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Lectures on Astronomy, Lectures on Natural Theology: In the Classroom with Margaret Bryan

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This most elegant system of the sun, planets, and comets could not have arisen without the design and dominion of an intelligent and powerful being.
-Isaac Newton, *General Scholium, Principia* (1713)

And here there are two things that are manifest Demonstrations of the presence and management of GOD, namely, That such Bodies should move at all: and that their Motion is so regular.
-William Derham, *Astro-Theology* (1715)

From Astronomy we learn the immensity of that Being, who could thus perfect his work in wisdom.—and control its various operation by his power.

Our wonder and admiration is naturally extended beyond all bounds by the sublime objects of our present consideration; yet if we examine through all nature, from the minutest object to the most enlarged, we shall find equal cause for astonishment.
-Margaret Bryan, *A Compendious System of Astronomy* (1797)

My opinion of Astronomy has always been that it is *not* the best medium through which to prove the agency of an intelligent Creator; but that, this being proved, it shews, beyond all other sciences, the magnificence of his operations.
-William Paley, *Natural Theology* (1802)

<1>Margaret Bryan (c. 1756/7–1836), née Haverkam, begins her October 3, 1811 letter to astronomer William Herschel (1738–1822) by reminding him of their initial meeting at his Slough residence and observatory before soliciting his observations of a recent comet and sharing her own measurements and understanding of its anticipated path.(1) Charles Hutton (1737–1823), Royal Military Academy math professor, had introduced Herschel and Bryan, a leading educator, and his support is documented in prefaces, dedications, and subscriber lists throughout Bryan's astronomical publications, which include: *A Compendious System of Astronomy, in a Course of Familiar Lectures* (1797), the last chapter of *Lectures on Natural Philosophy: the Result of Many Years' Practical Experience of the Facts Elucidated* (1806), and *An Astronomical and Geographical Class Book for Schools* (1815).(2) The majority of Bryan scholars read her lectures alongside the likes of Priscilla Wakefield, who wrote "familiar letters" on botany, and Jane Marcet, known for her "conversations" on chemistry. When that is not the case, her work is studied in light of science writing's "maternal tradition," wherein, according to Bernard Lightman, "a mother or mother substitute, such as governess or teacher, often play[s] a central role" (21). It is rare that Bryan is written about in her *own* right. I am not arguing for Bryan's exclusion from the previous categories, but because there is archival evidence of her independent astronomical work, her texts need reconsideration for their disciplinary interventions.(3) Continuing to analyze Bryan's lectures within past restrictive traditions would be detrimental on three fronts: it would serve to perpetuate the pattern of women's scientific marginalization, offer a limited view of their epistemological contributions, and continue to prioritize the male intellectual sphere.

<2> I begin this article with epigraphs that situate Bryan in very different intellectual company. In this essay, I attend to Bryan's uses and representations of natural theology, broadly defined as "the effort to gain knowledge of God from non-revealed sources—that is, from sources other than scripture and religious experience," as her means to derive scientific authority from her pedagogical authority (Manson 295).(4) In terms of the latter, Bryan's lectures rely on natural theology, so I have selected epigraphs that establish the enduring connection between astronomy and natural theology and that preview the trajectory that relationship took as disciplinary nuances seemingly played a more central role to the belief system's viability. The first three quotations illustrate general disciplinary alignment as to how various aspects of astronomy show the work and presence of God, while in the fourth, William Paley (1743–1805) opines that astronomy is *only* useful, in terms of natural theology, once the Creator is already believed to exist.(5)

<3>Bryan acknowledges the importance of Paley's work in her preface to *Lectures on Natural Philosophy*. She writes, "[t]hrough the whole of the *anatomical parts* of these Lectures I have followed the very excellent divine Dr. Paley, in his Natural Theology:—a work comprehensive in its nature, important in its application, and extensive in its elucidations of the divine wisdom and omnipotence of our great Creator" (emphasis added). I understand Bryan's articulation of the parts of Paley's argument to which she adheres as an implicit statement that there are unnamed portions of his natural theology that she does not adapt for her non-anatomical lectures. In further distinction from Paley, Bryan, in her 1806 text's astronomy lecture, professes an *equality* between bodies of natural theological evidence, similar to that which she champions in the epigraph's *Compendious System* quotation. She writes in the subsequent publication, "surely these effects are *not more admirable than the other evidences* of the amazing power of the Deity previously contemplated in these lectures" (283–284; emphasis added). This stands in contrast to the way in which Paley begins to rank scientific disciplines by their ability to produce evidence, when he asserts that once God has been proven by other means, astronomy "shews, *beyond all other sciences*, the magnificence of his operations" (199; emphasis added).(6)

<4>Bryan is not unique among women science writers in her use of natural theology, as is documented by Barbara T. Gates, Kristine Larsen, and James Secord, among others, but most consider how this theory features in women's publications *after* the publication of Paley's *Natural Theology*. While Bryan explicitly references Paley's natural theology in the preface to her 1806 book, there is no attribution or accounting for natural theology's origin or prominence in her 1797 work, prompting an investigation into what early sources Bryan selected to best serve her, both in the classroom and on the page. Natural theology was not a unified ideology; according to John Gascoigne, it was "elastic and pliable" and "could take different forms according to the scientific and theological presuppositions of its various practitioners" ("From Bentley" 220). Paley's natural theology, suited to natural history and anatomy, was thus a rendition of physico-theology, while other iterations, like Newtonian natural theology and astro-theology, accommodated astronomical systems.(7) I define and trace published uses of these prominent natural theological strands below to support my argument that, in order for Bryan to teach young women about astronomy, religion, and morality, she needed to draw from multiple, competing schools of natural theological thought, and that in synthesizing select components that would meet her needs as a writer and educator, she was making a gendered intervention into natural theology and thus astronomy.

In the Classroom with Margaret Bryan

<5>Gregory Girolami pieces together that from about 1791 to 1816, Bryan ran schools for young women at Bryan House on Hooper Hill in Margate (c. 1791–1797); in Tonbridge and Hadlow in Kent (July 1974); at Bryan House in Blackheath, near the Royal Observatory Greenwich (1798–c. 1807); 1 Gloucester Place, Portman Square (c. 1808/9); and finally at 27 Lower Cadogan Place in Chelsea (462–63). Nikki Lee traces a similar narrative of Bryan's early years, but reveals evidence of Bryan having lived at 21 Lower Cadogan Place prior to residing at Gloucester Place, locates Bryan in Holborn in 1814, and finds her using the address of her publisher's son before residing at 27 Lower Cadogan Place ("Margaret" 30–33).(8) Like much information about Bryan's life, these date ranges and locations of her schools are approximate, as they have been gleaned from tax records, advertisements, her publications' paratextual sections, and what few letters survive in archives. Susan Skedd explains the lack of data regarding schools:

> educational history has tended to overlook the commercial schools, which were mainly ephemeral organizations rarely surviving beyond two generations. In the absence of school records from the boarding and day schools, literary sources and autobiographical material have been used successfully by several historians to piece together a general history of girls' education in England prior to the foundation of elementary schools under the auspices of the National Society and the British and Foreign Society in the early nineteenth century. (102)

