

ABSTRACT

Title of Dissertation: BEAUTIFUL SCIENCE: VICTORIAN WOMEN'S
SCIENTIFIC POETRY AND PROSE

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Recent scholarship in literary studies and the history of science has demonstrated increasing interest in scientific writing by women. “Beautiful Science” investigates why form and genre are important interpretive tools—not static categories—for considering ways in which women entered Victorian scientific debates, how they accommodated scientific ideas for various audiences, and how formal tensions within their texts reveal broader intellectual frictions between secular and religious science in nineteenth-century Britain. Far from being marginal figures in scientific studies, the voices of these women were prominent, and their interpretations of contemporary theories shaped the reception of science among nonspecialists.

Literary forms and genres—including parables, fairy tales, verse dramas, novels, and comic poems—brought with them a wide horizon of readerly expectations into conversations about science. Deploying these genres for a variety of purposes, women science writers could deliver new knowledge in familiar, recognizable literary ways. My

first chapter uncovers Mary Somerville use of Byron's closet drama *Cain* both to explain an astronomical phenomenon, parallax, and to respond to the play's depiction of its protagonist's response to "sublime" astronomical distance. In chapter two, I demonstrate how Margaret Gatty and Arabella Buckley employ the genres of parable, beast fables, and fairy tales to negotiate the entangled debates of morality, religion, science, and education in the Victorian era. Chapter three suggests that reading George Eliot's early "Ilfracombe Journal," her *Westminster Review* essays, and *The Mill on the Floss* within a tradition of Victorian natural history writing illuminates matters of form and exchange within both natural history narratives and the development of the mid-Victorian novel. Lastly, in chapter four I argue Constance Naden's comic "Evolutional Erotics" poems and her philosophical poems all suggest an engagement with scientific and philosophical discourse at the level of prosody, particularly in Naden's choices of rhyme. As a whole, "Beautiful Science" argues that an examination of form and genre within both the nineteenth-century literary publishing world and the discourses of scientific popularization reveal the mutual exchange between both realms, and that Victorian women's writing makes these changes most visible.

BEAUTIFUL SCIENCE: VICTORIAN WOMEN'S SCIENTIFIC POETRY AND
PROSE

by

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Dedicated in memory of Lincoln McCausland Lang
Wildlife Biologist and Storyteller

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Introduction:

Women Writing Science

A reader opening A. S. Byatt's neo-Victorian novella "Morpho Eugenia," the first of the two tales composing *Angels and Insects* (1992), is likely to be struck by the resemblance of the naturalist protagonist, William Adamson, to his historical counterparts, Charles Darwin and Alfred Russel Wallace. Adamson returns to England in 1859, following a ten-year natural history expedition to the Amazon, and finds employment in the household of his aristocratic patron, Lord Alabaster. There he soon falls in love with and marries the oldest Alabaster daughter, the voluptuous Eugenia, and continues his entomological studies, observing the estate's ant colonies in the company of the slender Matty Compton, a young woman employed along with the governess and nursemaid in the care of the youngest Alabaster children. One of Byatt's focal points in the novella is the debate between Adamson—the name is a telling irony—and Harald Alabaster, who is writing a book defending natural theology from the atheistic materialism gaining prominence in the wake of Darwin's *On the Origin of Species* (1859) and other evolutionary texts. But Byatt also draws attention to her female characters using symbolism, contrasting the insects occupying Adamson's studies. First compared to the butterflies that comprise the collection William has been sending to her father from the Amazon, Eugenia takes on the luxuries of a queen bee as she gives birth to multiple children over the years, and even William compares himself to an enthralled drone; the taciturn, industrious Matty Compton resembles the dark ants she studies and draws.

As years pass, Eugenia retreats and emerges with regularity from one confinement to another, giving birth to five children. In these intervals, William focuses his attention on

studying and documenting Bredely Hall's ant colonies with Matty, and the two work together drafting *The Swarming City: A Natural History of a Woodland Society, its polity, its economy, its arms and defences, its origin, expansion and decline*. While William writes, Matty reads and revises the drafts. With his attention on natural history, William remains oblivious to the inner life of Bredely Hall (another ironic name), and only discovers the true, incestuous nature of the relationship between his wife and brother-in-law by accident. William's search for the truth of natural history blinds him to the reality of his own domestic life.

If Byatt's novella takes a naturalist's search for truth and origins as one theme, it likewise presents a heroine in the guise of Matty Compton. Wise both to the workings of the household and to the entomology she studies, Matty—or Matilda, as she finally tells William she ought to be called—not only illustrates the book on which she and William are working, but also writes a story of her own, too. Titled “Things are Not What they Seem,” Matty's “instructive fable” of magic narrates the adventures of a man named Seth among ants, caterpillars, and moths after he is enchanted by a Circe-like witch. If William Adamson immediately brings to mind Darwin, Wallace, and other Victorian naturalists, the inspirations for Matilda Compton's character are far less easily named. Narratives of Victorian science have only recently begun to include the contributions of women naturalists and writers, and most such histories often simply document their work as “popularizers,” writers who sought to extend scientific knowledge to broader audiences outside the professional world of science. But the forms in which women delivered scientific knowledge—the literary clothes in which they dressed such science—deserve further attention. Just as Matilda's instructive fable allegorizes William's life at

Bredely Hall and foreshadows the outcome of the plot, the tale likewise reminds today's readers that Victorian scientific women often called upon a variety of genres to instruct their readers, incorporating natural history and physical science into fantastical tales, realistic novels, and comic poems.

For much of the twentieth century, the most common stories of Victorian science have featured men like Charles Darwin, Robert Chambers, Michael Faraday, Charles Lyell, James Clerk Maxwell, or John Tyndall. But things were not what such a narrative would make it seem: Victorian women, too, conducted experiments, made observations, and shared their work with others. Byatt's novella reminds readers not simply that famous male scientists collaborated with women on their studies, but that women were investigators in their own right, and that they frequently found suitable outlets for their research and ideas in venues outside the professional communications of scientists. Like "Morpho Eugenia," this dissertation looks back to the nineteenth century and finds surprising examples of women's writings that were both instructive and entertaining. In Victorian women's scientific poetry and prose, literary genres and scientific theories inform and shape one other.

* * *

"Beautiful Science: Victorian Women's Poetry and Prose" is a study of why genre and form were important for the communication and interpretation of science in nineteenth-century Britain. More specifically, it is an examination of the genres women writers used for these purposes, and of how and why such women came to be the most frequent authors of works within a variety of genres and forms used to circulate and critique scientific ideas. "Genre" and "form" can be slippery categories, and classifying

them is not the primary aim of this project; however, their usage in the study at hand should be defined at the outset. By genre, I mean the kinds or categories of stories and poems, such as epic, romance, tragedy, comedy, and so on. A genre brings with it a range of writerly and readerly expectations, including theme, style, vocabulary, syntax, and allusion. Form refers to the type of text under consideration, like poem, prose, or drama; “poetic form” refers to matters usually outside a poem’s content and context.¹ Genre here is a conceptual category: it refers to features and elements texts share independent of the textual means of delivery. Form is a structural description, referring to the shape and composition of the text under scrutiny. Prose forms might be described according to length or its composite units, such as chapters, paragraphs, or sentences; and poetic forms are often categorized according their stanza types or meter. So while scientific popularizations might together fall under the umbrella of genre, the forms in which popularizations took shape varied considerably. Lectures, essays, and guides may have been the most common forms of popularization, but this dissertation adds fantastical tales for children, poems, natural history narratives, and novels to this list. The four chapters composing this study examine, respectively, a book synthesizing science for both women and fellow scientific practitioners; didactic books of natural history and physical science for children; realistic fiction written during the height of marine botanizing and “fern fever”; and poetry written in the wake of Darwin’s theories of natural and sexual

¹ For concise explanations of current understandings of genre and form, Susan J. Wolfson’s entry on “form” and Max Cavitch’s entry on “genre” in the 4th edition of *The Princeton Encyclopedia of Poetry & Poetics* (2012) are excellent references. Cavitch’s essay is particularly salient on our contemporary moment’s understanding of the novel as a synecdoche for genre (553). I say poetic form refers to matters “usually” outside a poem’s content and context because the field of Victorian historical poetics has suggested the variety of ways nineteenth-century poetic forms were not fixed categories, either. I discuss the contingencies of poetic form in greater detail in chapter four.

selection. Victorian women's science writing constitutes its own dynamic genre, full of variety and worthy of increased scholarly attention.

For reasons having to do with Victorian gender and class expectations for women, their access to formal education (or lack thereof), and the kinds of writing deemed acceptable or most suitable for them, women interested in studying and sharing science used a number of available genres: stories for children, handbooks, illustrated guides, poetry, and novels. They shaped their subject according to their intended audiences and according to their own interpretation of the scientific topic at hand. This shaping of a scientific idea within the genre likewise registered in the form or shape of the genre itself. Often women's inclusion of scientific ideas led other writers to follow suit, and sometimes genres themselves changed accordingly. Thus this dissertation understands a few key ideas as guiding premises: first, Victorian science was not an objective mode of inquiry but rather a communicative practice shared among a large group of practitioners and popularizers; second, that genres are not static categories but historically contingent; and third, that scientific practices and their literary transmission within a range of genres and forms mutually informed each other. Most crucially, this dissertation suggests that because of the contingencies of class, sex, and education, texts by Victorian women writers make these guiding premises most visible: while men with scientific interests could enter the professional realm and communicate their ideas in established journals and educational institutions, most Victorian women did not have this option until late in the century. To interpret science for nonspecialist audiences, women often needed to adopt creative strategies and forms; thus many of the innovations in forms used to communicate science were penned by women. Of course, men also participated in the

discourse of scientific communication, popularization, and interpretation, and thanks to literary and rhetorical histories, their efforts have been prominent. “Beautiful Science” instead places women’s accomplishments in the genres of scientific writing at its center.

To mention a project on nineteenth-century British women’s science writing has seemingly meant inviting one question more often than any other: “Are you working on Mary Shelley’s *Frankenstein*?” Though Shelley’s novel does not occupy a central place in this dissertation, it is an appropriate point at which to begin because the texts examined in the following chapters vary so dramatically from *Frankenstein*’s themes. According to Shelley’s account in her introduction to the 1831 edition of *Frankenstein*, the novel began in response to a storytelling challenge among Percy and Mary’s friends, including George Gordon, Lord Byron, gathered on the shores of Lake Geneva in June 1816. The group had been having a conversation about the principle of life, galvanism, and reanimation (Shelley 189), and Shelley recounts having had a frightful dream the night of the discussion in which a “pale student of unhallowed arts” brings to life a terrible counterfeit of a man. The scene, Shelley explains, would necessarily be alarming:

Frightful it must be; for supremely frightful would be the effect of any human endeavor to mock the stupendous mechanism of the Creator of the world. His success would terrify the artist; he would rush away from his odious handiwork, horror-stricken. (190)

In her dream and in the novel’s plot, Shelley’s grim perspective on the dangers of scientific ambition and the arrogation of divine powers of creation is clear: she demonizes a scientific method that fails to consider repercussions and rushes headlong after glory. Victor Frankenstein cannot escape from the guilt and grief caused by his

creation of the wretch; the creature likewise never receives the understanding and love he so desperately craves, becoming disgusted with his own existence; and Robert Walton, the ship captain who hears the confessions of both Victor and the creature, turns his ship around, saving the lives of his crew but abandoning his hopes for fame. Frequently symbolizing the peril of Victor's decisions in sublime scenery, including jagged Alpine peaks and frozen Arctic wastes, Shelley's novel counsels caution in the pursuit of scientific endeavors. Just as Keats famously lamented Newtonian science's destruction of "all the poetry of the rainbow," and Wordsworth deplored the "middling" human intellect's tendency to "murder to dissect" the beauties of nature, Shelley's *Frankenstein* participated in a wider Romantic conversation that esteemed poetry and imagination over the banal prose of experiment and scientific investigation.² It also juxtaposed the sublime and the beautiful. But for a number of the women writers discussed in this dissertation, such a distinction was a false opposition: sublimity could also be beautiful.

Though the Romantic generation of poets and novelists epitomized in Wordsworth, Keats, Byron, and the Shelleys may not have celebrated developments in natural philosophy, many of their comrades looked forward with optimism to scientific discovery and found beauty—not terror—in observation and experiment. Samuel Taylor Coleridge attended meetings of the British Association for the Advancement of Science (BAAS), and astronomers like William Herschel (1738-1822) and chemists such as Humphry Davy (1778-1829) eagerly anticipated the advancements science would offer, inspiring the likes of David Brewster, Michael Faraday, John Herschel, William Whewell, and

² Keats's remark came at the "immortal dinner" hosted by Benjamin Haydon in December 1817 (Holmes 318-319). Wordsworth's lines appear in "The Tables Turned," a poem printed in the *Lyrical Ballads* he first published with Samuel Taylor Coleridge in 1798.

many others. The women whose work comprises the subjects of this dissertation's chapters belong to this latter community of scientific investigators and advocates. Unlike Shelley's *Frankenstein*, books and poems by these women present a range of optimistic perspectives of science. Their engagement with scientific theories is not unequivocal, however: to be a proponent of science generally is not necessarily to agree with each individual theory. But the project of science for the women considered in the following chapters is one alive to the promise of scientific inquiry and progress, rather than one marked by fearful apprehension.

