force in vacuum space and testing whether candles would stay lit and what the effects of decompression were on insect and animal bodies. Their report of a bubble appearing in a viper's eye after it had been placed inside the vacuum receiver was "one of the first demonstrations of gas bubbles that occur in decompression sickness" (West 37).

Because of the associations between atomism and atheism, Boyle was careful to align his actions with religious orthodoxy. "Boyle admitted that he 'Explicat[ed] things chiefly according to the Atomical Principles,' but he claimed to have revised atomism to convince those 'addicted to the Epicurean Philosophy'" (Sheppard 118). Joseph Glanvill, an English natural philosopher, claimed in support of Boyle and similar atomists that their work supported a universe created and ordered by God. He writes, "They suppose, and teach, That God created matter, and is the supreme Orderer of its motions, by which all those diversities are made: And hereby Piety, and the Faith of Providence is secured" (qtd. in Sheppard 122). Hobbes, as an atheist, was not part of this company (122).

While Hobbes was, like Cavendish, an unorthodox thinker whose interests included atomism, he came into conflict with Boyle over his experiments with the air pump. At the heart of Hobbes's conflict with Boyle rested the concept of the vacuum. The argument in this case was primarily one of naming; both Hobbes and Boyle's philosophical positions relied upon the "proper use of language" for different purposes (Shapin and Schaffer 92). Shapin and Schaffer's work in *Leviathan and the Air Pump* demonstrates the importance of language in establishing experimental philosophy by underscoring the political stakes inherent in the language both Hobbes and Boyle used to describe the vacuum.

Language mattered in both the experiment itself and in its public dissemination. Although knowing or recognizing nothingness in the early modern period crossed disciplinary boundaries, language was at the center of all of these realms; how Boyle and Hobbes defined the term "vacuum" mattered greatly. Language was already a central aspect of the way Lucretius thought of atomic motion. Lucretius's axiomatic statement – *nil fieri ex nihilo*, that nothing can come from nothing – posited atomic motion against the figure of the void; what exists is matter and void. In *De Rerum Natura,* where he considers atomic motion and the void, he uses the relationship of letters to words to think about the relationship between atoms and matter: just as letters were joined in an infinite number of combinations to form words, so too was matter composed of atoms.

Boyle's experimental program as described included the development of a new scientific language: an experimental discourse that was wholly separate from "the traditional language of natural philosophy, now stigmatized as 'metaphysics'" (Shapin and Schaffer 80). Boyle's shift to an experimental discourse thus denied that the function of the laboratory was to settle metaphysical questions: this shift foregrounded the "matter of fact" and its careful establishment through literary technologies of witnessing as a key part of this experimental discourse.

Rather than participating in the debate between plenists and vacuists, Boyle's understanding of a vacuum gave the term meaning within the context of the experiment, where it could be sensibly discerned by a community of observers, removing it entirely from the realm of philosophical debate: "I understand not a space, wherein there is no body at all, but such as is either altogether, or almost totally devoid of air" (qtd. in Shapin and Schaffer 46). Giving the term "vacuum" experimental meaning in this way removed it from the realm of metaphysical discourse and brought it instead into a context where it could be the subject of communal inquiry and scrutiny:

> The Royal Society advertised itself as a 'union of eyes and hands;' the space in which it produced its experimental knowledge was stipulated to be a public space. Nevertheless, what Boyle was proposing, and what the Royal Society was endorsing, was a crucially important move towards the public constitution and validation of knowledge. (78)

Hobbes's debates with Boyle centered on this naming practice, which disseminated authority to a community of observers. Reeling from the Civil War, Hobbes opposed

opening up a space for communal dissent, which produced the political conditions for civil unrest. In a larger sense, Boyle's linguistic shift made knowledge at this moment in the seventeenth century the product of a (strictly regulated) public collective. This shift established certain ways of conceptualizing the creation and validation of knowledge.

This is not to say that participation in this experimental space was immediately available to everyone. Boyle's laboratory also had a role in defining certain types of knowledge as expert; some witnesses had greater expertise and authority than others. Despite the importance of disseminating knowledge of the experiment, the space of the laboratory "was public in a very precisely defined and very rigorously policed sense: not everybody could come in, not everybody's testimony was of equal worth; not everybody was able to influence the institutional consensus" (Shapin and Schaffer 78). To this end, philosophers of science such as Elizabeth Potter and Rose-Mary Sargent have debated whether Boyle's language and methodology reveal a masculinist bias: whether or not, for example, women were included as witnesses in Boyle's writing.[1]

In *We Have Never Been Modern*, Bruno Latour claims that, in fact, "all of them [historians of science, political philosophers] have had to 'see double' from Hobbes's and Boyle's day on" (27). To redefine what it means to "see double," Latour reads Boyle and Hobbes's debates as something that marks the invention of the "modern world, a

[1] See Rose-Mary Sargent's "Robert Boyle and the Masculine Methods of Science" and Elizabeth Potter's "Gender and Boyle's Law of Gases."

world in which representation of things through the intermediary of the laboratory is forever dissociated from the representation of citizens through the intermediary of the social contract" (27). The modern world, in Latour's reading, is characterized through its participation in the dual activities of "purification" and "translation" – where purification establishes stable boundaries between nature and culture while simultaneously constantly blurring those boundaries in the creation of hybrids, which combine aspects of both the cultural and the natural. This separation is part of the modern constitution and relies on paradoxes concerning this constant play between nature and culture (32). Latour's work opens up space for thinking about the interactive, mutually constitutive ways in which nature and culture are produced. Latour's work privileges these non-modern ways of thinking ("the premoderns – if we are to believe the anthropologists – dwell endlessly and obsessively on those connections between nature and culture").

This dissertation falls into two, generally chronological, parts. In the first, I turn to two texts, John Donne's "A Valediction: Forbidding Mourning" and Shakespeare's *The Winter's Tale*, where nothingness takes the form of profound absence – in Donne, the absence of a beloved person, and in Shakespeare, disappearance, loss, and presumed and actual death. While Donne's text is from the perspective of an individual observer as opposed to *The Winter's Tale*'s community of observers, both texts frame nothingness as something that can be sensibly discerned through observation. In the second half of my

dissertation, I mark the shift from observation to experience in two works from the latter half of the seventeenth century: John Milton's *Paradise Lost* and Margaret Cavendish's *The Blazing World*, published within a year of one another (1667 and 1666, respectively). Both Cavendish and Milton's texts link nothingness to world-building; Cavendish's husband wonders what it might mean for Cavendish to make her world out of "Nothing / but Pure Wit" and in Book VII of *Paradise Lost*, Milton rejects the idea of creation ex nihilo and instead imagines a world created from Chaos. Central to knowing the created world Milton imagines is the concept of experience (in a fallen world, experiment), an ambiguous tool in the poem. While Milton's vision of useful experience is one that is ultimately subject to divine authority, Cavendish imagines a world where all authorities are decentered and she herself is the prime maker.

The first chapter, "Encompassing Nothingness in Donne's Poetry," evaluates two of John Donne's poems from *Songs and Sonnets* alongside the introduction of the symbol of zero into Western systems of calculation and the invention of the microscope. I argue for a re-reading of poems such as "A Valediction: Forbidding Mourning" and "The Flea" that accounts for their seemingly paradoxical representation of absence and presence by considering Donne's thought in conjunction with mathematical developments as well as developing literary technologies. This culminates in the poem's well-known image of the compass: the drawing a circle centered on a point, which also inscribes the early modern Arabic symbol for zero; the poem thus participates in the broader project of

transforming nothingness into an appropriate object for scientific inquiry. Donne's poetry anticipates scientific method by forming imagined communities of observers whom he addresses and leads through a process of witnessing nothingness, thus revealing its status as an object of scientific inquiry, and consequently, as something after all.

Chapter 2, "Playing at Nothing in *The Winter's Tale*," looks at the treatment of nothingness in this play as a model for literature's production of experimental science in the seventeenth century. In *The Winter's Tale*, Leontes's solipsistic assurance of his wife's infidelity and the infallibility of his own senses gives way to knowledge formed collectively by a performance that reforms and reconciles the community. This performance suggests that the community, rather than the solitary individual, is the basis for building knowledge. Through analyzing Leontes's method of knowledge production versus the communal models that close the play, I argue that *The Winter's Tale* preemptively figures the shift from a patronage-based court philosophy to an experimental philosophy. In doing so, *The Winter's Tale* helps to revise the dominant narrative about when the idea of communal witnessing begins by emphasizing the importance of literary contributions to conceptualizing the history of science.

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nihilo and instead focuses on creation out of Chaos. Just as Boyle justified his explorations into atomistic philosophy and rejected the idea of a universe created by random atomic interactions, Milton's universe, too, is established and ordered by a divine Creator. Unlike Boyle, however, Milton rejects the experiment, which he identifies with a fallen world, in favor of experience – described in *Paradise Lost* as wisely used, individually mediated reason.

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1. Accounting for Zero: Encompassing Nothingness in the Poetry of John Donne

How do we account for absence? John Donne's "A Valediction: Forbidding Mourning" famously centers on an impending absence between two lovers, using the image of the compass to bind the two seemingly distant lovers together through space and time. While the image traced at the poem's end has been interpreted in various ways, I want to press for a reading of the poem that takes into consideration another potential sign of absence – the zero figure, whose status was very much in contention in early modern Europe.

John Donne's "A Valediction: Forbidding Mourning" closes with the following image: "Thy firmness make my circle just, / And makes me end, where I begun." These closing lines have been the focus of various and divergent critical interpretations. John Freccero interprets this figure as delineating a "swerving serpentine" formed by a compass: one which unites body and soul in a spiral that thus differs essentially from the "perfect circle" formed by "angelic love" (336-337). Eileen Reeves, in turn, unites early modern cartography and theology by arguing, after Freccero, that the oblique movement found in the poem's last stanza suggests the proper course of the sinning soul towards God: moving elliptically rather than directly towards the divine.[2]

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[2] In "John Donne and the Oblique Course," Reeves argues after John Freccero by claiming that the spiral's combination of straight line and circle, form and matter, serves as reconciliation between body and soul: "God and the angels in their rectitude, move in a straight line, while Satan enfolds the globe in a ring of evil.

Lisa Gorton's work focuses on similar aspects of "A Valediction: Forbidding Mourning," but her reading of Donne's imagery here stresses cosmography rather than cartography; she argues that the poem uses the circle to allow the lovers to move beyond the limited temporality of human relationships and instead access a spatial timelessness associated with the divine.[3] Tilottama Rajan, borrowing Stanley Fish's use of the "self-consuming artifact," applies this to Donne's *Songs and Sonnets*. Rajan highlights the imagery of compass and circle to underline the poem's "dissociation of intellect from feeling" intended to cultivate in the reader a necessarily skeptical attitude towards language and its creations (805-806). [4]

However, W.A. Murray's earlier note on "A Valediction: Forbidding Mourning" suggests an alternate reading for the circle which closes the poem.[5] The circle, as drawn

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'For the devil's way was circular, compassing the earth; but the angels' way to heaven upon Jacob's ladder, was a straight, a direct way' (VII, 244). In either case, however, the course left to man is a spiral one" (173).

[3] In "John Donne's Use of Space," Lisa Gorton writes, "There is, of course, a long tradition associating eternity with circles. It was built into the old cosmology and its associated physics. However, a circle can defeat time in two ways. It can defeat time by turning into itself, over and over again, making every ending a beginning. This is how God makes a Christian life into a circle. Donne says: 'God is a circle himselfe, and he will make thee one' (VI. Viii. 175). Such immortality is qualitatively different from eternity. He imagines a different kind of timelessness for God. God's eternity is 'not a Circle where two points meet, but a Circle made at once; This life is a Circle, made with a Compasse, that passes from point to point; that life is a Circle stamped with a print, an endlesse and perfect Circle, as soone as it begins' (S.2. 9.200). God's eternity is without sequence, and Donne imagines it as a space, describing God as 'millions upon millions of unimaginable spaces in heaven" (Gorton 32)

[4] "There is no language free of paradox and metaphor: to be committed to self-expression, is, hence, to be caught in a language that calls itself into question." (Rajan 815)

[5] "It has not, I think, previously been noticed that the immediately preceding image, in which the conjoint souls are compared to gold 'to ayery thinnesse beate,' actually suggests the compass image itself, since the

by a compass, shows a point enclosed by a circle: this resembles the alchemical symbol for gold, recalling the "love, so much refin'd," as well as the "gold to ayery thinness beat" mentioned in the poem's earlier stanzas.[6] Murray's reading is among the first to see the figure formed by the motion as a sign, albeit an alchemical one. The image Murray points out – that of gold beat "to ayery thinnesse" – is one that is participating in conjuring representations of nothingness in the poem.

A re-reading of Donne's poetry, in particular "A Valediction: Forbidding Mourning," that accounts for its seemingly paradoxical representation of absence and presence, points to the subtle influence of this mathematical change on Donne's thinking. The tension the poem exhibits between absence and presence – the absence of the beloved, their representational presence in the poem itself – culminates in the poem's well-known image of the compass, drawing a circle centered on a point, in essence outlining the figure of the zero as it was written in Arabic. Not coincidentally, I argue, this figure is also akin to the Arabic symbol for zero (sifr[7]), rendered in English as

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current chemical symbol for gold was ◯, which occurs in the table of transmutations, and also in the run of printed texts with case endings, e.g. ◯. i, for auri" (Murray 326).

[7] Its adoption by Western culture represented it as a dot, or in some instances, as a dot within a circle. For more on the introduction of zero in the early modern period Brian Rotman's *Signifying Nothing* (1987); on the history of the zero, see Charles Seife's *Zero: The Biography of a Dangerous Idea* (2000), Karl Menninger's *Number Words and Number Symbols* (1969), Robert Kaplan's *The Nothing That Is: A Natural History of Zero* (2000), and Georges Ifrah's *A Universal History of Numbers from Prehistory to the Invention of Computers*. For additional bibliography on early modern mathematics, consult David Glimp and Michelle R. Warren's

"cipher:" itself a paradox as a word indicating both nothingness and calculation.[8] Thus the paradoxes around the evocation of absence and presence in Donne's poetry echo those accorded to the zero as well, as a symbol, which is a thing, meant to represent the concept of nothingness. Donne's poetry harnesses the fundamental tension within the concept of zero and uses it to convert nothingness into an object of inquiry.

In a different but related move that also anticipates much later developments in the methods of scientific inquiry, Donne's narrator in "A Valediction: Forbidding Mourning" addresses imaginary communities of observers whom he leads through the process of witnessing nothingness, thus revealing its status as an object of scientific inquiry, and consequently, as something after all. This creation of imagined community of scientific investigators is a formative movement in seventeenth-century natural philosophy – Donne's poems ask of their readers nothing less. According to historians of science it was later in the century that debates over nothingness – in the form of the vacuum – functioned as the inaugural moment of experimental philosophy. Donne's poetry draws attention to the insensible and turns it into a subject for critical inquiry.

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collection *The Arts of Calculation: Quantifying Thought in Early Modern Europe*, as well as work by Shankar Raman, Mary Thomas Crane, and Amir Alexander.

[8] In *The Hindu-Arabic Numerals* (1911), David Smith and Louis Karpinski cite Johann Huswirt's writing as an example of "cipher's" doubleness in this way: "'Decimo X 0 theca, circula, cifra sive figura nihili appelat' [Enchiridion Algorismi, Cologne, 1501]. Later, 'quoniam de integris tam in cifris quam in proiectilibus'" (58). The first use of "cifra" defines it as a zero – like, "circula" or "theca," other historical names for cipher. The second, as Smith and Karpinski note, uses cipher to refer to accounting.

By subtly integrating new mathematical knowledge into the early century's thinking about science, Donne's "A Valediction: Forbidding Mourning" helped to establish the conditions of possibility for the experimental science practiced by members of the Royal Society. Both by identifying nothingness as a space of contentious debate, and by experimenting with the methods of scientific inquiry through poetic form, seventeenth-century poetry's inquiries were very much aligned with those of natural history in creating the new science.

The introduction of Hindu-Arabic notation into the European world not only changed European modes of accounting but also presented an epistemological problem to both medieval and early modern audiences. Although the concept of the zero, as well as positive and negative numbers, had been in circulation among Hindu mathematicians since the seventh century, it would take centuries for the concept to reach European audiences (Debnath 627). As Karl Menninger notes in *Number Words and Number Symbols*, while Hindu-Arabic notation was introduced to Europe around the thirteenth and fourteenth century, it took several hundred years before the system was fully understood and became widely used.[9] He cites Johannes de Sacrobosco's famous thirteenth-century text *Algorismus*, "which came to be used all over Western Europe and

[9] Additionally, as Menninger notes, different countries adopted Hindu-Arabic notation differently. For example, while the word "figura" was used to refer to the numerals (of which zero did not count as one, for reasons I will explore above), "this name was retained in English and French, but not in German" (403). In German, then, "cipher" meant only zero, whereas in English manuscripts, as I mentioned earlier, it was able to indicate both the sign of zero as well as signify ciphering.

continued to be copied in manuscripts until the seventeenth century" (402). In the *Algorismus*, as Menninger notes, Johannes de Sacrobosco introduces the nine Hindu-Arabic numerals. Of the zero, which he calls "theca, or circulus, or cifra, or figura nihili," he writes that it both functions as a symbol for nothingness and works to give the Hindu-Arabic numerals themselves greater value (i.e., because of its ability to change the numeric value of a 1 from 10 to 100) (Menninger 402-403). The zero's doubleness of function was accompanied by confusion around its changing status from a symbol, as noted in Sacrobosco, to a potential number in early modern Europe.[10]

Hindu-Arabic numerals had circulated in Europe before the early modern period; for example, in the thirteenth century, Fibonacci introduced them to Italian audiences (Sebregondi 2). Their widespread use and function in practices of accounting in Europe, however, did not occur until the fifteenth and sixteenth centuries.[11] Before the use of this system, Europeans used Roman numerals; while they were considered to be more difficult to alter, they were also more difficult to perform basic arithmetic with (Throop 292, 296). (Throop's example, "try dividing MCXXIV by MCVIX without

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[10] Further evidence of zero's status as a sign in the thirteenth century and not a numeral: in Leonardo of Pisa's 1202 Liber Abaci, he writes, "The nine numerals of the Indians are these: 9 8 7 6 5 4 3 2 1. With them and with this sign 0, which in Arabic is called cephirum [cipher], any desired number can be written." (Menninger 425)

[11] Menninger: "It was not from the universities but from Italy that the new numerals were taken into common use toward the end of the fifteenth century in the mercantile houses and the offices of the great German towns" (431). He also notes that the increased use of Hindu-Arabic symbols was due to the invention of printing in the fifteenth century, which included "algoristic textbooks of arithmetic" as "among the first popular didactic works to be printed" (431). Giulia Sebregondi's article, "On Architectural Practice and Arithmetic Abilities," also considers the adoption and use of Hindu-Arabic symbols and calculation by Renaissance architects in the sixteenth century.

converting to hindu-arabic numberals first," succinctly makes this point (292)). The introduction of Hindu-Arabic numerals made different kinds of calculation possible; as Menninger notes, "the young merchant apprentice from Northern Europe brought back home with him the Indian place-value notation and … the four basic operations of addition, subtraction, multiplication, and division" (429). Zero's participation in these processes was included in a number of early texts on English arithmetic that continued to be reprinted through the end of the sixteenth century.

One of the earliest known primers of English arithmetic, "An introduction for to lerne to reckon with the penne," printed by Nicholas Bourman in the 1530s, provides the following explanation for the zero, or cipher (Williams 167). [12] If "numeration is a maner of expressynge of numbers by certayn figures which are called figures of Algorisme, the which be tenne," "the tenth [is] called a siphre, sygnifieng nothyng of it selfe, but only set before the other significatyne fygurs augmentyth them signification" (3). Similarly, in Robert Recorde's *The Grounde of Artes*, he describes the ten figures in this manner: "there are but ten Figures that are used in Arithmetick; and of those ten, one doth signifie nothing by it self, which is made like an 0, and is called a Cypher. The other nine are called signifying Figures, and be thus wrote down" (6).[13] Both texts establish a

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[12] See Travis D. Williams's work on the history of arithmetic primers – "The Earliest English Printed Books" – as well as on the rhetorical device of enargeia in mathematical writing – "Mathematical Enargeia: The Rhetoric of Early Modern Mathematical Notation."

[13] From Robert Recorde's "Arirthmetick, or The ground of arts," 1699, Henry E. Huntington Library and Art Gallery.

separation between "signifying figures," that is, numbers one through nine, and the figure of the zero, which "signifies nothing of itself" but instead gives meaning to other numbers by "augmenting" them.

For example, both "The Crafte of Nombyrnge" and "The Art of Nombryng" described the role of the cipher in arithmetic. "The Crafte of Nombryne," as *The Earliest Arithmetics in English* (1922) notes, is based on a gloss of Alexander de Villa Dei's thirteenth-century work, while "The Art of Nombryng" was translated from Sacrobosco's work. "The Art of Nombryng," in particular, was translated through the late sixteenth century. In this text, though zero did not function as proper numeral, it participated in processes of calculation by giving value to other numbers relationally: for example, through multiplication, by being an integral part of the place-value system. The text states:

> And vnderstonde that ther been .9. lymytes of figures that representen the .9. digites. The .10. is clepede theta, or a cercle, other a cifre, other a figure of nought for nought it signyfiethe. Nathelesse she holdyng that place givethe others for to signyfie; for with-out cifre or cifres a pure article may not be writte. …. And vnderstonde wele that euery figure sette in the first place signyfiethe his digit; In the second place .10. tymes his digit; In the .3. place an hundrede so moche. (34-35)

In this passage, "cifre" is set apart as something different from the other numerals; nonetheless, it is termed a "figure," just as the other numerals are. Additionally, the "cifre" participates in processes of calculation through its role in the place-value system; i.e, as the text notes, by "infynytly mvltiplying by these .3. 10, 100, 1000" (35). What is

significant about this is zero's simultaneous status as a figure of nothing (but nonetheless a figure), but also an integral part of the place-value system that makes possible all the forms of calculation (addition, subtraction, mediation, duplication, multiplication, division, progression) described by "The Art of Nombryng."

While in Modern Standard Arabic (as well as some contemporary accounts, where the sifr was also written as a point encompassed by a circle), the sifr is written as a point, the point served a different function in Recorde's account of arithmetic (8-9). One speaker in the text notes that with increasing places, numbers become more difficult to read: "91359684 … But now I cannot easily nor quickly read it in order." Another speaker responds,

> You may attain to that by this means. First, put a Point over the fourth Figure, and so over the seventh. And (if you have so many), over the tenth, thirteenth, sixteenth, and so forth, still leaving two Figures between each two points. Then begin at the last Point, and see how many Figures are between it and the end, which cannot exceed three, reckoning itself for one: then pronounce them as if they were written alone from the rest, and at the end of their value, so many times Thousands as your numbers have Points. (8)

In this, points serve as a means of calculating value (each point is a signal to multiply by a thousand based on how many total points there are). This discussion of how to use points to both calculate and make it easier to read a given number immediately leads into a brief digression on the use of the cipher.

Recorde's scholar asks, "I have pointed them as you taught me, but I am in doubt whether I have done well or no, because of the Cyphers, for I remember you told me

that they do signifie nothing, and therefore I doubt whether I should reckon them for a Figure in the setting of the Points" (9). The Master's response indicates, as in "The Art of Nombryng," that while the cipher does not have any value on its own, its placement provides value to other numbers: "They are of no value themselves, but they serve to make up the number of Places, and to make the Figure following them to be in a further Place, and therefore to signifie the more value" (9).

In Robert Recorde's *The Grounde of Artes*, Recorde acknowledges the system's indebtedness to the Arab world by focusing on how reading figures differs from reading letters. The text, which is written in the form of a dialogue, poses the following question: "Why do men reckon the order of the places backward, from the right hand to the left?" Recorde's Master responds, "In that thing all men do agree, that the Chaldees, which first invented this Art, did set these Figures as they set all their Letters, for they write backward as you term it, and so do they read: And that may appear in all Hebrew, Chaldee, and Arabic Books, which are not only written from the right hand to the left, and so must be read; but also the right-hand of the Book is the beginning of it, whereas the Greeks, Latins, and and all the Nations of Europe, do write and read from the left hand toward the right" (13). While the Master later offers an additional explanation – that greater numbers come before the smaller and that place value determines number order – this first explanation traces the inheritance of a mode of reading and writing used by "Hebrew, Chaldee, and Arabic Books" as a means of ordering information.