<6>While this lack of records prevents scholars from establishing precise histories of schools in the late eighteenth and early nineteenth centuries, surviving curricular guidelines and textbooks shed light on acceptable subjects and pedagogical strategies. Bryan taught astronomy to young women at a time when including that science in a curriculum for girls was divisive.(9) And not only did she elect to teach this subject, but she made her position known with the publication of *Compendious System*. Nicholas Hans reads Thomas Broom's *Sketches of Female Education* (1790), John Burton's *Lectures on Female Education* (1793), and Erasmus Darwin's *A Plan for the Conduct of Female Education in Boarding-Schools* (1797), observing that they "do not agree on the question of scientific education for girls" (201). Hans introduces these authors and their texts, noting that they were "[t]he three authors on female education who published their books in the eighteenth century," making it sound as though no others were publishing on this subject (201). Marilyn Ogilvie concurs with Hans that Burton and Darwin were two of the three prominent writers on contemporary education, but names Hannah More's *Strictures on the Modern System of Female Education* (1799) in place of Thomas Broom (46). Hans and Ogilvie also agree that Darwin's book was the only

one of those surveyed that included science and mathematics in its curriculum for girls, and that two schools, one run by Bryan and the other by a Mrs. Florian at Epping Forest, were known to have adopted that plan.(10) Michèle Cohen provides a necessary expansion to these earlier surveys on contemporary women's education, including Hester Chapone's curricular recommendations, John Bennett's *Letters to a Young Lady on Useful and Interesting Subjects Calculated to Improve the Heart, to Form the Manners, and Enlighten the Understanding* (1789), and James Fordyce's *Sermons to Young Women* (1770), all of which included astronomy in their curricula for girls, albeit for varied reasons (Cohen 321–322, 327). Deborah Simonton elaborates on how young women's educations might vary by class; for middle-class and elite girls, sciences were often being taught for the sake of conversation, and thus the marriage market and child-rearing to follow (44–45).

<7> What's more, women, as mothers and teachers, were often responsible for the moral wellbeing of children and young adults. Jane Rendall uses Priscilla Wakefield's *Reflections on the Present Condition of the Female Sex* (1798) to illustrate "that for women of the upper and middle classes a commitment to 'the reformation of vice, the instruction of ignorance, and the promotion of virtue' was not merely a leisure activity, but a civic duty, conducive 'to the improvement of public morals, and the increase of public happiness'" (26). Morality is a subject that does not typically receive explicit attention in scholarship on scientific pedagogy, but it is significant to Bryan's teaching and writing given its centrality to both natural theology and the responsibilities unique to a woman in education. For instance, Bryan's *Lectures* conclude with an address wherein she advises her pupils to be obedient to their parents, faithful friends, affectionate sisters, and wives who "consider the solemn oath pledged before God" (290).(11) Morality permeated a range of discourses during the long eighteenth century and was thus imbued with the values and rhetoric of, at the very least, natural theology, education, philosophy, and sociology. And as Bryan developed her pedagogical strategies, she may have been faced with the challenge of reconciling morality's interdisciplinary tensions while taking into consideration the gender-specific aspects of morality with which her male counterparts, and likely sources of her 1797 iteration of natural theology, would not have been burdened.

<8>And what qualified Bryan and other women in education to undertake teaching these subjects? Unfortunately, as Simonton notes, teachers were not always qualified; in schools offering "a wide curriculum taught by one or two women, most lessons were mere glosses of the subject, particularly as the majority of teachers were not particularly well educated themselves" (45). Ruth Watts echoes this lack of competence, explaining that when Bryan was writing, "there were few

professional scientists outside the tiny number of university professors" and "by the 1860s the increasing elitism and exclusiveness which paralleled growing professionalism scorned both amateurs and women" (61, 60–61). And given the curricular inconsistencies mentioned previously, it was by no means guaranteed that women's formal educations would provide them with the requisite education to teach subjects like astronomy. Bryan, whose schools had an excellent reputation, is unique given the knowledge she acquired prior to and during her teaching career, which includes information potentially circulating in her professional science and education networks as well as that which was printed and circulating publicly.(12) Mary Brück, among others, has poured through *Compendious System*'s subscribers to compile a list of Bryan's most notable contacts: "Rev. Dr. Maskelyne, Astronomer Royal (whose only daughter may have been one of the pupils), Alexander Aubert FRS (astronomer friend of the eminent William Herschel and his sister Caroline); William Boys FRS (surgeon and polymath scholar), John Bonnycastle, [Royal Military] Academy, Woolwich (author of many well-known textbooks); Thomas Keith (author of *Treatise on the Use of Globes* and one time tutor to the Royal Princesses)…" (15).(13)

<9>As for publicly available resources, G.S. Rousseau catalogs the range of printed works a woman might readily access: "By approximately 1740 any literate woman, of low or high class, could select from . . . almanacs, broadsheets, weeklies, magazines, manuals, books—to quench her thirst for science, a trend that continued throughout the century, with a pronounced resurgence at the end" (213). The general book category includes, at minimum, textbooks, dictionaries, encyclopedias, anthologies, and literary works. Rousseau traces the evolution of reference works, noting that, "[a]s natural philosophy grew increasingly technical and specialized, dictionaries and encyclopedias, like other popular works, grew more specialized too . . . dictionaries after 1720 or thereabout were more specifically dictionaries of mathematics, dictionaries of astronomy, dictionaries of geography, and so forth" (212). As for literary works, women, both educators and the literate population, could learn about science from satire, poetry, and popularizations (Rousseau 214, 216–218).(14) Rousseau cites Gerald Meyer to sustain his point "that eighteenth-century ladies most certainly did not learn their science directly from the great scientists themselves—Newton, Huygens, Boyle, Hooke—or from their books: 'it was not to the primary works of these scientists that the ladies turned. Instead, professional expositors simplified and popularized for lay consumption the major scientific advances of the time.'" (214).(15) Hans expands Rousseau's list, writing about women's access to periodicals and printed versions of public lectures (205–206). Regarding the former, John L. Heilbron observes that Charles Hutton's *Ladies' Diary* was particularly instructive to Bryan: "From 1773 to 1818 [Hutton] edited

the *Ladies' [D]iary*, an almanac filled with puzzles and problems, mainly in geometry and algebra but also in the mathematical branches of natural philosophy, on which many would-be mathematicians, some women, honed their skills. One of them was the pious schoolteacher Margaret Bryan" (188–189).(16)

<10>As women engaged with these printed works, they were learning mathematics and astronomy as well as natural theology. Readers may not have learned each theology's definition or applicability to a particular discipline, but they were certainly subject to natural theological themes and shifting trends as these were adopted and mirrored by contemporary writers. Patricia Fara extends William Derham's (1657–1735) success to literary circles by way of poet Edward Young (bap. 1683–1765), whose "astronomical ideas were based on those put forward in Derham's *Astro-theology* (1715), [a] major source for the physico-theological poets" (147). Intertextuality comes full circle when Fara notes that astronomer James Ferguson quotes a line from Young's *Night Thoughts*: "An *undevout* Astronomer is *mad*" (147). And Bryan was certainly familiar with Ferguson's work, referring to him twice in *Compendious System* (114, 115).(17) In another instance, John Mullan quotes the 1733 *Ladies' Diary* preface, wherein one of the benefits of mathematical knowledge is that it provides "us a clear and extensive Knowledge of the System of the World, which . . . creates in us the most profound Reverence of the wise Creator" (55). And Richard B. Schwartz documents the effect physico-theological texts had on literary authors, compiling a list of concepts that became common to the period's literature through theologians' influence (17–18). Like Schwartz, Gascoigne also calls attention to the work of William Jones, who "has noted the way in which late eighteenth-century poets 'changed from the celestial systems to English flowers and birds' when praising the works of God" ("From Bentley" 232–233).(18)