While still relatively unfamiliar to many scholars of nineteenth-century Britain, the list of women science writers is long. This dissertation only studies a select few, according to the variety of their generic choices in communicating and interpreting science: Mary Somerville (1780-1872), Margaret Gatty (1809-1873), Arabella Buckley (1840-1929), George Eliot, the pen name of Mary Anne Evans (1819-1880), and Constance Naden (1858-1889). To these five, one might easily add women botanists like Pricilla Wakefield (1751-1832), Sarah Bowdich Lee (1791-1856), Elizabeth Twining (1805-1889), Anne Pratt (1806-1893), Jane Loudon (1807-1858), Phebe Lankester (1825-1900), and suffragist Lydia Becker (1827-1890). Aside from Mary Somerville, other nineteenth-century women astronomers included Caroline Herschel (1750-1848); Rosina Zornlin (1795-1859), whose interests also included geology and geography; Margaret Bryan (1797-1815); Mary Ward (1827-1869), who likewise wrote about microscopy for children; Agnes Clerke (1842-1907); and Agnes Giberne (1845-1939). On chemistry and natural philosophy, Jane Marcet (1769-1859) could just as easily occupy a chapter of this dissertation, as could Delvalle Lowry Varley's books on mineralogy, the writings on

natural history by the Kirby sisters, Mary (1817-1893) and Elizabeth (1823-1873), or Elizabeth Brightwen's (1830-1906) *fin de siècle* accounts of evolutionary biology. A future iteration of this project might entirely focus on genres these neglected women of science chose for communicating science. For example, Jane Marcet authored a fictional travel and natural history narrative, voiced by a young woman who moves to England after her father's death, entitled *Bertha's Visit to Her Uncle in England* (1830). Before becoming known for her botanical writings and illustrations, Jane Loudon wrote a novel set in the future called *The Mummy!* (1827); and the Kirby sisters wrote books for children both about natural history and the goods and technologies that Britain brought home from across its empire, including tea, china, coffee, and sugar.³

"Beautiful Science" strives to demonstrate the importance behind the varied genres chosen by women in thinking about, teaching, debating, and extending scientific knowledge during the Victorian era, and to show how important those particular choices were. These selected writers—Mary Somerville, Margaret Gatty, Arabella Buckley, George Eliot, and Constance Naden—share a common purpose to communicate scientific ideas to a wide readership, yet the shapes and styles of their texts differ dramatically. Though they belong to a wide tradition of women's writing, these women are exceptional cases, rather than representative: they warrant scholarly attention because of the particular ways they used poetry or prose to communicate science. I broadly construe "science writer" to include not only the expository works by practitioners working within the active community of investigators, but also the writers who hoped to "popularize"

³ The Kirby sisters' works, *Things in the Forest* (1861) and *Aunt Martha's Corner Cupboard* (1875) can be found in one of the volumes of Bernard Lightman's series on nineteenth-century science writing, *Science Writing by Women* (2004).

science—accommodating it for a nonspecialist audiences—and those who included science within forms characterized as *belles lettres*: that is, in fiction and poetry. Poets and novelists across the nineteenth century not only incorporated science into their literary texts, they offered important interpretations of science as well. Across these varying genres, women science writers tackled similar problems, and certain features emerge when looking at their texts as a long tradition across the nineteenth century.

These, then, are the themes this dissertation traces in each chapter: first, scientific texts by women, like those of their male counterparts, frequently participate in the discourse of the sublime. However, the affective register of this discourse in women's texts more often promotes scientific inquiry as a pleasurable study rather than one of self-sacrifice or moral duty as it has appeared in texts by men. Focusing on this ethos of pleasure, this dissertation describes an engagement with science concurrent with, but separate from, both the ascetic impulse behind Victorian scientists' quest for truth and the pragmatic aims of "useful" science. Second, scientific texts by women commonly feature the longstanding tension between religious and secular science, but their texts engaged the debate obliquely: that is, in writings distinct from essays addressing the debate itself. As many women sought to align scientific inquiry with religious faith, they chose genres befitting this difficult challenge, and the textual frictions emerging from this project show how unconventional genres were either adept at or insufficient for blending religious and secular beliefs. Lastly, as women gained entry into higher education and began to study scientific fields, their formal innovations used to popularize science diminished, paralleling the gradual reification of literary versus scientific genres or forms along

disciplinary lines by the end of the century that eventually led C. P. Snow to advance his model of the “two cultures” by the middle of the twentieth century.⁴

In contrast to recent scholarship that primarily discusses women’s science writing thematically and historically as part of a broad rehabilitation of Victorian popular science, I argue the literary elements of scientific discourse—by which I mean matters of form, genre, characterization, and narrative, among other devices—belong at the center of these histories. A number of literary scholars and historians of science, like Gillian Beer, George Levine, James Secord, Bernard Lightman, and Greg Myers, have already shown the ways in which popularizations of science by both men and women shaped public understanding of professional science, sometimes even more than professional men of science did in their own published work. Yet the manner of such shaping—how such popular texts went about this work of influencing their audiences—can be articulated more thoroughly in literary studies, using methods common among rhetoric scholars.⁵ Absent from many histories of Victorian science are detailed discussions of genre and how writers used familiar literary forms to transform scientific knowledge into

⁴ “The Two Cultures” was the title of the first part of Snow’s 1959 Rede Lecture at Cambridge University, based on an essay of the same name he’d published in 1956 in *The New Statesman*. Snow also published it as a book. In it, Snow argued that intellectual culture had been starkly divided between science and the humanities. In the Victorian era, however, this distinction had not fully come into being, though examples existed, like George Henry Lewes’s division in 1852 between science as “an expression of the forms and order of Nature” and literature as an “expression of the forms and order of human life” (46). The debate between T. H. Huxley and Matthew Arnold in the 1880s concerning an education based in the sciences versus one emphasizing the classics and liberal arts, respectively, is the most famous Victorian example.

⁵ In *Darwin’s Plots*, Gillian Beer examines Darwin’s rhetoric to reveal how he, like other such scientific men, “drew openly upon literary, historical and philosophical material as part of their arguments” (5). In *Rhetorical Figures in Science*, Jeanne Fahnestock traces the importance of series reasoning, demonstrating how Darwin’s use of figures like gradatio and incrementum proved crucial for supporting his central claims (114); and in *Rhetorical Style*, she demonstrates how the figure of amplification pervades the last paragraph of *Origin*, prompting Darwin’s readers to see evolutionary development as a sublime process.

wide understanding. Aside from discussions of how evolutionary thinking pervaded the Victorian novel after Darwin, relatively few scholars have analyzed what happened to literary genres like the fairy tale or forms like poetry in the nineteenth century once they were deployed for the popularization of science.⁶ Many of the most widely read of these popularizations were written by women. Thus, I contend such women had a critical impact on the reception of science throughout the nineteenth century, just as they fundamentally altered genres traditionally viewed as literary once they used them to transform science.

This study benefits from a corpus of works in a number of disciplines: the history and philosophy of science, the rhetoric of science, and literature and science studies. Works within the history of science are numerous, and David Elliston Allen's *The Naturalist in Britain* (1976) still serves as excellent introduction to the major figures of the eighteenth and nineteenth centuries. For the purposes of this project, histories that have highlighted science as a communicative and interpretive practice are most relevant. Thus sociological histories like Steven Shapin and Simon Schaffer's *Leviathan and the Air Pump: Hobbes, Boyle, and the Experimental Life* (1985), while not focused on the historical period at hand, offer a germane account of how Enlightenment science relied on literary technologies to argue for the validity of experimental practice. In

*Modest_Witness@Second_Millennium.FemaleMan©_Meets_OncoMouse*TM (1997),

Donna Haraway offers a vital interrogation of the experimental practice Shapin and

⁶ The field of nineteenth-century literature and science has grown dramatically over the past thirty years, and most of the work considering science's pervasiveness has focused on the Victorian novel. Gillian Beer, George Levine, Sally Shuttleworth, and John Christie have written some of the most foundational studies in the discipline. More recent studies have examined how Victorian science likewise pervaded poetry, including work by Barbara Gates, Barri Gold, Anna

Schaffer describe, demonstrating the ways it marginalized women and set the stage for the gendering of science and for centuries of essentialist thinking about sexual difference. Because of the essentializing conflation of women's intellect with their bodies, Haraway argues, there was no way for them to be the "modest witness" esteemed by scientific men like Robert Boyle. Feminist philosophers of science offer similarly important examinations of science's marginalization of women throughout its long history, including Evelyn Fox Keller's *Reflections on Gender and Science* (1985); Sandra Harding's *The Science Question in Feminism* (1986) and *Whose Science? Whose Knowledge? Thinking from Women's Lives* (1991); Londa Schiebinger's *The Mind Has No Sex? Women in the Origins of Modern Science* (1989) and *Nature's Body: Gender in the Making of Modern Science* (1993); and *Body/Politics: Women and the Discourses of Science* (1990), a volume of essays edited by Mary Jacobus, Evelyn Fox Keller, and Sally Shuttleworth. These accounts have taken science since the Enlightenment to task, interrogating its personification of nature as female, full of secrets that were the domain of science to uncover. Schiebinger's essay, "The Philosopher's Beard: Women and Gender in Science" (2003) demonstrates also how women's access to science was more diverse across Europe during the eighteenth century, and that status offered women the means of providing patronage in exchange for scientific knowledge (188). Yet for most women, access to scientific communities was always mediated by men—husbands, companions, and tutors (189). Though the Cartesian divide between mind and body had given rise to the notion that "the mind has no sex," epistemological practices of

Henchman, John Holmes, Alice Jenkins, and Jason Rudy. Of this list of scholars, only Barbara Gates has focused exclusively on women's popularizations.

observation led to experiments measuring the body and associating sexual differences with women's intellectual inferiority.

Within rhetoric of science studies, the sense of a “rhetorical turn,” a phrase coined by Richard Rorty in 1984, remains important for this dissertation's focus on the practices and processes of science, rather than its products, and upon the communities sharing their work with each other, not just upon the work they do in laboratories.⁷ Alan G. Gross's *Rhetoric of Science* (1990) likewise examines the rhetorical constitution of knowledge. Jeanne Fahnestock's *Rhetorical Figures in Science* (1999) offers a vital examination of the tools of scientific argument beyond the use of metaphor and argues for the importance of figuration in how scientific writings shape their meanings, while Greg Myers's essay on Jane Marcet's *Conversations* series, “Science for Women and Children: the Dialogue of Popular Science in the Nineteenth Century” (1989), has provided a particularly helpful model for examining the import of specific genres and forms of early nineteenth-century scientific popularization.

The field of literature and science gets richer with each passing year, especially in scholarship on the nineteenth century. Foundational scholarship on Victorian writers' intellectual engagement with contemporary science appear in works like Gillian Beer's *Darwin's Plots* (1983), Sally Shuttleworth's *George Eliot and Nineteenth-Century Science* (1984), George Levine's *Darwin and the Novelists* (1988), and John Christie and Sally Shuttleworth's *Nature Transfigured: Science and Literature, 1700-1900* (1989). This dissertation also draws upon Beer's and Levine's subsequent works, including, respectively, *Open Fields: Science in Cultural Encounter* (1996) and *Dying to Know:*

Scientific Epistemology and Narrative in Victorian England (2002). In addition to *Dying to Know*, Lorraine Daston and Peter Galison's chapter on the "scientific self" in *Objectivity* (2007) has been important for understanding the ethos or character of Victorian empiricism as a practice that sought to eliminate the self in its quest for objectivity (Daston and Galison 197), a practice at considerable remove from the women popularizers. Histories of popularization have been crucial to this project in their recovery of many Victorian writers who had fallen into obscurity. Notable texts in this area include Bernard Lightman's *Victorian Science in Context* (1997) and *Victorian Popularizers of Science: Designing Nature for New Audiences* (2007), as well as a collection of essays Lightman edited with Aileen Fyfe, *Science in the Marketplace: Nineteenth Century Sites and Experiences* (2007).