While Menninger's work focuses mostly on the history of numerical symbols, in *Signifying Nothing*, Brian Rotman focuses on the semiotic system that emerges with the introduction of this system of notation – specifically, the introduction of the zero. Like Menninger, he notes that while Hindu-Arabic notation had circulated in Europe centuries earlier, by "the early seventeenth century Hindu numerals had completely replaced Roman ones as the dominant mode of recording and manipulating numbers throughout Europe" (Rotman 8). Rotman notes that part of the resistance to the adoption of Hindu-Arabic notation was the form of the zero, which triggered theological anxieties about the implications of nothingness and the void (Rotman 7, 63-64). The use of zero accompanied a new way of thinking about calculation:

> At any place within a Hindu numeral the presence of zero declares a specific absence," while simultaneously marking "the starting point of the process [of counting] … It is this double aspect of zero, as a sign inside the number system and as a meta-sign, a sign-about-signs outside it, that has allowed zero to serve as the site of an ambiguity between an empty character (whose covert mysterious quality survives in the connection between 'cyphers' and secret codes), and a character for emptiness, a symbol that signifies nothing. (Rotman 12-13)

Rotman's project focuses in part on the nature of this "character for emptiness," the form of the zero itself (58). He connects his project to scientific developments in the seventeenth century, claiming that "the elaboration of the code of scientific discourse in the seventeenth century to accommodate the concepts and reality of 'vacuum' and 'empty space' was … the completion of an existing semiotic paradigm. Within this discourse the terms 'vacuum' or 'empty space' were obliged to signify the absence of

what before had been conceived as full, indivisible, and all pervasively present" (Rotman 72).[14]

Because Donne's "A Valediction: Forbidding Mourning" uses the imagery of the compass to talk about the impending absence between two lovers, I want to briefly mention the links between Elizabethan mathematicians and imperial conquest. As Amir Alexander notes in "The Imperialist Space of Elizabethan Mathematics," many prominent early modern mathematicians were also engaged in different English imperial projects; for example, "Robert Record … was employed by the Muscovy company and dedicated one of his major works to it. John Dee was perhaps the most famous promoter of British expansionism during the period, and by coining the term 'British Empire. …. Thomas Hariot himself was a member of Ralegh's first colony on Roanoke island, where he was instructed to report on the land and its inhabitants… both physically and professionally, the mathematical practitioners of early modern England occupied a distinctly imperialist space" (559-560). (Donne, additionally, attempted to lead the Jamestown project.) Alexander argues that because mathematicians existed in a

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[14] Part of what Rotman points out about the introduction of zero is this paradoxical nature, which he locates in its status as a meta-sign; however, part of Rotman's history of the zero focuses on its role in changing practices of accounting. Specifically, Rotman reads the zero's function with regards to shift to a mercantile economy. As he notes in his analysis of *King Lear*, the zero's function in drama is to "signal the death of a feudal classical order and the arrival of the accounting practices, and the commoditised reality of mercantile capitalism" (Rotman 78). However, Rotman's reading, while focusing on the paradoxes signaled by the zero, is limited with regards to thoroughly exploring these paradoxes; while he notes the "doubleness," of the zero, his reading of *King Lear*, for example, fails to read the zero as anything other than a meditation on the commoditization of human affection and the resulting tragedy this inspires.

particular political and cultural context, their problems not only emerged from that context, but both their texts and methods were actively shaped by that context as well (561). His argument, that "a certain type of mathematical atomism developed by Thomas Hariot was shaped by the rhetoric and ideology of the English imperial project," builds on Donna Haraway's claim that "scientific practice is above all a story-telling practice" (562-563). I argue that literary forms create the possibilities of scientific discourse later in the century. To fully understand the complex network of relationships that formed early modern science as well as, in consequence, our own experimental philosophy requires examining the challenges that literature issues to science.

While reading Donne's poem in relationship to the zero articulates Haraway's claim, this article provides helpful framing for explaining how inextricable the links between mathematical thought, imperialist concerns and navigational tools, and poetic practices are. Alexander's article focuses on reading Hariot's mathematical treatises as cultural narratives; although I argue for considering the impact of mathematical and technological developments on Donne's poetry, it nonetheless provides a useful framework for reading "A Valediction" alongside other readings of the poem.

For example, the compass's use as a navigational tool has encouraged readers of "A Valediction" to read the shape formed by the poem in the light of early modern navigational practices. Eileen Reeves, in "John Donne and the Oblique Course," writes

of the oblique course as a fusion of old tools with the New Science as well as of poetry and technology:

> That "A Valediction: Forbidding Mourning" involves a voyage is crucial to our understanding of the poem, for it is upon Donne's sailing to the continent that the metaphor of the oblique course, an essential navigational concept – and indeed the movement of the whole poem – is based. Navigation was, as Elizabethan mariners' manuals point out, of three distinct types: for short distances … one sailed along a straight line, for immense distances one sailed along a Great Circle route, and for intermediate distances one followed an oblique or loxodromic course. (174)

The oblique course – called forth by the compass as well as the phrase that comes at the close of the poem, "obliquely run" – encompasses both spiritual and physical travel, as well as "ground[ing] the spiral path of human love in a particularly apt metaphor" (181). In this manner, the technologies of science and mathematics provide context for understanding how Donne understands the paradox of absence in his poetry. Furthermore, Donne also makes it impossible for his audience to untwine the technologies of the New Science from a thorough reading of the poem.

As Donne would later write on the relationship between vapours in the body and rumor in the body politic in Meditation XII, "But when I have said, a vapour, if I were asked again, what is a vapour, I could not tell, it is so insensible a thing; so neere nothing is that that reduces us to nothing" (79). Donne's use of the word "ayery" to describe the thinness of the material is significant here. While he describes a "vapour" later in the Meditations as something that is near but not quite nothing, the speaker's

inability to interpret it turns *him* into nothing (i.e., someone incapable of using their senses to determine the world around them). Here, Donne's struggle anticipates that of Meditation XII, as he works to establish physical absence between two separated lovers as a connection, albeit a connection so slender – as gold beat to "ayery thinnesse" – as to be almost unknowable.

Murray's interpretation of "A Valediction: Forbidding Mourning" illustrates the problem highlighted by the connection between nothingness and insensibility in this poem. What "A Valediction" works to do is transform something insensible – like absence, or nothingness – into something capable of being observed. In "A Valediction," Donne deals with the threat posed by the insensible by making it into an object of rational inquiry. He leads the poem's audience through a series of comparisons that work to make what is absent physically present. While critics have noted this presence of nothingness in Donne's poetry, my reading of nothingness in Donne's "A Valediction" considers nothingness from an early modern epistemological standpoint.

Nothingness has been treated in different ways critically in readings of John Donne's work: some critics, such as Roy Booth, hold that Donne's exploration of nothingness within his sermons and poetry emerges from an awareness of the various creative and theological possibilities opened by nothingness: for instance, the ways in which Donne's "sense of himself as nothing" both triggers anxiety over Donne's poetic authority and also alleviates this same anxiety by aligning the poet with God in his

potential ability to annihilate himself (203). I do not want to discount the importance of theological readings of nothingness in Donne's work, since part of the challenges presented by nothingness and the vacuum are its theological implications. I am more interested, however, in tracing a lineage of nothingness that sees Donne's poetry as an important part of the later scientific debates that occurred around the subject in the middle of the seventeenth-century. An important aspect of this question is what precisely it means to be "scientific," and in what ways reading a text as either literary or scientific limits its interpretive possibilities. I argue that literary forms create the possibilities of scientific discourse later in the century. To fully understand the complex network of relationships that formed early modern science as well as, in consequence, our own experimental philosophy requires examining the challenges that literature issues to science.

Donne's poetry plays an important part in illustrating these different notions of nothingness that circulated at the beginning of the seventeenth century. We have seen that Hobbes's objection to Boyle's experimental definition of vacuum rested upon an insistence that there could be only one acceptable definition of vacuity: a metaphysical one. I show that, on the contrary, there were many contradictory notions of nothingness in circulation at this time, and that Donne's poetry illustrates the existence of these competing ideas about nothingness. To this end, I want to return to the introduction of

the sign for zero in early modern calculation as a site for similarly contradictory meanings of nothingness.

Donne's poetry in his *Songs and Sonnets* is deeply invested in exploring the different contemporary conversations about nothingness. While Donne's poetry demonstrates many different types of nothingness, these conceptions of nothingness are all joined by their status as subjects of scientific inquiry. Donne attempts to demonstrate that nothingness is an object that developing technologies are unable to access and is something that can only be known through poetic intervention. In this way, Donne is immersed within a historical context concerned with the same debates over the nature of nothingness. Donne's poetry already participates in circulating the various modes of nothingness that would occupy the minds of philosophers in the Royal Society half a century later.

While there are formal distinctions between late sixteenth- and early seventeenth-century poetry and the mid-century scientific writing it anticipates, early modern poems like "A Valediction: Forbidding Mourning" engage with questions that are equally invested in processes of knowledge-making. Although the epistemological status of nothingness was hotly contested in many disciplines, Donne's poetry uses nothingness differently – to proliferate many potential readings of nothingness, and to create a world in which these possibilities exist simultaneously. Unlike the debates over the nature of vacuum in the sixteenth and seventeenth century, which sought to close off

interpretive possibilities rather than open them, Donne's poetry celebrates the paradox at the heart of the culture's varying interpretations of nothingness.

In "A Valediction: Forbidding Mourning," Donne leads his audience from understanding absence as nothingness to something which is instead replete with being; through the process of witnessing this transforming, nothing becomes something. While many critics suggest that the crucial imagery of the poem is the circle, both in the poem's form as well as in the pattern drawn by the compass at the poem's end, I suggest that accounting for the figure of the zero offers yet another reading suggested by the poem. What the poem closes with is the image of a circle drawn by a compass; in Murray's reading, as noted previously, this figure is the alchemical symbol for gold. However, as Rotman notes, the "O" represented zero in early modern typeface, which explains some of the other names given to the zero figure – circulo, for example.

Furthermore, other scholars have noted that the Arabic symbol for as-sifr was still in usage in Europe through the fifteenth century (Menninger 273). The representation of as-sifr in early Arabic numeration, its introduction into early modern Europe, and the connection between these symbols and developing scientific technologies all influence my reading of the poem's evocation of the zero in addition to, not to the exclusion of, the compass imagery that closes the poem.

The poem's opening stanza begins with the problem of defining nothingness. Donne's speaker begins discussing the nature of his absence through poetic simile ("as")

– note that this is also how the closing stanza begins ("such") – and, in doing so, emphasizing the tension between absence and its representation. Absence, like nothingness, is seemingly insensible, and cannot be directly represented. The first stanza of "A Valediction: Forbidding Mourning" reads:

> As virtuous men passe mildly away,
> And whisper to their soules, to goe,
> Whilst some of their sad friends doe say,
> The breath goes now, and some say, no: (1-4).

Nothingness here is a quality that can only be approximated and not represented directly. Donne's speaker marks the dying man's breath as the initial site of troubled interpretation, because it plays with early modern anxieties about the potential unknowability of invisible perceptual objects – in this case specifically, air. As I have shown earlier, these epistemological queries are relevant to early modern discussions of the vacuum.

Furthermore, the sound of these lines employs alliteration to evoke the sibilance of this unknowability of nothingness. The presence or absence of the dying man's breath in the poem is what signifies death to the "sad friends" who accompany their dying companion; in the poem, this breath, like the air, is represented as something that is unknowable. The struggle to represent the concept of absence, however paradoxically, is illustrated insofar as the dying man's status between worlds rests on a single letter; Geoffrey Hartman notes that "the evidence of life [hangs] on a word, on less than a word, on a vocal inflection or quantity, the difference between 'now' and 'no'" (qtd. in

Susannah Mintz 109). The poem presents this breath, or "whisper" as an initial site of uncertainty that marks the last breath of the dying man's soul from his body, further fueling uncertainty over the man's passage into the next world. However, the repeated sibilance of the words in this stanza (e.g., "whilst some of their sad friends doe say") changes this absence into aural presence and thus turns it into something intelligible. The transformation of nothingness into presence is established then as a project taken on by the poem.

However, the first words of the first two stanzas serve another function. Donne begins by treating the subject of absence as something potentially unknowable – for example, as unknowable as the moment of death – but as something that can yet be understood through simile. In Terry G. Sherwood's *Fulfilling the Circle*, he remarks on the use of simile in "A Valediction" to lead the audience through a series of logical progression. He writes:

> Counterargument is neither invited nor expected; the argument to convince, clarifying to confirm shared assumptions, grapples with mutual fears while standing securely on mutual emotional and spiritual conviction. A pattern of logical comparisons would build that conviction into dignified action. ….Yet human reason has the gift to apprehend partially what it cannot comprehend totally, seizing a share of truth with the terms of its own temporal consciousness. (26-27)

The second stanza picks up on the instruction begun in the first stanza; if the first stanza functions like a hypothesis, then the second stanza forms the conclusion, by making concrete what is at first abstract or hypothesized, and thus turning a seeming nothing

into a something. Sherwood's argument in this section also focuses on the various motions represented by the poem – from the "moving of the earth" to the physical separation of the lovers' bodies to the motions of the compass. The different types of motion noted by Sherwood here might also be read, however, as both the logical progression of different similes through which Donne's speaker makes nothingness knowable, but also as a series of motions that echoes the diverse motions of a compass.

The first stanza, then, in comparing nothingness to death, transforms it into something knowable. In this way, metaphorical language is able to perform something that the poetic speaker represents initially as impossible; poetic language forces us to confront the limits of our understanding, but also presents the seemingly paradoxical as something that is ultimately knowable exclusively through poetry. This moment serves as an example of what reading "A Valediction: Forbidding Mourning" in relationship to early modern debates over the existence of the vacuum might accomplish: specifically that poetic language accomplishes something important in this debate. The deployment of the paradox – and its representation through poetic language – understands the vacuum as essentially multivalent.

The next stanza continues to expand upon the imagery used in the first stanza. In the second stanza, the parting of the lovers is compared to the parting of a soul from its body; however, the language of the first stanza makes it clear that what appears to be absence is actually in dispute. The first stanza underlines the unintelligibility of breath

as the first point at which nothingness is problematized in the poem. This continues in the second stanza, as the poetic speaker states, "So let us melt, and make no noise / No teare-floods, nor sigh-tempests move" (5-6). The parting that the poetic speaker imagines here engages with the imagery of breathing and air set up by the first stanza. The "melting away" experienced by the poetic speaker and his lover recalls the breath of the first stanza, where the simile is set up with the words, "as virtuous men pass mildly away / and whisper to their souls to go."

In the early modern period, one of the suggestions for the constitution of air was that although it could not be seen, it was a fluid substance.[15] Though produced after Donne's work, Hobbes, for example, suggests in the *Dialogus Physicus* that air is "infinitely divisible" and writes, "I suppose the air is fluid, that is, easily divisible into parts that are always still fluid and still air, such that all divisible quantities are there in any quantity"(Hobbes 353)[16]. When Donne's poetic speaker discusses "melting," he is not describing a melting away into nothingness, simply a separation into smaller units. What looks like absence – or nothingness – is actually demonstrated to be in the process of being something.

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[15] Also the example Hobbes uses later to talk about air particles in the air pump underlines the comparisons between air and water: "Just as in a vessel full of water, in which are a multitude of eels, the eels always take up the same space whether wound up or uncoiled. So they cannot propel the water with an elastic force, which is nothing but the motion of bodies uncoiling themselves" (Hobbes 380).
From Carla Mazzio, "History of Air:" "For air, the element long linked with blood in the humoral system, was part and parcel of a psycho-physiological economy that, as Gail Kern Paster has emphasized, was still powerfully operative in Shakespeare's England." (154)

[16] Trans. Shapin and Schaffer.

The poetic speaker attempts to resolve tension between absence and presence by evoking nothingness as something that can be observed through the senses. The third stanza functions through a comparison between earthly motions ("moving of th'earth") and cosmic motions ("trepidation of the spheres"). Donne's poetic speaker begins by describing something that can be directly and physically experienced; the "moving of th' earth" as well as the attempts to interpret these direct physical experiences ("Men reckon what it did and meant"). The poetic speaker then contrasts this to cosmic motions that are "greater farre" but ultimately "innocent" (i.e., not harmful, but also simple or natural). What the poetic speaker does, then, is make something that is unknowable – the "trepidations of the spheres"– and transform it into an earthly phenomenon that is capable of being experienced insofar as it implicitly serves as a guide for the behavior of the parted lovers.

As Charles Coffin also notes, what this stanza does is to combine two different ways of knowing the cosmos, situating Donne's poetry between the dissolution of the old system and the advent of the new. He writes: "Of the new astronomy, the 'moving of th'earth,' is the most radical principle; of the old, the 'trepidation of the spheres' is the motion of greatest complexity" (Coffin 98). As with debates over nothingness itself, with relation to the cosmos, Donne's poem refuses to take sides; his poetry demonstrates what it is like to be caught between two changing epistemological systems. The next

stanza encourages this reading, through the slight directed towards the "dull sublunary lovers love," whose love then stands in direct contrast to that of the poem.

Consequently, while lovers' absence also lacks visible signs -- they separate, but without "noise / No teare-floods, nor sigh-tempests move" – it is nevertheless transformed into something that is physically present. Although their parting is not accompanied by visible signs of distress, this absence ultimately becomes present through comparisons that shift the cosmic into a more earthly register.

The continued association between absence and air strengthens this – Donne's poetic speaker moves toward claiming:

> But we by a love, so much refin'd,
> What our selves know not what it is,
> Inter-assured of the mind,
> Care lesse, eyes, lips, and hands to misse. (17-20)

The word "refined" recalls not only the purification of air but the purification of metal through a process of separation.[17] Being broken down into separate pieces does not make the lovers any less part of the same system: "inter-assured of the mind, / Care lesse, eyes, lips, and hands to misse" because "our two soules, therefore, which are one" (19-21). The poem thus turns absence into presence and, in doing so, develops a theory of nothingness that asserts that nothingness is capable of being apprehended through

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[17] OED: To purify or separate (metals) from dross, alloy, or other extraneous matter by removing oxides, carbon, and dissolved gases, generally at high temperature; spec. to convert grey pig iron into white metal, or to purify and otherwise improve steel in the ladle after steel-making. Also: to separate metals from (ore, dross, etc.).

the senses. Specifically, the poem invites the audience to adopt the role of a group of witnesses in determining the transformation of absence, or nothingness, into something that can be discerned within an experimental community.

The next stanza combines both the images of refined metal as well as air in a paradox[18] that underlines the problem of knowledge the poem presents. Though the poetic speaker must leave, their souls "endure not yet / A breach, but an expansion, / Like gold to ayery thinnesse beate" (22-24). Like the melting and refinement mentioned in earlier stanzas, the imagery in this stanza envisions the lovers' parting as an expansion rather than a break. The "ayery thinnesse" suggests that just as the air can be known without being seen, the seeming absence of the lovers is actually a presence.

Donne's poem does this in part by making what is absent physically present on a formal level. While Donne's poetic speaker assures his partner that "our two soules therefore, which are one … endure not yet / A breach, but an expansion," the poem emulates the breach through the line break that expresses this sentiment. Though Donne's partner may not experience the breach, the poem's reader is forced to do so; however, in the process, the breach becomes something that exists in the poem's form, changing absence into something present in the structure of the poem itself. But the poem also transforms its audience; reading the poem involves serving as a witness to the

[18] Rosalie Colie sees the paradox here as functioning on a theological register, arguing that the paradox's form works to treat the unknowability of the soul in poetry: "Since his subject, the soul, is by traditional definition ultimately unknowable, the poet must rely upon both the general epistemological tradition of paradox and its special development in the paradoxes of the negative theology" (409).

transformation of nothing into something through the use of poetic form. The audience, too, is transformed in this act – into an experimental community.

This leads into the image of the compass, which is prefigured in the poem by the image of gold; one that also should be read as a zero in dialogue with early modern debates over the nature of nothingness. As I noted before, the alchemical symbol for gold resembles the circle drawn around the point of a compass according to Murray's reading of "A Valediction: Forbidding Mourning." However, I'd also like to suggest that the image formed here might additionally be read as a zero. In this stanza, Donnne's speaker notes:

> Such wilt thou be to me, who must
> Like th'other foot, obliquely runne;
> Thy firmness makes my circle just,
> And makes me end, where I begunne. (33-36)[19]

Earlier in this chapter, I suggested that the "ayery thinnesse" actually leads into a further exploration of nothingness through considering the alignment between the zero and equally epistemologically challenging concept of air. The image of the circle that closes the poem continues this conversation. The circle, which I read as a zero, makes the poem's discussion of nothingness clear. The poetic speaker claims that the circle that

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[19] Rosalie Colie deals with this paradox in Donne's poetry in *Paradoxia Epidemica*."In her chapter on "Being and Becoming," Colie writes about the role of paradox in the Scientific Revolution, and also the paradox that numbers present. "The circle is the emblem for the great paradox of eternity, as well as of the equally impossible notion of infinity. The area of the circle, also, is technically immeasurable, however small it may be. … On the authority of Aristotle and St. Augustine, he responded that the more difficult task was to find the center of a circle already drawn, the single center of a line of infinite points" (319).

"makes me end, where I begunne" is drawn through a fixed point in the center and the constant, circling motion of the other foot who "far doth rome."

The types of motion differently figured by the poem are all caught up in this final image. The motion of breath, the motion of the earth, and the motions of the spheres – an expansion similar to that of the "ayery thinesse" of gold – lead to the image of the compass's circular motions. What compasses trace, though, are not simply single tidy circles, but a wide range of connected circular and elliptical shapes. The poem itself ties these separate motions – like the motions of a compass – into the single circular shape that closes the poem, and which I argue is the zero. The form of nothingness, the zero, enables this reading in a way simply focusing on the compass does not; the poem's project of transforming the lovers' absence into constant, knowable presence is neatly aligned with the zero's similar function as a sign that makes nothingness itself knowable. The poem's argument uses a wide range of similes and motions to demonstrate to the audience the interpretability of nothingness (as well as the vast types of nothingness that exist). These arguments close with the embodiment of nothingness as a real, physical presence drawn by the poem.

If "A Valediction" explores the problem of nothing on a cosmic scale, "The Flea" turns to a point of view enabled by another recent scientific innovation: the microscope. While "A Valediction: Forbidding Mourning," looks towards the cosmos to engage with

the problem of nothing, "The Flea" examines the subject of nothingness on a microscopic level. As John Carey notes in *John Donne: Life, Mind, and Art*:

> Flea poems were, in fact, a smutty old joke. … The standard set-up was that a flea found itself on a girl's body and crawled around, providing a commentary on the bits and pieces it came across. Its remarks on the breasts and genitals were, of course, considered the cream of the jest. Donne shoves all this coy giggling aside, refashions the genre as a toughly argued monologue on sexual union, and, dispensing entirely with any mention of the girl's body, concentrates attention on the body of the flea. (146-147)

Carey describes this change of focus to the microscopic while marking the "delicate intentness" of the language that Donne uses to shift from discussing the body of the girl to the body of the flea. The "concentrated attention" Donne pays to the body of the flea is another way of dealing with nothingness at the limits of the visible.

As in "A Valediction: Forbidding Mourning," the poetic speaker of "The Flea" argues for union between the two lovers that occurs on a seemingly undetectable level; like the "two soules, which are one" that "endure not yet a breach," the lovers in the latter poem are joined "in this flea, [where] our two bloods mingled bee" (4). The speaker of "The Flea" makes a similar rhetorical move to that of "A Valediction." Donne's speaker uses the image of the circle to in "A Valediction" to suggest the transformation of the lovers' absence into presence: if the image is a compass, their relationship takes on a sort of global scale (like the lovers in "The Good Morrow" or "The Sunne Rising"). As a zero, this comparison is even more explicit: what may look like absence is actually full of meaning; what looks like nothing is everything. His final

words in "A Valediction" -- "makes me end where I begun" -- call upon a sort of eternity and timelessness that identifies the lovers with the divine.

In "The Flea," Donne demonstrates how the seemingly minute achieves cosmic proportions. While the absence of the lovers in "A Valediction" is a vast nothingness that Donne's poetic speaker makes physically present, "The Flea" focuses on making something almost invisible into a thing that is both sensory and sensual. The movement of "A Valediction" is telescopic; that of "The Flea" is microscopic.

The poem opens with the injunction to the poetic speaker's lover to "Marke but this flea, and marke in this, / How little that which thou deny'st me is" (1-2). The repetition of the word "mark" emphasizes this focus on the minute – as the OED notes, to mark means to distinguish from something else through a process of separation. The poetic speaker's first tactic is to enjoin his lover to note how "little that which thou deny'st me is" (2). However, the focus here quickly expands to the macroscopic, as the poetic speaker shifts from noting the minuteness of the flea only to argue for its cosmic significance:

> And pamper'd swells with one blood made of two,
> And this, alas, is more than wee would doe
> Oh stay, three lives in one flea spare,
> Where wee almost, yea more then maryed are.
> This flea is you and I, and this
> Our marriage bed, and marriage temple is (8-14)

The poetic speaker moves from drawing an implicit comparison between the insignificance of both the flea and his lover's chastity to treating the flea as a world

within itself that contains the two lovers. The flea changes, under Donne's focus, towards serving as the "mariage bed, and mariage temple" of the would-be lovers, and their potential union takes on spiritual and cosmic proportions (e.g., the "three lives in one flea spare" and its recollection of the Trinity).

While in Donne's poetry, the microscopic takes on a kind of enlarged significance, the expansion of the flea does not continue infinitely. In "The Sunne Rising," for example, the world's that "contracted thus" transforms the bedroom of the lovers into the entire world: "this bed, thy center is, these walls, thy spheare." This imagery functions through placing limits on the infinite, and this emphasis on bounding and limiting the infinite continues continues through "The Flea."

While in "A Valediction," Donne turns vast nothingness into something that can be known, in "The Flea," the microscopic might potentially become the infinite. Preventing the flea from functioning as an infinitely expanding microscopic world, however, is the poetic speaker, who constantly places limits on the flea. To resolve this potentially limitless expansion, the speaker states, "Though parents grudge, and you, w'are met, / And cloysterd in these living walls of Jet," introducing a limit to the otherwise seemingly limitless expansion of the flea through the evocation of actual, physical boundaries ("living walls," "cloyster"). The break in sound in these two lines – the dissonance of "met" and "jet" interrupt rhymes like "two"/"do," "spare"/"are," and

"me"/"be"/"three"- creates a sudden limitation to the euphony of the lines before and after: one that echoes the boundary simultaneously being evoked by the poetic speaker.

The poet reaffirms his limit of the "living walls of Jet" when he shifts the focus back to emphasizing the minuteness of the flea. While the first two stanzas of the poem expand the scope of the flea, the third stanza reduces it once more to its original size. The speaker addresses the beloved, saying:

> Cruell and sodaine, hast thou since
> Purpled thy naile, in blood of innocence
> Wherein could this flea guilty bee,
> Except in that drop which it suckt from thee?

The poem moves back towards diminishing the flea, once Donne's poetic speaker convinces his lover to take part in this argument:

> Yet thou triumph'st, and saist that thou
> Find'st not thy selfe, nor mee the weaker now;
> Tis true, then learne how false, feares bee;
> Just so much honor, when thou yeeld'st to me,
> Will wast, as this flea's death took life from thee. (23-27)

The flea that was, in the previous stanza, "our mariage bed, and mariage temple," is reduced to the size of a fingernail. The blood which previously mingled the lovers and in which there were "three lives in one flea," is reduced to the "drop" taken by the flea. The back-and-forth is almost dizzying in its change of focus, as the flea and its subsequent death are reduced to almost nothing: Donne's lover "find'st not [her] selfe… the weaker." However, the generic reversal Donne uses to highlight this ends up packing an entire self-contained world within the body of the flea.