Natural Theologies: Definitions and Trends

<11>William Schweiker defines *revealed* theology as "discourse about God grounded in an authoritative revelation within a specific religious community," and *natural* theology as "the attempt to demonstrate the existence of 'God' and divine purpose(s) through the observation of nature, experience, or the working of human reason" (310). Schweiker's articulation of natural theology calls attention to a line of teleological argument, "divine purpose(s)," and includes "human reason" as a valid method of demonstration. This stands in contrast to the evidentiary terms put forth in the more specific definition that Manson develops in his chapter, wherein proof of God comes from "empirical evidence," and highlights tension between empiricism and reason embedded in the ideology's history (295). Echoing Gascoigne concerning the "pliable nature" of natural theology, Neal Gillespie writes

about the imprecision of the term, in that it "may refer to theological beliefs drawn from the interpretation of nature, or to a theology based on deduction from a priori principles as opposed to revelation. These two may be merged in practice and, while formally distinct from revealed theology, may also blend with that form in any particular thinker" ("Natural History" 4).

<12>It follows that any form these blends might take would be contingent on the discipline(s) of the particular thinker. While Russell Re Manning introduces discussions around "historical, theological, philosophical, scientific, and aesthetic" perspectives, Gascoigne considers the ramifications of nascent scientific disciplines on the evolution of natural theology (2). Gascoigne draws on Arnold Thackray's observation that, in 1781, "the Royal Society's monopoly was broken and within sixty years there were sixteen new London scientific bodies in the provinces and over two dozen specialist ones," to argue that this schism "helped promote a greater diversity of scientific activities which was reflected in the increasing diversity of natural theology" (233).(19) While the Royal Astronomical Society was not founded until 1820, this is certainly still suggestive of an environment in which Bryan would have been able to adapt components of natural theology for her pedagogical purposes.

<13>Prior to the fracturing of this institutional monopoly, scientific disciplines had a shared motivation driving their respective adoptions of natural theology: their need to fend off atheism. In the seventeenth century, "'atheism' was associated with the new science and with the philosophical speculations that often kept it company" (N. Gillespie, "Natural History" 20). As for the eighteenth century, Kathleen Lundeen makes the case that astronomers were strategic in rhetorically aligning their findings with religion in order to distance themselves from the accusations of atheism faced by increasingly marginalized astrologers. Lundeen stresses the stakes of this alignment, writing that despite "the epistemological differences between eighteenth century science and religion—empiricism versus mysticism—English astronomers of the period often smoothed out any incompatibility between them" (5).

<14>Atheism thus incentivized many of this article's primary authors to publish tracts that, broadly, fall into one of two categories: physico-theological or astro-theological. I will focus on physico-theology, Newtonian-theology, and astro-theology, given their relevance to Bryan's 1797 natural theology, but it would be reductive to overlook other prominent iterations of astro-theology, such as the Cosmic Argument, Newtonian natural theology, and Newtonian physico-theology. For the sake of refining this argument, when scholarship refers to the Cosmic Argument as a school of natural theology and not style of argumentation, it will be

represented by astro-theology; likewise, Newtonian natural theology and Newtonian physico-theology will be represented by Newtonian-theology.

<15>In the *Oxford English Dictionary*, the first instances of *physico-theology* and *astro-theology* correspond to William Derham's publications, *Physico-Theology: A Demonstration of the Being and Attributes of God from His Works of Creation* (1713) and *Astro-Theology: Or a Demonstration of the Being and Attributes of God, from a Survey of the Heavens* (1715), both derived from his 1711–1712 Boyle Lectures. *Physico-theology* is "a theology based on the constitution of the natural world, esp. on evidences of design found there" ("Physico-theology"), or, as Samuel Johnson articulates it, "divinity enforced or illustrated by natural philosophy" ("Vol. 2" 352). And Neal Gillespie emphasizes the teleological aspect, that this design is "directed toward the accomplishment of purposeful ends" ("Natural History" 4, 14).

<16>Newtonian-theology developed prior to the official use of *astro-theology*. Lundeen distinguishes that "[w]hile Newton argued that astronomy was consistent with theology, his followers presented it as a branch of theology" (6). As a concept, Newtonian-theology was first promoted by Richard Bentley (1662–1742) in 1692, when he delivered the first Boyle Lecture. But, as Gillespie stresses, "mathematical Newtonian natural theology was too esoteric for common minds" ("Divine Design" 218–219; "Natural History" 37). Gascoigne even quips that Bentley "was barely competent to follow the *Principia*" ("From Bentley" 222). Margaret Jacob provides a gloss for the intellectual climate in which Newtonian-theology came to prominence: "In the common parlance of the seventeenth century, God revealed his will through both his word and his work. The lectures by the Newtonian commentators dealt with God's work, specifically, with the operations of nature according to the principles proclaimed by Sir Isaac Newton" (*Newtonians* 163). Matthew Eddy and Gascoigne delve into how Newton's principles were recast along theological lines. Eddy, pinpointing the "two recurring tenets that retained strength," articulates, "[t]he first was that God actively superimposed force upon animate and inanimate matter. The second was the equating of the divine attributes, namely omniscience and omnipresence, to the forces of nature—a move that fused a biblical understanding of God with empirical observation" (102). For Gascoigne, Newtonian-theology is "a form of natural theology which attempted to maintain a balance between two images of the Deity—a general Providence who created the world *ex nihilo* and established and kept in being the laws by which it continued to operate, and a special Providence who continued to intervene in the workings of the universe in the manner suggested by Newton" ("From Bentley" 227).