Without the recuperative scholarship of Ann B. Shteir and Barbara T. Gates, however, most of this dissertation's analysis would not have been possible. Shteir's *Cultivating Women, Cultivating Science* (1996) and Gates's *Kindred Nature: Victorian and Edwardian Women Embrace the Living World* (1998), along with their collected edition of essays, *Natural Eloquence: Women Reinscribe Science* (1997) demonstrated ways in which women's importance to nineteenth-century science could be articulated, enlarging the field of literature and science to include women's scientific writing. Gates's anthology, *In Nature's Name: An Anthology of Women's Writing and Illustration, 1780-1830* (2002) remains the only work of its kind, though Lightman and James Secord have each edited collected works by women, making accessible some work that now exists

⁷ On the "rhetorical turn," see also Randy Allen Harris's introduction to *Landmark Essays on Rhetoric of Science: Case Studies* (1997).

only in a handful of libraries around the world.⁸ Exciting recent scholarship on nineteenth-century literature and science include Alice Jenkins's *Space and the 'March of Mind': Literature and the Physical Sciences in Britain, 1815-1850* (2007), William A. Cohen's *Embodied: Victorian Literature and the Senses* (2009), John Holmes's *Darwin's Bards: British and American Poetry in the Age of Evolution* (2009), Jason R. Rudy's *Electric Meters: Victorian Physiological Poetics* (2009), Barri J. Gold's *Thermopoetics: Energy in Victorian Literature and Science* (2010), and Daniel Brown's *The Poetry of Victorian Scientists: Style, Science and Nonsense* (2013). Anna Henchman's *The Starry Sky Within: Astronomy & the Reach of the Mind in Victorian Literature* (2014) is the most recent book to join this list, appearing just as this dissertation was being prepared for its defense.

Because their examinations of evolutionary theory's pervasiveness in Victorian intellectual history have been foundational for Victorian literature and science studies, "Beautiful Science" relies especially upon the work of Beer and Levine. In *Darwin's Plots*, Beer traces the intellectual excitement that followed in the wake of Darwin's *Origin* and *The Descent of Man* (1871), and she focuses not only on writers who were known to have read Darwin, but on Darwin's writing itself, identifying the ways in which Darwin's thought was influenced by his own reading and how it shaped both the content (Malthus, for example) and the style of his arguments. Levine's approach differs from Beer's in his interest on the assumptions the public made about evolutionary science—rather than its direct influences—and his emphasis on science as a "cultural discourse" and "cultural formation" underlies my understanding of scientific practices and

⁸ See James A. Secord, *Collected Works of Mary Somerville*, 9 vols. (2004) and Bernard

exchanges among a variety of communities. Levine traces the presence of evolutionary ideas in the imaginations of writers who had not necessarily read Darwin directly, demonstrating the pervasive diffusion of this theory into Victorian intellectual life and beyond.

Likewise, Bernard Lightman's history of Victorian popularization provides biographical introductions to some of the women this dissertation discusses, and his *Victorian Popularizers of Science* supplies detailed examples of scientific accommodation in a particular historical moment and a coherent sense of how the practice of popularization changed over the century. Acknowledging the vexed usage of the terms "popular" and "popularization," Lightman prefers it to alternatives like "vernacular" and "commercial," though both of those have useful applications, as Lightman notes, but neither sufficiently covers the breadth of popularization within the Victorian era (*Victorian Popularizers* 10). Therefore, I try to use the terms communication, interpretation, accommodation, and popularization with care, designating the various contexts in which writers adapted their prose according to the audience they addressed, and when I use the term popularization, I mean it in its broadest sense of speaking to a public with varying degrees of knowledge, without focusing on its pejorative connotations. Lightman's *Victorian Popularizers of Science* has been an especially useful reference in researching this dissertation, demonstrating the different traditions in which writers of science were working, like that among clergymen, the "maternal tradition" from which women science writers were able to draw their

Lightman's *Science Writing by Women*, 7 vols. (2004).

authorities as writers of moral education, and the variety of forms in which science was made popular, including visual means of lecture demonstration and spectacle.

Shteir and Gates have provided this dissertation's most relevant models for examining women's scientific writing. Shteir's *Cultivating Women, Cultivating Science* demonstrates how women in the early nineteenth century were actively engaged in botanical study and prolific in sharing their knowledge across a variety of genres including verse, juvenile natural history books, novels, and introductory books for family-based education (5). My study's analysis of women's accommodations of physical science throughout the nineteenth century finds a model in Shteir's book, which focuses solely on botany in the earlier period of the late-eighteenth and early-nineteenth centuries. Though Shteir arranges her book according to genre, she does not interrogate genre and form as interpretive tools in the same way as this dissertation. Her chapter "Elegant Recreations? Configuring Science Writing for Women," however, does trace ways in which generic changes occurred in tandem with institutional changes and how a number of formal innovations by women paved the way for men to do similar kinds of science writing (236). Shteir's observation here became one of the premises informing my analysis of Margaret Gatty and Arabella Buckley in chapter two. Barbara Gates's volumes likewise collect and examine the genres of women's science writing. *Kindred Nature* traces women's engagement with the natural world, highlighting nineteenth-century modes of nature writing. Gates considers the parallel work of women as popularizers, illustrators, and collectors; but she also demonstrates how such work led women toward activist roles on nature's behalf, marking the fledgling disciplines of ecological and environmental writing.

“Beautiful Science” focuses these ongoing conversations about women’s responses to and communication of science via an examination of genre to suggest both what is literary about Victorian science, and how adept women writers were at finding salient methods of accommodating science for new audiences. In “Reflections on Popular Science in Britain: Genres, Categories, and Historians” (2009), Ralph O’Connor argues that “a closer and more systematic engagement with literary history, especially in relation to genre, has the potential to transform our understanding of science as a set of communicative practices” (333). Published in *Isis*, the professional journal of the History of Science Society, O’Connor’s essay makes a case for eroding some of the disciplinary boundaries between histories of science and of literature (337). “Literary craft has always been a vital part of science popularization,” writes O’Connor, “and an understanding of genre is needed to appreciate how these texts were written and read” (338). “Beautiful Science” represents one possible response to O’Connor’s call. It likewise makes women’s scientific writing one locus of a fluid, dynamic dialectical relationship between “discourse” and “genre” (Williams 520). As Victorian scientific “discourse” names a set of cultural practices, so too should “genre” name a cultural as well as literary category. Throughout the following four chapters, I strive to demonstrate the ways in which using genre as an interpretive tool, not a prescriptive category, might illuminate how Victorian women writers shaped contemporary science for their readers, and how scientific culture took its varied forms.

Chapter one begins this study of genres of science by considering ways in which the discourse of the sublime pervades and exceeds Mary Somerville’s otherwise unembellished delivery of scientific terminology and phenomena in *On the Connexion of*

the Physical Sciences (1834). Focusing on a woman famous among her contemporaries for the communication of the most current discoveries and theories in physical science, this chapter examines the rhetorical devices and poetical allusions Somerville uses to synthesize and accommodate scientific knowledge for a wide audience. Called the “queen of science” at her death, Somerville translated Pierre Simon Laplace’s book on celestial mechanics, wrote a synthesizing work of physical science that was read by some of the most prolific Victorian poets and novelists, and extended her research into the most up-to-date studies of geography, microscopy, and molecular biology. Her *Personal Recollections* gained wide interest for its account of her journey from being a self-taught young woman in Scotland to become a woman eminent among the ranks of Europe’s pre-eminent scientific circles. This chapter focuses on Somerville’s *Connexion* as a work ostensibly directed to a female audience, yet serving also the research of men working in the professional community of science. If Somerville’s genre was an early version or prototype of what today we think of a science textbook, this chapter demonstrates what that generic category could not readily accommodate or contain within its boundaries: the linguistic, aesthetic, and intellectual discourses of the sublime. That is, the sublime cannot be bounded by any one genre, and noting its deployment in early nineteenth-century science can offer insight into the nuances of scientific debate. Alluding to lines from Byron’s play *Cain*, Somerville’s chapter on parallax in particular suggests both a way to understanding an astronomical concept and to interpreting its significance. Somerville’s book of physical science rejects the disenchanted sentiment found within Byron’s play and aligns Victorian physical science instead with a Kantian ideal.

Chapter two examines juvenile books of science that use fable and fairy tale genres to evoke children's wonder and imagination to embark on scientific inquiry. Because of these chosen genres, the works of Margaret Gatty and Arabella Buckley stand apart from texts by their contemporaries that prompted similar affects but used conventional descriptive prose. Gatty's and Buckley's books demonstrate the generic tensions emerging from the combination of religious and scientific discourses. Choosing genres that call to mind systems of belief and imaginative states of mind, Gatty and Buckley found spaces in which to develop science as a similar practice. But their books also reveal how these mental stances did not sit easily with each other, and an examination of genre demonstrates where these texts fall short of their stated aims. At the same time, I argue we can locate many of the tensions between religious and secular science within the frictions generated by the inclusion of scientific ideas, especially in the wake of Darwinism in the second half of the century. That is, the tensions between spiritual belief and scientific practice found in Gatty's and Buckley's volumes can be productive for today's reader who discerns the limitations of the chosen genres for their intended purposes. Further, Gatty and Buckley offered their contemporaries examples of what fables and fairy tales could look like once scientific ideas were included, shaping the ways these genres would develop in coming decades. Works by Lewis Carroll, Charles Kingsley, and Rudyard Kipling, for instance, bear the traces of Gatty and Buckley's forays into fantastic tales.

Chapter three turns to the novel, a genre and form capacious enough to incorporate a multitude of themes timely for the Victorians. As one of the most respected Victorian novelists—and among those most often examined in today's literary scholarship—

George Eliot was remarkable in her attention to science as both a theme and a methodology. Her novels' attention to both development over time in nature and the education of girls in a novel like *The Mill on the Floss* (1860) makes it relevant for this dissertation's examination of genre and gender. While previous scholars have traced the images of natural history in *Mill*, this chapter demonstrates the ways George Eliot's formal methodology finds inspiration in the natural history narratives that were so popular in the two decades leading up to the *Mill*'s publication. Though Eliot read Darwin's *Origin of Species* almost immediately upon its publication in October 1859, she had already nearly completed her draft of *Mill*, and I suggest her prose owes more to the kinds of handbooks that her female contemporaries were publishing than an account of her Darwinian influences would have today's reader believe. Looking to the coastal holiday she took with George Henry Lewes in the summer of 1856 and the essays she wrote for the *Westminster Review* that autumn, I demonstrate how George Eliot's fiction presents the most relevant case study for the mutual influence of natural history and fictional narratives at mid-century. The imagery of *The Mill on the Floss*, its presentation of Maggie's impetuous but curious character, and its meditation on the influences of heredity, environment, and chance all place it not merely within a conversation about Darwinian evolution, but rather in a wider discourse of women's natural history narratives.

Chapter four concludes this study with an examination of Constance Naden's comic and philosophical poetry. Of all the women writers studied in this dissertation, Naden enjoyed the most extensive formal scientific education, and she was a poet as well. Her poetry offers insight into her efforts to combine both scientific parody and philosophical

contemplation. This chapter examines both, identifying the poetic forms Naden employed to interpret the implications of Darwinian sexual selection on the one hand and to incorporate an atheistic, materialist philosophy on the other. Naden's abandonment of such a project through poetry suggests that while many women at the *fin de siècle* used poetry to satirize Darwin, her own ambitions found poetry too confining as a genre. As much as women science writers earlier in the century had found success in adapting and transforming genres for their purposes, Naden held on to fixed notions of a division between scientific and literary genres. Thus where this dissertation begins at a time when a range of genres and styles of delivery stood available for women's accommodations of science, it ends in the decades when the divisions between "science" and "literature" began to harden. As disciplinarity became a fixture of the late nineteenth and the twentieth centuries, the discourses of science and the humanities likewise seemed to diverge. This dissertation's use of genre as an interpretive tool to examine these discourses in the Victorian era can likewise suggest that seemingly fixed literary categories applied today—like romance, science fiction, fiction, poetry—have similarly permeable boundaries when it comes to the treatment, exposure, and acceptance of scientific ideas.

* * *

Perhaps one more reading of Shelley's *Frankenstein* should suggest that the novel is invested more in the absence of women in the creative process and practice of science than it is in undermining the discipline as a whole. Conspicuously absent from Shelley's novel are women in general, and mothers in particular. Victor's dead mother is a ghostly presence over the whole family during his youth, while his creation—the monster itself—

destroys the Frankenstein family's ward, Justine, and Victor's bride, Elizabeth. If Shelley's novel condemns scientific hubris on the one hand, it counsels the inclusion of women's morals and sentiment on the other. The following chapters suggest what such an inclusion offered British science over the rest of the nineteenth century: a sense of the aesthetic beauty of physical laws and pleasure in apprehending them; the possibility that nature could counsel right action and moral behavior; a method of observation that could inspire sympathy and raise possibilities for social reform; and an appreciation for the spiritual and ideal *within* the material, not separate from it. But none of these seeming virtues for scientific inquiry was a province held exclusively by women. What set women's responses apart were matters of form, and understanding how Victorian women writers addressed scientific questions provides insight not only into nineteenth-century scientific debates themselves and the gendered expectations of how women could enter into them, but also illuminates developments in Victorian literary history and the evolution of its genres and forms.

Chapter 1:
Somerville's Sublime and Byron's Abyss:
Nineteenth-Century Astronomy's Pleasures and Perils

During the first astronomy lesson shared by the two protagonists of Thomas Hardy's *Two on a Tower* (1882), Lady Viviette Constantine and Swithin St Cleeve share a decidedly gloomy interpretation of human insignificance in the face of a vast universe:

“We are now traversing distances beside which the immense line stretching from the earth to the sun is but an invisible point,” said the youth. “When, just now, we had reached a planet whose remoteness is a hundred times the remoteness of the sun from the earth, we were only a two thousandth part of the journey to the spot at which we have optically arrived now.”