Reading John Donne's "The Flea" in conjunction with Robert Hooke's *Micrographia*, one of the first books to widely publicize the microscope and its functions, focuses on the importance of the minute point in both texts. Like Donne in "The Flea," Hooke situates the minute point as the most appropriate place of beginning both mathematical study as well as scientific inquiry. To this end, Hooke writes, "As in Geometry, the most natural way of beginning is from a Mathematical point, so is the same method in Observations and Natural history the most genuine, simple, and instructive. We must first endevour to make letters and draw single strokes true before we venture to write whole Sentences, or to draw large Pictures" (1). What Hooke notes here is that in order to form an appropriate picture of natural history as a whole, the scientist must first pay attention to smaller points.

Additionally, Hooke's *Micrographia* begins by drawing attention to the epistemological uncertainty accorded to perceptual objects:

> This I mention the rather because of these kind of Objects there is much more difficulty to discover the true shape than of those visible to the naked eye, the same Object seeming quite differing in one position to the Light, from what is really is and may be discover'd in another. And therefore I never began to make any draughts before by many examinations in several lights, and in several positions to those lights, I had discover'd the true form. ("Preface")

As a result, one of the objects that Hooke examines in the *Micrographia* follows both of these statements: the flea is not only a proper "point" with which to begin a program of scientific inquiry, but one whose very minuteness makes it difficult to apprehend

visibly. In the *Micrographia*, however, the flea's size is represented through an illustration that measures eighteen inches. However, while the microscope and the *Micrographia* physically represent the flea's new, massive stature, this expansive potential is revealed to be already present within the body of the flea itself. Though these discoveries are enabled by the microscope, the ability for expansion is already there, as Hooke notes. Hooke writes:

> For its strength, the Microscope is able to make no greater discoveries of it then the naked eye, but onely the curious contrivance of its leggs and joints, for the exerting that strength, is very plainly manifested, such as no other creature, I have yet observ'd, has any thing like it; for the joints of it are so adapted, that he can, as 'twere, fold them short one within another, and suddenly stretch, or spring them … out to their whole length, that is, of the fore-leggs.

Hooke notes that the flea's capacities for "exerting that strength" are unlike those of any other organism he has witnessed under the microscope. The flea's body, like its representation in the text itself, engages in processes of expansion by "folding" its joints "short within one another," and then suddenly becoming "stretched … out to their whole length."

Although Hooke's *Micrographia* and Donne's poem are separated by decades, bringing these texts together shows us the role of observation in Donne's poetry. Donne, writing earlier in the century, relies on a series of observations that, as Hooke would suggest later, build upon a single point – quite literally ("marke but this flea" leads to "marke in this / How little that which thou deny'st me is"(1-2)). However, Donne asks

his listener to rely upon his observations, and through the process of induction, to accept his conclusions; while his opening lines begin with an appeal to the listener to mark individual points, the final lines close with the conclusion these points support: "then learne, how false, feares bee"(25).

What Donne's poem playfully points out, though, are the problems (as well as the possibilities) produced by accepting the observations and conclusions of an independent observer as authoritative. That is to say, Donne's poetic speaker leads the listener through a series of seeming observations where the body of the flea changes size and significance at the whim of the poet. As Bacon imagined science as a collaborative intellectual project in the House of Salomon in his *New Atlantis*, in *The Winter's Tale*, knowledge becomes possible through communal witnessing, in opposition to the solipsistic knowledge of an authoritative, independent ruler.

2. Playing at Nothing in *The Winter's Tale*

In early modern England, nothingness was the subject of much dispute; the introduction of the zero figure into early modern calculation[1] and the revival of Lucretian philosophy, for instance, made understanding the nature of nothingness a central part of early modern epistemology. Shakespeare's *The Winter's Tale*, in its portrayal of Leontes's uncertainty over his wife's fidelity, centers on the problems that knowing entails by asking how we know anything at all. At a critical moment in the play, Leontes emphasizes his certainty in his own empirical knowledge, stating, "Is this nothing? /Why, then the world and all that's in 't is nothing" (I.ii.395-396). In *The Winter's Tale*, the play asks how knowledge is created through characters' attempts to understand nothingness: knowing anything means *knowing* nothing.

This concern – what nothing is, and how to recognize it – is often only recognized as a central debate of empirical knowledge production later in the century, when, in the 1660s, Thomas Hobbes and Robert Boyle's debates over whether the air pump produced a vacuum or not characterized nothingness as an object of experimental

[1] For a reading of the impact of the introduction of the zero into early modern Europe and its effect on early modern mathematics and economics, see Brian Rotman's *Signifying Nothing* (1987); on the history of the zero, see Charles Seife's *Zero: The Biography of a Dangerous Idea* (2000), Karl Menninger's *Number Words and Number Symbols* (1969), Robert Kaplan's *The Nothing That Is: A Natural History of Zero* (2000).

philosophy.[2] These debates over nothingness in the Royal Society affirmed the creation of knowledge through the process of communal witnessing; Boyle's experiments positioned the laboratory of the scientific *community* as the primary locus for the production of knowledge, encouraging dissent and debate within the rules of the laboratory itself.[3] The dubiousness of knowing absence required that multiple people agree to it, because it was so antithetical to the "self-evident" facticity of sensorial experience that empiricism – that is, knowledge that comes from the senses, and especially sight – imagined itself to affirm, and also highlighted precisely the stakes of the relationship between positive existence (that which could be sensed) and the negative or non-existent.

Indeed, prefiguring crucial epistemological problems that would pervade the institutionalization of early modern science, Shakespeare's *The Winter's Tale* raises a series of questions about perceiving nothing. How does one empirically know nothing when nothing is precisely an absence, and therefore unperceivable? *The Winter's Tale* locates the capacity to know nothing only in communal legitimation of such knowledge

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[2] In their analysis of the rise of experimental culture, Steven Shapin and Simon Shaffer identify Hobbes and Boyle's debates in the middle of the seventeenth century as inaugurating what we now assume constitutes a "scientific" program. See: *Leviathan and the Air Pump: Hobbes, Boyle, and the Experimental Life* (1985).

[3] Shapin and Schaffer point to this moment in the mid-seventeenth century as marking an epistemological shift that separates the court philosophers who operated in a patronage-based system to the community of natural philosophers who worked within the Royal Society. Of the communally sourced knowledge within the Royal Society, they write: "Nevertheless, what Boyle was proposing, and what the Royal Society was endorsing, was a crucially important move towards the public constitution and validation of knowledge." (78)

- through the performance of shared witnessing as well as the shared witnessing of a performance. In doing so, *The Winter's Tale* not only locates scientific concern with nothingness much earlier than science studies usually does, but also troubles the distinction between theatricality and science that historians of science tend to emphasize as a crucial distinction between science as rigorous empiricism – one dedicated to a "real" understanding of sensorial perception – and modes of "performance" more invested in tricking the senses.

Although these later scientific debates depended on a distinction between performance and experimentation, throughout the seventeenth century the boundaries between the space of the theatre and that of the scientific laboratory were not always distinct. As John Shanahan writes about mid-century scientific practices, implications of theatricality troubled early modern experimenters' claims to legitimacy; Shanahan cites Boyle's statement, for example, that natural philosophy was wholly unlike the "pageants, that entertain princes, where concealment is requisite for wonder" (551).[4] Earlier in the century, Francis Bacon connected skepticism over the function of the theatre to skepticism over uninterrogated natural philosophies that have been passed down from antiquity. Like the theatre, which creates "fictitious and theatrical worlds,"

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[4] Shanahan, John. "Theatrical Space and Scientific Space in Thomas Shadwell's The Virtuoso." Studies in English Literature 1500-1900 49.3 (Summer 2009): 549-571. Shanahan's article shows how the public nature of experimental science triggered anxieties over the potential "publicity and theatricality of experimentation."

philosophies from antiquity with "perverted laws of demonstration" are simply "so many plays brought out and performed."[5] Bacon's use of theatrical imagery to describe his distrust of both previous false philosophies and those that "can still be composed" demonstrates the status of the theatre – like imagination more broadly, theatrical or fictitious knowledge was seen as suspect. As a result, practioners of early modern science sought to distinguish itself from modes of knowledge that might be identified as theatrical (552).

Although literature and science are often characterized as separate spheres, as in C. P. Snow's famous lament, the importance of nothingness to plays like *The Winter's Tale* and *King Lear* alongside philosophical debates over nothingness outside the theatre in fact further demonstrates the lack of division between literary and scientific disciplines in the early modern period.[6] *The Winter's Tale* demonstrates that nothingness as a feature of empirical knowledge—that is, knowledge that comes from the senses, and especially sight—is central to the concerns of Shakespeare's theater. The play offers a particularly salient example of the collective validation of empirical experience as shared knowledge. As a space for performances created by "insubstantial pageant[ry]" whose

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[5] Bacon, Fracis. *Novum Organum*. Ed. Joseph Devey. Trans. William Wood and Joseph Devey. 1902.
[6] Raymond Williams's *Keywords* provides a useful gloss on the definition of "science" to demonstrate that literary and scientific projects shared similar concerns in the early modern period. Williams's etymology of "science" traces its origins back to its Latin root, "scientia," and claims that it is this definition of "science" that is in circulation before the 19th century – although he does notice that a distinction between practical and theoretical knowledge occurs earlier. See C.P. Snow's *The Two Cultures and the Scientific Revolution* (1959).

actors "melt into air, into thin air," as Shakespeare would later write in *The Tempest*, the theatre produces knowledge from seeming, airy nothingness. In *The Winter's Tale*, questions of knowing – whether it is over Hermione's fidelity, Mamillius's parentage, or the oracle's prophecy – are intimately tied to understanding nothingness in the play, which can only be affirmed through communal witnessing. Decades before the Royal Society would turn to mass affirmation in the absence of self-evident fact, Shakespeare made it clear that epistemological legitimacy would depend on corroboration – and, too, that self-evident facts were perhaps only self-evident because their corroboration could be assumed and was not under debate.[7]

Here, instead of functioning as parts of two distinct disciplines, literary and scientific practices in early modern England were mutually formative. Not only was an experimental regime – what now we might term "scientific" – an emerging product of the seventeenth century, but it was one produced through multiple social spheres and networks. In *The Winter's Tale*, the questions of how knowledge works and, importantly, where it is formed are central to the play. Knowledge and its construction spur the play onward; from Leontes's initial confidence in Hermione's infidelity to Hermione's

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[7] On the subject of the shift to communally produced knowledge in the Royal Society, for example, Thomas Sprat's account in *The History of the Royal Society* notes that a major "corruption of Learning" had previously been "for the most part heretofore, not Laboratories, as they ought to be; but only Scholes, where some have taught, and all the rest Subscribd. … For first, as many Learners as there are, so many hands, and brains may still be reckon'd upon, as useless. It being onely the Master's part, to examine, and observe; and the Disciples, to submit with silence, to what they conclude" (68-89).

restoration at the play's close, questions of who knows what (and, particularly, *how* they know) occupy the stage.

Just as the content of the play dramatizes these questions, another layer to the play's preoccupation with knowledge is the participation of the audience (the literal enactment of scientific spectatorship) in these practices of knowledge making; it asks how does the audience come to know, for example, of Leontes and Perdita's reunion or that Hermione is still living? In this essay, I show that *The Winter's Tale* is a text that experiments with multiple modes of knowing, demonstrating that even forms of knowledge based on individual physiology or objectivity are, in fact, only validated through collective knowledge production. Moreover, it is not only the individual facts of science that require collective constitution, but the general parameters of empiricism itself. Because the play's collective is represented by a community of observers contained within diegetic space as well as by the audience watching the performance, the play asks us to consider how the theatre works to produce knowledge, and allows us to consider the performative work of knowledge production and its legitimation more generally.[8]

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[8] For further reading on the theatre's functions as a laboratory in the seventeenth century, see John Shanahan's "Theatrical Space and Scientific Space in Thomas Shadwell's The Virtuoso" in *Studies in English Literature* (49.3) and "Ben Jonson's Alchemist and Early Modern Laboratory Space" in the *Journal for Early Modern Cultural Studies* (8.1).

Recent scholars have already suggested that such a precedent for the centrality of communal knowledge production existed prior to Boyle and Hobbes. In *The Jewel House: Elizabethan London and the Scientific Revolution* (2007), Deborah Harkness focuses on the relationship between communal practices of knowledge construction and the development of the experiment; however, unlike Shapin and Schaffer, Harkness argues that the sort of experimental community envisioned by literary and scientific figures such as Francis Bacon existed prior to the institution of the Royal Society. She argues that the late sixteenth and early seventeenth centuries already possessed these scientific communities in practice, even if they were not yet officially founded.[9] Harkness's work examines the development of collaborative scientific practices within an urban network; her work significantly revises the historical narrative that places experimental philosophy's origins with those of the Royal Society.

Although Harkness focuses primarily on the role of social spaces in forming experimental culture, I argue that the elision of literature's participation in these practices obscures narratives about the origins of experimentation.[10] By placing literature at the center of debates about experimental philosophy, *The Winter's Tale* establishes the theatre as an arena for knowledge production and shows how performance produces

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[9] Harkness, Deborah. *The Jewel House: Elizabethan London and the Scientific Revolution*. New Haven: Yale University Press, 2007. 8-9.

[10] Other early modern scholars share this focus on reading the practices of knowledge formation in early modern writing and science. For further reading, see Elizabeth Spiller's *Science, Reading, and Renaissance Literature*; Henry Turner's *Shakespeare's Double Helix*; Howard Marchitello's *The Machine in the Text*.

knowledge that escapes officially sanctioned modes of inquiry. *The Winter's Tale* frames the theatre as a space for communal knowledge production before the official instantiation of such spaces in The Royal Society. While nothingness in the form of a vacuum would become the object of experimental inquiry later in the seventeenth century, in *The Winter's Tale*, nothingness, through the communal space of the theatre, serves as both the site and subject for making knowledge. The play marks the movement from individual observation to communal assertion as a way of knowing the world, identifying knowing nothingness with knowing anything at all.[11]

In *The Winter's Tale*, knowledge is a central theme of the play, which opens with the question of Hermione, Leontes's queen's, fidelity. Because he believes her to be unfaithful to him with his childhood friend, Polixenes, his jealousy and seeming knowledge throw the rest of the court into disarray. Leontes orders Polixenes poisoned (he escapes); their new child, Perdita, abandoned (she survives); and Leontes then tries Hermione for treason (she's proclaimed innocent). When he refuses to believe her, their

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[11] Observation was essential to Bacon's scientific program. In the *Novum Organum* – particularly, how to both organize and understand observation. Bacon writes of previous flawed systems, "Nothing is rightly inquired into, or verified, noted, weighed, or measured, in natural history; indefinite and vague observation produces fallacious and uncertain information. … a natural history compiled on its own account, and one collected for the mind's information as a foundation for philosophy, are two different things" (79). Bacon's system of induction is built upon the collection of observations – and the constitution of facts from those observations: "in forming our axioms from induction, we must examine and try whether the axiom we derive be only fitted and calculated for the particular instances from which it is deduced, or whether it be more extensive and general. If it be the latter, we must observe, whether it confirm its own extent and generality by giving surety, as it were, in pointing out new particulars, so that we may neither stop at actual discoveries, nor with a careless grasp catch at shadows and abstract forms, instead of substances of a determinate nature" (83-84).

son, Mamillius. Hermione faints, and Leontes is told she is also dead. Leontes recognizes he has been mistaken, but it is too late. Fifteen years later, Perdita is being raised as a shepherdess's daughter and courted by Polixenes's son in disguise; Florizel and Perdita eventually escape to Sicilia, where her true identity is revealed. The end of the play stages a scene of reunion between Hermione, Leontes, and Perdita, where Hermione is also revealed to have survived in secret.

Reading nothingness is a necessary part of thinking about how knowledge is formed in *The Winter's Tale* – questions of Hermione's fidelity, how to read her body and that of Mamillius, whether knowledge is produced individually or in isolation, what implications others' narratives have for Leontes – these questions are intimately connected to nothingness from the play's opening scenes. The play stages a debate among different ways to interpret the world around us; the play's use of nothingness, in these debates, signals the problems and possibilities opened up by these different constructions of knowledge. Knowledge is formed in *The Winter's Tale* by processes that are affectively and intellectually experienced within a networked community of participants: the "laboratory" for these practices is the theatre itself. In so doing, *The Winter's Tale* provides a literary framework for experimental philosophy, suggesting that experimentation arises from dynamic interactions among texts, performances, and communities that extend beyond disciplinary boundaries. Through this

experimentation, literature produces the methods and subjects for later scientific undertakings.

Discussions of nothingness in the play, in the form of absence and the void, force its characters to come to terms with nothingness in ways that anticipate experimental inquiries into the vacuum in the mid-seventeenth century. For example, in the first scene of the play, Archidamus and Camillo's conversation over the relationship between their respective masters, Leontes and Polixenes, uses nothingness to describe the physical absence that has long characterized this royal relationship. Camillo states:

> Since their more mature dignities and royal necessities made separation of their society, their encounters, (though not personal), have been royally attorney'd with interchange of gifts, letters, loving embassies; that they have seemed to be together, though absent, shook hands, as over a vast, and embrac'd, as it were, from the ends of oppos'd winds. (I.i.24-31)

It appears that Camillo and Archidamus jointly praise the two kings' mutual affection for one another – respectively praying that the "heavens continue their loves," and stating, "there is not in the world either matter or malice to alter it." But the language in this speech underlines the role of absence in their relationship (I.i.31-34). Each time Camillo indicates intimacy – "their encounters … have been royally attorney'd" and "they have seemed to be together" – he immediately qualifies it by emphasizing the distance between the two men: "their encounters" are "not personal" and they are "together, though absent."

In addition to describing the interplay between absence and presence, these speeches also establish the kings' relationship as something that initially seems opposed to nothingness: their closeness as childhood friends stands framed against a "vast,"—an immense, immeasurable space. However, the next scene troubles Polixenes and Leontes's relationship by moving this "vast" into the space of the kings' friendship. While the initial lines place their relationship in contrast to the void, the following scene evokes the language of nothingness to characterize Polixenes. In this manner Polixenes's potential inability to be known to and by Leontes is signaled by the use of nothingness.

Nothingness takes multiple forms that were central to philosophical debates outside the theater, including not only the vast/void, but also the cipher or zero. For example, in the first act, when Polixenes thanks Leontes for his hospitality and prepares to leave for Bohemia, he says of himself: "and therefore, like a cipher, / (Yet standing in rich place), I multiply / With one 'We thank you' many thousands moe / That go before it" (I.ii.6-9). This conversation – where Hermione's attempts to persuade Polixenes to stay succeed where Leontes's fails – begins Leontes' musings on Hermione's possible infidelity. In this speech, Polixenes compares himself – and his speech – to a cipher, another word for zero. Polixenes emphasizes that he is both nothing and standing in rich place simultaneously, drawing attention to the dual function of the zero – but also drawing attention to the instability of properly reading the zero. Polixenes' use of the cipher figure underlines how knowing anything in *The Winter's Tale* is necessarily bound

to knowing nothingness.[12] In this period, the ontological status of the cipher / zero was the subject of vigorous debate; whether zero was an integral number or a mathematical figure was very much in question.

In *The Winter's Tale*, reading Polixenes in relationship to the cipher involves reading him both relationally – like the zero, as something that stands in relationship to other digits and gives them value – and as an isolated sign. Polixenes employs the figure of the cipher as a courtly acknowledgment that any words of his would fall short of the debt he owes Leontes, but, as I demonstrate, this metaphorical language also introduces a sense of the instability and unreliability of all language. Shakespeare shows the intractability of the relationship between numeracy and language, although later thinkers would elide such a relation, thinking of *zero* or *nothing* as an ontological reality rather than a linguistic valuation.

Read in this light, the line refers to knowledge of both self and others in relation to Polixenes. By aligning the "I" of Polixenes with the unknowability of the cipher – "like a cipher, yet standing in rich place, I" – these lines demonstrate Polixenes' potential inability to be fully known by Leontes. On the one hand, for Leontes, to read Polixenes

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[12] As Karl Menninger notes in *Number Words and Number Symbols*, while Hindu-Arabic notation was introduced to Europe around the 13th and 14th century, it took several hundred years before the system was fully understood and became widely used. He cites Johannes de Sacrobosco's famous 13th-century text *Algorismus*, where Johannes de Sacrobosco introduces the nine Hindu-Arabic numerals. Of the zero, which he calls "theca, or circulus, or cifra, or figura nihili," he writes that it both functions as a symbol for nothingness as well as working to give the Hindu-Arabic numerals themselves greater value (i.e., its ability to change the numeric value of a 1 from 10 to 100) (402-403). This dual function for the zero paralleled the confusion that accompanied its changing status from a symbol, as noted in Sacrobosco, to a potential number in early modern Europe

as a cipher means to consider him relationally – which Leontes does, in relation to both himself and to Hermione. While Polixenes is Leontes's childhood friend – "and there rooted between them such an affection" – he is also potentially cuckolding Leontes. On the other hand, to read Polixenes as a cipher entails dealing with a permanent uncertainty about what he is, the sense that he can never be known fully to Leontes.

Unknowability as an existential problem magnifies rather than trivializes unknowability as a social problem. Upon discovering Hermione's supposed infidelity with his closest friend, Leontes muses, "I / Remain a pinch'd thing; yea, a very trick / For them to play at will" (II.i.50-52). In his next few lines, at the beginning of Act II, he seizes Mamillius (who has been in the midst of telling his mother a story) and confronts Hermione with his knowledge of her adultery; Hermione cries, "What is this? Sport?" Leontes responds by transforming Hermione's language from a potential joke to evidence of infidelity, saying, "Away with him [Mamillius], and let her sport herself / With that she's big with" (II.i.60). These lines necessarily recall Leontes's earlier contemplation of Hermione's adulterous behavior in Act I; addressing Mamillius, he says, "Go play, boy, play: thy mother plays and I / Play too, but so disgrac'd a part, whose issue / Will hiss me to my grave" (I.ii.187-189). Although the text initially

associates "play" with childishness, it quickly shifts to thinking about playing and how it shapes practices of knowledge.[13]

The text brings together multiple meanings of play – joking, pleasure, sexual congress, and performance – and connects them with storytelling through Mamillius, who has been onstage this whole time, alternately playing and telling stories to Hermione. The play forges connections among these different types of playing and their consequences not only in the plot, but on an aural level as well, in order to emphasize how playing creates and alters knowledge. Leontes' repeated injunctions to Mamillius to "play" quickly descend to a contemplation of his own "*dis*graced part" and the "*iss*ue" that will "*hiss* me to my grave." The aural similarities between the sibilance of "disgraced," "issue," and "hiss" form another layer of play within the text. While, at this specific moment, Leontes is concerned about the illegitimate "issue" of Hermione's womb and the blow to his reputation this infidelity might entail, on a larger scale, this moment begins the process of thinking about the relationship between nature and culture. Hermione's pregnant body – and how to know what that body represents – is something that becomes known through the medium of the staged text.[14] The play

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[13] See Gina Bloom's "'Boy Eternal': Aging, Games, and Masculinity in *The Winter's Tale*" in *English Literary Renaissance* for a feminist reading that argues that it is Leontes' and Polixenes' relationship to boyhood that threatens their masculinity in the play. In exploring the narratives that link boyhood and manhood in the play (and what happens when the two concepts are collapsed), Bloom troubles a dominant psychoanalytic narrative that "assumes male psychic trauma stems primarily from a conflict with women and/or femininity" (332).

[14] For Leontes's reading of Hermione's pregnant body in the context of Hermione's garden and early modern debates around nature and art, see Amy Tigner's "The Winter's Tale: Gardens and the Marvels of

begins thinking about the relationship between art and the natural world as something that is about engaging with these different ways of knowing. That is to say, knowledge is created in this scene through both the play as performance and through playing with language, engendering experience as experiment-at-work (or play) for both characters and viewers/listeners.

The association between Mamillius (whom Leontes reads in ways that he attempts to read Hermione's pregnant body) and storytelling underlines the role of the co-constituency of knowledge and nature in the play. The confluences among the body, narrative, and knowledge are present in Leontes' interrogation of Mamillius. He states: "What, hast smutch'd thy nose? / They say it is a copy out of mine. Come, captain, / We must be neat; not neat, but cleanly, captain: /And yet the steer, the heifer and the calf / Are all call'd neat" (I.ii.121-125). Leontes reads Mamillius' face, while also recounting how others have read it previously (as Mamillius himself responds to this, "I am like you, they say"). Leontes attempts to understand Mamillius' body by emphasizing the multiple narrative accounts that surround it, underscoring the play's presentation of multiple modes of knowledge production.

Transformation." Tigner traces the symbolic function of the garden in the play - from a space that initially represents Hermione and Perdita's "potential illicit behavior" to one where Hermione regains authority as "Queen as co-ruler of the kingdom" (133-134).

But this reading is complicated by multiplicity: confusion between originals and copies, between representation and knowledge. At the same time, the difficulty of how to read the nose that is a "copy" of Leontes' own is indicated by Leontes' evocation of the *damaged* copy – the "smutch" on the copy that should identify Leontes as Mamillius' legitimate parent rather than set off a meditation on the word "neat." Not only do these words evoke Leontes' symbolic castration (through the figure of the steer, a castrated male cow), they also continue to engage with the problem of knowledge in the play – the ambiguity of the word "neat" as a pun as well as a category underlines Leontes' uncertainty over knowledge of Hermione's fidelity – or anything at all. By collapsing "the steer, the heifer, and the calf" into one thing, Leontes focuses on the difficulty of knowing the world around him through language. His initial appreciation of the plurality of meaning with his wordplay on "neat" ("We must be neat; not neat, but cleanly") ultimately gives way to anxiety, collapsing three different types of animal – the steer, the heifer, and the calf – into one category ("and yet"). The play stages a series of debates over different ways of knowing – through language, texts, bodies, and communities.