<17>That *astro-theology* comes into use with the delivery of William Derham's Boyle lectures (1711–1712) does not mean that there was an explicit lexical shift from Newtonian- to astro-theology. For the purpose of this article, I find it generative to see these two theologies as imbricated with one another and difficult to meaningfully separate. As the earlier eighteenth-century lecturers revised the Newtonian model to suit their arguments and audiences, they moved further from the tenets central to Newtonian-theology. Fara illustrates this point by tracing the plurality of worlds premise, standard by the mid-1700s, as it is alluded to in Newton's works. Fara observes that plurality was entirely absent from the 1687 *Principia*, covered with "a cautious 'if' in his one sentence on the subject" in the 1713 General Scholium, and "the possibility in a non-uniform cosmos" was "tentatively broached" in *Opticks* (146). Newton acknowledged the possibility without officially endorsing it; the same cannot be said of his acolytes. This example illuminates the way in which the move away from the "esoteric" Newtonian-theology meant the acceptable integration of ideas that could not be mathematically proven, which, for many, meant the incorporation of scripture into their publications. Since not all interpretations of astro-theology feature scripture, I am not arguing that the integration of revealed theology was constitutive of a universal shift to astro-theology, but rather that this inclusion supports the seemingly acceptable pattern of liberties that might be taken with Newton's theories. This is consistent with another of Jacob's points, that a "theme in the Boyle lectures of the period centered . . . on finding rational arguments to validate the truth of God's word as revealed in Scripture" (*Newtonians* 163). Derham's case renders apparent how the lecture platform that began popularizing *Newtonian-theology* ended up generating *astro-theology*, defined by Johnson as "divinity founded on the observation of the celestial bodies" ("Vol. 1" 180). Neal Gillespie calls this the "cosmic argument," and defines it as, "that variety of natural theology which based its belief on the lawful order seen in nature—especially astronomical order, which was held to be rational in its origin, but which had no obvious or necessary purpose or end beyond the presumed gratification of the Creator" ("Natural History" 4). In contrast with Gillespie's physico-theology, there is emphasis on astro-theology's *lack* of teleology here.

<18>Basic definitions thus established, the trajectories of physico- and astro-theologies prior to the 1802 publication of Paley's *Natural Theology* are fundamental to understanding the natural theology Bryan curated for her 1797 *Compendious System*. Most scholars tracing the arc of physico-theology begin with *The Advancement of Learning* (1605), wherein Francis Bacon delineates his *natural theology*. Stuart Peterfreund illustrates a shift in early physico-theological thinking with a comparative reading of Bacon and Robert Boyle's respective representations of the eye. While Bacon "makes clear his belief that the

eyes work not on the basis of a mechanical principle, but on the basis of a spiritual principle," Boyle's focus, which establishes a mechanistic trend that lasts, in varying iterations, at least until Paley publishes *Natural Theology* in 1802, is "on the design and use of the eye *as a mechanism* by means of which to learn something" (Peterfreund 30). Astronomy, with its reliance on the telescope, is certainly implicated in this ongoing debate over the eye's mechanical and spiritual connotations, with proponents of each—unmediated visual experiences and technologically-assisted observations—weighing the epistemological repercussions.(20)

<19>Also underpinning Boyle's natural theology was the need for "irresistible evidence," to successfully "persuade atheists and reassure Christians" (N. Gillespie, "Natural History" 27). Boyle "saw no clear evidence of providential care in the cosmic vastness. To give natural theology a sounder basis than heavenly mechanics, Boyle had turned to human anatomy and the living creation, finding therein a union of complex organization and purposeful ends that seemed beyond question" (N. Gillespie, "Divine Design" 218). John Ray (1627–1705) and Derham continued this tradition of a biologically based physico-theology, but given their professional positions, "naturalist-parsons," and following obligations to prioritize evidence that would be accessible to all, they link "popular British natural history to natural theology," which remained standard until the 1687 publication of Newton's *Principia*. (N. Gillespie, "Divine Design" 218).

<20>In July 1691, Robert Boyle included in his will a bequest to establish a formal lectureship in order to substantiate Christianity.(21) Jacob observes that in the lectureship's early years, speakers were principally "churchmen who were also important followers of Isaac Newton," and as such, the lecture series "first articulated one of the dominant versions of eighteenth-century Newtonianism" (*Newtonians* 146, 144). Gascoigne takes issue with Jacob's tendency "to treat the Boyle lecturers as an ideologically consistent school, [as] such divisions of opinion were even reflected in the differing outlook of the Boyle lecturers themselves" ("From Bentley" 222–223). Neal Gillespie characterizes the change to natural theology brought about by this group:

> While not rejecting physico-theology, Newton and his followers placed a greater emphasis on the contingency of certain features of the orderly, inanimate, cosmic system that they thought could not possibly have resulted from the operation of mechanical principles alone, but that must have involved creative volition on the part of a supreme intelligence. Newton and

> his spokesmen were thus able to refurbish the cosmic argument and rescue it from the reluctant suspicions of Boyle… ("Natural History" 37)

Gillespie expands his explanation of this "rescue" of the cosmic argument in a different essay, articulating the point in more mechanistic terms: "Newton and his followers had rescued celestial mechanism for natural theology by postulating a world machine that required a cosmic engineer to both design and operate it" ("Divine Design" 218). Since, to prove the existence of a Creator, Newton's work relied on astronomical evidence, as opposed to biological, the early eighteenth century gave rise to a novel natural theology, or, "a reversal of the tendency which was apparent in English natural theology before the *Principia* commanded widespread public attention" (Gascoigne, "From Bentley" 232).

<21>Jacob credits Richard Bentley, Samuel Clarke, John Harris, and William Derham as the "first popular commentators on the Newtonian natural philosophy," and claims that, "[w]ithout their lectures, the new Newtonian philosophy would not have existed by the early eighteenth century as a coherent system to be understood by anyone outside the rather small circle of Newton's scientifically trained followers" (*Newtonians* 145–146). Speaking to how few men could follow Newton, of the lecturers examined here, Jacob writes that only Clarke, "Boyle lecturer in 1704–1705, possessed the technical skill necessary to comprehend the *Principia*, and at the time of his lectures he was on intimate terms with Newton" (*Newtonians* 178). Importantly, this underscores that the qualifications for lecturing on Newton did not include complete mastery of the technical aspects of his work and that women were not the only ones for whom some translation of the more abstract and difficult aspects of Newtonian theory was necessary. Within this group of four lecturers, Jacob recounts their respective translation and print histories, noted below, to conclude that, vital to thinking about whose work maintained authority when Bryan was teaching and writing later in the century, "of all the lectures those by Bentley (1692) and to a larger extent by Clarke (1704–05) and Derham (1711–12) exercised the greatest influence throughout Europe" (*Newtonians* 162).(22)

<22>Considering the contributions of Bentley, Clarke, and Derham to the rise of new theologies, Scott Mandelbrote observes a shared evidentiary trend: their "[m]athematical descriptions of natural laws now underpinned the physico-theology of the argument from design" (90). Individually, Gascoigne attributes Bentley's success to his "selective exposition of Newton's work," wherein "he and his allies were helping to focus public attention on those aspects of theology about which there was widespread agreement rather than on those contentious areas of revealed theology which were a source of division" ("From Bentley" 223). Considering

Clarke's acclaim, I have encountered evidence of his popularity—from scholars citing general influence on other Boyle lecturers and recounting his epistolary debate with Leibniz to documenting Samuel Johnson's enthusiasm for his work—but given the print histories detailed by Jacob, Rousseau, and Neal Gillespie, Clarke seems to have had the least lasting impact of the three.(23) As for most impact, Gillespie understands Derham's popularity as a result of his ability to build on previous successful physico-theological work, most significantly that of Ray. This scaffolding strategy allowed Derham to draw on his own expertise as a natural historian while introducing concepts central to a new theology. Derham's ability to harness the strength of mathematical evidence while applying "the physico-theological argument of designed utility to the heavens," secured his legacy in his own disciplines as well as others (N. Gillespie, "Natural History" 48).(24)