“Oh, pray don't; it overpowers me!” she replied, not without seriousness. “It makes me feel that it is not worth while to live; it quite annihilates me.”

“If it annihilates your ladyship to roam over these yawning spaces just once, think how it must annihilate me to be, as it were, in constant suspension amid them night after night.” (28-29)

The pair describe a feeling of annihilation, an obliteration of self in relation to cosmic distances, and as readers of Hardy's novel will know, his star-crossed lovers receive no mercy or solace from the motions of the heavens by the book's conclusion. *Two on a Tower* offers a darkly pessimistic vision of human affairs in an unforgiving universe, and the notion of gazing into the void of the night sky seems an act of self-punishment when, as Swithin claims, “the actual sky is a horror,” filled with the “impersonal

monsters...immensities...monsters of magnitude without known shape” (29). The only solace such a view offers is that of diminishing the banal problems and worries of daily life.

Though many Victorian intellectuals may have sympathized with the cynical worldview of Hardy’s novel, nineteenth-century astronomers like Mary Fairfax Grieg Somerville (1780-1872) offered a strikingly different story. An astronomer and mathematician, Somerville was a woman at the center of nineteenth-century European science, writing books that sold widely and were read by a varied audience of both laypersons and professional men of science. Her most ambitious work was *On the Connexion of the Physical Sciences* (1834), a book that stood apart from other scientific texts at the time in its wide, synoptic view of all of the known physical sciences and its transmission of this knowledge in prose that avoided difficult mathematical expressions in her prose, or really, any math at all. Somerville explained science verbally—albeit in later editions with frequent diagrams appended to the end of the volume. Within the pages of this otherwise dry and technical textbook of physical science appear passages of amplified rhetoric and expansive prose. These passages direct a reader to a far more positive frame of mind in which to view the celestial heavens and the universal laws binding the action of planets and stars than Hardy’s *Two on a Tower* would later suggest. In *Connexion*, the study of astronomy possesses an intimately spiritual—and aesthetic—value. Its activities and implications become pleasurable for the practitioner. Further—and unexplored by Somerville scholars to date—*Connexion*’s explanation of the universe’s massive scale and vast distances contains within it an implicit rebuttal of

Byron's depiction of the sublime in his closet drama, *Cain* (1821), a play that, like Hardy's *Tower*, offers no consolation to an observer of the cosmic abyss.

In this chapter, I examine why a woman dubbed the “queen of science” would have alluded to Byron's play within her instruction of astronomy.⁹ *Cain*'s significance only becomes fully visible within the pages of Somerville's manuscript notebooks, and these manuscripts likewise enrich our understanding of Somerville's published works. The manuscripts demonstrate how *Cain* offered Somerville both an analogy for explaining an astronomical concept—parallax—and an epistemology against which she could position her own arguments. Together, Somerville's notebooks and the published volume of *On the Connexion of the Physical Sciences* illustrate an ethos of the sublime particular to the study of physical science in the nineteenth century. Somerville's sublime is rhetorical, aesthetic, and philosophical, and it is an attitude that likewise undergirds much of Victorian physics and mathematics.¹⁰ Many nineteenth-century scientific texts share a discourse of the sublime, including Alexander von Humboldt, John Herschel, and William Whewell. Mary Somerville's use of the sublime is notable, however, because it emerges in the teaching of astronomical concepts: if readers recognize the feeling of sublime distance—as in Byron's *Cain*—then they may begin to understand the kind of distances involved in discerning an appreciable angle of parallax.

⁹ See the obituary for Somerville in *The Morning Post* on 2 December 1872: “whatever difficulty we might experience in the middle of the nineteenth century in choosing a king of science, there could be no question whatever as to the queen of science.”

¹⁰ Somerville's sublime variously draws upon the ideas of Longinus, Burke, and Kant, and I trace these connections within the body of this chapter. For Longinus, the sublime was a rhetorical category, a discourse used when describing grand, elevated subjects. For Burke, it was an aesthetic category, delineating differences between the terrifyingly large, vast, or distant; and for Kant, the sublime was conceptual, that is, an intellectual and philosophical response to such visual stimuli or the ideas they evoked. More detailed explanations of these notions of the sublime follow throughout this chapter.

The present chapter suggests a re-estimation of Somerville's contributions to Victorian intellectual life is long overdue. Historians of Victorian science have begun emphasizing Somerville's importance to the professional and popular world of science, and literary scholars have highlighted her *Personal Recollections* (1873), Somerville's posthumously published memoir, because of its reflections on the progress of a self-educated girl from eastern Scotland to become accepted within the foremost scientific circles of London and Europe. The importance of her scientific works to Victorian culture requires further discussion beyond the field of the history of science. Close attention to Somerville's amplified rhetoric in *On the Connexion of the Physical Sciences* reveals tensions within Romantic natural philosophy that pulled science toward both the idealized mathematics and the disinterested quest for Truth that came to define the Victorian era.

In the pages to follow, I sketch an overview of Mary Somerville's life and works, followed by a discussion of her reputation within current scholarship in both literary studies and the history of science to make a case for her importance within Victorian studies. I then describe her manuscript notebooks and the context of her quotations from *Cain* to highlight how her ethos of the sublime in physical science differs from the Burkean sublime found in Byron. I finally examine how *Cain* helped Somerville shape her delivery of astronomical instruction. In doing so, I place Byron's play into the context of nineteenth-century debates about astronomy and physical science, not just the geological debates where scholars have sometimes located it.¹¹ Somerville's sublime view of astronomy in *Connexion* epitomizes an attitude toward science that characterized

much of Victorian epistemology, a perspective critics like Hardy, however, would continue to oppose throughout the nineteenth century.

Somerville's History and Criticism

“My life has been domestic and quiet,” writes Somerville at the outset of her *Personal Recollections* (1873), “I have no events to record that could interest the public. My only motive in writing it, is to show my country women that self education is possible under the most unfavourable and even discouraging circumstances” (1). And yet, far from having “no events...that could interest the public,” Mary Somerville’s life as a mathematician, astronomer, and scientific writer is remarkable for the impact she had on Victorian science. Born on December 26, 1780 in Jedburgh, Scotland to Lieutenant William George Fairfax and his second wife, Margaret Charters, Mary Fairfax grew up in the port town of Burntisland, Fife. She mainly taught herself from the family library, apart from one year at boarding school. She read copies of Euclid’s *Elements of Geometry* and Bonnycastle’s *Algebra* her younger brother’s tutor brought back for her from Edinburgh, but when her father learned of her studies, he tried to forbid her from continuing (McMillan 41-2).¹² In 1804, she married a cousin, Samuel Greig, who became commissioner for the Russian navy and the Russian vice-consul for Britain in London and with whom she had two sons. Greig discouraged her studies, but upon his untimely death in 1807, she returned to Burntisland and began her endeavors in mathematics and science anew as an independent woman. She remarried in 1812, this time to another

¹¹ See, e.g., Dimitri Karkoulis’s ““They pluck’d the tree of Science/And sin”: Byron’s *Cain* and the Science of Sacrilege” (2007).

¹² Citations for *Personal Recollections* refer to Dorothy McMillan’s edition of Somerville’s memoir, *Queen of Science: Personal Recollections of Mary Somerville*. Edinburgh: Canongate Books, Ltd., 2001.

cousin, army doctor William Somerville (1771-1860), and the pair had two daughters. William Somerville, a Fellow of the Royal Society and member of the Linnaean Society, encouraged his wife's pursuits and together the pair was welcomed into scientific society throughout Scotland, London, and Europe (Patterson 1-17). The Somervilles moved to Italy in 1838 for William's health, and aside from visits, they never took residence in Britain again. William Somerville passed away in 1860, and Mary died in Naples on November 29, 1872.

Despite the accolades she received during her life, Somerville belittled her own accomplishments in science, stating, "I was conscious that I had never made a discovery myself, that I had no originality. I have perseverance and intelligence but no genius" (McMillan 145). Yet she did, in fact, contribute to the field of astronomy, publishing two articles on sunlight and magnetism in the *Philosophical Transactions* of the Royal Society (Brock 257). When her claims were later shown to be incorrect, Somerville continued to experiment and publish (Brock 258). She did not begin a career in scientific writing until she was forty-seven, when Lord Henry Brougham approached her about translating Pierre-Simon Laplace's *Mécanique céleste*, which she worked on for three years and published in 1831 as *The Mechanism of the Heavens. On the Connexion of the Physical Sciences* followed in 1834, *Physical Geography* in 1848, and *On Molecular and Microscopic Science* in 1869. By late in the nineteenth century, Mary Somerville's star was waning in terms of book sales. Increasing professionalization of science and disciplinarity—the movement toward distinct scientific disciplines—meant that synoptic overviews of current developments within the various branches of physical science and natural history were less feasible. When tasked with editing the tenth and last edition of

On the Connexion of the Physical Sciences after Somerville's death in 1872, Arabella Buckley—whose work I consider in chapter two—feared she could not do it justice: each branch of the physical sciences had progressed and deepened beyond any single individual's knowledge. Yet Somerville's reputation lingered. Her honors had been varied and numerous throughout her career: polar explorer William Parry named an island after her on his first voyage to the arctic in 1819. Whewell intimated the term “scientist” could describe Somerville when he reviewed *Connexion* in 1834, early in her career and just months after he coined the term at the 1833 meeting of the BAAS in Cambridge.¹³ Her most solid recognition came in the form of a government pension awarded by King William IV, when Sir Robert Peel placed her on the Civil List in 1835 for her work as a popularizer of science (Patterson 151). The same year, the Royal Astronomical Society unanimously elected Somerville and Caroline Herschel as honorary members (Patterson 155).

Over the past fifteen years, Somerville has gained increasing scholarly attention. Elizabeth Chambers Patterson conducted the first comprehensive study of Somerville in 1969 and catalogued the extensive Somerville Collection held at Oxford's Bodleian Library. Patterson's *Mary Somerville and the Cultivation of Science, 1815-1840* (1983), was the first full-length Somerville biography, but as her subtitle reveals, it concludes in the middle of Somerville's career. Katherine Neeley drew readers' attention to Somerville's lyrical treatment of physical science in *Mary Somerville: Science, Illumination, and the Female Mind* (2001), and Alan Chapman's biography, *Mary Somerville and the World of Science* followed in 2004. Historians of science like Bernard

¹³ Whewell suggested the term “scientist” as a general category designating “the students of

Lightman have included her in histories of Victorian popularization, and James A. Secord edited a nine-volume set of her collected works in 2004.¹⁴ Only in the past ten years, in fact, has Somerville's importance to histories of Victorian science and its intellectual life really begun to emerge.¹⁵ Anna Henchman's *The Starry Sky Within: Astronomy and the Reach of the Mind in Victorian Literature* (2014) is the most recent study of astronomical metaphors—many echoing Somerville's prose—in Victorian novels and poetry.

On the Connexion of the Physical Sciences appeared during a cultural moment in Britain that saw a burgeoning market for self-improvement literature, including scientific studies. Between 1829 and 1846, Dionysus Lardner published volumes ranging from history to arts and manufacture to natural philosophy in *Lardner's Cabinet Cyclopaedia*. Two of John Herschel's books, for instance, *Preliminary Discourse on Natural Philosophy* (1831) and *A Treaty on Astronomy* (1833) appeared in the series, as did books by Sir David Brewster on optics and John Phillips on geology. Other series devoted to the spirit of mass education included Brougham's Library of Useful Knowledge, Brewster's

the knowledge of the material world" (59).

¹⁴ See, e.g., Lightman's *Victorian Popularizers of Science* (2007) and Secord's *Collected Works of Mary Somerville* (2004).

¹⁵ Alice Jenkins highlights Somerville's negotiation of both gender and spatial boundaries in *Space and the March of Mind* (2007). Ruth Watts argues for Somerville's importance as a female explicator of science at a time when women were marginalized, tracing the value of Somerville's work to other scientists and highlighting her readers' reactions. Claire Brock complicates Watts's essay on Somerville's influence by citing a broader range of public opinion and shows why one of the controversies about Somerville that came during Parliamentary debate about the Civil List's pensions was politically motivated (260-266). Earning a pension for her work as a "popularizer"—here meaning a writer who was commissioned by the Society for the Diffusion of Useful Knowledge (SDUK) to explain science to Britain's nonspecialist readers—Somerville's *Mechanism of the Heavens*, in fact, was most useful to university students and professional men of science. Thus Brock suggests that Somerville "relished the specialist aspect of her writings and valued the difficulties which prevented the ordinary reader from obtaining ultimate insight into celestial mechanics" (255). On the heels of *Mechanism's* mathematical sophistication came the equation-free *On the Connexion of the Physical Sciences*, a book whose less-technical content, Brock suggests, was aimed at an audience Somerville was in danger of losing.