In *The Winter's Tale*, Leontes frames knowledge of Hermione's infidelity as something that is objectively true, yet reveals that such objectivity is a matter of self-

affirmation of sensorial experience: empiricism.[15] Though Leontes, for example, muses that Hermione's infidelity has made of him "a pinched thing … a very trick / For them to play at will," a statement that suggests how he is implicated and produced through this narrative, he begins by claiming a position of objectivity: "How blest am I / in my just censure, in my true opinion! / Alack for lesser knowledge" (II.i.36-38; 51-52). However, Leontes' seeming knowledge of Hermione's infidelity is one that is also produced through embodied experience; his sense of certainty is one that is corroborated by the physical evidence of his own body. For example, he comments on her interactions with Polixenes, claiming "oh, that is entertainment / My bosom likes not, nor my brows" (I.ii.118-119).

Aligned with this physiological, self-produced knowledge is the play's first discussion of nothingness. Leontes states:

> Affection! Thy intention stabs the center.
> Thou dost make possible things not so held,
> Communicat'st with dreams – how can this be?—
> With what's unreal thou coactive art,
> And fellow'st nothing. Then, 'tis very credent
> Thou mayst co-join with something, and thou dost. (I.ii.138-143)

In this passage, Leontes reads the coupling that is going on in his imagination onto the outside world; he acknowledges that the joining of his suspicions with "what's unreal" ultimately connects them with nothing. However, these lines underscore the

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[15] For reading Leontes's belief in Hermione's infidelity in this early scenes as his failure to respond to the ethical demands of a Levinasian other, see James A. Knapp's "Visual and Ethical Truth in The Winter's Tale," *Shakespeare Quarterly* 55.3 (Fall 2004): 253-278.

difficulty of understanding nothingness. Leontes literally takes nothing for something here, insofar as the very act of imagining his suspicions being "coactive" with nothing transforms them into something. Consequently, Leontes is able to conclude, "Tis very credent." As a result, if Leontes can imagine something, it becomes believable; if it becomes believable, it becomes true.

Leontes moves from a knowledge that is rooted in his physiology to a knowledge that is seemingly objectively true, something he discovers; as he states, "thou may join with something … and thou dost … and I find it / (And that to the infection of my brains / And hard'ning of my brows)" (I.ii.141-146). For Leontes, having the capacity to see anything at all means seeing the proofs of Hermione's adultery. He allows for no other interpretive possibilities, and reads his analysis of Hermione's infidelity as one that springs from a seemingly objective position. The language he uses when accusing Hermione of adultery to Camillo stresses the unassailable authority of Leontes' position:

> Ha' not you seen, Camillo
> (But that's past doubt, you have, or your eyeglass –
> Is thicker than a cuckold's horn), or heard
> (For to a vision so apparent, rumor
> Cannot be mute), or thought (for cogitation,
> Resides not in that man who does not think)
> My wife is slippery? If thou wilt confess,
> Or else be impudently negative,
> To have nor eyes, nor ears, nor thought, then say
> My wife's a hobbyhorse... (I.ii.267-276).

Notice first the almost tautological nature of his speech at this point in the play: "Cogitation / Resides not in that man who does not think – my wife is slippery" While

the line can read, "anyone who can think – i.e., any man – thinks Hermione is a whore," the alternate reading – "thinking is not a characteristic of men who are unthinking--underlines this tautology. The conditions for thought – as for vision, and hearing, and all other senses – rest in Leontes' reality alone. Leontes constructs Hermione's adultery as a fact too obvious to be ignored by anyone capable of rational thought.

Leontes overemphasizes the formative power of his own perceptions and creates a reality that is entirely solipsistic; to refuse to confess a "vision so apparent" – as in Leontes' language – is to lack the ability to know anything at all. In rejecting the vision of reality prescribed by Leontes, his counselors risk losing their grasp on their own ability to constitute reality; failing to see Hermione's adultery is equivalent to losing ears, eyes, thought, and any real basis for communication. To refute the truth of Leontes' words is under these circumstances consequently impossible, because there can be no knowledge or communication of that knowledge outside the grounds that Leontes has established[16]. For example, as Hermione notes while she is being tried for adultery, "Mine integrity being counted falsehood, shall, as I express it / Be so received" (III.ii.25-257). But this perception of knowledge is ultimately a destructive one.

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[16] See Stanley Cavell's *Disowning Knowledge: In Seven Plays of Shakespeare* for a reading of Leontes's skepticism in the play. Cavell argues that the play articulates the limits of perceptual knowledge; it engages with but ultimately repudiates the skeptical position embodied by Leontes in the play where skepticism is the sense of "knowing more than his fellows about the fact of knowing itself, in having somehow peeked behind the scenes, or, say, conditions, of knowing" (Cavell 197).

The failure to accept Leontes' vision of knowledge as entirely based in his own perceptions is destructive not only on a personal scale (to Camillo, for example, as well, of course, as to Leontes), but also on a global scale. Leontes confronts Camillo, who tries to convince him that he is making something out of nothing, and that Hermione's virtue is intact. Leontes rages:

> Is whispering nothing?
> Is leaning cheek to cheek? Is meeting noses?
> Is kissing with inside lip? Stopping the career
> Of laughter with a sigh (a note infallible
> Of breaking honesty)? Horsing foot on foot?
> Skulking in corners? Wishing clocks more swift?
> Hours, minutes? Noon, midnight? And all eyes
> Blind with pin and web, but theirs, theirs only,
> That would unseen be wicked? Is this nothing?
> Why, then the world and all that's in 't is nothing,
> The covering sky is nothing. Bohemia nothing,
> My wife is nothing, nor nothing have these nothings,
> If this be nothing. (I.ii.284-295)

Significantly, part of Leontes' consternation arises from his anxiety over how to interpret the world around him, a problem he frames using the subject of nothingness. The physical evidence that Leontes notes – whispering, leaning cheek to cheek, meeting noses, kissing – have to mean *something* if the world itself is to retain any meaning at all for him. Leontes' interpretation of nothing, then, is as an object that potentially unhinges reality.

Leontes potentially empties reality of meaning; no alternative grounds for speech or knowledge exist other than the ones he posits. Notice, too, the further emphasis on

what can be visually discerned in this speech: "And all eyes blind with pin and web, but theirs, theirs only, that would unseen be wicked" (I.ii.290-292). His accusation of Polixenes and Hermione at this moment assumes that they are so deeply entrenched in their adulterous relationship that they assume everyone is blind to their actions. While Leontes' speech to Camillo takes the form of a series of questions, he has made answering these questions in any meaningful way impossible. Because of this, when Leontes asks whether whispering is nothing, there can be no response to his question, because answering in the negative and thus failing to adhere to Leontes' perspective empties the world itself of meaning: as Leontes claims, if his knowledge about Hermione's infidelity is false, "the world and all that is in it is nothing." Leontes' stranglehold over knowledge is shown to be entirely destructive, and indeed, his autocratic insistence on his incorrect reading of Hermione's infidelity leads to Hermione's trial and apparent death, the death of their son, and the dissolution of his family for sixteen years.

After Hermione collapses upon hearing of her son's death, Leontes realizes he has "too much believed mine own suspicion" and encourages his court to "apply to her [Hermione] some remedies for life," but it is too late (III.ii.151). Paulina appears soon after, framing Hermione's death as the final and most damning offense in a list of tyrannous actions by Leontes:

> That thou betray'dst Polixenes,'twas nothing;
> That did but show thee, of a fool, inconstant

> And damnable ingrateful: nor was't much,
> Thou wouldst have poison'd good Camillo's honour,
> To have him kill a king: poor trespasses,
> More monstrous standing by: whereof I reckon
> The casting forth to crows thy baby-daughter
> To be or none or little;
> Nor is't directly laid to thee, the death
> Of the young prince, whose honourable thoughts,
> Thoughts high for one so tender, cleft the heart
> That could conceive a gross and foolish sire
> Blemish'd his gracious dam: this is not, no,
> Laid to thy answer: but the last,--O lords,
> When I have said, cry 'woe!' the queen, the queen,
> The sweet'st, dear'st creature's dead. (III.ii.183-190, 192-198)

Paulina's litany of offenses includes events that have occurred onstage – Leontes' command to kill Polixenes and his order to cast off the infant Perdita – as well as ones that take place offstage: the death of Mamillius and Hermione. Given Greek tragic conventions, where death occurs offstage, the audience is primed to accept Paulina's report of both their deaths. Additionally, Hermione's death is reported as the latest in a list of events we know to be true.[17] Leontes, though seemingly repentant at this juncture, still insists upon the authoritative power of his own perceptions; though he accepts Paulina's rebukes, he demands confirmation from his own senses: his final words of the scene – and his last words before the intervening space of sixteen years – are:

> Prithee bring me

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[17] See Sean Benson, "The Resurrection of the Dead in The Winter's Tale and The Tempest" on the audience's access to knowledge in the play; Benson notes that Hermione's "quasi-resurrection is the only moment in Shakespeare's plays where first-time audiences are not privy to the fact that she has apparently been alive all this time. Shakespeare's decision to exclude the audience from all knowledge of what happened to Hermione during those sixteen years is to place us in the situation of most of the characters" (9)

> To the dead bodies of my queen and son.
> One grave shall be for both; upon them shall
> The causes of their death appear (unto
> our shame perpetual). (III.ii.234-238)

Despite his realization that he has "too much believed" the seeming evidence of his own senses, he nevertheless treats the event of Hermione and his son's death as something he must, as it were, see to believe.

As the play progresses, it introduces a different mode of knowledge production, one upheld within and verified by the community, rather than one produced by the solitary individual. The tragedy of the first three acts of *The Winter's Tale* rests on a representation of individual knowledge that is entirely destructive. As the play moves from an individually constructed knowledge to one that is mediated by the community (both within and without the play), the use of pastoral imagery parallels this shift, moving from pastoral imagery premised on exclusivity to imagery built around hospitable relations to a wider community.

In contrast to Polixenes' childhood friendship with Leontes, which is premised on exclusivity, the shepherd encourages his adopted daughter, Perdita, to serve as hostess and "bid / these unknown friends to 's welcome, for it is / A way to make us better friends, more known" (IV.iv.64-66). The shepherd's speech indicates the integration of strangers into the community – a way of making known what is unknown

in a manner that expands the community, in opposition to the work that goes on during Act I of the play.[18]

Polixenes and Perdita's debate about the relationship between art and nature further engages this question of the community's exclusivity. Perdita initially argues against grafting, saying, "I care not to get slips of them [gillyvors]" – cross-bred flowers that, as she notes, are thought to be "Nature's bastards" (IV.iv.82-84). Perdita argues that grafting blurs the boundaries between what is natural and what is artificial, reporting "I have heard it said / There is an art, which in their piedness shares / With great creating Nature" (IV.iv.86-88). Polixenes replies as follows:

> Say there be;
> Yet Nature is made better by no mean
> But Nature makes that mean; so over that art,
> Which you say adds to Nature, is an art,
> That Nature makes. You see, sweet maid, we marry
> A gentler scion to the wildest stock,
> And make conceive a bark of baser kind
> By bud of noble race. This is an art
> Which does mend Nature, change it rather; but
> The art itself is Nature. (IV.iv.88-97)

Polixenes, on the other hand, maintains that this cultivating art is itself a part of nature, saying, "This is an art which does mend nature – change it rather, but the art itself is nature."Polixenes closes his speech with this encouragement of hybridity,

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[18] See Andy Mousley's *Re-Humanizing Shakespeare: Literary Humanism, Wisdom, and Modernity* (Edinburgh University Press, 2007) for more on the use of the pastoral to both rewrite the relationship between art and nature as well as to open up the communities of the play.

saying, "And do not call them (the gillyvors) bastards." In this, Polixenes echoes the shepherd's earlier insistence in extending hospitality and expanding the community.

What this debate also seems to perform, though, is a staging of the relationship between literature and science. Polixenes claims that this form of artifice – cross-breeding flowers – is not counter to nature, but is itself a part of nature. While Polixenes suggests that art, in its various manifestations, works in service to nature, the play suggests precisely the opposite – that nature instead operates in ways that have more in common with the construction of art. Part of this seems to come through in the final act of the play, with Hermione's seemingly miraculous transformation from stone statue to living queen.

As *The Winter's Tale* progresses, it introduces a different mode of knowledge production, one upheld within and verified by the community, rather than one produced by the solitary individual, as in the scene of reunion between Leontes and his now grown daughter Perdita. The action described in this scene occurs almost entirely offstage and is recounted through a relay of perspectives.

In response to Autolycus's query – "Beseech you, sir, were you present at this relation?" – the First Gentleman opens, saying, "I make a broken delivery of the business. … A notable passion of wonder appeared in them; but the wisest beholder that knew no more but seeing could not say if th' importance were joy, or sorrow – but in the extremity of the one it must needs be. Here comes another gentleman that happily

knows more" (V.ii.1-2, 15-20). The Second Gentleman picks up where the First Gentleman left off, and continues – "The oracle is fulfilled; the King's daughter is found; such a deal of wonder is broken out within this hour that balladmakers cannot be able to express it. Here comes the Lady Paulina's steward; he can deliver you more" (V.ii.22-25). This introduces the multiplicity of perspectives that cast doubt on the possibility of individual "objectivity" and emphasize instead the possibility of collectively constituted knowledge of objects and phenomena.

The narrative continues to unfold as each witness to the reunion emphasizes the partial and faulty nature of their own perspective, while simultaneously adding to our knowledge as an audience of what has unfolded offstage. The Third Gentleman, following the first two, notes the difficulty of accurately recounting the reunion – "Then have you lost a sight which was to be seen, cannot be spoken of" (V.ii.42-43). What these different, partial narratives accomplish is manifold – first, they counter the mode of knowledge production that opens the play - Leontes' insistence on the world-making authority of his own language and perception – and stress, instead, a type of knowledge that is created and modified through the participation of a community of witnesses.

This scene's demonstration of a knowledge that is communally formed rests also on the characters' investigation of the wondrous experience being performed. When the first gentleman recounts the reactions of Leontes and Camillo to the revelation of Perdita's kinship, the first gentleman states:

> They seemed almost, with staring on one another, to tear the cases of their eyes. There was speech in their dumbness, language in their very gesture; they looked as they had heard of a world ransomed, or one destroyed. A notable passion of wonder appeared in them, but the wisest beholder that knew no more but seeing could not say if th' importance were joy or sorrow. (V.ii.11-20)

Even the wisest beholder cannot say from viewing the scene what Camillo and Leontes experience – what speaks louder, according to the first gentleman's testimony, is their silence. This theme continues as the third gentleman notes, "Then have you lost a sight which was to be seen, cannot be spoken of," emphasizing that the import of this scene emerges from its communal experience – the experience of silent wonder for which Paulina praises Leontes in the final scene of the play.

Furthermore, the speech of the three Gentlemen demonstrates how knowledge acts back upon the community that creates it. For example, each Gentleman emphasizes the communal experience of wonder that characterizes the witnesses to Perdita and Leontes' reunion: "There was speech in their dumbness, language in their very gesture / A notable passion of wonder appeared in them" (V.ii.13-14). One of the final descriptions further underlines the transformation of these witnesses that results from their participation in this mode of knowledge production – "Who was most marble there changed color; some swooned, all sorrowed" (V.ii.89-90) This is paralleled by the description of Hermione's statue, soon to be reanimated, as a "work, [that] would beguile Nature of her costume, so perfectly is he her ape" (V.ii.99-100).

Leontes, too, responds in silent wonder to the sight of Hermione's statue, and only speaks after Paulina enjoins him to do so; she instructs him, "I like your silence; it the more shows off / Your wonder; but yet speak, first you, my liege" (V.iii.21-22). These lines are almost immediately echoed a few lines later, after Paulina awakens the silent, statue-like Hermione through her incantatory speech. Camillo says, "She hangs about his neck/ If she pertain to life let her speak too," but Paulina denies its necessity, stating, "It appears she lives / Though yet she speak not" (V.iii.112-113, 117-118). [19]

The space of the theatre – and the space of the stage within the play – uses wonder affectively to produce knowledge. Therefore, when Paulina states at the play's close– "I like your silence / the better it shows off your wonder" – she identifies wonder as the place where the community recognizes and witnesses the formation of a new kind of knowledge.[20] The concept of "wonder" in this play has been the subject of various critical interpretations – e.g., wonder as the "proper response to the apprehension of the

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[19] On the power of Hermione's silence towards Leontes as an escape from the misogyny perpetuated by the play's zero-sum game on verbal authority, see Lynn Enterline's "'You Speak a Language that I Understand Not': The Rhetoric of Animation in *The Winter's Tale*," Shakespeare Quarterly 48.1 (Spring 1997): 17-44.

[20] See Lorraine Daston and Katharine Park's work in *Wonders and the Order of Nature*. Daston and Park demonstrate how wonder moved from the margins of scientific inquiry to the heart of natural philosophy in the sixteenth and seventeenth centuries. Their study highlights the status of wonder as both an affect (the function of curiosity as an impetus for further study, for example) as well as an object (as wonders became associated with the development of the scientific fact through the collection of particulars in Bacon's scientific schema). What Daston and Park illuminate is the centrality of wonder to the establishment of a scientific program.

miraculous."[21] However, I want to draw attention to the ways in which *The Winter's Tale* as a performance similarly creates a scientific program through its use of wonder.

This indeterminacy between art and audience, and between life and death, continues most prominently through the play's closing scene. Hermione's transformation from seeming statue into living woman is echoed manifold times in the scene[22]; Leontes states, "Does not the stone rebuke me, / For being more stone than it?" and goes further to include Perdita as one similarly afflicted: "O royal piece! … which has … from thy admiring daughter took the spirits, / Standing like stone with thee" (V.iii.37-42). Paulina's language responds to Leontes' description of personal transformation in kind: "Indeed, my lord," she states, "If I had thought the sight of my poor image / Would thus have *wrought* you … I'd not have showed it," underlining the deeply transformative effect witnessing this spectacle has accomplished in Leontes who thinks "we are mocked with art" (V.iii.56-59).

But rather than being "mocked by art," both artwork and audience are transformed through the experience of witnessing a performance that crosses boundaries between life and death – significantly, the community at hand is

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[21] Lim, Walter S. H. "Knowledge and Belief in The Winter's Tale." *Studies in English Literature* 1500-1900 41.2 (Spring 2001): 317-334. Lim also writes of wonder's more negative valence in the period (though one not actively highlighted by the play) as symptomatic of gullibility and a vulnerability to rumor.
[22] For a reading of the importance of Euripides's *Alcestis* to this particular scene in *The Winter's Tale*, see in particular Sarah Dewar-Watson's "The 'Alcestis' and the Statue Scene in 'The Winter's Tale'" in *Shakespeare Quarterly* 60.1 (Spring 2009): 73-80. Dewar-Watson identifies George Buchanan's translation of *Alcestis* as a possible source for *The Winter's Tale*.

transformed by their experiences with this very indeterminacy, because they do not yet know Hermione is alive. As Paulina says, "My lord's almost so far transported that / He'll think anon it lives" (V.iii.69-70) She then tells Leontes, "If you can behold it, I'll make the statue move indeed, descend, / And take you by the hand;" Hermione's reanimation is conditional upon his act of witnessing (V.iii.87-89). [23]

The requirements that Paulina establishes for Hermione's awakening – "It is required / You do awake your faith"—places emphasis precisely on the quality Leontes lacks earlier in the play: the ability to include interpretive perspectives besides his own (V.iii.94-95). Critics such as Walter Lim have read this moment as a profession of faith in the fundamentally unknowable, situated within the context of early modern religious debates.[24] During the play's opening, Leontes is only able to trust his own flawed vision – he believes that what he sees constitutes the only version of reality. At this point, Leontes and the rest of the assembled community are required to place their trust specifically in what they collectively see, even though it should be practically impossible.

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[23] For a different reading of the role of the community in this final scene, see Donald R. Wehrs, "Placing Human Constants within Literary History: Revision and Affective Sociality in The Winter's Tale and The Tempest" in *Poetics Today* 32.3 (Fall 2011): 521-591. Wehrs reads Leontes and the community's redemption through Erasmus's conception of grace, and highlights the importance of "affective susceptibility" in opening up a space for ethical engagement with the other (555-559).

[24] Lim agrees with Enterline and Felperin's reading of the play as one that is deeply engaged with the problems of knowledge; however, his reading of these problems of knowledge through The Winter's Tale's "theological and philosophical interests" explicitly addresses "early modern England's encounter with the boundaries of the unknowable" (327).

Leontes' reliance on the authority of his own perception is replaced by a knowledge that is communally mediated.[25] Paulina, Camillo, Polixenes, and Perdita are all gathered to witness Hermione's transformation, and all parties contribute, like the three gentleman, to the overarching narrative of the scene: Leontes begins by stating, "O, she's warm!" Polixenes then notes, "She embraces him," and Camillo finally says, "She hangs about his neck" (V.iii.109-112). At the close of the scene, he echoes the language of the three gentlemen, arguing that knowledge is created by submitting one's own experiences to the scrutiny of the community, prefiguring the establishment of an experimental community later in the seventeenth century. At the close of the play, Leontes enjoins the other characters to share their "parts" of the story; their separate experiences will be collected and revised into a thoroughly communal narrative:

> Good Paulina,
> Lead us from hence, where we may leisurely
> Each one demand and answer to his part
> Performed in this wide gap of time since first
> We were dissevered. Hastily lead away. (V.iii.151-155)

The Winter's Tale closes by emphasizing knowledge that is created and witnessed by the community as a whole, and where the audience, too, is changed by the act of witnessing and creating this knowledge. In so doing, *The Winter's Tale* establishes the space of the theatre as a kind of laboratory for knowledge production; the audience is asked not only

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[25] James A. Knapp's reading of this scene – as a juncture where Leontes is asked to choose the ethical relationship to the other over empirical knowledge – is one that I depart from at this point. Rather than prioritizing ethics, I argue that the play does not ask us to disavow empirical knowledge, but instead, focuses on empirical knowledge that is verified by a community of witnesses.

to validate the creation of knowledge within a community, but also to acknowledge its own participation in these knowledge-making practices.

The Winter's Tale charts a change in how knowledge is formed; the play performs and enacts a knowledge that is communally mediated rather than individually determined. The play's emphasis on the centrality of wonder to this communal experience is crucial; not only is wonder a key feature of early modern natural philosophy, but it also brings the relationships among performance, performativity, and knowledge-making into focus. In *The Winter's Tale*, nothingness and its treatment give rise to a scientific program; however, in so doing, the play asks us to question both the grounds for empirical knowledge and how those grounds are formed. *The Winter's Tale* changes the status of early modern science, but also widens the roles played by the theater and theatricality at the very moment "science" attempts to narrow theatricality to mere representation or drama, not experimentation.

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3. Experience in *Paradise Lost*

In *The Winter's Tale*, we watch Paulina and the rest of the players assemble to witness the reformation of a community marred by deep personal loss. In *Paradise Lost*, by contrast, the magnitude of that loss is much too large to be witnessed. It can, however, be experienced, and in *Paradise Lost* Milton creates as he explores that experience. "The early Restoration years were characterized," observes the literary scholar Erin Peters, "by an extensive effort in text to respond to the divisive and disabling trauma of the Civil War, with frequent occurrences of words such as accord, reconciliation, healing, and settling" (Peters 87). Appearing with some regularity in *Paradise Lost*, this vocabulary witnesses the mark that the experience of the Civil War has left on Milton, and on his poem.

Experiencing, unlike witnessing, entails giving a first-person account rather than observing from the audience's perspective. While *The Winter's Tale* acknowledges that there is no impartial observer capable of knowing the complete and objective truth, and that witnesses too are transformed through the act of witnessing, in *Paradise Lost*, experience takes precedence. To observe in *Paradise Lost* is to experience the world through the senses and to hold oneself accountable for what one sees and feels.

In *Paradise Lost*, Milton's attitude towards experience is ambivalent; experience in the poem is linked to both an older notion of observation as well as the developing idea of the experiment, and Milton demonstrates this transition by representing multiple

versions of experience in the poem. One definition of experience circulating in the seventeenth-century was Aristotelian, relying upon memory and collective knowledge. As historian of science Peter Dear writes, "Aristotelian experience is not about having witnessed a singular event; it was therefore perfect for incorporation into a body of shared, established, public knowledge--"demonstrated" knowledge. A statement of experience was acceptable because, at least ideally, it was what everyone knew. It was a universal statement of common experience" (Dear 666). Alternately, there was particular, singular experience – the kind that Boyle would later appeal to in the creation of the scientific fact (676). *Paradise Lost* captures Milton's ambivalence towards this changing concept in the seventeenth-century by testing different versions of experience against one another in the poem, as well as demonstrating the shift from observation to experience as a method of knowing the world.

The meaning of observation was changing in sixteenth- and seventeenth-century England. An observer was previously someone who followed a code of conduct, as when the wooer of the jailer's daughter in Shakespeare's *Two Noble Kinsmen* is advised to "Observe her in every way," meaning to court her by all appropriate methods. An observer was, alternatively, someone who fulfilled the specifics of a religious ritual as even today we speak of someone who is an observant Catholic. Earlier, in the fifteenth century, watching for omens or astrological movements might also have been termed "observing" (OED)). By the sixteenth century, however, the definition of what it meant

to be an observer had begun to expand into a different realm of experience; "observing" began to include using one's senses to gain empirical knowledge of the world.[1] Accelerated by the development of telescopes, microscopes, and other instruments which enhanced the capabilities of the senses, and making objects previously invisible to human sight fully present, the act of observing took on entirely new dimensions. In the Preface to the *Micrographia*, Robert Hooke addresses this quality of the microscope, stating, "and by the help of Microscopes, there is nothing so small, as to escape our inquiry; hence there is a new visible World discovered to the understanding."[2] Where Paulina's audience does not at first understand what they are watching as observers of a performance, the technologically enhanced scientific observer knows the visions are real.