<23>By the 1750s, Newtonian- and astro-theologies were falling out of favor. Gascoigne writes that "aspects of Newton's work had been largely overshadowed by the increasing emphasis on the way in which the Creator worked through the laws of nature—a development which cannot be directly explained in terms of scientific changes within the period," and elaborates on surfacing "tensions that had always existed in Newtonian natural theology between an interventionist God capable of miracles and a God who was the source of the universe's order and predictability" (230, 231). The need to understand God through the laws of nature aligns with the resurgence in popularity of Ray's works, about which Neal Gillespie writes:

> While it was not until several decades after Ray's death in 1705 that widespread popular support for natural history appeared, the popularity and the many editions of *Wisdom* show that he had hit a responsive chord in the minds of many English people. With each subsequent expanded edition, both *The Wisdom of God* and *Three Physico-Theological Discourses* became more and more textbooks in natural history and natural theology. By the mid-eighteenth century popular British natural history had been successfully amalgamated with physico-theology. ("Natural History" 46)

Peterfreund attributes the general return to a physico-theological position to disciplinary progress, contending that, "advances in anatomy and physiology had diverted science from the single-minded contemplation of the mechanism and brought it back to a contemplation of the creature as a mechanism that took form and lived because of some indwelling principle" (33). While Gascoigne does not assign such causality, he does note that the growth of disciplines and professional societies contributed to physico-theology showing "a greater freshness and ability to capture the public imagination than Newtonian astro-theology" (233). Rousseau's summary

of scientific publishing trends for the century corroborates this point: "Mechanics, hydrostatics, pneumatics and optics continued to be popular throughout the century, but astronomy and mathematics waned as 'natural history'—botany, biology, and zoology—overtook and gradually supplanted it" (210).

A Natural Theology of Her Own

<24>When physico-theology was once again in vogue and Bryan was composing *Compendious System*, she recuperated an earlier iteration of natural theology. Jacob comments on Bryan's brand of natural theology in *Lectures*, noting how, "Bryan confesses to being a follower of William Paley's version of natural theology," however, "she revered a century-long tradition of Newtonian preaching that became fashionable with the 1705–6 Boyle Lectures of Samuel Clarke" ("Truth" 323). Since I have already shown similarities between the natural theologies Bryan put forth in her 1797 and 1806 texts, it would then follow that *Compendious System* would reflect, to some extent, this alleged reverence for Clarke's Boyle lectures. Having read *Compendious System* in light of the aforementioned influential lecturers, Bentley, Clarke, and Derham, I contend that Jacob's characterization of Bryan's natural theology is reductive, as it does not reflect Bryan's attention to individual lecturers and the nuances of their respective theologies. In alignment with Gascoigne's critique of the Boyle lecturers being represented as "an ideologically consistent school," there are stylistic elements and disciplinary themes wherein I see Bryan's writing as more convincingly aligning with the natural theology Derham made "fashionable."

<25>Recall that Boyle established his lecture series to substantiate Christianity. Clarke's first Boyle lecture, *A Demonstration of the being and attributes of God: more particularly in answer to Mr. Hobbes, Spinoza and their followers, wherein the notion of liberty is stated, and the possibility and certainty of it proved, in opposition to necessity and fate*, delivered in 1704 and published in 1705, "was intended to deal with the foundations of natural religion by providing demonstrative philosophical arguments to substantiate a belief in a benevolent Deity" (Gascoigne, "Clarke"). As such, Clarke's text reads more like a standard philosophy book than a basic astronomy text. Gascoigne elaborates on Clarke's approach: "as befits a student of the *Principia* . . . he sought to apply to metaphysics a mathematical style of reasoning. As he wrote in the preface, the argument of the work is 'as near as Mathematical as the Nature of such a Discourse would allow'" (Gascoigne, "Clarke"). This rhetorical approach is conspicuously at odds for Bryan's audience of mathematical neophytes; as indicated in the subtitle of her work, her lessons on astronomy "are clearly elucidated so as to be intelligible to those who have not

studied the mathematics." While Derham's audience is not designated in his title, in his prefatory writing, he consistently denotes rhetorical strategies based on inclusivity. He starts by naming those new to astronomy: "it is necessary I should, by way of a Preface, give some account of them, to enable such persons to read my Book as are unacquainted with Astronomical matters" (Derham ix). Then he considers both the inexpert and the skeptical populations: "Thus having, for the sake of the Unskilful [sic] Reader, given an account of the three *Systemes* principally concerned in the following Book, and having also for the sake of the Doubting Reader, insisted more largely than ordinary upon the two last of those Systemes…" (Derham lvii). Lastly, he justifies using a common measurement system: "but to make my Excuse (if it needs any) for assigning the Diameters and Distances of the Heavenly Bodies in English miles, rather than other larger Measures, which would perhaps have come nearer the truth: But this was also for the sake of such as are not very conversant in Astronomical matters and Dimensions" (Derham lviii). Speaking on different intents, Gascoigne sees "Bentley, Clarke, and others of Newton's early clerical disciples . . . enlist[ing] Newton's work as a means of defending the position of the established church and, indirectly, the political order with which the church was inextricably linked" ("From Bentley" 226). Bryan, like Derham, used Newton's work to serve more astro-theological purposes. The established church did not need defending in the late eighteenth and early nineteenth centuries as it did when Bentley and Clarke were lecturing. Further, this is not a responsibility that would have fallen on the likes of Bryan.

<26>Clarke's second lecture is a similarly an unfit a model for what Bryan sought to accomplish with *Compendious System*. Clarke's *A discourse concerning the unchangeable obligations of natural religion, and the truth and certainty of the Christian revelation*, delivered in 1705 and published in 1706, does not overtly cover topics in astronomy, but rather deals "more explicitly with the nature of revealed religion. Such a division of theological labour reflects the view held by Clarke, Locke, and many of their contemporaries that one could distinguish between natural religion open to human reason and a revealed religion that both confirmed and supplemented such a natural religion" (Gascoigne, "Clarke"). While Bryan does use scripture in her lectures, "revealed religion" is not a subject covered in the scope of Bryan's *Compendious System*. In the entire lecture series, Bryan only mentions "revealed religion" once, in the service of the Christian history that followed Ptolemy's death and the decline of speculative astronomy (46).