Edinburgh Encyclopedia, and the *Encyclopedia Metropolitana* (Patterson, “Mary Somerville” 330 n.121). But none of these books individually tried to synthesize multiple branches of physical science the way that Mary Somerville’s *Connexion* did. For a scientific text, it became a commercial and critical success, if not exactly a sensation. The first edition of 2,000 copies immediately sold out, and sales of later editions totaled 15,000. *Connexion* appeared in nine updated, successive editions between 1835 and 1877 (Patterson 193; Neeley 42).¹⁶

The book was remarkably popular because it verbally explained up-to-date scientific developments, thereby opening a path to scientific knowledge to readers outside the academy’s walls who lacked an education in higher math. Likewise, the book’s prestige drew professional men of science into its audience and helped advance British science by filling gaps with discussions of Continental discoveries. Additionally, Somerville’s continued updates to *Connexion* meant it contained what was state-of-the-art science, and she drew together the reports of various professional “gentlemen of science,” helping to form consensus via a process similar to the referee procedure common today (Neeley 114). Of course, one of the charges leveled at Somerville from many quarters, herself included, was that she did not contribute original scientific knowledge to her community but rather merely distilled it, disseminated it, and interpreted it. Indeed, *Connexion* is, at its core, an extended “literature review” in which Somerville summarizes and brings together the research and findings of many men of science, including Newton, Laplace, William and John Herschel, Faraday, Young, Biot, Fresnel, Humboldt, and many others,

¹⁶ Subsequent editions appeared in 1835, 1836, 1837, 1840, 1842, 1846, 1849, 1858, and 1877. The last edition was posthumously published and edited by Arabella Buckley, formerly

both British and continental European, as well as explorers like James Cook and Edward Parry. Certainly *Connexion* gathers together a vast international conversation about science. But the privilege “originality” has in scientific fields has not abated in the years since Somerville was writing, and it has diminished her reputation as a result.

Because the text of *Connexion* resides in the interstices between professional scientific papers and more watered-down popularizations, it troubles categories. But this troubling is precisely what *Connexion* offers to scholars of the nineteenth century who investigate its intellectual history, constructions of gender, and genre theory. Somerville’s *On the Connexion of the Physical Sciences* is a book critical to accounts of Victorian literature and culture, uniting in its pages the terrestrial and the astronomical, the prosaic and the poetic. A look at her manuscripts helps readers today see that unity most clearly.

Somerville’s Manuscripts & Byron’s Abyss

Over a dozen quotations from Byron’s *Cain*, copied in Somerville’s hand, occupy three striking pages in a small, brown, undated notebook hardly more than four by six inches in size (Somerville Collection Dep c. 352, fol. 5). Kathryn A. Neeley notes the presence of these quotations with just this tantalizing remark:

In one of the notebooks, the left-hand page contains a summary of a statement from William Herschel, indicating the number of stars that passed across the view through his telescope in an hour. Below this passage is a quotation from Byron concerning human insignificance in the grand scheme of nature. On the opposite

Charles Lyell’s secretary. Figures quoted by Patterson and Neeley indicate sold copies; James Secord records 17,500 copies printed (xi).

page, there are extensive quotations from Byron's *Cain* (1905),¹⁷ which refer to the 'beautiful, unnumbered, and endearing' suns 'not dazzling, and yet drawing us to them.' *Although the poetry itself does not, the images and sentiment conveyed by the poetry find their way into Somerville's text.* Science, poetry, and philosophy are interwoven into a coherent and inspiring account. In note form, the account seems chaotic, even schizophrenic; in finished form, it is enormously rich. (7; emphasis mine)

Neeley's praise of Somerville's finished prose is fitting, highlighting the implications and vibrancy of Somerville's writing when it rises into an elevated poetic register. Yet, as my following pages will show, I suggest an alternate interpretation of the quotations' significance. One line of Byron's verse does appear in *Connexion*, and while Somerville uses some of the same cosmic imagery, her sentiment differs markedly from Byron's. But before examining how passages both in Somerville's notebook and in the published volume of *Connexion* interrogate the ideas suggested by these quotations from *Cain*, a very brief summary of the play itself may be useful for readers unfamiliar with Byron's text.

Cain : A Mystery (1821) retells the Genesis story of Adam and Eve's family after their expulsion from Eden and before Cain's killing of Abel. Selecting Cain as his play's protagonist and anti-hero, Byron portrays Cain's distress about his mortality and his temptation by Lucifer, who takes him on a journey both to a remote space beyond the stars and to Hades, a realm of death where Cain sees creatures that had preceded man on

¹⁷ Neeley uses a 1905 edition, but *Cain* was printed in 1821, along with *Sardanapalus* and *The Two Foscari*.

the earth. Lucifer argues that mortality was not a good part of God's plan and that the sum of human knowledge ultimately concludes with understanding how very insignificant man is in relation to the universe. Returning to his family, Cain tries to tear down the altar where the family made sacrifices to God. When Abel stands between Cain and the altar, the latter strikes him down. In contrast to the Old Testament's description, Byron's telling suggests the first fratricide was motivated not by Cain's jealousy but rather was an effect of his despair and rage.

Byron's play follows Milton's example in *Paradise Lost* of rewriting Biblical tales of an antediluvian "fall." Importantly, though, Byron chooses to depict his fratricidal Cain's lack of spiritual faith or religious conviction within the context of early nineteenth-century natural history. Lucifer provides a history of the earth in Act II that follows Georges Cuvier's catastrophic theory of geology propounded in the "Preliminary Discourse" to his *Researches on Quadrumed Fossil Bones* (1812).¹⁸ Byron provides in his Preface a short note for the scientific theories with which the play engages:

the notion of Cuvier, that the world had been destroyed several times before the creation of man. This speculation, derived from the different strata and the bones of enormous and unknown animals found in them, is not contrary to the Mosaic account, but rather confirms it; as no human bones have yet been discovered in those strata, although those of many known animals are found near the remains of the unknown. (337-8)

Cuvier's theory suggested that the earth went through catastrophic periods that extinguished all planetary life, offering an explanation for gaps in the fossil record.

Geology was one of the most active fields of natural philosophy in Britain in the first decades of the nineteenth century. Byron admits, though, that he takes some poetic license within the explanations Lucifer offers Cain. The discovery of fossils of extinct animals in the geological record prompted Cuvier to propose his theory, and in the play, part of Cain's crisis comes from seeing "pre-Adamites," rational creatures who had previously inhabited the earth, in Hades.

The catalyst for Cain's crisis—his lack of faith and consequent killing of Abel—is his journey to the "abyss" of space, an unspecified but vast distance from the earth. It is not a pit like the hell into which Dante descends, but it prompts a similar feeling of terrible distance for Cain. When Somerville copies lines from Byron's play into her notebook, all of the lines come from this key scene.

Somerville used loose paper and notebooks to work out equations and calculations, and into her notebooks she also copied passages from work by her scientific colleagues like Faraday, Herschel, and Whewell, as well as quotations from many nonscientific acquaintances. In this regard her notebooks often served as scientific commonplace books. She did not uniformly attribute her sources, which makes tracing those sources a challenge. Nor did she consistently date her entries, so I rely here on those moments when she does date a notebook, the content that definitively appears as published text, and the original cataloguing work by Patterson.¹⁹

¹⁸ French title: *Recherches sur les ossements fossiles de quadrupèdes*

¹⁹ The Somerville Collection includes completed manuscripts, drafts, notes, notebooks, letters, diaries, genealogies, business papers, personal papers, honors, and awards. Housed in Oxford's Bodleian Library, the collection occupies three linear meters—nearly ten feet—of shelf space. When Patterson began cataloguing the collection in the late 1960s, she estimated its contents at over 10,000 pieces; Somerville College now approximates a more conservative 9-10,000 (Patterson "Mary Somerville" 334; Somerville College "Somerville collections at the

In the small brown notebook described previously, Somerville recorded a variety of notes from well-known scientific figures of her day, including correspondents like Laplace, Sir John Leslie, and William Herschel. Byron is the notable poetic anomaly. The quotes begin immediately below this passage describing Herschel's observation of stars through a telescope pointed out from his window: "Herschel mentioned that 116,000 stars passed through the field of his telescope, which subtended an \angle of 15° , in a quarter of an hour. If we compute from such a narrow gaze, the whole celestial vault must display within the range of telescopic vision, more than 5 Billion of fixed stars" (Somerville Collection c.352,2).

To follow this data-filled passage with lines of Romantic poetry at first seems an odd juxtaposition, and the pages immediately following these poetic quotations turn again to astronomical topics. The Byron pages are surrounded by quotes from experts in physical science and astronomy.²⁰ Yet for Somerville, the connection between astronomical wonder and Byron's dramatic lines wasn't unusual, not least because one of *Cain*'s settings is the depths of space. The quotations' placement following Leslie's passage on light and Herschel's observation of the night sky suggest they made Somerville think of Byron's plays, not the reverse. Byron's play becomes one among many of Somerville's

Bodleian"). Bodleian archivist Chrissie Webb re-catalogued the entire collection in 2012-13, and a list of its contents is now available online. My visit to the Bodleian to research in the Somerville Collection took place just as this cataloguing began, and I thank the staff of the Special Collections Reading Room in the Radcliffe Science Library for accommodating me at an inconvenient time.

²⁰ Kathryn Neeley discusses how Somerville engages a poetic tradition via a pattern of describing the world from a "cosmic platform" and via a method of "tracing the mazes" (110-113). Neeley, however, does not provide nor examine the complete Byron quotations themselves except within the short account of how the Herschel description which precedes them in the notebook appears in the text of *Connexion* itself. Yet there is substantive connection between Byron's poetry and the kind of scientific exposition, or popular accommodation, Somerville was trying to compose.

sources for her astronomical writing. Given the widespread practice of including poetic lines in books within a variety of genres across the nineteenth century, it is possible Somerville was just keeping a list of potential choices for future use. But later pages in the same notebook indicate Somerville's use of *Cain* within the prose of *Connexion* was not simply decorative.

The striking common thread among all of the copied Byron quotations—which I discuss in greater detail below—is their expression of humankind's limited ability to observe or comprehend the vast reaches of the universe. By contrast, *Connexion* opposes Byron's Romantic poetic constructions by showing how scientific analysis—even without recourse to mathematics, the unifying language of science—can begin to bridge the gulf of incomprehensibility within the sublime. Somerville's notes have an internal logic to them less chaotic than Neeley suggests. Somerville incorporates Byron's visual aesthetic, but not his moral one. She does not import Byron's sentiment into her work; to the contrary, she uses it as a framework to argue against.

Somerville's selected quotations indicate a debate within her own work that was aesthetic as well as scientific. The *Cain* quotations all evoke the Burkean sublime, a sense of terrible fascination with the immensity of the universe and the individual human's relative insignificance in the presence of such seeming infinity, as well as the calming reassurances of earthly nature's smaller beauties. But Somerville's sublime is not quite the sublime of Byron or Burke, though it strongly resembles Kant's "mathematical sublime."²¹ Hers is an admiration not only for wonders of the universe, but also for the

²¹ Many scholars have traced the eighteenth-century aesthetic theories. See for instance, Terry Eagleton's *The Ideology of the Aesthetic* (1990), Frances Ferguson's *Solitude and the Sublime*:

imaginative leaps the human mind can take to the vast depths of space, its ability to comprehend the motions and gravitational relations between astronomic bodies, to measure them, and to understand how the same laws govern the action of planets as well as the motion of matter on earth. To Somerville's way of thinking, even if human beings fall short of full comprehension of the causes of these natural laws, this is not cause for dismay. In short, Somerville delights in the pleasures of reason, and her lyrical prose aims to kindle that delight in others.

Somerville's Sublime

Cain's plot provides a context for understanding the quotations Somerville copies into her commonplace book: "What nothings we are before the least of these stars," for example. Or, "Myriads of starry worlds, of which our own/ Is the dim and remote Companion, in/ Infinity of life," and "this should be the human sum/ Of Knowledge, to know mortal nature's nothingness." All of these lines appear in the conversation between Cain and Lucifer as they gaze down at the earth from "the Abyss of Space." Lucifer teaches Cain how truly small and insignificant he and all humankind are in the wider universe of divine creation. When Somerville asks her readers to imagine these distant perspectives, however, she draws far different conclusions, and her rhetoric explicitly draws upon the discourse of the sublime.