The ability of these tools to enhance the senses is framed by Hooke as compensating for a natural lack that recalls the deficits resulting from original sin; Hooke posits that perhaps by "the addition of such Artificial Instruments and methods, there may be, in some manner, a reparation made for the mischiefs, and imperfection, mankind has drawn upon itself … whereby every man, both from a deriv'd corruption, innate and born with him is very subject to slip into all sorts of errors." Such an argument sounds much like Milton's creed in *The Doctrine and Discipline of Divorce,* that

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[1] Alan Salter. "Early Modern Empiricism and the Discourse of the Senses." The Body as Object and Instrument of Knowledge. Eds. Charles T. Wolfe and Ofer Gal. Netherlands: Springer Publishing. 59-74.
[2] The new "visible world" Hooke refers to is the earth itself, opened up to "[shew] quite a new thing to us … in every little particle of its matter," through processes of observation that turn the earth into as great a spectacle of wonder as the telescope did the cosmos (Preface).

with the proper reformation of divorce laws one might repair the ruins of the fall, "as much as may be," as if Milton could agree with Hooke that the 17th century offered a moment when it would be possible to repair some of the tragic effects of the fall. Milton's position on the possibilities offered up by experience is an ambiguous one, however; caught up in a moment where experience pointed to both universal generalities as well as particular events, Milton is deeply ambivalent about the value of experience. In *Paradise Lost*, he plays these different concepts of experience against each other.

The references to Galileo and the telescope are notoriously ambiguous and seem to suggest that Milton didn't think much of its ability to aid men in the search for the truth that mattered. But the poem pays close attention to the kind of knowledge that comes through the senses, specifically tracing the move from observation to experience. The word "experiment" only appears once in Milton's *Paradise Lost* – and that only after the Fall. Far more common instead is "experience" - a concept central to both the poem's narrative of mankind's fall and its engagement with early modern natural philosophy. Indeed, "experience" comes into play at a crucial moment in Book IX – in the words with which Eve convinces Adam to have his first fatal taste of the apple: "on my experience, Adam, freely taste, / And fear of death deliver to the winds" (IX.988-989). Eve encourages Adam to profit from her experience by repeating it, and Adam follows suit – although it is "against his better knowledge" and he is "not deceived, but

overcome with female charm" (IX 998-999). With a macaronic pun on "taste" and the Latin word for knowledge--"Sapience," from "saper" to taste--the poem juxtaposes two kinds of knowledge: one based on the senses and another based on inward wisdom, what one could term faith. Eve tempts Adam to make an experiment out of the apple to demonstrate that what happened to the snake and to her will happen to him as well, thus proving the efficacy of tasting the apple of the knowledge of good and evil. In this conversation Milton is playing with concepts deeply debated by natural philosophers.

Many scholars have studied the relationship between experience and experiment in early modern thought, noting that the meanings of both words often overlapped, and in the seventeenth century in particular, began to signify "concepts … in dramatic flux" (Schmitt 86, Edwards 18). Although the word "experimentum" was used in philosophy prior to the development of the experiment as we know it, from the medieval period through the early sixteenth century, it indicated, as historian Charles Schmitt observes, "a recipe or formula of some sort used to bring about a non-natural change in the course of natural events" (Schmitt 87). As the idea of the experiment itself took on new meaning, so too did the role of experience in forming scientific knowledge.[3]

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[3] Karen Edwards, *Milton and the Natural World: Science and Poetry in Paradise Lost*, Cambridge UP, 1999. "Turning to the complex semantic histories of experiment and experience, we can discern two strands of meaning in the seventeenth-century usage of each word. One strand involves an informal, pragmatically observational mode ("let's try it and see what happens"), the other, a more formal observational mode … by the eighteenth century, the first strand of meaning, in which knowledge or 'proof' was seen to derive largely from informal observation, had come to be signaled primarily by the word experience. The second strand of meaning, in which the notion of testing is dominant, had attached itself by the end of the seventeenth and

Schmitt shows how experience, in some cases, served as the basis for medieval and early modern natural philosophy before the seventeenth century. For example, sciences such as astronomy and anatomy relied upon experience through direct observation as a form of evidence; in the Middle Ages, he notes, "Jean Buridan's well-known critique of Aristotle's theory of projectile motion … gives a most telling series of *experientie* which point up the many real problems involved" (Schmitt 88). Even though Buridan was an Aristotelian in some respects, he demonstrated the flaws in Aristotle's theory of projectile motion by showing that force was something that might be transmitted from the thrower of an object to the object in motion (rather than external force carrying an object forward). Buridan's contribution to the demise of Aristotelian philosophy was through his explanation of this force, which he labeled impetus (Zupko).

Because experience was in flux in the seventeenth century as well as in Milton's text, the question of experience in *Paradise Lost* has continued to perplex readers of the poem, as is evident in the contested critical interpretations of Eve's phrase, "Experience, next, to thee I owe,/ Best guide; not following thee, I had remained /In ignorance." Stanley Fish's reading of Eve's temptation by Satan in *Surprised by Sin* turns the scene of

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the beginning of the eighteenth to the word experiment. During the decades in which Milton was writing, the strands of meaning had just begun to separate." (20-21)

seduction into a warning against the empirical method of repeating experiments to test the truth (Fish 251). By contrast, scholars such as Karen Edwards and Catherine Gimelli Martin argue that this position – which sees Milton as critical of the new philosophy – is a recent construct of 20th century literary criticism and counter to Milton's reception in his own time (Martin 231). [4] "If the experience Eve praises were identical to the experience endorsed by the new philosophers," notes Edwards, then Kester Svendsen would be right about Milton's scientific backwardness" (Edwards 17).[5] Instead, Edwards argues that Eve's version of experience is different than the one that emerged from experimental philosophy later in the century and that, if anything, Eve should have been "more of an empiricist" (33).

Although the word "experience" comes up fewer than ten times in the poem, it is nonetheless central to Milton's engagement with early modern natural philosophy, occurring at crucial moments in *Paradise Lost*. It first appears in Book I, in Satan's first speech in the poem – his declaration to the fallen angel Beelzebub that, despite their

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[4] Although both Edwards and Martin want to read against the scholarly trend that sees Milton as anti-experimental philosophy, in accordance with scholars like Stephen Fallon in *Milton and the Philosophers* and John Rogers in *The Matter of Revolution*, Edwards focuses on forwarding a new understanding of Milton's concept of experience and his relationship to natural history; Martin focuses instead on reinterpreting Milton's cosmology in the context of seventeenth-century natural science – a cosmology that, in seeming to "stand on the wrong side of the great scientific revolution initiated by Copernicus, furthered by Galileo, and completed by Newton," has played a part in reading Milton as a poet who rejects the new philosophy (Martin 233).

[5] In *Milton and Science*, Kester Svendsen argues that Milton's scientific knowledge was derived from the popular encyclopedias in circulation at the time.

defeat on the plains of Heaven, "all is not lost" (I.106). In his passion, Satan frames experience as an activity that is perpetually ongoing and a source for further rebellion:

> Since by fate the strength of gods
> And this empyreal substance cannot fail,
> Since through experience of this great event
> In arms not worse, in foresight much advanced,
> We may with more successful hope resolve
> To wage by force or guile eternal war
> Irreconcilable, to our grand Foe,
> Who now triumphs, and in the excess of joy
> Sole reigning holds the tyranny of Heaven. (I.116-124)

The preceding lines cover Satan's refusal to "repent or change," despite being cast out of Heaven and his determination to continue the fight; a possible solution to these problems is heralded by Satan's repetition of the word "since" – "since by fate" and "since through experience." Experience, Satan argues to his audience, is a potential resource to the fallen angels should they renew their fight with Heaven: "we may with more successful hope resolve / To wage by force or guile eternal war." Additionally, this passage characterizes experience as continually in process; while the enjambment in the line "we may with more successful hope resolve" for a brief pause suggests resolution rather than resolve, it is swiftly followed by the intent to wage "eternal war irreconcilable." By asking his audience to treat the experience of an event as a source of potential knowledge – something that grants them "foresight much advanced" – Satan transforms their experience of defeat into an opportunity to instigate rebellion against Heaven eternally.

"Experience" next appears in the poem when Satan has rallied his troops for an infernal congress, where the angels debate what strategy to pursue next:

> Advanced in view, they stand, a horrid front
> Of dreadful length and dazzling arms, in guise
> Of warriors old with ordered spear and shield,
> Awaiting what command their mighty chief
> Had to impose: He through the armed files
> Darts his experienced eye, and soon traverse
> The whole battalion views, their order due,
> Their visages and stature as of gods,
> Their number last he sums. (I.563-571)

The fallen angels, "advanced in view," have achieved the "foresight much advanced" that Satan assures Beelzebub the angels have gained. Since "experience" appears in this passage as a reference to Satan's "experienced eye," this description summons the earlier moment in Book I, when…. While in the first passage "experience" is collective, however, in this one, "experience" is undergone individually and more explicitly linked with individual perception rather than collective memory. Here experience is similar to *The Winter's Tale*, when the Gentlemen try to recount the irreproducible experience of Perdita's reunion with her father: "that which you hear you'll swear you see" and "you have lost a sight, which was to be seen, cannot be spoken of" (V.ii.3140-1, 3151-2).

"Experience" marks the distinction between Satan's "experienced eye" and Eve's "unexperienced thought," which is to say her profound innocence. In this passage, Eve recalls her first waking moments after her creation:

> That day I oft remember, when from sleep
> I first awaked, and found myself reposed

> Under a shade on flowers, much wondering where
> And what I was, whence thither brought, and how.
> Not distant far from thence a murmuring sound
> Of waters issued from a cave, and spread
> Into a liquid plain, then stood unmoved
> Pure as the expanse of Heaven; I thither went
> With unexperienced thought, and laid me down
> On the green bank, to look into the clear
> Smooth lake, that to me seemed another sky. (IV.447-457)

Eve's memories begin with her questioning "where / and what I was, whence thither brought, and how" – questions about the nature of her own being, not unlike those of a natural philosopher. Eve's "unexperienced thought" leads her into possible confusion in interpreting the natural world around her. She sees a "clear/ smooth lake" and moves to investigate it, thinking it "another sky."

Eve's pleasure in looking at her own reflection is prefigured in the lines that lead up to that moment: words like "murmur," repeating syllables, and the alliteration (wondering, where, what, was, whence) in her questions about her own identity. When Eve looks into the only *seeming* sky (significant in that Adam, in Book VIII, looks up to the actual sky), she sees herself:

> As I bent down to look, just opposite
> A shape within the watery gleam appeared,
> Bending to look on me: I started back,
> It started back; but pleased I soon returned,
> Pleased it returned as soon with answering looks
> Of sympathy and love: There I had fixed
> Mine eyes till now, and pined with vain desire,
> Had not a voice thus warned me; 'What thou seest,
> 'What there thou seest, fair Creature, is thyself;
> 'With thee it came and goes: but follow me,

'And I will bring thee where no shadow stays
'Thy coming, and thy soft embraces, he
'Whose image thou art.'" (IV.458-470)

Eve's narration of her confusion between her reflection and her self is accompanied by the implication that she is mistaking shadow for substance. In Ovid's *Metamorphoses*, Narcissus's love for his own reflection is described as follows: "spem sine corpore amat, corpus putat esse, quod umbra est," – "he loves a hope without substance, and thinks that a substance is only shadow." Here, Eve is told that she will be brought "where no shadow stays," and that seems to indicate that she presumably cannot make the mistake Narcissus does, of confusing shadow and substance.[6]

Although Satan is involved in the next two scenes in which Milton uses "experience" in the poem, the usages suggest his ambivalence about the term. In the first instance, in Book IV, Satan charges Gabriel with "inexperience": "thy words at random, as before,/ Argue thy inexperience …. / A faithful leader, not to hazard all / Through ways of danger by himself untried" (IV.927-931). As in Book I, Satan argues that using experience, particularly after "hard assays and ill successes past," is necessary. Here, as with Satan's "experienced eye," experience is personally gained – Satan makes his case for first testing "ways of danger by himself untried" before subjecting his fellows to it, although he is of course lying about his motivations.

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[6] In *King Lear*, shortly after the Fool tells Lear that he is "an O without a figure" after dividing his kingdom among his daughters, Lear asks, "Doth any here know me? …. Who is it that can tell me who I am?" (I.iv.715, 748, 752). The Fool answers, "Lear's shadow" and demonstrates the confusion between shadow and substance that takes place in *Lear* after he has abandoned his crown to his daughters (I.iv.753).

Experience has a different meaning, however, in Book V, after God has sent Raphael to tell Adam of the war in Heaven and the danger that Satan poses to them. Here Raphael recounts Abdiel's objections to Satan's treason:

> Shalt thou give law to God? shalt thou dispute
> With him the points of liberty, who made
> Thee what thou art, and formed the Powers of Heaven
> Such as he pleased, and circumscribed their being?
> Yet, by experience taught, we know how good,
> And of our good and of our dignity
> How provident he is; how far from thought
> To make us less, bent rather to exalt
> Our happy state, under one head more near
> United. (V.822-831)

At this particular moment, what Abdiel argues is that what the angels are taught "by experience" is a greater understanding of God's nature – specifically, what they know is "how good,/ And of our good and of our dignity / How provident he is." (Provident, as per the OED, meaning "foresight").

In Book I of the poem, when Satan informs Beelzebub of the value of experience, he reminds him that experience provides them with "foresight much advanced." The distinction – contrasting Satan's argument in Book I with Abdiel's position Book V – seems to be in part that while Satan's foresight, derived from experience, is self-directed and self-determined, the foresight Abdiel refers to is God's. Satan's "foresight much advanced" is a tool the fallen angels can use to renew the fight against Heaven; Abdiel's is about recognizing God's foresight, i.e., uncovering the workings of God's providence. He takes this discussion of God's providence further into an explanation of angelic

creation and angelic hierarchy, saying, "By whom / As by his Word the mighty Father made / All the spirits of Heav'n,/ By him created in their bright degrees/ Crowned them with glory" (V.835-859). It is not experience that is the problem, but how you understand your experience in relationship to God.

The divide between Abdiel's belief (that experience unfolds the workings of the divine) and Satan's (that experience serves one's own ends) continues through their argument over angelic creation. After Abdiel reminds the angels of their creation by God, "his zeal / None seconded" by any of the angelic assembly, and Satan responds "That we were formed then say'st thou" (V.849-853). Satan continues, denying Abdiel's account of the angels' creation, "Who saw / When this creation was? Remember'st thou / Thy making, while the Maker gave thee being? / We know no time when we were not as now; / Know none before us, self-begot, self-raised / By our own quick'ning power" (V.855-861). Satan's appeal to the angels begins with an appeal to empirical knowledge – "Who saw / when this creation was?" he asks.

Instead of having experience confirm their place in the hierarchy of created beings, Satan urges the fallen angels to use experience as a means to upset that hierarchy. As Robert Boyle argued for a union of "eyes and hands" in the experimental laboratory, here Satan claims that "our own right hand / Shall teach us highest deeds, by proof to try / Who is our equal" (V.854-866). Furthermore, the angels themselves will

determine their place through their own actions – "by proof to try who is our equal"--connecting experience to experiment through "trial" and "proof" (V.865-866): [7]

> But apt the mind or fancy is to rove
> Unchecked, and of her roving is no end;
> Till warned, or by experience taught, she learn,
> That, not to know at large of things remote
> From use, obscure and subtle; but, to know
> That which before us lies in daily life,
> Is the prime wisdom: What is more, is fume,
> Or emptiness, or fond impertinence:
> And renders us, in things that most concern,
> Unpracticed, unprepared, and still to seek. (VIII.188-197)

Although critics often cite this passage to argue Milton's anti-science position, Adam's words here are in response to Raphael's seeming warning about trying to uncover the workings of the organization of and nature of the universe, which immediately precedes this passage: "Heav'n is for thee too high / To know what passes there; be lowly wise:/ Think only what concerns thee and thy being; / Dream not of other worlds, what creatures there/ Live, in what state, condition or degree" (VIII.172-176).[8]

But as other readers of this passage have noted, Raphael's warning follows his portrayal of a universe in line with the Copernican rather than Ptolemaic model. Referencing a debate between heliocentrism and geocentrism that was relevant and

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[7] See Dayton Haskin on "experimental" in mid-seventeenth century religious writing: "associating their religious experience with a dynamic sense that their lives involved recurring tests, people used the word 'experimental' to characterize the sincerity and intensity of their devotion. They spoke about the emotional impact of the 'experimental' knowledge they got from the Bible and opposed this to a knowledge (sometimes called 'historical' knowledge) derived from 'mere testimony or conjecture'" (Edwards 67).
[8] See Grant McColley's "The Theory of a Plurality of Worlds as a Factor in Milton's Attitude toward the Copernican Hypothesis" in Modern Language Notes, Karen L. Edwards in *Milton and the Natural World*.

revolutionary, he simultaneously engages and discourages Adam's scientific curiosity. Consider the question question he poses earlier: "What if the sun / Be center to the world, and other stars / By his attractive virtue and their own / Incited, dance about him various rounds?" (VIII.122-125). Raphael leaves the question open and further instructs Adam to leave these things behind – "Whether the sun predominant in heav'n / Rise on the Earth, or Earth rise on the sun/ … or she from west her silent course advance / With inoffensive pace" (VIII.160-164). If Raphael seems to diminish scientific curiosity, the poem does not necessarily do the same work in its conscious staging of a major contemporary philosophical debate. Whether the universe is geo- or heliocentric is, while an interesting question (and truly asked by Eve before), not part of what Adam needs to know to remain "lowly wise."

Adam thanks Raphael for fully satisfying his queries – despite the fact that Raphael's speech to Adam ends by telling him that an angel cannot provide a definitive answer to some of his questions: "dream not of other worlds … contented that thus far hath been revealed/ Not of Earth only but of highest Heav'n" (VIII.175, 177-17). Adam claims that he is fully satisfied and agrees that the "easiest way" is to leave "perplexing thoughts" and "anxious cares" to God, but the matter does not end there. He immediately provides Raphael with an excuse for his curiosity: Adam knows that some matters are in theory best left to God, but he can't help but wonder about the nature of

things: "But apt the mind or fancy is to rove / Unchecked, and of her roving is no end; / Till warned, or by experience taught" (VIII.188-190).

Adam repeats the phrase that Abdiel uses (via Raphael's explanation of the war in Heaven) in Book V of the poem, but while Abdiel's phrase is used in the face of temptation, Adam's is used to justify his continued curiosity. Where Abdiel argues that experience teaches the subject to apprehend God's will, Adam here claims that only experience can redirect the mind from "things remote / From use, obscure and subtle" to the more humble matters of everyday existence. Anything more than this ("daily life") "is fume / or emptiness, or fond impertinence….And renders us, in things that most concern, / Unpracticed, unprepared, and still to seek" (VIII.194-197). Although both Abdiel and Adam frame experience as something that redirects them back to God, Abiel's portrayal of this experience is ultimately one of unity with other angels and God: "under one head more near / United" (V.830-1). Adam's description of experience, however, ends with everything that experience is supposed to direct him away from: "fume, or emptiness," which leaves him "still to seek" (V.194-5, 197).

Furthermore, this experience is described as something that must continually check a mind whose "roving" knows "no end" and that searches after knowledge that leaves that mind both "unprepared" and unable to stop searching for such knowledge. Experience, in this sense, must be continually redirect the mind's focus back to the mundane matters of existence and away from the inner workings of the cosmos.

Significantly, too, in this passage, both "fume" and "emptiness" are forms that sit at the boundary between substance and the immaterial in this poem (vacuity doesn't exist in Milton's cosmos, though the void does) – and fume's previous uses in the poem link it to scent (something that can be sensibly discerned). Adam's attempts to dismiss the sought-after objects of a wandering mind or fancy are foiled by the kind of language he uses – both "fume" and "emptiness" aren't necessarily as insubstantial or empty as he would like them to be, highlighting that despite Raphael's advice to the contrary, he cannot dismiss the curiosity that has him reading the universe for signs other than God's providence.

At this juncture, Raphael says, "Nor less think we in Heav'n of thee on Earth / Than of our fellow servant, and inquire / Gladly into the ways of God with man" (VIII. 224-226). While this reiterates Milton's invocation to the muses at the poem's beginning and his stated intention to "assert eternal providence / And justify the ways of God to man," it also arrives a mere fifty lines after Raphael's seeming warning to Adam to "solicit not thy thoughts with matters hid / Leave them to God above" (I.25-26). Raphael dissuades Adam from inquiring into "matters hid" but encourages his curiosity in "the ways of God," underlining that Adam's fancy should be directed towards discerning God's presence in the created world. This holds with Raphael's earlier answers to Adam's questions: "To ask or search I blame thee not, for heav'n / Is as the book of God before thee set" but "the rest / From man or angel the great Architect / Did wisely to

conceal, and not divulge / His secrets to be scanned by them who ought / Rather admire" (VIII.66-75). The distinction seems to be that curiosity is fine, though best suited to mundane rather than celestial matters. To this end, Raphael also implies that in analyzing or attempting to ferret out the truth about the heavens, the scientist fails to show proper admiration for God's works – he is "scanning" God's secrets rather than admiring them.

Adam and Eve's creation stories demonstrate the difference between these two types of experience: one that is directed towards discerning the divine and one that is self-directed and unbounded. Although Adam's account of his own creation begins with a line reminiscent of Satan's treasonous challenge to his fellow angels, Adam's curiosity in the narrative of his creation is ultimately described as directed towards creation (and a Creator) first, himself second. "For man to tell how human life began / Is hard; for who himself beginning knew?" Adam asks, as Satan asked, "Remember'st thou / Thy making?" (VIII.251-252).

While Eve wonders what she is, and where she is, and how she has been brought here, Adam watches the sky with wonder, admires the other animate beings around him, and then finally turns to examining his own form: "Myself I then perused, and limb by limb / Surveyed, and sometimes went, and sometimes ran / With supple joints, as lively vigor led: / But who I was, or where, or from what cause/ Knew not" (VIII.267-271). While Eve "bends down" to look at her own reflection in the water, which seems

like a second sky to her, Adam looks at the true sky and springs up "by quick instinctive motion" and "upright / Stood on my feet" (VIII.259-261). In addition to tracing different movements – Adam looks up, Eve bends down -- Adam and Eve's narratives also show how they think differently about the nature of the self. Upon waking, Eve's first thought is to wonder about her own nature; Adam's thoughts about his own origins only come after witnessing other parts of creation (the "hill, dale, and shady woods, and sunny plains," the "creatures that lived, and moved, and walked, or flew"). It is only after experiencing all these things that Adam finally turns to himself.

Alternately, Eve's first questions upon waking are about her own nature – following that, she explores the world around her (she hears the sound of water and goes to investigate, and then becomes entranced by her own reflection). Eve's story, in contrast to Adam's, is replete with events in which she is passive "whence brought, invisibly thus led." In contrast, Adam's narrative could be read as something that shows more sense of his place in a created hierarchy – when he sees the things around him, he asks the "enlightened earth" to tell him "how came I thus, how here? He has an immediate and intuitive grasp of divine agency: "Not of myself; by some great Maker then." Adam acknowledges both his own created-ness and his necessary reverence to God: his position to a "Maker … / In goodness and in power pre-eminent" and his desire to discern "how may I know him, how adore, / From whom I have that thus I move and live, / And feel that I am happier than I know" (VIII.280-282).

Adam then sits down on a "green shady bank" and almost falls asleep, fearing somewhat that "I then was passing to my former state / Insensible, and forthwith to dissolve" (VIII.285-291). Such notice recalls Eve's earlier narrative of her own creation, where she "laid me down/ On the green bank" and gazed at a reflection. Adam almost falls asleep though he fears that this will undo him - that he will be returned to whatever state he occupied before awaking; Eve becomes lost in looking. Both Adam and Eve are called forth from this state by a voice that reveals itself as God to Adam, though not Eve, and also gives both Adam and Eve their respective purposes: Adam is charged with responsibility for Paradise and warned about the fatal consequences of eating from the Tree of Life; Eve is brought to Adam and entrusted with the reproduction of the human race.

As Adam recounts how he learned his place in the hierarchy of created beings, consider the parade of animals Adam witnesses after learning that he and his race are charged with the care and keeping of Paradise. As Adam "fell / Submiss" in "adoration at his feet," so too do the animals submit to Adam:

> 'In sign whereof, each bird and beast behold
> 'After their kinds; I bring them to receive
> 'From thee their names, and pay thee fealty
> 'With low subjection; understand the same
> 'Of fish within their watery residence,
> 'Not hither summoned, since they cannot change
> 'Their element, to draw the thinner air.'
> As thus he spake, each bird and beast behold
> Approaching two and two; these cowering low
> With blandishment; each bird stooped on his wing.

> I named them, as they passed, and understood
> Their nature, with such knowledge God endued
> My sudden apprehension. (VIII.341-354)

The poem then begins to quote the Bible when God says "each bird and beast behold / After their kinds," and then, a few lines later, this is precisely what happens. "As thus he spake, each bird and beast behold;" apparently God not only creates through performative speech, but also choreographs. Similarly, in naming the animals, Adam "understood / Their nature, with such knowledge God endued" (VIII.352-354). While, on the one hand, Adam is getting knowledge directly from God, he is also being set up by God to draw certain conclusions about the nature of animals and the need for companionship (this is glossed in the text, but basically, having the animals parade two-by-two here, as they do not in Genesis, might mean that "Milton's Adam seems intended to think about companionship" (Kerrigan et al. 507)).

This trial is explicitly characterized as such later in the poem; when Adam asks, "In solitude / What happiness who can enjoy alone /Or all enjoying, what contentment find?" God tests him by asking "Is not the Earth / With various living creatures, and the air/ Replenished, and all these at thy command?" (VIII.364-366, 369-371). This conversation continues; Adam argues for "social communication" – "by conversation with his like to help, / Or solace his defects" – and finally God acknowledges that he has been testing Adam. He says: 'Thus far to try thee, Adam, I was pleased, / And find thee

knowing not of beasts alone, / Which thou hast rightly named, but of thyself, / Expressing well the spirit within thee free" (VIII.437-440).