<27>Further, I am not inclined to see Clarke as a likely model for Bryan given the way in which she maintains that physico- and astro-theologically sourced evidences are equally viable in proving the existence of God. This is not a theme that is

apparent in the sermons of Bentley or Clarke, but it is a feature of Derham's works. Derham's first lecture addressed physico-theology and his second astro-theology; earlier, I cited Gillespie's observation of Derham's ability to use mathematical proof as evidence while applying physico-theology to his novel argument about the heavens ("Natural History" 48). While this approach, given its spread across multiple publications, is more scaffolded than Bryan's, her advocacy for and integration of the two theologies is following a tradition set forth by Derham in his lectures and subsequent publications. For example, Bryan continues to emphasize the adequacy of astronomical and earthly evidence: "Thus, whether we soar in contemplation of the majesty and glory of God displayed in the Heavens, or pursue our scrutiny of the wonders and benevolence of his administration and dispensations, manifested in the organization and effects of things upon Earth,—still we discover new cause for congratulation, new sources of delight and adoration" (162). Additionally, Bryan assimilates physico-theological support—perhaps out of necessity given astro-theology's shortcomings when it comes to teleological evidence—by way of the caterpillar's life cycle, that humans are intended for a "future exalted, state," (215):

> This insect changes its natural state of existence in a manner analogous to our translation from this life to a better—for after being to all appearance dead, it rises again in a new and beautiful form. In the winter of its age, foreseeing, we may suppose, its approaching change, it begins to prepare its tomb, and works unremittingly till it is shut out from all visible means of subsistence; in this state it continues a certain time, and then rises again from its temporary obscurity to a life of joy; in which new and beautiful form it wings its way with exalted renovation, soaring above those things which in its former degraded state appeared its proper sphere of action . . . Like this insect, we must pass our allotted time in our present state, then be entombed, and to all appearance dead—yet shall that Power which supports the chrysalis in its state of apparent inanity, sustain our spiritual part,— and finally, at the time decreed by divine command, we shall rise again to a most pure, a most ennobled state... (215)

<28>I find further similarity between Bryan and Derham regarding their uses of the "great chain of being" metaphor. Derham leverages his argument that God had populated other worlds to extend the "great chain of being" metaphor, which Bryan employs in the passage above, as well as in several other lectures. Charles Gillespie cites Arthur Lovejoy's *The Great Chain of Being* (1936) to provide a brief history of this non-scientific concept, which originated with Plato but was once again popular in the first half of the eighteenth century. Gillespie defines the structure as

"a chain of being, the links of which consist of all created forms stretching from the humblest and crudest types right up a graded ladder of perfection to the highest, God Himself. The series was perfectly continuous and harmonious, without chasms or gaps" (17–18). In spite of the chain's original disconnect from science, it was adopted by physico-theologians; Schwartz lists this metaphor as a physico-theological concept that had worked its way into literature of the period. As physico-theologians studied nature though, they began to find gaps that severed the chain and, by extension, the metaphor, thus causing it to fall out of favor by the century's close. Gillespie articulates the problem with "temporalizing" the chain: "Instead of being a description of the universe as it is and always has been, the chain came to be conceived as a process of creation occurring in time. The principle of plentitude became the program rather than the description of the universe—sooner or later all possible forms would have been created" (18). Derham uses the plurality of worlds to fill the problematic gaps. In his *Astro-theology*, in addition to the analogical justification previously discussed, he provides another reason for the population of other planets: economy. Derham "held that the other planets constitute so vast an arena for being that God could not have left them so unpopulated. There, thought Derham, would be found the forms not represented on the earth" (C. Gillespie 18). Since God was responsible for the universe, the great chain's links could not be limited to what could be discovered on Earth. In *Compendious System*, this is most evident in Bryan's third lecture, wherein she tells her students, "[w]e have reason to suppose that our Sun, with its planets, forms only one link of the great chain of the universe" (51). Bryan also applies this metaphor when she talks about the processes of reflecting and judging, which "make us feel the important rank we hold in creation, with the certainty of a *future state* of more glorious existence" and considers the rank of "brute creation[s]" below humans, as "they are not designed for a *future state* of reward or punishment, but were created for our use, though not for our abuse" (120–121, 127; emphasis added). Not only does Bryan adopt her natural theology from earlier in the century, but she also employs a dated metaphor; both strategies stand in contrast to the attention she paid to updating editions of her publications with the latest astronomical discoveries.(25)

<29>In Bryan's pioneering of a natural theology for the young women in her late eighteenth- and early nineteenth-century classrooms, her books reflect much interplay between scientific and religious writing. Although the convention of presenting "astronomy as . . . a means of religious reflection" was expected by some readers, interpreting Bryan's rhetorical decisions in light of extant patterns sheds additional light on her potential natural theological source texts (Lundeen 7). Before looking at *Compendious System* alongside the Boyle lectures, it is worth sharing Lundeen's apt pairing of Bryan's text with John Keill's (1671–1721) *An*

Introduction to the True Astronomy. Lundeen observes that while "Bryan and Keill revere Newton's genius, they reject the concise and often clinical exposition of *The Principia*, reverting to a much earlier convention of interfusing scientific discourse with religious references" (4).(26) While Keill's text certainly features Newtonian-theological content, he does not draw on scripture to the same extent as Bryan and Derham. It is possible that Bryan encountered Keill's text at some point in her own education, as it was published throughout the century and, when translated to English in 1721, dedicated to "the Fair Sex" (sig. A3*r*–*v* qtd. in Henry).

<30>Returning to the Boyle lecturers, recall that Bentley avoids controversies of revealed theology for the sake of making Newtonian ideas palatable, and that while Clarke does focus on revealed theology, he does not integrate scripture with astronomy as Derham does. Peterfreund, writing about Derham's *Physico-Theology*, compares Derham's work to Ray's, noting that the former's arguments "foreground the biblical intertext even more strongly" (32). Charles Gillespie provides a similar comparison, examining Derham's earlier work in light of Paley's school of natural theology. Of the two, Derham "attached primary importance to revelation. *Physico-Theology* discussed the human soul as well as man's physical situation, and Derham concluded his book by outlining the duties of adoration, reverence, fear, and obedience which we owe to God" (C. Gillespie 19). In Derham's preface to *Astro-Theology*, he cautions his readers as to how they should interpret the scriptures. He begins by pointing out inconsistent representations of the sun and determines that the scriptures were designed "rather to instruct men in *Divine and Moral Doctrines*, than in *Philosophical Truths*" (Derham xxxiii). In spite of this warning, Derham's text includes both in-line and footnoted citations to biblical passages incorporated into scientific discourse. For instance, the fifth chapter includes a passage that reads:

> Why should we sacrifice our Innocence for it, or part even only with a Good Name for it, which *Solomon* saith (1) *is rather to be chosen than great Riches*? Why should we do this, if we were sure of gaining the whole terraqueous Globe, much less do it for a small pittance of it, as the best Empire in the world is? For as our blessed Saviour argues, Matt. 16. 26. *What is a man profited, if he shall gain the whole World, and lose his own Soul? or what shall a Man give in exchange for his Soul*? (Derham 221–222)(27)

<31>In a slight variation of Durham's inclusion of scripture, Bryan quotes passages, but does not provide any attribution, raising the question about whether knowledge of these ascriptions was expected of her community but not of Derham's. Bryan also varies her tactics when it comes to interspersing biblical information; in addition to direct quotation without credit, she occasionally paraphrases Psalms, and at one

point traces the history of astronomy to Genesis.(28) Lundeen also takes note of the following *Compendious System* passage, which concludes by excerpting the Book of Job, to illustrate the first of these strategies: "As the great Newton could not define the cause of gravity, it is not likely that we shall be able to discover what that penetrating genius could not fathom; let us then be satisfied with the benefits we derive from it, and with the knowledge he has afforded us of its nature, without attempting to penetrate its essence:---'For who can by searching find out God.'" (Bryan 17).(29) In another instance, Bryan precedes her consideration of the mind's operations with the following query: "He that made the eye, doth not he see?" (4). The closest match for that question comes from St. Augustine of Hippo's exposition of Psalm 39:16, but again, bibliographic information is not provided. Further, Lundeen argues that Bryan adapts Psalm 8.3–4 without using quotation marks. The Psalm reads, in part, "When I consider thy heavens, the work of thy fingers, the moon and the stars, / which thou hast ordained; / What is man, that thou art mindful of him?" (qtd. in Lundeen 6). Bryan's version, significantly longer,

> echoes the syntax and lexicon of the psalm: 'When we consider this power retaining the planets in their orbits, making them observe their proper distances from the sun and from each other, causing them to perform their regular returns of periods by which the utmost harmony prevails, how do we admire the wise adjustment of this complicated, yet simple, machinery, and bless that Power who formed, who directs, this invisible agent, the influence of which, were it one moment to cease or be diminished, would produce universal chaos in a system so perfectly, so harmoniously, beautiful!' (22). (Lundeen 6)(30)

Finally, in opening Lecture II with a history of astronomy, Bryan draws from Genesis, illustrating the necessity of that the science to Noah's descendants, as they needed to anticipate seasons for the planting and harvesting of necessary food (23).