"The heavens afford the most sublime subject of study which can be derived from science," Somerville writes in her introduction to *Connexion*. Beginning her study of the physical sciences with astronomy, Somerville adheres to a longstanding tradition for

Romanticism and the Aesthetics of Individuation (1992), or *The Sublime: A Reader in British Eighteenth-Century Aesthetic Theory*, edited by Andrew Ashfield and Peter de Bolla (1996).

encyclopedic reviews, from Pliny to John Ray. Astronomy holds within it the principles that cover the rest of physical science, and the magnitudes of its objects are massive. It is appropriate, then, for Somerville to treat her high subject in the manner of Longinus's sublime: a lofty subject requires grand, elevated discourse. In *Connexion's* second edition, Somerville explains how astronomy combines

the sciences of number and quantity, of rest and motion. In it we perceive the operation of a force which is mixed up with everything that exists in the heavens or on earth; which pervades every atom, rules the motion of animate and inanimate beings, and is as sensible in the descent of a rain drop as in the falls of Niagara; in the weight of the air, as in the periods of the moon. (1)

Here Somerville's prose differs distinctly from the expository text that follows in the majority of the book. In terms of rhetorical discourse, it is far more epideictic than forensic. With its dense use of figures in a short space, it prompts readerly affect, inspiring her reader to undertake an imagined journey through the universe. Rhetorically, Somerville's use of antithetical phrasing creates a syntactical tension that mimics the vast gulf between human and divine. Somerville's syntax not only contrasts but also links "rest and motion"; "in the heavens or on the earth"; "the descent of a rain drop" and "the falls of Niagara"; "weight of the air" and "periods of the moon." Each parallel phrase amplifies the one preceding it. In two of these—the antitheses of heavens and earth, rain drops and Niagara—the contrast is one of scale: the actions of both the very large and the very small, Somerville argues, are governed by the same laws. Somerville's rhetorical figuration calls upon a reader to imagine the very small and the immense together,

suggesting that the same laws of physics apply to each, and to everything that falls in between.

Somerville's next line employs the figure of climax or gradatio (elements are arranged in increasing importance), including a progressive anadiplosis (a repetition of the last word of the previous phrase or clause), to take her reader's thoughts from a planetary plane to a solar and divine sphere:

Gravitation not only binds satellites to their planet, and planets to the sun, but it connects sun with sun throughout the wide extent of creation, and is the cause of the disturbances, as well as the order of nature: since every tremour it excites in any one planet is immediately transmitted to the farthest limits of the system, in oscillations, which correspond in their periods with the cause producing them, like sympathetic notes in music, or vibrations from the deep tones of an organ. (1-2)

From satellite to planet, planet to sun, and sun to cosmos, Somerville's construction shows gravitational force's ubiquity within a linking rhetorical figure of increasing magnitude. Readers might hear in her construction an echo, too, of Kepler's theory of the "harmony of the spheres" when she shifts to an auditory metaphor of oscillating vibrations of sound waves in music. Despite the practical content of most of the volume, many such expressive syntactical figures punctuate Somerville's prose. The greatest frisson for Somerville's novice readers may have come from this aesthetic and affective tension between human and divine perspective.

Somerville's expressions of unity and connection are not so different—in either subject or its rhetorical style—from one of the lines she copies from Act II of Byron's

Cain into her commonplace book: “The little shining fire-fly in its flight/And the immortal star in its great course,/ Must both be guided” (379). Byron’s line, spoken by Cain to Lucifer when the latter asks him what he thinks of “worms and worlds,” suggests a unifying force more divine than mechanical, and it echoes the same notion of a basic law underlying both the miniature and the cosmic. But similarities in subject and rhetorical style, while curious, are not sufficient to link *Connexion* and *Cain*.

In fact, Somerville does quote Byron’s *Cain* just once within the pages of *On the Connexion of the Physical Sciences*.²² The line appears when she explains the concept of parallax, one of the same topics surrounding the quotations in her commonplace book.

Parallax was a defining metaphor out of nineteenth-century physical science in the same way relativity and uncertainty came to characterize the early twentieth. In the figurative sense, parallax suggests a visuality inflected by the Newtonian physics and Euclidean geometry of the Enlightenment, that is, one far more uniform and regular than the relativistic and quantum physics that characterize metaphors emerging from the work of Albert Einstein and Werner Heisenberg. George Eliot uses parallax as a metaphor, for instance, in her *Westminster Review* essay, “Silly Novels by Lady Novelists” (1856), a text I discuss in chapter three, while Tennyson echoes Somerville’s diction in his own literary use of parallax in *In Memoriam* (Henchman 85-120).²³ Because astronomical parallax requires the observer or student to imagine vast, seemingly incomprehensible

²² The same quotation appears in the “Preliminary Dissertation” to *Mechanism of the Heavens*. Because *Connexion* is the expanded version of the “Preliminary Dissertation” and it had a more prominent influence throughout the century, I focus on the longer book. Much of the text in the “Preliminary Dissertation” is quoted verbatim in *Connexion*.

²³ Both Eliot and Tennyson read Somerville between 1839 and 1840. Anna Henchman’s new monograph, *The Starry Sky Within* traces what she terms literary parallax, demonstrating how relevant this optical metaphor was to Victorian writers.

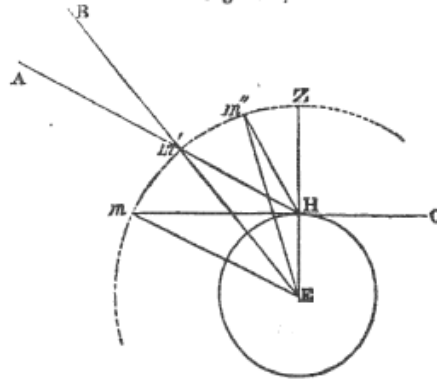
distances, it often evokes the kind of fear and despair epitomized in *Cain* and, at the outset of this chapter, *Two on a Tower*. And it is here, in her discussion of parallax, where Somerville's marked refusal to accept the kind of unease expressed by Byron and Hardy can most clearly be found.

Stated most simply, parallax is a visual effect in which there is an apparent difference in an object's position when viewed along two different lines of sight. Imagine, for example, how the backgrounds might differ if two friends positioned a great distance apart took a photograph of a third companion from their locations. The apparent difference in the friend's location is a phenomenon called parallax. Mary Somerville's definition in *Connexion* is far more precise. The following passage opens *Connexion*'s eighth chapter:

The parallax of a celestial body is the angle under which the radius of the earth would be seen, if viewed from the centre of that body; it affords the means of ascertaining the distances of the sun, moon, and planets. When the moon is in the horizon at the instant of rising or setting, suppose lines to be drawn from her centre to the spectator and to the centre of the earth; these would form a right-angled triangle with the terrestrial radius, which is of a known length; and as the parallax or angle at the moon can be measured, all the angles and one side are given; whence the distance of the moon from the centre of the earth may be computed. (61-62)

NOTE 126. p. 67. *Parallax*. The angle $a\delta$, fig. 29., under which we view an object $a\delta$: it therefore diminishes as the distance increases. The parallax of a celestial object is the angle which the radius of the earth would be seen under, if viewed from that object. Let E, fig. 32., be the

Fig. 32.



centre of the earth, EH , its radius, and mHO , the horizon of an observer at H . Then, HmE is the parallax of a body m , the moon for example. In measure, as m rises higher and higher in the heavens, to the points m' , m'' , &c. the parallax $Hm'E$, $Hm''E$, &c. decreases. At Z , the zenith, or point immediately above the head of the observer, it is zero, and at m , where the body is in the horizon, the angle HmE is the greatest possible, and is called the horizontal parallax. It is clear that, with regard to celestial bodies, the whole effect of parallax is in the vertical or in the direction $m'm'Z$, and as a person at H sees m' in the direction $Hm'A$, when it really is in the direction $Em'B$, it makes celestial objects appear to be lower than they really are. The distance of the moon from the earth has been determined from her horizontal parallax. The angle EmH can be measured. EHm is a right angle, and EH , the radius of the earth, is known in miles, whence the distance of the moon Em is easily found. Annual parallax is the angle under which the diameter of the earth's orbit would be seen, if viewed from a star.

Figure 1: Diagram from the second edition of *On the Connexion of the Physical Sciences* (1835). Somerville's first edition did not contain diagrams. Google Books.

What is noteworthy about the difference between my rudimentary but more common example and Somerville's is the position of the observer in the two descriptions. My explanation would suggest that an astronomical parallax concerns the relative position of a stellar body according to two independent observers, and to an extent, this is true. But parallax is really the angle drawn from the perspective of the celestial body to the earth, not the angle originating at the position of the earth-bound astronomer. The imagined point of observation lies *within or from* the stellar object, so that the imagined gaze is

directed at the earth, and the angle described is that between one line drawn from the stellar object to the center of the earth, and the other line is drawn to an observer on the earth's surface. Such a perspective exemplifies a trope common throughout *Connexion*, a view from the heavens, as it were, that Kathryn Neeley terms Somerville's "cosmic platform" (8). Parallax offers the student of astronomy a specific example of Longinus's elevated subject. But so too can it prompt the reader to imagine a terrifying, vertiginous perspective of the universe: an individual poised at the outermost reaches of space. Thus parallax satisfies the parameters of not just Longinus's sublime, but Burke's as well.

In her chapter on parallax, Somerville writes about an imagined view from the planet Uranus's position, as well as from that of the nearest fixed star (identified in later editions as Alpha Centauri):

Situate²⁴ on the verge of the system, the sun must appear to it not much larger than Venus does to us. The earth cannot even be visible as a telescopic object to a body so remote. Yet man, the inhabitant of the earth, soars beyond the vast dimensions of the system to which his planet belongs, and assumes the diameter of its orbit as the base of a triangle whose apex extends to the stars. ...If a fixed star had a parallax of one second, its distance from the sun would be 20500000000000 of miles. At such a distance not only the terrestrial orbit shrinks to a point, but the whole solar system seen in the focus of the most powerful telescope, might be covered by the thickness of a spider's thread. (65)

In Somerville's prose, abstract geometric calculations elevate the human mind to imagined vistas across the heavens; taken to the remote location of a star, that same mind

might contemplate human insignificance, evoked in the image of a thin, seemingly fragile spider's thread. The expansion and contraction apparent within Somerville's imagery—the millions of miles in distance to planets and stars versus the millionth of a meter across a spider's thread (diameter=1 μ m)—prompt an affective response for a reader: the awe of the Burkean sublime. The passage continues by reminding readers that our perception of distant galaxies and their relative distances from each other might be skewed, not just in terms of our far-off view—a spatial displacement—but a temporal one, too:

In the milky way and the other starry nebulae, some of the stars that seem to us to be close to others, may be far behind them in the boundless depth of space; nay, may be rationally supposed to be situate many thousand times farther off; light would therefore require thousands of years to come to the earth from those myriads of suns, of which our own is but “the dim and remote companion.” (66)

“Dim and remote companion” is a line from Act II, scene 2 of *Cain*, and with that allusion, Somerville betrays a larger conversation in which human beings contemplate their place in the universe. And yet, while she uses Byron as a touchstone for explaining parallax, her notebook suggests that her readers have more to gain via a study of astronomy or microscopy than via the kind of despair Cain professes or the terror which Burke suggests always accompanies a contemplation of the infinite (54).

All of the passages Somerville copies from Byron's writings contemplate the heavens. “And thou who kindlest and quenchest Suns,” reads the line copied from the final speech of the eponymous protagonist of *Marino Fallero, Doge of Venice: An Historical Tragedy in Five Acts*. The *Cain* lines all come from Act II, when Lucifer takes

²⁴ Archaic.

Cain to the farthest reaches of the universe: from “the Abyss of Space” to Hades itself, here not an underworld but a seeming realm beyond the stars, a place no sunlight reaches. Their placement in the notebook is significant: the copied passages track Somerville’s sources for her own explanations of astronomical physics. Together they suggest that Byron’s plays served as analogies that could help Somerville translate astronomy—parallax, in particular—for her own readers. Yet Somerville prompts her readers not to bemoan mortal limitations; instead, she suggests comprehension of universal laws is a facet of human reason worth celebrating.

The quotations Somerville copies into her notebook point to human limitations in contrast to an immortal omniscience, perfection, and immortality. The lengthiest quotation Somerville selects derives from one of Cain’s dialogues with Lucifer in “The Abyss of Space”:

Oh thou beautiful
And unimaginable ether! and
Ye multiplying maker of increased
And still increasing lights, What are ye? What
Is this blue wilderness of interminable
Air, Where ye roll along, as I have seen
The leaves along the limpid streams of Eden?
Is your course measured for ye? Or do ye
Sweep on in your unbounded revelry
Through an aerial universe of endless
Expansion, at which my soul aches to think,

Intoxicated with eternity? (378)

Cain's adjectives contrast human finite abilities with divine, infinite phenomena:

"unimaginable ether," "interminable air," "unbounded revelry," and "endless expansion."

All these concepts pain his thoughts, making him feel "intoxicated with eternity." His tone in this apostrophe to the fluid ether, which he compares to terrestrial "limpid streams," is somber, and both his pentameter and diction echo Keats's speaker in the opening lines of "Ode to a Nightingale," particularly Cain's aching, intoxicated soul. Mortal man, both poets suggest, cannot contemplate the infinite without paining their senses.

This passage from *Cain* points to a larger intertextual conversation taking place both in Somerville's commonplace book and in her printed volumes. Works like *Connexion* engage with philosophies not limited just to the scientists Somerville names, and her scientific thought comes into sharper focus as it engages with literary—here poetic—texts. This larger framework becomes especially clear in a striking passage, likely composed by Somerville herself²⁵, pages later in the same notebook where the *Cain* quotations appear:

Pleasure in ~~scientific pursuits~~ astronomy does not merely consist in the beauty of the phenomena but in the order and design of the system, the harmony of its parts, the skill and efficiency of its contrivances, and in the means by which man has ascertained truths and arrived at results which seemed for ever placed beyond his grasp. ~~From the efforts of produced~~

²⁵ I have not yet been able to trace this passage's source. It does not seem to appear in Somerville's published texts, nor any other published books I have been able to search via strings of text.