While Adam intuits knowledge of every creature's nature through the act of naming them, that received knowledge alone is not sufficient: Adam must be able to use that knowledge to know something of himself, i.e., to see God's image, "not imparted to the brute." God gives his reasons for challenging Adam: "for trial only brought, / To see how thou could'st judge of fit and meet" (VIII 447-448). In other words God's test for Adam has been about discernment – God's argument with Adam serves as a way to test his knowledge of the creatures of Paradise and also himself. Again, God reminds Adam that it's not about knowledge as much as it is experience or the application of that knowledge.

The importance of companionship comes up again in Book IX of *Paradise Lost*, when Adam and Eve debate dividing their labors; if they separate, do they risk being easy prey? Additionally, Adam reminds Eve that:

> I from the influence of thy looks, receive
> Access in every virtue; in thy sight
> More wise, more watchful, stronger, if need were
> Of outward strength; while shame, thou looking on,
> Shame to be overcome or over-reached,
> Would utmost vigor raise, and raised unite.
> Why shouldst not thou like sense within thee feel
> When I am present, and thy trial choose
> With me, best witness of thy virtue tried? (IX.309-317)

In this passage, Adam seems to rewrite his earlier claims to Raphael about feeling potentially undone by Eve's beauty: he notes that he is "weak / Against the charm of beauty's powerful glance" and perceives Eve to be "so absolute … / And in herself complete, so well to know / Her own …/ All higher knowledge in her presence falls / Degraded" (VIII.532-533, 547-52). Raphael assuages Adam's fear that he's being unmanned by admonishing, "Accuse not nature, she hath done her part; / Do thou but thine" – and reduces Eve to her physical form, saying to Adam: "what transports thee so, an outside?" Raphael chides Adam for reading Eve's physicality incorrectly; his engagement with her should convey the knowledge that he is her head (VIII.574).

Additionally, Raphael's reminder to Adam about nature – that "she hath done her part," etc. – foreshadows Adam's reminder in Book IX to Eve as he encourages her to stay strong against temptation, although in Adam's closing words to Eve, God takes the place of nature: "On what thou hast of virtue, summon all, / For God towards thee hath done his part, do thine" (IX 374-375).

Raphael's argument with Adam over Eve's nature is relevant to the action of Book IX in any event, but it is curious that the two sections are linked with such close verbal echoing. In Book VIII, Raphael listens to Adam's concerns about Eve's ability to make wisdom appear "like Folly" and responds:

> Weigh with her thyself;
> Then value: Oft-times nothing profits more
> Than self-esteem, grounded on just and right
> Well managed; of that skill the more thou knowest,

> The more she will acknowledge thee her head,
> And to realities yield all her shows. (VIII.570-575)

The combination of words that indicate evaluation, such as "weigh her," "value," and "profit" demonstrate that Adam is being asked to use his discernment with regards to Eve – this seems related to the test that God sets for Adam earlier when he parades pairs of animals in front of him. Adam is being asked to understand his relation to and difference from the animals given into his care; although Eve is called Adam's companion and equal, she's similarly put under his protection, and he's asked to evaluate her in relationship to himself.

In Book IX, Eve is the first to suggest separation from each other while working; she argues for a division of labors rather than constant companionship. When Adam worries that, by leaving her side, he will be exposing her to potential threats – "leave not the faithful side / That gave thee being, still shades thee, and protects" – Eve takes offense, sensing that Adam believes her incapable of standing firm on her own (IX.265-266). Significantly, what Eve moves towards is an experience that separates her from the knowledge of her place in a hierarchy of creation; this experience is characterized by Adam as a "trial," linking it immediately to the idea of the experiment.

The conversation ends with a commentary on the nature of free will as well as a rewriting of Raphael's earlier correction of Adam: because Eve insists on her own ability to withstand temptation without help from Adam, and argues that they will be better able to perform their labors separately, Adam says: "But, if thou think, trial unsought

may find / Us both securer than thus warned thou seemest,/ Go; for thy stay, not free, absents thee more" (IX.370-372). This statement follows Adam's characterization of his and Eve's free will in the language that God uses earlier –

> Happiness in his power left free to will,
> Left to his own free will, his will though free,
> Yet mutable; whence warn him to beware
> He swerve not, too secure. (V.235-238)

God's warning to Adam, delivered via Raphael, cautions him against swerving – the potential result of having free will. In this context, to "swerve" means to err. And yet, the phrase follows God's constant repetition that Adam possesses free will. In Epicurean philosophy, the swerve is what facilitates free will. As per Ada Palmer in *Reading Lucretius in the Renaissance*:

> Though the Epicurean cosmos is mechanistic, it is not deterministic. …According to Epicurus, however, the motion of atoms is not linear, or predictable. Instead, atoms have a slight random swerve, which makes them curve and strike one another unpredictably. It was this random motion that led atoms floating in the void to clash, ricochet, tangle together, and eventually form substances, worlds, stars, and human beings, instead of continuing infinitely in parallel paths yielding nothing. Thanks to this swerve, the atoms that compose the thinking organ of the human being are not locked into mathematically predictable patterns, leaving room for thought and choice to be genuinely spontaneous. (Palmer 12)

While the swerve in this context not only enables free will, choice, and all human thought, it is also presumed to be potentially responsible for the creation of worlds, at this point in *Paradise Lost*, it's glossed by God as error.

In the first line, it is happiness that is "left free to will." The next line changes what "free" is modifying, clarifying that happiness is left to Adam's free will: "left to his own free will." The first two pieces of this spell out the practice of free will – desire and action. But the last piece of this line quickly modifies what precedes it, reminding us that though Adam's will is free, it can potentially be changed into something else entirely – the word "mutable" here articulates the potentially unforeseen consequences of free will. What could free will be changed into? Impossible to say, its practice necessarily leaves it open-ended. Free will is itself potentially described as a trial or experiment – though God knows the outcome, the experience itself is left up to Adam.

> When Raphael recounts this to Adam later in the same book, he says:
> That thou art happy, owe to God;
> That thou continuest such, owe to thyself,
> That is, to thy obedience; therein stand.
> This was that caution given thee; be advised.
> God made thee perfect, not immutable
> And good he made thee, but to persevere
> He left it in thy power; ordained thy will
> By nature free. (V.520-524)

In relationship to God's earlier statements about Adam's free will, Raphael emphasizes "standing" alongside God's "not swerving." Because "standing" (from the Latin verb, *stare*) implies constancy and faith, Raphael's instruction to Adam to stand firm carries that meaning as well as a kind of stasis and solidity. While God tells Raphael that Adam's will "though free" is "yet mutable," here, it is Adam himself who is "perfect, not immutable."

Adam's conversation with Eve in Book IX also continues to note this divide between standing and swerving. In Book IX, Adam reminds Eve of Raphael's earlier words:

> Not then mistrust, but tender love, enjoins,
> That I should mind thee oft; and mind thou me.
> Firm we subsist, yet possible to swerve;
> Since Reason not impossibly may meet
> Some specious object by the foe suborned,
> And fall into deception unaware,
> Not keeping strictest watch, as she was warned.
> Seek not temptation then, which to avoid
> Were better, and most likely if from me
> Thou sever not: Trial will come unsought. (IX.357-366)

While God's warning through Raphael to Adam cautions him to "swerve not," here, Adam notes that "firm we subsist, yet possible to swerve." Subsist in this sentence once again draws upon the idea of standing firm as opposed to swerving or falling, through the Latin *subsistere*, to come to a stand. The change from "swerve not" to "possible to swerve," though, suggests the flexibility and ambiguity necessary for the will's freedom to choose good or bad.

The opposition between standing firm--constancy--and swerving is applied earlier in the poem in Book V, when Abdiel confronts Satan and the host of fallen angels. After Satan and his cohort argue that they are self-made and will independently prove their worth rather than submitting to a higher authority, Abdiel is described with these words:

> Nor number, nor example, with him wrought

> To swerve from truth, or change his constant mind,
> Though single. (V.901-903)

Again, swerving is identified with erring in this passage; also, what is potentially named as a source of error is being persuaded by "number" or "example" to change one's position since Abdiel's potential temptation by Satan occurs earlier in the poem than Adam and Eve's, it models the proper use of experience against temptation.

Abdiel's trial asks the reader to consider what kind of evidence is credible. What counts as valid evidence: is it "number" (collective opinion) or "example" (from exemplum, meaning pattern or sample)? Satan encourages the angels to disavow God by taking their own observations as valid evidence, specifically relying on memory and sight. He asks, "Who saw when this creation was?" and "remember'st thou thy making?" (V.856-858). He also tells them that "our own right hand / Shall teach us highest deeds" (V.864-865). Satan tellingly begins this speech through an appeal to reason: "Who can in reason then, or right, assume / Monarchy over such as live by right / His equals" (V.794-796).

When Abdiel returns to Heaven with the news of Satan's disavowal and his declaration of war against God, God praises his fortitude in standing alone against Satan:

> Servant of God, well done; well hast thou fought
> The better fight, who single hast maintained
> Against revolted multitudes the cause
> Of truth, ….

> The easier conquest now
> Remains thee, aided by this host of friends,
> Back on thy foes more glorious to return,
> Than scorned thou didst depart; and to subdue
> By force, who reason for their law refuse,
> Right reason for their law. (VI.29-42)

God also notes that Abdiel's resistance takes the form of "standing;" he says, "for this was all thy care / To stand approved in sight of God" (VI.35-36). God's praise of Abdiel's standing highlights choice as an exercise of faith. Abdiel conquers temptation by "maintaining" God's law and thus "stands approved" Additionally, God rewrites the language that Satan has used in his address to the fallen angels; he characterizes the fallen angels' actions as a rejection of not just reason but "right reason" – "right reason" in this sense means not pure reason alone but something closer to the exercise of free will in accordance with God's law.[9] Where Satan asks for the angels to use reason to evaluate whether God has the right to authority or to "introduce law," God calls for "right reason" as law.

This division of reason from right reason fits with Milton's description of the debates in Hell in Book II, when Belial, who "could make the worse appear the better

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[9] Walter S.H. Lim, in *John Milton, Radical Politics, and Biblical Republicanism*, writes: "Like Cicero, Milton commits himself to the ideal of virtue as right reason. Mastering the self, Milton asserts, entails obeying right reason. Right reason has both a classical and Christian humanist dimension … In Reviving Liberty, Joan Bennett has argued that Milton shares with Richard Hooker the basic idea that a godly nation is built upon the right reason of the natural law. In line with his view that right reason indeed constitutes the very basis of civil and political liberty itself, Milton finds himself significantly arguing … for a God who operates instead according to rational principles" (20). The other conversation on "right reason" happens as Michael explains to Adam what reason looks like in a fallen world and what the role of "right reason" is in forming a political state (internal tyranny reflected externally in political tyranny).

reason" uses "words clothed in reason's garb" (113-114, 226) – and, recalls Adam's reminder to Eve that reason alone can be swayed by false propositions. He reminds her to rely on more than her sensory knowledge of the world – she must "well be ware, and still erect; / Lest, by some fair-appearing good surprised, / She dictate false; and misinform the will" – and to choose right reason "for what obeys / Reason, is free; and Reason he made right" (VIII.351-55). The reminder to stay "still erect" recalls the language of "standing" and "subsisting," as it also enforces the idea of remaining upright.

The contrast between standing still and falling (motion) continues in Book VII's discussion of creation. In Book VII, after Raphael relates the fall of Satan and the other renegade angels to Adam and Eve, Adam asks if Raphael can move from speaking of these higher matters to telling of lower ones: specifically, the creation of the Earth. He inquires,

> … what cause
> Moved the Creator, in his holy rest
> Through all eternity, so late to build
> In Chaos; and the work begun, how soon
> Absolved; if unforbid thou mayest unfold
> What we, not to explore the secrets ask
> Of his eternal empire, but the more
> To magnify his works, the more we know. (V.90-97)

Adam argues that knowledge about the Earth's creation is not just intended to indulge his own curiosity, or to penetrate the secrets that lie hidden from him, but to "magnify his works" through acquiring further knowledge. Adam's speech is full of consciousness

of the potential limitations here; he notes that such disclosure might not be possible: "if unforbid thou mayest unfold," and asks the angel to "relate / What may no less perhaps avail us known" than the warning that Raphael issued earlier.

This sense of limitation is also present in the language he uses for posing his questions in the first place; his description of the heavens acknowledges the vastness of the universe but moves towards a language of containment: "How first began this heav'n … with moving fires adorned / Innumerable, and this which yields or fills all space, the ambient air wide interfused / Embracing round this florid Earth?" (VII.86-90). Even before Adam notes that the Earth has been built from "Chaos," he describes the presence of "ambient air" that "fills all space" and encompasses the Earth. Furthermore, Adam recognizes that there will be a temporal limit to their conversation as well, though he argues that the power of Raphael's storytelling might potentially be able to delay it: "the great light of day yet wants to run / Much of his race though steep, suspense in heav'n, / Held by thy voice" (VII.98-100). Adam clearly adheres to the geocentric notion of the universe, his comment hinting that Raphael's narration might settle this debate, though of course it does not.

Raphael's response to Adam draws further attention to the limitations of what he can convey to him, as well as to the limits of Adam's request: "This also thy request with caution asked / Obtain: though to recount almighty works / What words or tongue of Seraph can suffice / Or heart of man suffice to comprehend?" (VII.111-114). While Adam

initially thinks that the limits might only be to his own knowledge (or his capacity for gaining knowledge), Raphael's remark indicates that the limitations are also due to his own angelic nature. He then tells Adam that God has permitted him to relay certain knowledge – "to answer thy desire / Of knowledge within bounds" – which theme he continues in Book VIII in greater detail (VII.119-120).

The constant repetition of boundaries early in Book VII is important, because it gives way to God's description of the creation of the Earth and of mankind (which is filled with language that emphasizes boundlessness and infinitude instead; i.e., God describes his creation of "a race / of men innumerable" (VII.155-156)). But before this happens, Raphael's speech to Adam continues to emphasize restriction and containment: although there are secrets beyond "knowledge within bounds," "enough is left besides to search and know" (VII. 120, 125). Tellingly, Raphael's description of Adam's desire to know (as well as the poetic speaker's earlier in the book) analogizes that desire to hunger: "But knowledge is as food, and needs no less / Her temperance over appetite, to know / In measure what the mind may well contain / Oppresses else with surfeit, and soon turns / Wisdom to folly, as nourishment to wind" (VII 126-130). Raphael's word-choice – "temperance," "in measure," "contain," and "surfeit" – all caution Adam against boundless indulgence in curiosity.

By way of contrast, Raphael retells the story of Earth's creation in language that emphasizes God's infinitude and boundlessness: that other world where God will create

"out of one man a race / Of men innumerable, there to dwell, / Not here, till by degrees of merit raised / They open to themselves at length the way / Up hither, under long obedience tried, / And Earth be chang'd to Heav'n, and Heav'n to Earth, / One kingdom, joy and union without end" (VII.156-161). In contrast to the angels, men are "innumerable," and although there are physically boundaries in place (men are "there to dwell, / not here,") their potential spiritual path is one that allows them to access and take part in God's infinitude, when after obedient service to God, Earth and Heaven become one and the same: "one kingdom, joy and union without end" (VII.161).

The creation of Earth takes place through the Father and Son; God instructs the Son, "And thou, my Word, begotten Son by thee / This I perform, speak thou, and be it done" (VII.163-164). In Milton's theology, the Son is subordinate to the Father, and the Son's creation of the world only occurs through the Father's strength and with the help of the Holy Spirit (481). The Father's description of this world-building through the Son and "overshadowing Spirit" is described as follows. God bids the Son to:

> … ride forth, and bid the Deep
> Within appointed bounds be Heaven and Earth;
> Boundless the Deep, because I am who fill
> Infinitude, nor vacuous the space.
> Though I, uncircumscribed myself, retire,
> And put not forth my goodness, which is free
> To act or not, Necessity and Chance
> Approach not me, and what I will is Fate. (VII.166-173)

Milton has carefully prepared for his impressive swerve away from the Catholic doctrine of creation ex nihilo, and instead has the Second Person of the Trinity depict

creation of the world from a pre-existing chaos; rather than a creation from nothingness, the separation that initially creates Heaven and Earth is by imposing boundaries upon the "bounded deep" – within appointed bounds. Despite the imposition of these boundaries, the deep remains "boundless," because God's nature is infinite; there can be no vacuum because God's nature prohibits it.[10] As he tells the Son, "I am who fill / Infinitude" (VII.168-169).

Surprisingly the boundary of Chaos and Chaos itself are populated by allegorical personifications who are ontologically different from the other actors in the poem. It is possible to understand the thinness of Sin and Death as resulting from their "creation" by Satan, first his thought of, then his rape of, Sin. Satan is not a real creator, so his offspring are in some fundamental way, non-existent. Chaos is a different matter. In Book II, when we are introduced to Sin and Death, Sin opens the gates of Hell at Satan's bidding, and what appears is the boundless deep of Book VII: "The secrets of the hoary deep, a dark / Illimitable ocean, without bound, / Without dimension; where length, breadth, and height, / And time, and place, are lost; where eldest night / And chaos, ancestors of nature, hold / Eternal anarchy" (I. 891-896)." The "secrets of the hoary deep"

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[10] See M.S. Berkowitz's article, "'With Balanc't Air in Counterpoise:' Milton & Robert Boyle," for a brief discussion of Milton's knowledge of Boyle's experiments with the air pump. For a discussion of the nature of Chaos in *Paradise Lost*, see John Rumrich's "Milton's God and the Matter of Chaos," Sarah Ellenzweig's "*Paradise Lost* and the Secret of Lucretian Sufficiency," and Stephen Fallon's "Milton Among the Philosophers: Poetry and Materialism in Seventeenth Century England."

recall the secrets that Raphael argues should not be the subject of Adam's curiosity, and this deep is consistently described as "without bound."

However, the depiction of Chaos in Book II is personified as an active figure there: "Chaos umpire sits, / And by decision more embroils the fray / By which he reigns: next him, high arbiter, / Chance governs all" (II.907-910). Chaos seems distinct in these lines, but we know from Book VII that the boundless deep is filled by God. Kerrigan et al. footnote that "the attribution of eternal being to Chaos and Night thus renders Milton's account of primordial matter heretical in one of two ways: either Chaos represents a realm distinct from God and, like him, eternal and existentially independent, or Chaos represents an aspect of eternal God himself. The discussion of matter in Christian Doctrine indicates Milton endorsed the later heresy (1.7)" (352).

Chaos, at this point, is described as "the vast immeasurable abyss / Outrageous as a sea, dark, wasteful, wild / Up from the bottom turned by furious winds / And surging waves, as mountains to assault / Heav'n's highth, and with the center mix the pole" (VII.211-215). Chaos's unruliness and destructiveness ("assaulting Heav'n's highth") is tamed into order by the actions of the Son, who speaks, and Chaos listens: "For Chaos heard his voice: him all his train / Followed in bright procession to behold / Creation, and the wonders of his might" (VII.221-222). Chaos is transformed from elements fighting against order-– unruly, surging up to assault Heaven – into a "bright

procession" that witnesses the creation – rather than disrupting order, they are now part of and witnesses to it.

Exercising his nature as the Logos in a perfect chiasmus, the Son creates the world by dividing Chaos into its separate elements: "Silence ye waves, and thou deep, peace" (VII.216). The word by which the Word creates is "silence." Calling upon chaos and ordering that its "discord end," the Son creates the universe out of an immense something.

> … and in his hand
> He took the golden compasses, prepared
> In God's eternal store, to circumscribe
> This universe, and all created things:
> One foot he centered, and the other turned
> Round through the vast profundity obscure;
> And said, Thus far extend, thus far thy bounds,
> This be thy just circumference, Oh World,
> Thus God the Heaven created, thus the Earth,
> Matter unformed and void. (VII.224-233)

The compasses rely on imagery drawn directly from the Bible that refers to the creation of the world in Genesis 1:3-7; the idea of being circumscribed reminds us of the imposition of boundaries and order upon chaos (Kerrigan 483). We have chaos as the "vast profundity obscure" and also as the "matter unformed and void." In Book II and Book VII, it seems that Milton's chaos is the product of different philosophical

definitions for what prime matter is, rooted in both Aristotle's *Metaphysics* as well as Lucretius's *On the Nature of Things*.[11]

N.K. Sugimura's *Matter of Glorious Trial: Spiritual and Material Substance in Paradise Lost* covers the tension between Aristotelianism and Lucretian philosophy in the poem:

> For Milton, however, the ancient alternative of atomism provided an intriguing alternative to Aristotelianism. By introducing a Lucretian element to his figuration of Chaos, Milton explores not only what the undifferentiated (first) substance of prime matter might be, but also the complication this sort of mathematization introduces to (orthodox) theology. … The metaphor meant to confer greater materiality on its subject ends by breaking apart its subject matter (from sands to clans to atoms). In this respect, the 'hoarie deep' (II.8.91) that is home both to Chaos and Night materializes and simultaneously dematerializes itself before our eyes. (240)

In Sugimura's reading, prime matter shifts between being pure material or "pure vacuous space:" though it never reaches total nothingness in the poem (243). The tension between materiality and immateriality is performed through Chaos and Night – reading Chaos as more material, with the clash of embryon atoms, while Night is closer to absence and vacuum (248). Instead of being pure vacuum, Milton's void possesses

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[11] Hunter, "Milton's Power of Matter" – "Not so John Milton. He gladly accepts the Aristotelian hypothesis, with the modification that 'prime matter' exists. For him as for Aristotle matter is 'only a passive principle,' and as for Thomas it is good, though originally formless." (557) Not sure I agree that Milton represents prime matter (through Chaos) as necessarily passive; we hear it described as formless, certainly, and becomes shaped into the created universe through the imposition of order, but we also have all of those images in Book II of atoms bouncing around in the void: "For Hot, Cood, Moist, and Dry, four champions fierce / Strive here for mast'ry, and to battle bring / Their embryon atoms" (II 898-900) and "But all these in their pregnant causes mixed / Confus'dly, and which thus must ever fight, / Unless th'Alimighty Maker them ordain / His dark materials to create more worlds" (II913-916).

qualities that liken it to material objects; Sugimura looks at the friction of the void in Satan's description of being "forct to ride" the void (243).

In Milton's depiction of Chaos even what is material is, on a microscopic level, something that contains empty spaces. As a challenge to critics who believe Milton's universe to be wholly material, Sugimura writes that "Milton's poetry suggests in its figuration of Chaos that even materiality is inwardly structured by miniature pores or infinitely small spaces. … Milton attempted to account for what these empty pockets of space actually were" (251), In *Paradise Lost*, the Son functions as the thing that carries the action across these empty spaces: an intermediary between the Father and the created world (257). This serves as an explanation for why, according to Raphael's account in Book VII, it is the Son – with the "overshadowing Spirit" and the might of the Father – who "rides forth" and acts upon the prime matter in order to create the world at the Father's behest. But as an intermediary between God and the created world, the description of the Son during the world's creation have him hold "the golden compasses, prepared / in God's eternal store, to circumscribe / This universe" (VII.225-227).

This scene, in its depiction of the creation of the world from a geometrical perspective, draws upon the belief that mathematics were "eternal and unchangeable" and in so doing, "Milton allows us to see one view of the Creation through the lens of mathematical abstraction" (Sugimura 257). While this abstraction might seem at first to

move the description of the creation towards a focus on the immaterial by using mathematical tools to depict it, what these tools enable the Son to do is make something unmeasurable and seemingly infinite into a discrete and known quantity – the created world (258). Sugimura writes:

> God creates out of himself but without diminishing his power or greatness. In the symbol of divine unity – the circumference of a circle – Milton's Son imposes order at the Creation instantaneously; he uses prime matter's indefinite extension to create sensible, that is, geometrical, objects. (258)

One difference in Milton's treatment of prime matter in *De Doctrina Christiana* and *Paradise Lost* is that in *De Doctrina Christiana* "'original matter' is neither evil nor worthless, because it is 'derived from the source of all substance,' namely, God" whereas in *Paradise Lost*, original matter is aligned with more ambiguous figures like Chaos and Night ("counter-things") (Sugimura 259). Additionally, in the more material account of creation that follows the Son's creation of the universe via a mathematical apparatus, the world's formation comes about by purging "black tartareous cold Infernal dregs / Adverse to life" (259).

Those "black tartareous cold infernal dregs / Adverse to life," are, as per the second act of creation in Book VII, what is left after "darkness profound" covers the abyss in order to create the world. What remains is "adverse to life" – as per the description of creation in this passage, "His brooding wings, the Spirit of God outspread / And vital virtue infused, and vital warmth / Throughout the fluid mass" (VII.235-237).

Not only are the dregs that remain "adverse to life" but they are hellish ("tartareous," "infernal") and characterized as the refuse of creation – what's left over afterwards. The Holy Spirit's "brooding wings" recall the account of creation we are presented with in Book I, during the poem's invocation. The poet writes of the Spirit, "Thou from the first / Wast present, and with mighty wings outspread / Dove-like sat'st brooding on the vast abyss / And mad'st it pregnant: what in me is dark / illumine" (I.19-22). [12]

What remains after the creation seems to be Night, or darkness. Milton departs from Augustine's conception of night, though, as wholly material, in his portrayal of chaos and the abyss - the "darkness profound" in Book VII, despite his portrayal of the abyss as having "dark materials" (Sugimura 264-265). While Augustine's darkness is linked with nothingness, Milton's darkness is both material and eternal. In *Paradise Lost*, in III.18, he describes it as "eternal night," which further complicates its relationship to the Father: are both the Father and night co-eternal (Sugimura 266-7). In *De Doctrina Christiana*, Milton rejects a creation ex nihilo – and recognizes that while the "eternal darkness" of the abyss is something, the immaterial components of that something are not "strictly speaking, God, yet we do not deny that they are eternal … the haunting suggestion is that what remains in the space devoid of God is Night" (Sugimura 266).