<32>While much has been made of Bryan's association with Paley's 1802 *Natural Theology*, to gain more insight into Bryan's use of scripture in *Compendious System*, I suggest considering Paley's earlier publications as potential natural theological influences. Paley's first three publications were *The Principles of Moral and Political Philosophy* (1785), *Horae Paulinae* (1790), and *A View of the Evidences of Christianity* (1794). James Crimmins describes *Principles* as based on Paley's own lectures on ethics revised for publication, and notes that Paley's second and third books "were concerted attempts to prove the credibility of the New Testament as a historical record of revelation." Bryan was familiar with at least one of Paley's works when she was writing *Compendious System*, as she tells her students,

> I recommend those who doubt, to peruse Payler's [sic] Truths of Christianity, in which they will find ample sources of consolation and conviction. I will not invade the clerical province, by offering to establish truths, and confute erroneous opinions of religion, in this place, but conclude this part of the subject, by exhorting to guard against being misled by common opinions, by examining into the Truths of Christianity; and this I think it my duty to caution my pupils against, being conscious that any innovation in religion . . . is but the forerunner of its total destruction. (128)

Assuming Bryan meant Paley's 1794 *Evidences of Christianity*, she might have encountered this text if her school was indeed following Erasmus Darwin's curriculum, *A Plan for the Conduct of Female Education in Boarding Schools* (1797). Desmond King-Hele's biography of Darwin states that when his daughters established their school in 1794, they asked for his advice, which he wrote down for their use. Darwin's "manuscript was in great demand, and three years later he was persuaded to publish . . . it was circulated from 1794 onwards" (King-Hele 234–235). Thus, there exists the possibility that she learned about Paley's texts through Darwin, who recommends Paley's *Evidences* in the main text and two others in the catalogue of recommended books (60). In the "Morality" category, Darwin includes "Paley's System of Morality" and in the "Religion" section, he lists "Paley's Evidences of Christianity" (126). "System of Morality" most closely matches *The Principles of Moral and Political Philosophy*, so there is reason to believe Bryan might have accessed the work with just enough time incorporate its ideas into *Compendious System*. In the preface to *Principles*, Paley provides a literature review, in which he details what he understands to be the problems with contemporary texts on morality. Pertinent to Bryan's integration of scripture, Paley critiques morality publications because they "they divide too much the law of Nature from the precepts of Revelation; some authors industriously declining the mention of Scripture authorities, as belonging to a different province; and others reserving them for a separate volume: which appears to me much the same defect" (*Principles* iii). Thus, had Bryan read Paley's *Principles* and Derham's works, the latter of which is also mentioned in Darwin's catalogue, she would have been driven to integrate scripture by two sources.

<33>The goal of this article has been to illustrate the ways in which Margaret Bryan's natural theology is innovative, by considering her treatment of individual theological components against the backdrop of what was acceptable for contemporary astronomy writers, lecturers, and classroom teachers. Positioning her text alongside other astronomy and natural theology lectures calls attention to the fact that she does not follow one astro-theological model faithfully, but rather she

integrates facets of various theories, based on the need to customize her approach for her unique audience, thus deriving scientific authority from pedagogical authority. In order for Bryan to teach young women astronomy, religion, and morality—which were very much intertwined at the turn of the nineteenth century—she needed to draw on a diverse range of natural theological sources. She recovers astro-theology when it was unfashionable and departed from several notable Boyle lecturers on select features and models of Newtonian- and physico-theologies they presented. Bryan prioritizes the consideration of gender in choosing how to best represent natural theological components, such as the equality of physico-theological and astro-theological evidence, the uniformity of laws, analogy and the great chain of being, and lastly, the blended approach to merging scripture and science as encouraged by the works of William Derham and William Paley, who were most influential in Bryan's curation of natural theology to demonstrate the existence of God through astronomy.(31)

Notes

(1)In addition to expressing my gratitude to Professors Nicole Aljoe, Elizabeth Maddock Dillon, and Marina Leslie for their support and detailed feedback on an earlier version of this project, I want to thank to Dr. Sian Prosser at the Royal Astronomical Society for guiding my work with the Herschel archive in January 2016. Gregory Girolami and Nikki Lee have recently uncovered important biographical information about Margaret Bryan, née Haverkam, so I've chosen to use estimates of Bryan's birth and death dates based on their archival findings versus the 1760?–1816 dates that appear in previous scholarship. Girolami and Lee confirm that Bryan was baptized on October 12, 1759. Girolami, uncertain about where and when Bryan died, references a *Morning Post* (London) death record, consistent with Bryan's other biographical and geographical information, that indicates Bryan died on March 30, 1836, at age 79. This suggests a birth year of 1756 or 1757, which is possible given the confirmed christening date (Girolami 464). Lee confirms Bryan died on March 31, 1836, citing the E.D. Batson Executorship document ("Margaret" 33).(^)

(2)Bryan's astronomical writing also appears, to an undetermined extent, in a revision of John Wallis's board game, *Science in Sport, or the Pleasures of Astronomy*, which first went on sale in December 1804. For details on Bryan's involvement, game design and editions, as well as rules of play, see Melanie Keene and Voula Saridakis.(^)

(3)As further evidence of Bryan's independent astronomical work, Lee mentions that Bryan purchased a "4-inch Georgian reflector telescope from W. & J. Jones of Holborn" shortly after marrying her husband, William, on July 12, 1783 ("Margaret" 24). Lee also references a portrait of Bryan's Blackheath school, but I'm not confident that Bryan commissioned the observatory's construction. In an interview between Lee and Sue Bowler, Lee mentions a portrait of the school, "which shows the beautiful little wooden observatory she'd had built on the roof" ("Finding" 5.43). The reference to the observatory in Lee's longer article is as follows: "A contemporary illustration of Bryan House depicts the building in more detail with its rooftop wooden observatory . . . It is tempting to speculate that the lone figure of the woman in black at the front of the building, or the woman feeding ducks by the pond, is Margaret Bryan" ("Margaret" 77, 38n77).(^)