~~Some of the phenomena~~

~~The means by which~~ (Somerville Collection Dep c. 352, fol. 5)

Both the strikethroughs and the replacement of “scientific pursuits” with “astronomy” suggests that this is not simply a transcription error from a secondary source. (Somerville does not often make sustained copying errors.) Were it a translation, it is unusual for Somerville to leave the thought incomplete. The phrases themselves suggest multiple efforts at drafting an original sentence to follow the first sentence’s line of thought. In emphasizing the “pleasure” one might derive from analysis— “the means by which man has ascertained truths and arrived at results which seemed forever placed beyond his grasp”—these lines seem to belong in a conversation with Byron about apprehending the sublime. But Somerville acknowledges what Byron, in Cain’s voice, leaves unsaid: apart from apprehension at the universe’s vast size, there is also a feeling of aesthetic pleasure—of appreciation, even intoxication—at the “harmony of its parts” and a satisfaction at having discerned “truths” and “results” via geometric and mathematical analysis. The pleasure of astronomy is not merely one of appreciating beauty; it is also the enjoyment of comprehending invisible, calculable laws and of using one’s power of reason to do so.

Interestingly, too, the lines of text Somerville has struck out are immediately followed on the page by a passage from an anonymously authored text, *The Friend, or, Advocate of Truth*, which was published in Philadelphia in 1830. Rather than completing her thought, Somerville instead copies another writer’s statement on the same topic. The lines read:

He is led to the conception of a power and completeness of a power and Intelligence adequate to the production and maintenance of that he sees in nature, —a power & Intelligence to [omitted: which] he not only sees no actual limit to the instances in which they are manifested, but finds on the contrary that the farther he enquires and the wider his sphere of observation extends, they continually open upon him in increasing abundance; and that as the study of one prepares him to understand and apprehend another refinement follows on refinement, wonder on wonder, till his faculties become bewildered in admiration, and [end of page] his intellect falls back on itself in utter hopelessness of arriving at an end. (Somerville Collection Dep c. 352, fol. 5)

Here, much like Cain's "intoxicated with eternity" speech, the theme is the bewilderment of the human mind as it tries to trace the workings of a "superior" intelligence. In fact, Somerville misses or omits a segment of text found in the printed volume: after "Intelligence" the original phrase next reads, "superior to his own." In this passage, the writer suggests that human minds are destined to be thwarted by the fact that questions only bring about more questions: "the farther he enquires and the wider his sphere of observation extends, they continually open upon him in increasing abundance." Faced with "wonder on wonder," the student or observer fails "in utter hopelessness" of reaching an ultimate answer.

Yet I do not interpret these lines as a position Somerville embraces. Rather than picking up on the thread of "hopelessness" from the preceding quotation, Somerville's next entry is an unattributed passage focusing on the delights of scientific study, even if knowledge is finite:

One of the pleasures is to investigate the causes from their observed effects to determine the connection between these causes and thus to arrive at general laws, but in seeking the origin of these laws he is led to a boundary which he cannot pass and is compelled to confess that *the sum of human knowledge is ^to know mortal nature's nothingness* and to ~~acknowledge the goodness of~~ refer the glory to Him who has granted such powers to man as clearly to perceive truths which must have been clearly known to the divine Intelligence from all eternity.

(Somerville Collection Dep c. 352, fol. 5; emphasis mine)

Once again, the lines contain strikethroughs that are not simply corrections but revisions, suggesting they are Somerville's own prose. The fourth line of this passage echoes Lucifer's lines copied earlier in the notebook: "And this should be the human sum/ Of knowledge, to know mortal nature's nothingness" (408). But Somerville does not let Byron's Lucifer have the last word. If this passage about the pleasures of investigation is Somerville's, her lines counter the notion that knowledge only consists of "mortal nature's nothingness"; rather, the pleasure she highlights is that of investigating causes by observing their effects—an empirical epistemology—and determining "connections" that lead to "general laws." Somerville halts at the idea of trying to decipher or pursue "the origin of these laws," affirming a religious faith and celebrating the gift of human reason.

Connexion itself concludes with a lengthy passage that does precisely what the book's title promises, in a concise, impressive summary. Somerville delivers a recap of her volume's contents in a single paragraph: from terrestrial dynamics to their corresponding action in celestial bodies, from gravitational attraction to fluid dynamics to barometric pressure, from sound and light to chemical action and heat, electricity and magnetism. At

the close of the paragraph, she writes, “Innumerable instances might be given in illustration of the immediate connexion of the physical sciences, most of which are united still more closely by the common bond of analysis, which is daily extending its empire, and will ultimately embrace almost every subject in nature in its formulae” (413).

Somerville’s optimism is clear: analysis (a combination of physical science and mathematics) will rule the day, not unlike Britain’s aspirations for its own power and reputation around the world. Readers today might chafe at such a Eurocentric mindset, fraught with the history of imperialism and the scientific technologies that undergirded colonialism. But while Somerville was closely allied with the European science community, she was not herself an agent of the British empire. The connotations of Somerville’s statement on quantitative reason’s ubiquity should be weighed alongside the paragraph to follow, which closes the book as a whole and revisits Somerville’s sense that the practice of science and analysis was less about dominating nature or the nations of the world and more about a closer existence with the divine, a far more personal ambition. Somerville concludes:

These formulae, emblematic of Omniscience, condense into a few symbols the immutable laws of the universe. This mighty instrument of human power itself originates in the primitive constitution of the human mind, and rests upon a few fundamental axioms, which have eternally existed in Him who implanted them in the breast of man when He created him after His own image. (413-14)

Somerville’s concluding portrait of science is intimate: analytical reasoning exists in the human heart or mind because it was placed there by a divine creator. There is a harmony in her understanding of reason and scientific inquiry because it does not pit science

against religion. Again, Somerville's stance toward science is a rejection of Cain's worries in Byron's drama: her conclusion refutes the idea that "this should be the human sum/ Of knowledge, to know mortal nature's nothingness." *Connexion* asserts the opposite: understanding an order and a divinity in the universe leads one to discover a divinity within.

Conclusion

Somerville's styled prose—passages that stand out in their appeals to the reader's imagination, their descriptions of scale or color or complexity, their claims of the natural world's grandeur—demonstrates an ethos at the core of her scientific study strikingly different from the cold, detached image we may have of Victorian striving for Truth: hers is a principle or spirit of enjoyment in using human reason and an appreciation for the beauty of the laws of nature, not just nature's beauties themselves. Her sublime lay in apprehending the physical laws connecting natural phenomena on earth and in the depths of space. She directed her efforts of conveying science to disparate audiences along at least two trajectories within her books: one of unornamented expository prose that gave histories of discoveries and explained astronomical motion, heat, molecular attraction, electricity, the composition and transmission of light, and the effects of gravitational forces. The other important element of her prose was her use of affective imagery and literary allusion. If the former appealed to an audience already invested in physical science, the latter sought to engage a readership of potential practitioners and hobbyists. Byron was only one source Somerville drew upon when she contemplated how to explain astronomical concepts like parallax to such readers, a linking text that provided a suitable

metaphor. Byron's play dramatized the position Somerville's own readers would need to imagine in understanding parallax.

But Somerville's notebooks suggest she did not fully accept the import of Byron's play, particularly indicated by the fact her copied quotations all come from those scenes set in non-earthly realms, and none evoke the moral questions Byron's protagonist asks his family elsewhere in the play. Instead, parallax as a concept reminds Somerville of *Cain* and the questions it asks in relation to magnitude and scale. The play calls for the same kind of imaginative work in contemplating astronomical distance and size. When it comes to the concept of parallax, the same mental action is required of a reader of Byron as it is of Somerville. As part of a shared discourse of sublimity, the correspondences are not so surprising despite, even, Cain's spiritual crisis. Alice Jenkins describes, for example, how "the scientific reverence which connected God with the great forces of the natural world was partly fuelled by the discourse of the sublime, which allowed the emotional impact of awe and wonder to slide easily between allegiances to religion and to science" (86). The "emotional impact" Jenkins notes about the sublime was not necessarily agreeable. And the fact that Romantics like Byron often responded to the universe's scale with a seeming awe leads us initially to think Somerville's sublime is similar. Her sublime is almost as uncomfortable, but for a different reason. Somerville calls upon a reader to use an imagination that is composed of intellect rather than fancy, fed by reason and analysis, and expressed ultimately in mathematics.²⁶ The mental work required was considerable.

²⁶ Somerville's sublime resembles in many respects Kant's mathematical sublime in Book II of his *Critique of the Power of Judgment*. For Kant, infinity is a concept one might apprehend, but scarcely comprehend. The difference between apprehension and comprehension evokes in the mind a feeling of the sublime, which lies not in the natural object but in the human power of

In Byron's play, Cain's soul "aches" when he contemplates an infinite universe, especially in contrast to his own limitations and his family's exile from Paradise. Somerville's *Connexion* seeks to replace that ache with the intellectual pleasures of physical science, turning both ontological and epistemological crises into intellectual delight. Yet her volumes pained the senses of her own readers, including women readers who were the addressed audience of *Connexion*. About the "Preliminary Dissertation," Somerville's friend, the Irish writer Maria Edgeworth, wrote to Somerville at the end of May, 1832:

For my part, I was long in the state of the boa constrictor after a full meal—and am but just recovering the powers of motion. My mind was so distended by the magnitude, the immensity, of what you put into it! I am afraid that if you had been aware how ignorant I was you would not have sent me this dissertation, because you would have felt that you were throwing away much that I could not understand, and that could be better bestowed on scientific friends capable of judging of what they admire. I can only assure you that you have enlarged my conception of the sublimity of the universe, beyond any ideas I had ever before been enabled to form. (Macmillan 163)

Edgeworth's intellectual indigestion—emphasized in her own use of the discourse of the sublime—resonates with other apparent physiological effects readers might anticipate.

imagination and reason. Kant writes, for instance, "true sublimity must be sought only in the mind of the one who judges, not in the object in nature, the judging of which occasions this disposition in it. And who would want to call sublime shapeless mountain masses towering above one another in wild disorder with their pyramids of ice, or the dark and raging sea, etc.? But the mind feels itself elevated in its own judging if, in the consideration of such things, without regard to their form, abandoning itself to the imagination and to a reason which, although it is associated with it entirely without any determinate end, merely extends it, it nevertheless finds the entire power of the imagination inadequate to its ideas" (139-140).

Almost a decade later, on June 23, 1840, young Mary Ann Evans wrote to her friend Maria Lewis, “I am ashamed to send you so many ill-clothed nothings. My excuse shall be a state of head that calls for four leeches before I can attack Mrs. Somerville’s *Connection of the Physical Sciences*” (Haight I.56). Even to the intelligent Evans—not yet the novelist George Eliot—*Connexion*’s small size belied the quantity and complexity of knowledge it contained. Surely Evans was not the only reader to approach the volume with some trepidation or an application of leeches to treat a headache before opening its pages: precise details of planetary rotation and precession, conic sections and parallaxes, barometric pressure and wave refraction likely tax even the most able of nonspecialist readers.

Connexion, then, was not an easy book for a reader with some scientific background, let alone a novice, to comprehend, despite its stated object in Somerville’s dedication. The *British Magazine* remarked, “Probably our own language does not afford another summary at once so brief, so able, and so accurate, of the leading doctrines now prevalent in the various departments of physical science. It must require unwearied industry to pursue, and a very powerful intellect to grasp and master, so many difficult and abstruse subjects” (469). The *Edinburgh Review* praised its “condensed and perspicuous view of the general principles and leading facts of physical science,” but voiced “some doubt whether it is sufficiently popular to initiate our fair countrywomen into knowledge of the laws of the material universe” (155-56). That doubt was something Somerville would have hoped to avoid. In 1837 MP Charles Buller would argue in front of Parliament that Somerville’s £300 per annum pension was a “waste of money” because he rejected the very idea her works had “enlarged the bounds of science” (qtd. in

Brock 255-56). Buller's assertion speaks to a wider assumption about nineteenth-century women's writing and their intended audiences. In Somerville's case, Buller presumes her work should have been simpler in tone and style, and the implication of his criticism is that Somerville continued to speak within the community of practicing men of science, rather than exclusively for readers outside those circles. Somerville found herself up against competing notions of what her book—as a so-called popular text—“should” do, according to reviewers and Parliamentarians, and what she herself aimed to accomplish.