[12] See Rumrich's "Milton's Poetics of Generation" for a discussion of reproductive roles at this moment in the poem.

In Book III, God makes it clear that mankind's fall is the result of aspiring to godhead: "Man disobeying / Disloyal, breaks his fealty, and sins / Against the high supremacy of Heaven / Affecting God-head" (III.203-206). While "affecting God-head" seems aligned with seeking the knowledge that God "did wisely to conceal" from man and angel alike – those secrets that are foolishly "scanned by them who ought rather admire," what is the relationship to experience? (VIII.73-75).

Having already discovered Adam and Eve, Satan tempts Eve to desire more knowledge. He crouches by Eve's ear until he's arrested there by the angels - "squat like a toad, close at the ear of Eve, / Assaying by his devilish art to reach / The organs of her fancy, and with them forge / Illusions, as he list, phantasms and dreams" (IV.798-801). In Book V, Eve awakens from this dream that Satan inspires. In this dream, Eve follows Adam's voice to the tree of knowledge, where Satan greets her and asks, "Is knowledge so despised? / 'Or envy, or what reserve forbids to taste? 'Forbid who will, none shall from me withhold / 'Longer thy offered good; why else set here?" (V.60-63). Satan's attack flows through several different points here: framing knowledge as a general good, sowing suspicion of God, and sophistically arguing that the tree's presence implies its logical intention to be used.

Satan continues his temptation, suggesting that in tasting the apple, Eve will become godlike. In her dream, he persuades her that this consists of the following: that she will "be henceforth among the Gods / 'Thyself a Goddess, not to earth confined, /

'But sometimes in the air, as we, sometimes / 'Ascend to Heaven, by merit thine, and see /'What life the Gods live there, and such live thou!" (V.77-81). The knowledge he appeals to is sensory - the apple, which gets described vividly by Eve in the dream, "the pleasant savory smell / So quickened appetite." Additionally, Satan promises Eve that she will attain heaven by her own merit– if she's to be "henceforth among the Gods," as Eve relates, "forthwith up to the clouds / With him I flew, and underneath beheld / The earth outstretched immense, a prospect wide / And various: Wondering at my flight and change / To this high exaltation; suddenly / My guide was gone" (V.86-87). Although there are other, more obvious problems here – Satan's reference to plural Gods rather than a singular God, that access to heaven is the product of individual effort ("merit thine") rather than divine grace -- the particular form of knowledge Eve seems to be granted in this vision is a central problem. She is physically raised to heaven by merit rather than by grace (in the poem, Christ merits – "hast been found / By merit more than birthright Son of God, / Found worthiest to be so by being good" (III.308-310).)

But what is more interesting is what Eve sees – the earth outstretched before her. In Book VIII, Adam's conversation with Raphael takes off over the earth's relationship to the surrounding cosmos – "When I behold this goodly frame, this world, / Of Heaven and Earth consisting; and compute / Their magnitudes; this Earth, a spot, a grain, / An atom, with the firmament compared / And all her numbered stars" – the same

conversation that ends with Raphael's cautioning words to Adam that "Heaven is for thee too high … be lowly wise" (VIII.15-19, 172-173).

What Satan presents to Eve in her dream seems related to this conversation that Adam has with Raphael later in the poem. Her ascension signals both a potential change in her physical substance – she's led to believe that she will become like the angels, who are materially different from Adam and Eve – as well as a change in the kind of knowledge to which she has visual access. What Satan seems to promise Eve is access to a different kind of vision; i.e., the "prospect" that greets Eve in her dream is not "the verdurous wall of Paradise upsprung; / Which to our general sire gave prospect large / Into his nether empire neighboring round" (IV.140-143). What greets her instead of Eden, the site that is actually supposed to be man's dominion, is the earth itself ("a prospect wide and various") (V.88-89).

The difference between the two seems to be viewpoint – where the "prospect" is coming from, and with that, perspective. Adam and Eve's "prospect" into their empire on earth is different from Eve's prospect of earth while floating – or dreaming that she's floating above it. Her shift in "prospect" (to look forward, outlook) recalls the different meanings of the word "foresight" that circulate earlier in the poem between Abdiel and Satan. Here, Eve's change in prospects seems to carry with it an observation that is all-knowing – one that recalls the creation in Book VII. At this moment, the Creator returns up to Heaven to behold "this new created world / … how it showed / In prospect from

his throne" (554-556). Significantly, too, he is exalted by all creation: "the earth, the air / Resounded" (VII.560-561).

Because Satan encourages Eve to view her situation in Paradise as confinement rather than being situated in an empire – she is "to earth confined," according to Satan – this also adds to the change in perspective here (V.78). Additionally, the line continues with Eve's wonder at her "flight and change / To this high exaltation; suddenly / My guide was gone" (V. 89-91). The isolation of the word "change" here covers both Eve's change "to this high exaltation" as well as the change she undergoes upon eating the apple; Eve is "exalted" in that she is raised high but it also carries the attendant threat of aspiring to God-head. The line break that immediately follows this enacts the quick disappearance of Eve's seeming guide – Satan – who will again guide her to the tree in Book IX where, in eating of the apple, she proclaims, "Experience, next, to thee I owe, / Best guide; not following thee, I had remained / In ignorance" (IX.807-809).

After Eve recounts her dream to Adam, he responds by questioning where the evil in the dream itself came from – since Eve, created pure, cannot possess evil within herself. He rightly notes that the "uncouth dream" is of "evil sprung" but urges Eve not to attribute that to fault within herself; after all, her horror upon waking from the dream gives Adam hope that "what in sleep thou didst abhor to dream, / Waking thou never will consent to do" (V.120-121). Instead, Adam places the blame for Eve's dream elsewhere, arguing that the dream was the result of the workings of the "lesser faculties"

that “serve / Reason as chief” – in particular, fancy (V.101-102). Adam then discusses fancy’s role in forming knowledge with Eve. He explains: Fancy’s function is, “of all external things, which the five external senses represent” “she forms imaginations, aerie shapes, / Which Reason, joining or disjoining, frames / All what we affirm or what deny, and call / Our knowledge or opinion” (V.105-108).

Working in conjunction with reason, fancy takes our sensory experiences of the world and is guided by reason into shaping knowledge; without reason’s oversight, however, fancy sometimes errs. This is what Adam attributes Eve’s dream to - when Fancy:

> then retires
> Into her private cell, when nature rests.
> Oft in her absence mimic Fancy wakes
> To imitate her; but, misjoining shapes,
> Wild work produces oft, and most in dreams;
> Ill matching words and deeds long past or late.
> Some such resemblances, methinks, I find
> Of our last evening's talk, in this thy dream,
> But with addition strange. (V.109-116)

In imitating Reason, Fancy produces strange hybrids – rather than joining things that belong together, Fancy connects things that do not necessarily share a temporal or a logical connection. Adam hypothesizes that pieces of Raphael’s previous conversation made their way into Eve’s dream as a result. All the same, though, Adam’s hypothesis is thrown into doubt by the fact that Fancy has not only misjoined things but potentially

added something new – the danger is not just in Fancy's error but in its "addition strange."

Cavendish in *The Blazing World* similarly worries the relationship between Fancy and Reason. Of the distinction between the two, Cavendish writes:

> But mistake me not, when I distinguish *fancy* from *reason*; parts of matter; but by *reason* I understand a rational search and enquiry into the causes of natural effects; and by *fancy* a voluntary creation or production of the mind, both being effects, or rather actions of the rational part of matter. (123-124)

Though following fancy and reason produce different outcomes – "the end of fancy is fiction" and the "end of reason, is truth" – what Cavendish's introductory statement reveals is that fiction is engaged in the same processes of knowledge-making as natural philosophy Cavendish states, after all, that she "mean[s] not as if fancy were not made by the rational parts of matter," which is also what spurs natural philosophers to seek out the "one truth in nature" (123).

While both Milton and Cavendish consider the use of the experiment to produce truths about the natural world, Milton rejects the experiment entirely in favor of particular individual experience mediated by reason. At the end of the poem, when Eve says, "By sad experiment I know / How little weight my words with thee can find," Eve has transformed experience into experiment by making her individual experiences the basis for general truths (X.948-949). In the final few lines of the poem, "Providence" is

Eve's guide instead, and Adam and Eve, hand in hand, must go "their solitary way" (XII.647-9).

4. To Make Your World of Nothing – Nothingness in Cavendish's *The Blazing World*

In the commendatory poem that serves as a preface to Margaret Cavendish's proto-science fiction utopia, *The Blazing World* (1666), her husband, William Cavendish, draws attention to the relationship between nothingness and world-making as it pertains to the text, asking, "Then what are You, having no Chaos found / To make a World, or any such least ground? / But your Creating Fancy, thought it fit / To make your World of Nothing, but Pure Wit." The caesura in the final line of this excerpt suggests that, if only for a brief moment, one might *make* a world of nothing before dismissing it as a question.[1]

Unlike Milton's world in *Paradise Lost* that emerges from Chaos, William notes that Margaret, on the other hand, has "no such Chaos found." In contrast to a world made from chaos, *The Blazing World* stands, however briefly, as a world made out of nothing. Although William Cavendish claims that *The Blazing World* is ultimately a world concocted of nothing *but pure wit*, he has still posed the question: what might it mean to make one's world of nothing, even if that possibility only exists until our eyes scan the following line?[2] The focus on nothingness here – and in other points of *The*

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[1] William Cavendish's use of "nothing" may also be meant to signal its punning usage as a reference to female genitalia here. Timothy Raylor, in "'Pleasure Reconciled to Virtue': William Cavendish, Ben Jonson, and the Decorative Scheme of Bolsover Castle."

[2] For a feminist reading of Cavendish's world-building that begins with this prefatory poem, see Yaakov Mascetti, "A World of Nothing, but Pure Wit." Mascetti also reads *The Blazing World* as a response to the

Blazing World -- signals an often unnoticed concern of scholarship on early modern science and literature: the role nothingness plays in the construction of knowledge in both fields. Specifically, I explore what it means for Margaret Cavendish to "make her world of nothing, but pure wit" when nothingness was the subject of contentious interdisciplinary debate. In *The Blazing World*, Cavendish thinks of nothingness through her own philosophies of atomism; specifically, Cavendish uses her world of "Nothing / but Pure Wit" to expose the limits of perceptual knowledge and discredit institutionalized experimental authority by representing scientific societies as entirely partial as well as a breeding ground for dissent. She instead produces a world – albeit a practically imperceptible world - where she herself has absolute authority through a hybrid text that is proto-science fiction and romance, and where she herself is both author and authorial subject.

Cavendish's own explanation of her philosophical and literary project in her prefatory letter to the reader emphasizes how consciously Cavendish thought of her work as a hybrid between literature and science. Joining together William's poem, which questions what it might mean to make your world from nothing, and Margaret's letter, which characterizes her world-making as a hybrid project of fiction and natural

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experimental debates of the mid-seventeenth century, but reads Cavendish's participation in those debates as one invested in establishing a "'place' of independent feminine knowledge."

philosophy, when read together, identify nothingness as a potential space for creative and scientific production.

In this opening letter, Cavendish engages with the following set of questions: what kinds of knowledge are produced through both fiction and natural philosophy? How and where is this knowledge formed? What might it mean to "join" a work of fancy to one of philosophy? Cavendish's letter to the reader presents *The Blazing World* as a blend of fiction and natural philosophy; her opening lines immediately align her "work of fancy" with "serious philosophical contemplation" and ask the reader to consider how both works of fancy and the projects of natural philosophy are constructed. [3]

She states, "If you wonder that I join a work of fancy to my serious philosophical contemplations; think not that is out of a disparagement to philosophy; or out of an opinion, as if this noble study were but a fiction of the mind" (123). Although this

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[3] Hobbes's definitions of "fancy" and "phantasm," their relationship to perception: when we see something, that object creates "pressure on the sense organ … and there this motion causes 'a counter-pressure, or endeavor of the heart to deliver itself; which endeavor, because outward, seemeth to be some matter without. And this seeming, or fancy, is that which men call sense.'"

See also John Shanahan on Margaret Cavendish in "The Experimental Virtuoso: Margaret Cavendish's Experimental Spaces," for more on Cavendish's critique of experimental culture. Shanahan argues that Cavendish, in addition to turning domestic spaces into places of knowledge production, also moves these spaces into the world of the theatre. With regards to her critique of experimental societies, he writes, "Cavendish's challenge to the empirical adequacy of neoclassical stage illusion revealed the extra-literary assumptions behind the seemingly natural approach of following decorum. To the nascent discourse of experimental fact production she does the same: recognizing and criticizing the emerging community's basic fictions and self-images." (240).

statement seems initially to argue against the idea that natural philosophy is a construct – is not a mere "fiction of the mind" – Cavendish then turns to argue *against* the dismissal of fiction as well as to claim that both fiction and natural philosophy proceed from the same point: from the actions of the "rational part of matter." She writes, "But mistake me not, when I distinguish *fancy* from *reason*; I mean not as if fancy were not made by the rational parts of matter; but by *reason* I understand a rational search and enquiry into the causes of natural effects; and by *fancy* a voluntary creation or production of the mind, both being effects, or rather actions of the rational part of matter" (123-124). Though following fancy and reason produce different outcomes – "the end of fancy is fiction" and the "end of reason, is truth" – what Cavendish's introductory statement reveals is that fiction is engaged in the same processes of knowledge-making as natural philosophy Cavendish states, after all, that she "mean[s] not as if fancy were not made by the rational parts of matter," which is also what spurs natural philosophers to seek out the "one truth in nature" (123).

Although, despite these similarities, Cavendish maps out fiction and natural philosophy as separate realms – she describes her project as "join[ing] them as two worlds at the ends of their poles" – her introductory letter finds shared ground for them in framing *The Blazing World* as a hybrid product of both fancy and reason. If fancy and reason are "as two worlds" at the "ends of the poles," *The Blazing World* is then something entirely different – neither fiction nor natural philosophy, but something

comprised of both.[4] In Cavendish's description of *The Blazing World*, she further articulates this by explaining that one part is romancical, the second philosophical, and the third merely fantastical (124). *The Blazing World's* hybridity corresponds with the hybridity of the animal-human hybrids who serve as experimental scientists in the text itself and through whom Cavendish undercuts the authority of the Royal Society.

Bacon's *The New Atlantis* serves as a literary predecessor for Cavendish's *The Blazing World*. The two texts have structural similarities; *The New Atlantis*, like *The Blazing World*, opens with travelers who stumble upon a heretofore-unknown island: Bensalem. On Bensalem, the group of travelers, when allowed to approach, discovers a utopia: one prominent feature of which is an institution devoted to scientific inquiry, Salomon's House.

In Salomon's House, Bacon describes the origins of the scientific method. Salomon's House, as an institution, is dedicated to: "the Knowledge of Causes and Secrett Motions of Things" (35-36). The House anticipates the modes of experimentation that would later become enshrined in the Royal Society; indeed, such experimentation is a key feature of the House of Salomon, where different experimenters devote themselves

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[4] See also Nicole Pohl's "'Of Mixt Natures': Questions of Genre in Margaret Cavendish's *The Blazing World*." Pohl reads Cavendish's characterization of The Blazing World as a hermaphroditic text – one that joins fiction and natural philosophy – as something that enables Cavendish to challenge "the constraints of gender on genre," forwarding a notion of subjectivity in the text that can participate in a "range of speculative prospects which do not reduce discourses of gender, knowledge and power to crude either/or choices" (63, 52).

to different features of experimentation. Some members try new experiments; others organize the results; others report the experiments; others translate the results of such experimentation into axioms. Such experimentation was, however, based on the accumulation of observations and then the translation of those observations into scientific fact. Additionally, the role of the scientific community – not simply the single experimenter – is crucial to the success of the House of Salomon.

Cavendish's text intentionally begins from a similar place: lost travelers find a scientific utopia. In Cavendish's text, though, her revision of Bacon's work is immediately apparent. Rather than a group of travelers, Cavendish's lost traveler is a solitary woman. Instead of stumbling upon a utopia of scientific inquiry, Cavendish's Empress creates scientific societies rather than passively observing them. Furthermore, while Bacon's text establishes the institutional scientific community as the locus of knowledge production, Cavendish's text rejects both the institutional community itself and its methodology.

Framing these debates over nothingness and its relationship to institutional authority in the text of *The Blazing World*, however, is William Cavendish's praise of Margaret Cavendish for creating her world out of "Nothing, but pure wit." *The Blazing World* was published alongside Cavendish's book of experimental writing, *Observations Upon Experimental Philosophy*, in 1666, which as literary scholars Isabelle Clairhout and Sandro Jung note, is a "clear attack on Robert Hooke and other members of the Royal

Society … using Hooke's *Micrographia* as a guide and disproving his arguments one by one" (733).[5] Its plot follows the travels of a young woman who winds up on the shores of a strange land peopled by animal-human hybrids; she meets the (human) emperor, becomes the empress, establishes a number of societies (including a mock Royal Society), and converts her subjects to her religion. She soon becomes lonely and asks for a scribe; while Hobbes, Descartes, and Galileo are all suggested, the Empress ultimately chooses the soul of Margaret Cavendish, who is then brought to her. They become intimate friends, create worlds in their minds, and their souls travel to Earth together, where they meet William Cavendish, with whom they have a mind-melding three-way.[6]

In *The Blazing World*, Cavendish takes up this debate over the nature of nothingness early on in the text: most notably, she does this through her depiction of the community of scientists established by the Empress of the Blazing World. After she is made Empress, one of the first things that the Empress of the Blazing World does is to organize the various animal-human hybrids that live in the Blazing World into scientific and political organizations. Each of the hybrids – and there are plenty – finds labor that accords with their natures, according to the narrator:

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[5] Isabelle Clairhout and Sandro Jung's article, "Cavendish's Body of Knowledge," also examines Cavendish's critique of early modern experimental scientists like Boyle and the ways in which she blurs the boundaries between subject and object in her work; they focus on her fragmented discussion of the body and its relationship to self-fashioning and Cavendish's rejection of empirical knowledge in her *Observations on Experimental Philosophy*.

[6] This is sort of like *Dawn*, where the aliens serve as the connection between two humans sexually in the production of new hybridized forms of life.

> Some were Bear-men, some Worm-men, some Fish- or Mear-men, otherwise called Syrens; some Bird-men, some Fly-men, some Ant-men, some Geese-men, some Spider-men, some Lice-men, some Fox-men, some Ape-men, some Jack daw-men, some Magpie-men, some Parrot-men, some Satyrs, some Gyants, and many more, which I cannot all remember; and of these several sorts of men, each followed such a profession as was most proper for the nature of their Species, which the Empress encouraged them in. (133-134)

When the Empress arrives, she separates them into different societies and also starts schools. She names "the bear-men her experimental philosophers, the bird-men her astronomers, and fly-, worm-, and fish-men her natural philosophers … [and] the spider- and lice-men her mathematicians" (134).

Shortly after she establishes her subjects into societies, she calls them to account for their discoveries, and the political, religious, and scientific life of the Blazing World becomes a bit more fleshed out. Unlike the heads of the rest of her societies, her priests and statesmen are humans – "princes of the Imperial Blood" (133). They inform her that the Blazing World has but one religion, that women are barred from the congregation, and that, despite being prohibited from participation in public affairs, they still manage to influence their husbands and meddle in politics anyway (135). Into this setting comes the Empress, who upon meeting the Emperor of the Blazing World, is "first conceived … to be some goddess" by the Emperor, who, "rejoicing, made her his wife, and gave her an absolute power to rule and govern all that world as she pleased" (132). While the society the Empress enters is one that theoretically bars women from participating in public life, it succumbs to absolute female rule rather quickly: "her subjects, who could

hardly be persuaded to believe her mortal, tendered her all the veneration and worship due to a deity" (132). Once the Empress begins ruling the Blazing World, we rarely see the Emperor until the second half of the text.

In addition to describing the religious and political life of the Blazing World, the Empress also has her scientists account for different phenomena. For example, she brings her bird-men in to court to question them about the planets and questions them about why "the sun and the moon did often appear in different postures or shapes" (137). They also discuss a subject that will hold more meaning later, when the Empress asks them what "creatures" constitute "the motes of the sun" (138).

One of the major subjects of their debates of the Empress's societies, however, is whether the vacuum exists – much like Hobbes and Boyle's contemporaneous arguments in the Royal Society. However, while Hobbes's and Boyle's arguments over the existence of the vacuum served as an origin point for experimental philosophy, Cavendish uses the same subject – the nature of nothingness – as the starting point for her own critique of the same philosophy and the creation of a world centered around absolute female authority**.** Cavendish's critique of experimental societies like the Royal Society is important because the shift to a new scientific culture was one that categorically excluded women from its ranks.[7]

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[7] As Nicole Pohl writes on Cavendish, gender, and genre, "Modern scholars like Wolfgang van de Daele, Londa Schiebinger and Deborah Taylor Bazeley among others have confirmed this slow elimination of the general

The actions of natural philosophers and their organization into scientific societies are central to understanding the text. In *The Blazing World*, Cavendish explicitly satirizes scientific communities like the Royal Society – communities that both William and Margaret were deeply familiar with. Notably, Cavendish herself was a visitor to the Royal Society in 1667, a year after she published her *Observations on Experimental Philosophy* alongside *The Blazing World*.[8] At this meeting of the Royal Society, one of the experiments performed for the Duchess included Boyle's work with the air-pump. In this experiment, by using a vacuum-pump to empty a glass receiver, Boyle attempted to determine the weight of air - underlining the importance of debates centering on the nature of nothingness to early modern scientific thought (Samuel Mintz 174). Cavendish, in *The Blazing World*, would later dismiss these experiments within the text by attributing them to the "lice-men" who "endeavoured to measure all things to a hair's breadth, and weigh them to an atom; but their weights would seldom agree, especially in the weighing of the air, which they found a task impossible to be done"

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public and traditional professionals, including women, from the scientific discourse of the mid-seventeenth century" (Pohl 56).

[8] Samuel Mintz's article on Margaret Cavendish's visit to the Royal Society describes in detail the circumstances of Cavendish's visit to the Royal Society in 1667. While he does note Cavendish's opposition to experimentation, he reads this skepticism as indicative of Cavendish's lack of understanding and as a part of her personal eccentricities – as the result of Cavendish's "candid, undisturbed, childlike love of the natural world" and a "disregard for the methods and utilitarian aims of science." Such "disregard" on Cavendish's part, though, was not the result of any failure of understanding, and was instead tied to her philosophical work.

(159). Because these experiments in particular cause nothing but pointless debate, "The Empress began to be displeased, and told them, that there was neither truth nor justice in their profession; and so dissolved their society" (160).

Both Cavendish and her husband were also personally familiar with the philosophical debates over the existence of vacuums outside of Cavendish's visit to the Royal Society. Thomas Hobbes and William Cavendish belonged to the same intellectual circles, and Cavendish was a patron of Hobbes: Hobbes dedicated his work on optics to William Cavendish.[9] As Sarah Hutton reminds us, "We should not forget that when Margaret Cavendish married William, Duke of Newcastle, in Paris in 1645, she married into a family at the centre of developments in seventeenth-century intellectual life. Sir Charles Cavendish, her brother-in-law, was closely connected with figures at the forefront of new developments in science and philosophy" (422-423).

It is not surprising, then, that Margaret Cavendish's interest in contemporary scientific inquiry over the existence of the vacuum is demonstrated throughout *The Blazing World*, as well as in her *Observations on Experimental Philosophy*. After the Empress's experimental philosophers show her their microscopes, the narrator informs the audience that despite their skill, there is one thing that these philosophers are unable to visually determine: the vacuum.

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[9] Hutton, Sarah. "In Dialogue with Thomas Hobbes: Margaret Cavendish's Natural Philosophy." *Women's Writing* 4.3 (1997) 421-432.

The narrator tells us that although the experimental philosophers possess "great skill, industry and ingenuity" – a claim we should be skeptical of, given their representation in the text – they are unable to see a vacuum reproduced in their laboratories. To this end, the narrator states:

> Only this was very remarkable and worthy to be taken notice of, that notwithstanding their great skill, industry and ingenuity in experimental philosophy, they could yet by no means contrive such glasses, by the help of which they could spy out a vacuum, with all its dimensions, nor immaterial substances, non-beings, and mixed-beings, or such as are between something and nothing; which they were very much troubled at, hoping that yet, in time, by long study and practice, they might perhaps attain to it. (145)

In contrast to William Cavendish's prefatory poem, nothingness in this passage continues to present an epistemological problem in the text – both for the Empress and her cohort as well as for readers. In the above passage, the Empress's scientists acknowledge they have no way of perceiving the vacuum – among other things. In addition to being unable to "contrive … glasses" by which they can "spy out a vacuum," the Empress's experimental philosophers are also unable to see the following: "immaterial substances, non-beings, and mixed-beings, or such as are between something and nothing" (145).

Cavendish interestingly suggests that "mixed-beings," or what lies between "something and nothing" are also imperceptible, which further complicates the representation of hybridity in the text. But *The Blazing World* also asks us to think about

what it means to perceive, or "spy out" something in the text.[10] Cavendish's narrator tells us that the Empress's experimental philosophers are unable to make tools by which they can perceive a vacuum; however, the reliability of all perception is challenged in the text.[11]

This question about what lies at the limits of perception has everything is intimately tied to defining nothingness and thinking about atomism in *The Blazing World*. Earlier in the text, the Empress asks her bird-men – who are responsible for the knowledge of celestial bodies – to tell her "what opinion they had of those creatures that are called the motes of the sun?" (138). While the word "creatures" in particular is striking, Cavendish here is drawing upon Lucretius's depiction of atomic motion in Book II of *De Rerum Natura*:

> For behold whenever
> The sun's light and the rays, let in, pour down
> Across dark halls of houses: thou wilt see
> The many mites in many a manner mixed
> Amid a void in the very light of the rays,
> And battling on, as in eternal strife,
> And in battalions contending without halt,
> In meetings, partings, harried up and down.
> From this thou mayest conjecture of what sort

[10] Cavendish is specifically referring to the use of technologies like the telescope, for example, to visually locate something. OED defines "spy" as (3) to "look at, examine, to observe closely or carefully; to see or behold … spec., to investigate with a spy-glass or telescope."