(4)Mary Brück describes the pattern of the 1806 lectures as including "an account of the wonders of the Almighty as revealed in the particular phenomenon under discussion, a discursive scientific explanation, and an account of the usefulness of these findings to the human race" (18). I do not find the structure of the 1797 lectures to be quite so formulaic; at times, natural theology begins *and* ends lectures, while in other instances, Bryan frames the discussion with thematically relevant poetry.(^)

(5)James Secord calls Paley's *Natural Theology* the "most widely circulated work in the tradition" (10), and Alan Rauch uses Maria Hack's (1777–1844) successful popularization of Paley, *Harry Beaufoy; or, the Pupil of Nature* (1821), as evidence that Paley's text "was important enough to need to be made accessible to children" ("Pupil of Nature" 78).(^)

(6)I acknowledge that where I see differences in Bryan and Paley's natural theologies, one reviewer in particular saw enough similarity to accuse Bryan of plagiarism. Lee points readers toward a particularly severe review published in an 1807 issue of *Monthly Literary Recreations*. The reviewer called *Lectures* "only a compound of Ferguson's Lectures and Paley's Natural Theology" (qtd. in Lee, "Margaret" 27, 39n90).(^)

(7)Gascoigne writes that natural history and anatomy are the two primary sources of evidence in *Natural Theology*, as Paley understood those subjects to be more appealing to readers, given the layperson's access to plants and animals versus objects in the heavens ("From Bentley" 232).(^)

(8)Girolami and Lee have unearthed important archival holdings contributing to a more nuanced breakdown of school operation dates and locations. For earlier records

of Bryan's schools, see: Bryan's *Orlando* entry, Gabriella Bernardi, Nicholas Hans, Voula Saridakis, Mary Brück, Melanie Keene, Patricia Phillips.(^)

(9)Perhaps in service of this point, Girolami mentions that an advertisement for Bryan's Tonbridge and Hadlow curriculum does not include "astronomy or any other aspect of natural philosophy" in the list of topics on which students are to receive instruction (462).(^)

(10)In contrast to Hans and Ogilvie's appraisal of Bryan's curriculum, *The Critical Review*'s January 1798 assessment of *Compendious System* deems Bryan's pedagogical approach innovative and original, not fitting into either of the "two systems contending with each other for the preference in female education" (72). The reviewer continues, "[b]etween the systems a third may be formed, in which regard shall be equally paid to personal and mental accomplishments; which shall accommodate knowledge to the sensibility of the female character; and which shall not give occasion to pedantry by too great an attention to abstruse studies, or, by the pursuit only of trivial accomplishments, become the school of coquetry. The system, in short, should elevate the virgin to the idea of being the rational companion to man, not the mere slave to his wanton pleasures. The amiable authoress of the work before us seems to have formed herself upon this plan; and no one seems better qualified for the task which she has undertaken" (72–73). The ingeniousness of her plan is worth emphasizing; she is not aligned with any of the contemporary, male-authored curricula for young women.(^)

(11)Lee shares other instances of Bryan's morality and loyalty, from her donning mourning dresses and making sure her wedding band was prominent in her first book's engraved frontispiece to her counseling students on what characteristics make for a "friend and husband" ("Margaret" 24–26).(^)

(12)For evidence of Bryan's success, see Hans pp. 203–204. Further, Lee cites Bryan's inclusion and flattering representation in the anonymously authored storybook, *The English Girl; A Tale for Children*, as evidence of Bryan's excellent reputation (27). Regarding Bryan's formal education, scholars have yet to discover where Bryan attended school, but Lee speculates that Bryan's guardian and maternal grandfather's friend, Joseph Green, might have influenced the twelve-year-old's scientific curiosities, and that her husband, William Bryan, was supportive of her professional endeavors (23–24). Separately, Girolami and Lee have recently identified Bryan's husband as William Bryan, not John Nesbit Bryan as mentioned in earlier research.(^)

(13)Lee points out that Paley's son, Edmund, subscribed to *Lectures* (24). Watts has gleaned from Bryan's subscriber lists that she "obviously moved in more conservative circles, having many contacts in the upper class and the established church" (59).(^)

(14)See John Mullan for genres and texts that were pivotal in popularizing Newtonianism for women readers.(^)

(15)See Meyer's *The Scientific Lady in England, 1650–1760.*(^)

(16)Almanacs did not have short shelf lives as one might expect; Hutton, for example, made 1704–1773's editions of *Ladies' Diary*, which ran from 1704–1841, available to readers by publishing five bound volumes of the almanac titled *The Diarian Miscellany: Consisting of All the Useful and Entertaining Parts, both Mathematical and Poetical, Extracted from the Ladies' Diary* (1775). And Thomas Leybourn (1770–1840), British mathematician and Sandhurst teacher, edited a four-volume collection of *Ladies' Diary* math problems, published as *The Mathematical Questions Proposed in the Ladies' Diary and Their Original Answers, together with Some New Solutions, from its Commencement in the Year 1704 to 1816* (1817). See Teri Perl for more on the *Ladies' Diary*.(^)

(17)And see note 6 above, wherein Bryan stands accused of plagiarizing Ferguson.(^)

(18)Both Schwartz and Gascoigne reference William Jones' *The Rhetoric of Science* (1966).(^)

(19)See Thackray p. 674.(^)

(20)I have found Al Coppola and Erin Webster useful to understanding these positions as well as how they were represented in literary works.(^)

(21)Patricia Phillips notes that women were invited to attend the Boyle lectures (124).(^)

(22)"Bentley's lectures were translated into Latin, German, French, and Dutch. See A.T. Bartholomew and J.W. Clarke, *Richard Bentley, D.D. A Bibliography of His Works and of All the Literature Called Forth by His Acts or His Writings* (Cambridge 1908), 1–9. Derham's lectures went through thirteen English editions by 1768 and translations into Dutch, English, Swedish and German. See John J. Dahm, "Science and Apologetics in the Early Boyle Lectures," *Church*

History, 39 (1970), 4, n. 17. Clarke's lectures were translated into French in 1717" (Jacob, *Newtonians* 162n2). Rousseau also tracks the popularity of Derham's 1713 *Physico-theology,* which was based on his Boyle lecture, documenting that it "went through 12 editions by 1754" (243n24). Derham's 1715 *Astro-Theology* "had gone to fourteen editions by 1777" (N. Gillespie, "Natural History" 48).(^)

(23)For an overview of the Clarke-Leibniz correspondence, see Gascoigne "Clarke," and for more on Johnson reading Clarke, see Jacob, *Newtonians* 162 and Schwartz 127.(^)

(24)For example, see paragraph 10 for Derham's literary impact.(^)

(25)See Brück 17.(^)

(26)Lundeen cites the 6th edition (1769).(^)

(27)The "(1)" here indicates a footnote for "*Prov*. 22. 1" (Derham 221n1).(^)

(28)Somewhat tangential to a discussion exclusively on scripture, Bryan also references sermons she has read aloud to her pupils (*Compendious System* 55).(^)

(29)Lundeen's references are to the third edition of *Compendious System* (1805), so her pagination and punctuation might be different from what is cited here. See pp. 22–23 of the third edition.(^)

(30)See pp. 16–17 of the first edition.(^)

(31)For more on publications known for their syntheses of astronomy and natural theology later in the century, see Pamela Gossin p. 242.(^)

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