[11] For more on the limits of perception in early modern England, and the role of technologies in defining and rewriting these limits, see Carla Mazzio, "The History of Air: Hamlet and the Trouble with Instruments."

> The ceaseless tossing of primordial seeds
> Amid the mightier void… [12]

In this passage, Lucretius describes the motion of atomic matter as akin to the movement of dust in a beam of light: just as dust particles are moved about at random in the sunlight, so too are atoms tossed about to constitute the material world. In particular, those atoms intermix and create matter against the backdrop of the void: "the many mites in many a manner mixed / amid a void in the very light of the rays."

Cavendish gives her own reading of Lucretius's passage in this moment of the text. The Empress wants to know what the particles that float in a ray of sunlight are; the bird-men answer that "they were nothing else but streams of very small, rare and transparent particles, through which the sun was represented as through a glass; for if they were not transparent, said they, they would eclipse the light of the sun … nevertheless they were thinner than the thinnest vapour, yet were they not so thin as the body of air, or else they would not be perceptible by animal sight" (138).[13] In their explanation to the Empress, the bird-men importantly define the particles against the concept of nothing, just as Lucretius's atoms move against the backdrop of void space: they are, to paraphrase, "nothing if they are not streams of small, transparent particles."

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[12] Titus Lucretius Carus. *De Rerum Natura*. Trans. William Ellery Leonard. E.P Dutton. 1916. Project Gutenberg.

[13] A vapour in Donne's Meditations is "so insensible a thing … so near nothing that that reduces us to nothing" (Donne 79). In Donne's Meditation XII, vapours are a vehicle for Donne to discuss the destructive impact of rumor upon the body politic; similarly, it is the imperceptibility of the air and the fruitlessness of debate around the void that causes Cavendish's protagonist to find the society of natural philosophers a threat to the body politic and shut it down.

These particles are defined through their near imperceptibility, at the moments when they come up against the limits of perception: when they are described as, for instance, "thinner than the thinnest vapour" – which, for Donne, was "near nothing" enough – yet "not so thin as the body of air" (Donne 79).

In Cavendish's text, in place of matter being tossed around ceaselessly, the narrator claims the following: that matter is conscious, self-moving, and animate. In this passage, this means that the particles of dust are transformed into "living creatures … because they did increase and decrease, and were nourished by the presence, and starved by the absence of the sun" (139). [14]

Additionally, when the Empress and her scientists have a debate over whether beings can be colourless, she learns that it is impossible "that a Natural nothing can have a being in Nature" and is asked, "For how is it possible, that a Natural nothing can have a being in Nature? If it be no substance, it cannot have a being, and if no being, it is nothing." This statement captures the problem nothingness presents in the text – while we can ask how a natural nothing might come to be and we can then be shown its impossibility ("if it has no substance, it cannot have a being"). While the first attempts to

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[14] For more on Cavendish's theories of mater, see Lisa Sarasohn's *The Natural Philosophy of Margaret Cavendish: Reason and Fancy During the Scientific Revolution*.
Also see Lara Dodds, *The Literary Invention of Margaret Cavendish*. In the chapter on William and Margaret's different authorial figurations through their disparate readings of Donne's poetry, see the section on Cavendish's engagement with Donne's "First Anniversary" through her poem "A World in an Eare-Ring" and "A World Made by Atomes" for Cavendish's atomism: that atoms are themselves "generative of self-sufficient and autonomous worlds" (81, 82).

define nothingness in the text rely on defining nothingness by its limits – as in the episode where the Empress's bird-men re-read the Lucretian specks of dust that analogize atomic motion – this episode defines nothingness by what it is not: "If no being, it is nothing." This final move identifies nothingness as something.

The Blazing World continues to explore the limits of perceptual knowledge through the Empress's establishment of different scientific societies within the text. In *The Blazing World*, these limits are articulated in a way that connects them to the problem of defining nothingness both in the Empress's Blazing World within the text and in early modern culture at large. For example, Cavendish's *The Blazing World* engages contemporary scientific debates, and incorporates many relevant technologies: for example, the rise of the microscope and telescope, both developing technologies in the sixteenth- and seventeenth- centuries. Hooke's *Micrographia*, published 1665 by the Royal Society, famously depicts an image of a flea enlarged under a microscope. In Cavendish's text, similarly, after founding a society of scientific philosophers, the Empress has them walk her through the uses of various tools and instruments: she sees a flea enlarged through a microscope…

> Lastly, they showed the Empress a flea, and a louse; which creatures through the microscope appeared so terrible to her sight, that they had almost put her into a swoon; the description of all their parts would be very tedious to relate, and therefore I'll forbear it at this present. (144)

… and a whale contracted to the size of a gnat.

> Whereupon they took one of their best and largest microscopes, and endeavoured to view a whale through it … The Empress, seeing the insufficiency of those magnifying glasses, that they were not able to enlarge all sorts of objects, asked the bear-men whether they could not make glasses or a contrary nature to those they had showed her … such as instead of enlarging or magnifying the shape or figure of an object, could contract it beneath its natural proportion. (144)

Cavendish's critique of such experimental tools follows quickly after. Rather than detailing the descriptions of the flea and the louse, the narrator of *The Blazing World* informs us that they would be "very tedious to relate" and as a result, she avoids doing so entirely.

Furthermore, after the Empress sees the flea through a microscope, she asks what the practical purpose of these instruments is: "she desired to know whether their microscopes could hinder their biting, or at least show some means how to avoid them? To which they answered, that such arts were mechanical and below that noble study of microscopical observations" (144). Dismissing the details of such observations as "tedious," Cavendish demonstrates the limits of these new technologies; while her scientists can make a flea appear as large as a whale, she wants to understand what that knowledge does practically, while the scientists themselves dismiss practical application as unworthy of their time and attention.

In another incident, the Empress questions, "whether they had not such sorts of glasses that could enlarge and magnify the shapes of great bodies, as well as they had done of little ones" (144). Her scientists, in response, endeavor to view a whale through

a microscope and fail totally: "but alas! the shape of the whale was so big, that its circumference went beyond the magnifying quality of the glass; whether the error proceeded from the glass, or from a wrong position of the whale against the reflection of light, I cannot certainly tell" (144). Cavendish's narrator focuses on the "insufficiency" of experimental tools like the microscope, both in terms of their usefulness (microscopes can't stop fleas from biting) and their scope (you can't view a whale through a microscope), and emphasizes the possible "error" that the glass produces.

While the Empress, "seeing the insufficiency of those magnifying-glasses," is eventually able to assist them in constructing one that reduces "a huge and mighty whale" so that it appears "no bigger than a sprat," the narrator concludes that "to relate all their optic observations through the several sorts of their glasses, would be a tedious work, and tire even the most patient reader, wherefore I'll pass them by" (144-145). [15]

This is in keeping with the Empress's earlier perspective on the utility of tools like the telescope. Earlier in *The Blazing World*, the Empress's experimental philosophers give her different reports about the stars and planets from viewing them through their telescopes:

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[15] Hobbes's 1646 treatise on optics – *A Minute or First Draught of the Optiques* – part of which was published in *De Homine* (1658) was dedicated to William Cavendish. Hobbes's theory of perception, as Antoni Malet describes it in "The Power of Images: Mathematics and Metaphysics in Hobbes's Optics," "Hobbes claimed 'vision [to be] butt phancie' caused by motion, 'phancie being nothing else butt the Judgement concerning the place and force of the lucid or illuminated Agent that worketh on the organ' (Hobbes, 1983, p. 398). Compare this with Cavendish's theories of perception in *The Blazing World* and *Observations on Experimental Philosophy* in the body of the chapter.

> To avoid hereafter tedious disputes, and have the truth of the phaenomenas of celestial bodies more exactly known, [the Empress] commanded the bear-men, which were her experimental philosophers to observe them through such instruments as are called telescopes … but these telescopes caused more differences and divisions amongst them, than they had ever before; for some said, they perceived that the sun stood still, and the earth did move about it, others were of the opinion, that they both did move … some fell into a great dispute with others concerning the bigness of the stars. (140-141)

The Empress indicates that the purpose of such scientific inquiry is, from the first, to "have the truth of the phaenomenas of celestial bodies more exactly known" (140). In *The Blazing World*, this entails a number of things – to start, it is significant that this scientific inquiry begins over a dispute in language: the bird-men "affirm that thunder was a sudden and monstrous blas … but the Empress not knowing what they meant by blas (for even they themselves were not able to explain the sense of this word" (141). This particular incident underlines the importance of language to the processes of scientific inquiry.

Secondly, the Empress commands her experimental philosophers, the bear-men, to use telescopes in order to "avoid hereafter tedious disputes." What happens, of course, is that the use of these instruments causes a proliferation of different opinions: "these telescopes caused more differences and divisions amongst them than ever they had before" (140). Scientific inquiries into objects that are on the limits of perceptibility cause these debates, just as with the debates that take place between the lice-men over whether the air can be weighed or not, or how to identify a vacuum.

After the Empress realizes that rather than forming a more precise version of the truth (the "truth" that is "more exactly known"), the telescopes cause different seeming to be debated, she "grow[s] angry" commands her experimenters to destroy their telescopes. Worried that the only product of her societies and their technologies is false reasoning, dissension, and debate, the Empress votes to abandon the project entirely. Since the telescopes can "give no better intelligence," she tells them the following:

> I do plainly perceive, that your glasses are false informers, and instead of discovering the truth delude your senses; wherefore I command you to break them, and let the bird-men trust only to their natural eyes, and examine celestial objects by the motions of their own sense and reason. (141)

The bear-men protest and complain that the fault is "not the fault of their glasses," but inherent in their own sensory organs.

The Empress, despite this, holds to her opinion about the usefulness of technologies like the telescope and states that one's natural "sense and reason" still have precedence over such instruments, serving in this moment as a mouthpiece for Cavendish's own distrust of sensory evidence when not coupled with reason.[16] She tells them:

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[16] See Sarah Hutton, "Science and Satire: The Lucianic Voice of Margaret Cavendish's Description of a New World Called the Blazing World." Hutton explains that Cavendish forwarded reason as a more reliable mode of investigation than observation, because knowledge obtained through the senses was inherently unreliable – as this episode points out, where the bear-men blame the differences in their vision rather than in their glasses (163). Instead of relying on observation, Hutton explains, Cavendish believed that knowledge arrived through rational discourse. (163)

> … that if their glasses were true informers, they would rectify their irregular sense and reason; but, said she, nature has made your sense and reason more regular than art has your glasses, for they are mere deluders, and will never lead you to the knowledge of truth; wherefore I command you again to break them; for you may observe the progressive motions of celestial bodies with your natural eyes better than through artificial glasses. (141-142)

The Empress of the Blazing World wants experimental tools to serve a purpose – that of ferreting out the truth. Because instruments like the telescope cause dissension among her experimental philosophers rather than agreement, she encourages them to turn to their natural sense and reason instead, framing these as more accurate and more reliable than telescopes, for example, which are "mere deluders" (142). The bear-men eventually convince the Empress to let them keep their telescopes, because, as it turns out, they "take more delight in artificial delusions, than in natural truths. Besides, we shall want employment for our sense, and subjects for arguments; for were there nothing but truth, and no falsehood, there would be no occasion for to dispute" (142).

This episode underlines Cavendish's critique of scientific institutions like the Royal Society – a critique that shows that the experimental philosophers are a product of experimentation rather than impartial observers. At this moment in the text, Cavendish's critique centers on the revelation that the Empress's experimental philosophers enjoy their telescopes for the sake of argument itself – they enjoy "confuting and contradicting each other" (143). Not only do instruments such as the telescope cause conflict over the nature of truth, but the resulting conflict is ultimately

revealed to be useless. Cavendish's argument here is in part that debate is the only product of institutions like the societies in her text; the "truth" they establish is just senseless debate that provides the continued reason for their existence.

While the Empress allows the bear-men to keep their telescopes in this episode, it is only with the understanding that "their disputes and quarrels should remain within their schools, and cause no factions or disturbances in state, or government" (142). Here, the Empress echoes Hobbes's position on knowledge that is communally rather than individually formed; the Empress warns against experimental procedures that were likely to cause political and civil unrest, and displace authority from its rightful seat in the monarch. The Empress, as a result, commands her experimenters to keep their "disputes and quarrels" within their schools.

Here, I want to briefly turn to Latour's *We Have Never Been Modern* and his reading of Hobbes and Boyle's debates over the vacuum in the 1660s to think about the role of animal-human hybrids in Cavendish's text. The debates over the vacuum, according to Latour, mark the invention of the "modern world, a world in which representation of things through the intermediary of the laboratory is forever dissociated from the representation of citizens through the intermediary of the social contract" (27). Concurrent with Cavendish's *The Blazing World*, these debates over the air pump, as I mentioned earlier, centered on whether or not a vacuum could be produced within the space of a laboratory (and if so, what kind of vacuum it was – an

experimental or metaphysical vacuum). For Latour, this moment – the division of the social from the natural – marks the beginnings of the modern world.

This modern world comes into being through its participation in the dual activities of "purification" and "translation" – where purification establishes stable boundaries between nature and culture while simultaneously proliferating hybrids of both. He claims that this separation – and its simultaneous production and rejection of hybrid quasi-objects that are neither subject or object, nor wholly social or natural—has always been a part of the constitutional framework of modernity (32, 51).

Latour's aim is to clarify the workings of the modern constitution, which separates nature from culture, as well as concentrating on the distinctions between subjects and objects. These hybrids are neither subject nor object, strictly social nor entirely natural but come into being through the constitutional separation of nature and culture. Quasi-objects live "between and below the two poles;" significantly, this is also precisely where Cavendish situates the location of *The Blazing World* in her introduction to the text: between the poles of fiction and natural philosophy (55).

The hybridity of genre that is Cavendish's text echoes that of the chimera who fill the Empress's laboratories. One of her first actions as Empress is to create schools and societies headed by these hybrids; for example, "the bear-men were to be her experimental philosophers, the bird-men her astronomers, the fly-, worm-, and fish-men her natural philosophers, the ape-men her chemists, the satyrs her Galenic physicians,"

and the list continues – of the huge variety of hybrids that fill the text, all are separated by the Empress into political or scientific roles and responsibilities (134). Cavendish's choice of animal-human hybrids as experimenters plays with the role of animals in laboratories in the mid-seventeenth century: as objects of experimentation.

Experimentation on animals in the seventeenth century is well known. Robert Boyle engaged in a series of experiments that centered on the circulatory system of dogs (and involved injecting milk or broth into their veins, or bleeding them to death, or trying dog-to-dog transfusions) (Knight 6-15). It is also a part of the history of the air pump. When Boyle received word of Guericke's designs, he had them modified by Hooke because he was concerned that there was not sufficient room to fit animals inside the hemispheres (West 36). Boyle's experiments with the air pump, after its completion, included "a number of experiments … on small animals placed in the receiver. For example, a large fly was reduced to walking and a butterfly 'fell down as in a swoon.' …. Some animals developed convulsions when the pressure was lowered" (West 37). Cavendish's decision to transform the normal objects of experimentation into experimenters reveals her critique of the Royal Society, its methods, and its technologies.

The animal-human hybrids in the text reveal the following: that what experimental philosophy produces is not only the experiment itself, but also the experimenters. Reading the animal-human hybrids in Cavendish's take on the Royal Society as quasi-objects exposes the project of the modern constitution according to

Latour: that these hybrids, normally repudiated, hidden, and untraceable exist intentionally in Cavendish's text to demonstrate the impossibility of separating nature from culture in spaces like the Royal Society. As in Cavendish's introductory letter to *The Blazing World*, which posited two poles between natural philosophy and fiction, the animal-human hybrids that serve as scientists and politicians in her text are likewise situated between these two poles.

The hybrid nature of the experimenting self is one that continues to emerge in *The Blazing World* and hinges on questions of knowledge and perception. Cavendish's letter to the reader acknowledges the imperfect nature of scientific knowledge. Although philosophers:

> … err in searching and enquiring after the causes of natural effects, and many times embrace falshoods for truths … and since there is but one truth in nature, all those that hit not this truth, do err, some more, some less; for though some may come nearer the mark than others, which makes their opinions seem more probable and rational … yet as long as they swerve from this only truth, they are in the wrong; nevertheless, all do ground their opinions upon reason … at least, they think they do. (123).

Furthermore, the foundation of "schools and several societies" by the Empress quickly introduces questions about the perceptual limits of scientific observation. As her bird-men, her astronomers, tell her: "nature is so full of variety, that our weak senses cannot perceive all the various sorts of her creatures" (134, 138).

The tools of the laboratory that the bird-men use to aid in this perception further produce them as experimental selves. For example, when the Empress learns that

despite their telescopes, her bird-men and bear men can "give no better intelligence," she instructs them to discard these glasses and trust instead to their own natural eyes; "for, said she, now I do plainly perceive, that your glasses are false informers, and instead of discovering the truth, delude your senses." (141) However, the bear-men resist the Empress's rejection of instruments like the telescope, saying, "that it was not the fault of their glasses, which caused such differences in their opinions, but the sensitive motions in their optic organs did not move alike, nor were their rational judgments always regular" (141). Rather than locating error in the instruments, the bear-men acknowledge that it is through the interaction between individual senses – "the sensitive motions in their optic organs that do not always move alike" – and the glasses that scientific knowledge (in this case, errant scientific knowledge) is produced.

This episode reveals that it is through the interaction between experimental subject and object that a different kind of self emerges: one that is jointly producing and produced by the act of experimentation. Cavendish's critique of experimental culture, like the one enshrined by the Royal Society in seventeenth-century England, takes as its starting place one of the moments that in retrospect produced our modern experimental regime – debates over the nature of nothingness. What Cavendish's hybrid text recognizes and argues for are the limits of perceptual knowledge as well as the impossibility for objectivity within the laboratory.

Cavendish's satire of the Royal Society comes through clearly in her discussion of the lice-men, who are the mathematicians as well as the scientists who attempt to

measure the weight of the air. When the Empress first is given the microscope, she views "a flea, and a louse… the description of all their parts would be very tedious to relate, and therefore I'll forbear it at this present" (144). The narrator's conscious statement of refusal to articulate all the parts of the flea and louse is a direct jab at Hooke, whose *Micrographia* of course lists all the various parts of the animal in detail. But the Empress continues, saying of those "terrible creatures called lice, who instead of thanks, do reward them with pains and torment them for giving them nourishment and food" (144).

A few pages later in the text, we are told of the Empress's lice-men, who are her geometricians. The lice-men endeavor "to measure all things to a hair's breadth, and weigh them to an atom; but their weights would seldom agree, especially in the weighing of air, which they found a task impossible to be done" (159). The Empress's irritation with the lice-men causes them to be the first society to become disbanded in the text, since there is neither "truth nor justice in their profession" (160). Eventually, at the suggestion of in-text Cavendish herself (as her soul visits with the Empress), the Empress decides to disband all the societies, since what they have resulted in are "factions" (202). Cavendish ultimately suggests that the Empress's world will be better off without societies (like the Royal Society) whose very nature is given over to "controversy and quarreling" and where "some are so wedded to their own opinions, that they never yield to reason" (202). In Cavendish's utopia, she allows the Empress to

establish these societies in order to show the dangers of institutionalized scientific authority and the impossibility of objectivity, and then rids the text of these societies entirely.

In place of institutionalized scientific authority in the text is Cavendish's own authority. When the Empress first desires a scribe, she initially asks for the soul of some "ancient famous writer, either of Aristotle, Pythagoras, Plato, Epicurus, or the like," but is told that those men are too "wedded to their own opinions" to be scribe to the Empress (181). The same happens when the Empress suggests "Galileo, Gassendus, Descartes, Helmont, Hobbes, H. More, etc" (181). Who ends up becoming scribe and platonic lover to the Empress but Cavendish, the Duchess of Newcastle, herself? When the Duchess announces to the Empress her desire to be Princess, the Empress seeks out some way for her to realize her desire: "[be not] there another world, whereof you may be Empress as well as I am of this?" (184). What the Duchess and Empress both learn is that there are an infinite number of immaterial worlds, which they may create and rule over at whim.

What this discovery leads to is another opportunity to diminish contemporary scientific authorities in favor of Cavendish's own authority. Cavendish, the Duchess within the text, tries making a variety of worlds after the philosophical opinions of traditional authorities. She begins with Thales, Pythagoras, and Plato, but soon is "not able to endure the trouble which those ideas caused her; wherefore she also annihilated

that world" (187). The Duchess then begins to experiment with making a world out of nothing – but discovers she can't do it: she

> … was resolved to make one according to the opinion of Epicurus; which she had no sooner begun, but the infinite atoms made such a mist, that it quite blinded the perception of her mind; neither was she able to make a vacuum as a receptable for those atoms, or a place which they might retire into; so that partly for the want of it … the confusion of those atoms produced such strange and monstrous figures as did more affright than delight her, and caused such a chaos in her mind, as had almost dissolved it. (187)

When the Duchess within the Blazing World attempts to make a world according to Epicurus – atoms swirling against the infinite void – she finds it impossible to do and something that almost destroys her. (Cavendish the writer, though, is able to entertain the possibility, however brief, of what it might mean to create a world of nothing.) The Duchess briefly considers making a world out of Aristotle's opinions but once again underlines her earlier point, reminding herself that "out of nothing, nothing could be made" (187).

After these episodes, the Duchess tries to create a world in the style of either Descartes or Hobbes, but finds that "no patterns would do her any good in the framing of her world" (188). The only solution, of course, is a world in which Cavendish refuses the influence of any traditional authority, which the Duchess realizes: "she resolved to make a world of her own invention" (188). When the Empress sees the Duchess's world, she is so impressed that she first asks the Duchess if she might live there (thus implicitly

becoming her subject), but, after the Duchess refuses, she asks the Duchess to help her order and create her own.

At the close of the text, in the "Epilogue to the Reader," Cavendish once again returns to the question of authority and authorship. She writes, "By this poetical description, you may perceive, that my ambition is not only to be Empress, but Authoress of a whole world" (224). Cavendish diminishes the idea of institutionalized authority and especially scientific objectivity, replacing it with her own authority instead – here, in this text, identified as authorship. Just as Cavendish demonstrated the failures of objective knowledge and experimentation in portraying the members of the Royal Society as animal-human hybrids, she demonstrates the possibilities opened up by authorship, where she fashions herself as both author and authorial subject, through her depiction of the Duchess. In *The Blazing World*, Cavendish argues that the experiment produces the experimenters themselves as much as it produces any kind of knowledge; significantly, Cavendish brings this argument to life in a world that is potentially "made of nothing."

5. Conclusion

This project began with a particular set of questions: why was nothingness the central focus of early modern experimentation? How might literature explain the role nothingness came to play in forming both the subject and the methods for the experiment? As I started research for my dissertation, this list of questions changed to focus on different topics over the course of six years, often as a result of other interests I pursued simultaneously. I studied Arabic and wondered what the relationship the concept of the zero had to changing definitions of nothingness. How did early modern audiences recognize and interpret the Hindu-Arabic zero? I worked as a teaching assistant for a class that studied *The Winter's Tale* but I also started playing video games; both asked me to think more seriously about the role of the audience in creating knowledge in collaboration with the text. After working with severe depression and an eating disorder and after witnessing my colleagues, who are some of the most compassionate and brilliant people I know, struggle to deal with the precariousness and soul-killing loneliness of academic life, I've become interested in loss and trauma.

This is all to say, I think, that while I can speak now about where I think this project might go, research and writing have never been intellectually neutral pursuits for me. Where this project turns to will probably depend more upon the communities and spaces I've invested in, as well as whatever emotional work I'm doing, than anything

else. In any case, here's a short note about what I think is most interesting about my dissertation at this moment in time and where this might go in the future.

What has become most interesting about the project is thinking about the zero / nothingness as a figure whose existence is crucial to the construction of our ways of knowing the world around us, and yet is erased at every turn. The zero's association with marginalized bodies and cultures, however, adds another layer to this erasure. Consider the zero's Hindu-Arabic roots and its doubleness as a sign and a number, as well as the different contemporary connotations of "nothing," one of which includes female genitalia. This underlines Leontes's dismay in *The Winter's Tale* as he attempts to interpret Hermione's pregnant body and his claim that "my wife is nothing" as anxieties about knowledge rooted in what it means to know nothing, but significantly, the form that nothingness takes is a woman's. What I want to suggest is this: if the methodologies through which Western philosophy has come to know the world around it are rooted in questions about what it means to know nothing, but this process is constantly one of recognition and erasure, what does it mean for us to consider that nothingness isn't a neutral concept? What if, when we think about whether nothingness has a body or not, we also consider what that body might look like and how it moves through the world?

My dissertation could expand in many directions – more on this later – but I think one of the first things that is underdeveloped here is any focus on the above, even though I think there are ways in which it could be drawn out. I've already given some

examples of how this might work in *The Winter's Tale*, but it's significant too that it's against masculine interpretations of nothingness that Margaret Cavendish's figure is able to build her own world in *The Blazing World*. The second area I could research further is a more extensive project on the differences between each form of nothingness; they became interchangeable in ways that didn't always work here. Collapsing together the vacuum, the zero, nothingness, and the void was probably necessary in order for me to complete the project, but it happened to the detriment of its complexity.

Finally: I worried that leaving academia would feel unbearably heavy. I haven't felt a profound sense of loss at all – I love what I'm doing right now. That said, I can't help but be conscious of everything that's been lost along the way: not just for me, but for my colleagues, my friends, current and former partners, and our shared communities. Some of us are jobless, uninsured, chronically ill, dead, or miles away from our families. I don't know what to do except bear witness to that here. Much of my project has circled around what it means to define nothingness, absence, and loss, how to bear witness to it, and how people and communities can reencounter one another and create something out of nothing. That's all.

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