In *Connexion*'s framing, scientific study is as much spiritual as it is secular. In this regard, Somerville participates in a trajectory of women practitioners like Jane Marcet, Margaret Gatty, Mary Ward, Arabella Buckley, and Agnes Clerke, each of whom also presented science from a stance of religious belief. But that stance was one of personal satisfaction and gratification—taking pleasure in their intellectual employments—rather than abnegation, and here I contend that nineteenth-century British women science writers engage in an epistemology that differs in many ways from the supposedly objective, disinterested empiricism practiced by a number of their male contemporaries. However, I do not wish to pit these two epistemological forms against each other; rather, I suggest that women's exclusion from academic science and the professional societies in the early part of the nineteenth century led them to follow a different course. The increasing profile of evolutionary theory by mid-century signaled a rise in secular theories, and the divergence between religion and science began to solidify for reasons not tied to distinctions in gender or class. Practitioners of science, both men and women, sought to reconcile new scientific theories with their faith throughout the latter half of the century and beyond.

Like many of her successors, Somerville celebrates not only the spiritual quest but also the aesthetic appeal of the universe's majesty and the simplicity of laws that bind its functions together. Connections between the various sciences reveal an order and an elegance within natural law. It is no wonder Somerville's diction and syntax evoke a sublime that initially seems similar to Byron's. The discourse of the sublime—from Longinus through Kant and Burke—lends itself to Somerville's work first because of the universe's size and the vast distances at play when calculating distant stars' positions. Secondly, the aesthetic of simple laws undergirding the immense and the minute has an appeal of its own. Yet Somerville's sublime always culminates in analysis and its utility in discerning these basic principles, illuminating a majestic world. In *Connexion*, Somerville subtly distills the sublime notions of Longinus, Kant, and Burke within the crucible of nineteenth-century physical science. Her sublime—a sublime evident to her careful readers—is one that underlies much of Victorian physics and mathematics.

Mary Somerville's *On the Connexion of the Physical Sciences* was widely revered and consulted by professional men of science in her own day: its audience was professional as well as amateur. It kept practitioners up to date on the latest developments, helped promote consensus among competing theories, and offered nonspecialist readers, including and especially women, an entry into a male-dominated discourse. James Clerk Maxwell cited *Connexion* as being among "suggestive books" valuable not just for reporting science, but advancing it. Such books, he wrote, "put into definite, intelligible and communicable form, the guiding ideas that are already working in the minds of men of science, so as to lead them to discoveries, but which they cannot yet shape into a definite statement" (qtd. in Patterson 98; see also Watts 392, 402). But

because it fell victim to assumptions of value based on original discoveries—including accusations Mary Somerville levied at herself—her work gradually retreated into the shadowy recesses of histories of Victorian science. As scholars across the philosophy of science, rhetoric of science, women’s studies, and literary studies all have engaged in various recuperative studies undergirded by feminist thought, Mary Somerville’s reputation has begun shining more brightly. Now, too, we might consider what light her scientific works shed on other nineteenth-century texts and revise our notions of both genre and Victorian intellectual discourse.

Chapter 2:

Fantastic Physics: Teaching Science with Fables and Fairy Tales in

Margaret Gatty and Arabella Buckley

“Can Astronomy be presented to the young as an entertaining study? Has any one attempted to cull from treatises addressed to the not wholly unlearned in science, facts and anecdotes, the ‘light literature’ of this sublime study, and to tell these things in simple words to the young?”—Mary Ward

The epigraph quoted above begins Mary Ward’s astronomy book for children, *Telescope Teachings* (1859). Ward’s questions about describing science’s grandeurs for children speak both to my previous chapter’s examination of the sublime within Mary Somerville’s work and to similar descriptions of marvelous natural phenomena found within books by the two women whose work I examine in this chapter, Margaret Gatty (1809-1873) and Arabella Buckley (1840-1929). Ward’s emphasis on the possibility of “entertainment” within scientific study is common to many nineteenth-century efforts to educate a young audience in natural history and physical science. Like Ward, both Gatty and Buckley sought ways to demonstrate the “sublime” aspects of science to young audiences. However, while their books contain the “simple words” and “light literature” Ward describes, Gatty and Buckley are noteworthy for the ways in which their books diverge from existing models of scientific popularization by women. Margaret Gatty and Arabella Buckley stand apart from contemporaries like Ward in their choices of genre—fable and fairy tale, respectively—in which to deliver scientific instruction, and their generic innovations have yet to be fully appreciated by scholars. If Somerville used poetic allusion to evoke the sublimity of astronomical distance and unities among

physical laws, Gatty and Buckley selected genres whose fantastic features bring expectations for reverence and delight with them into a discussion of science.

In chapter one, I argued that Mary Somerville's poetic allusions and rhetoric in *On the Connexion of the Physical Sciences* (1834) signaled a transitional moment in nineteenth-century British epistemology, and that Somerville's ethos of pleasure within scientific study was shared by a number of her contemporaries and successors. In this chapter, I turn to pedagogical science texts for children written by two women in the second half of the nineteenth century: Margaret Gatty's *Parables from Nature* (five volumes, 1855-1871) and Arabella Buckley's *The Fairy-Land of Science* (1879). Gatty and Buckley share Somerville's spirit of enjoyment in their scientific pursuits, and like many of their female contemporaries who wrote for broad audiences outside the "gentlemanly" professional and academic communities of science, they adopted prose styles designed to spark their young readers' curiosity and interest. Gatty and Buckley are distinctive, however, because they departed from both the more typical "familiar" format of question-driven, dialogical prose found in so-called "governess books" popular during the first part of the nineteenth century and the expository prose found in contemporaries like Mary Ward.²⁷ Gatty's stories and Buckley's lessons harness children's

²⁷ At the turn of the nineteenth century, a number of writers were engaged in writing texts providing "useful" knowledge to children, including Maria and Richard Edgeworth's *Practical Education* (1798) and a host of "conversations" on chemistry, natural philosophy, mineralogy, and astronomy. A conversational delivery, the Edgeworths thought, resembled the manner in which children learned and was more interesting than expository prose alone (Myers 175). The conversation format was common to various kinds of didactic juvenile literature, and in its scientific use, it was most famously employed by Jane Marcet in her *Conversations on Chemistry* (1806) and *Conversations on Natural Philosophy* (1819), usually consisting of lessons given by a teacher to two students who could ask questions and converse about the topic. In form, these conversations resemble the question and answer format of catechism. Inspired, too, by the likes of John Newberry's *Tom Telescope* (1761), many of these texts included spiritual or religious digressions from the science lesson, so that as a whole, this genre of didactic literature closely

imaginations—their abilities to picture scenes and phenomena—and direct their young readers to apply familiar ways of thinking and seeing to new situations.

Attention to genre in Gatty's and Buckley's books reveals ways in which the entangled debates about morality, education, religion, and science were negotiated—but not necessarily resolved—within scientific pedagogies by women. Genres call to mind an assortment of cultural and historical assumptions and expectations. Employing familiar forms to do new work—the instruction of science, for instance—calls on readers to use their assumptions about the known to interpret the new. Gatty's and Buckley's tales demonstrate, too, how science books for children used an affective register, versus one of emotion-free logic, to invite young readers into scientific investigations. These are books intended to foster wonder and stimulate curiosity.²⁸ For both Gatty and Buckley, natural phenomena were infused with divine, spiritual meaning, and they chose genres befitting their simultaneously scientific and spiritual enterprise. Gatty and Buckley stand out among a long list of women who wrote popularizations of science in nineteenth-century Britain because of these fable and fairy tale forms: genres that, in Gatty's and Buckley's hands, explicitly bridge a gap between belief and reason, religion and science. Their stories not only highlight the religious and moral imperatives found within “natural theology,” but they also signal the kind of habits of mind, observational practices, and

associated science and religion. See Rauch's “A World of Faith on a Foundation of Science” (1989).

²⁸ Laurence Talairach-Vielmas argues that Victorian natural history books appealed to readers' imaginations and their ability to experience fear and wonder vicariously, and that this wonder transforms in the second half of the nineteenth century because science became harder to visualize. “With the advent of evolutionary theory,” he writes, “science became harder to conceive and writers turned increasingly to fairies and motifs traditionally associated with the marvelous to familiarize readers with new scientific methods” (109). Talairach-Vielmas suggests fairies entered popular science works in the second half of the century as a substitute for God (110).

methodologies necessary in an increasingly complex and professional world of science.²⁹ Gatty's *Parables* and Buckley's *Fairy-Land* aim to shape the reception of scientific inquiry as both a moral and spiritual practice; in turn, their adaptation of genres from established literary traditions for scientific instruction transformed those genres from tales of belief and make-believe into narratives of inquiry and investigation. *Parables from Nature* and *The Fairy-Land of Science* changed the parameters of what fables, fairy tales, and scientific textbooks could be, breaking new ground for what these forms could encompass, and what they would become in the latter half of the nineteenth century and the beginning of the twentieth.

In the present chapter, I provide first a brief biographical overview of Gatty and Buckley, then a summary of how the critics have positioned them within both literary studies and the history of science. Lastly, I examine Gatty's *Parables* and Buckley's *Fairy-Land*, considering how they both adhered to and deviated from established generic forms in their science lessons for children. My intention is neither merely to compare these tales against static definitions of fable and fairy tale nor simply to catalogue what a set of children's lessons in Victorian science looked like. Rather, attention to form and variations within this transformation from the literary genre to the scientific lesson—and

²⁹ Natural theology denotes a belief that natural phenomena and physical laws are evidence of a divine order. The term derives from William Paley's *Natural Theology, or, Evidences of the existence and attributes of the Deity: collected from the appearances of nature*, published in 1802 and widely read in the early decades of the nineteenth century. Paley's book argued that evidence of design implies a designer, or creator, introducing also the now-familiar analogy of the watch and watchmaker. Paley was not the originator of this idea, however; he was influenced by John Ray's *The Wisdom of God Manifested in the Works of Creation* (1691) and William Derham's *Physico-Theology* (1713). Paley's argument received its biggest challenge in the Victorian era from Darwin's thesis of adaptation and evolution through natural selection in *On the Origin of Species* (1859). While Gatty was an adherent of natural theology, Buckley's position with relation to Darwinism and theology was an ambivalent one.

vice versa—highlights how nineteenth-century juvenile literature participated in and helped to change a dynamic Victorian scientific discourse.

Lives and Works

Though both Margaret Gatty and Arabella Buckley published many books and were widely read in their own day, their reputation has faded since the end of the nineteenth century. While a number of scholars over the last twenty years have recovered their writings and written more detailed biographies elsewhere, a brief history of their lives is likely helpful to orient a reader coming to them for the first time.

If Margaret Gatty is known today among nineteenth-century literary scholars, she may more often be remembered for her founding of *Aunt Judy's Magazine* in 1866, a publication she edited with her daughter, Juliana Horatia Ewing. Yet as the daughter of one minister and wife of another, Margaret Gatty combined her Christian faith along with her botanical study to become a widely-read author of moral children's stories on natural history and guidebooks for women about marine vegetation. Margaret Scott was born on June 3, 1809 to the Reverend Alexander John Scott, who had served as chaplain to Horatio Nelson at the Battle of Trafalgar, and Mary Frances Ryder in Burnham, Essex. Her earliest education came in her father's library, and she briefly wrote poetry before giving it up when *Blackwood's* rejected her. Though her father initially refused to allow her to marry Alfred Gatty, a local curate, Scott eventually relented, and the couple married in 1839. She gave birth to ten children, eight of whom lived beyond infancy, and it was as she recovered from illness by the sea in Hastings (some attribute her illness to childbirth) in 1848-49 that her physician recommended Dr. William Henry Harvey's *Phycologica Britannica* (1846-51, 4 vol.) for her to read and to study seaweeds as she

convalesced.³⁰ For fourteen years living in the Ecclesfield parish of Yorkshire, near Sheffield—and raising her large family—Gatty collected algae and seaweeds along the British coastline, culminating in her publication of *British Seaweeds* (1863).³¹ In the same years she was researching seaweeds, she was also writing the stories to be included in *Parables from Nature*. Gatty continued to be troubled by ill health in her later years, suffering from intermittent muscular paralysis. She died in the Ecclesfield vicarage on October 4, 1873. Visitors today to the Ecclesfield parish church will find a memorial window that commemorates her life.

Unlike Gatty, little is known of Arabella Buckley's early personal life and education aside from her birth and parentage. Born on October 24, 1840 in Brighton to vicar John Wall Buckley and Elizabeth Burton, Buckley became Charles Lyell's secretary when she was twenty-four years old. Her employment as Lyell's secretary between 1864 and 1875 provided her introduction to a famous circle of Victorian evolutionary scientists that included Charles Darwin and Alfred Russel Wallace. Following Lyell's death, Buckley found other work as a popular science writer and lecturer, editing, for example, the 1877 edition of Mary Somerville's *On the Connexion of the Physical Sciences*. She published her first book, *A Short History of Natural Science*, in 1876. Like Gatty's *Parables*, Buckley's work demonstrates as a guiding principle something animating nature beyond

³⁰ In her memoir preceding the 1880 volume containing the parables in their entirety, Juliana Horatia Ewing, Gatty's daughter, just cites "an illness," but Bernard Lightman records that she was slow to recover from her seventh "confinement" in 1848 and also suffered from a bronchial condition. See *Victorian Popularizers of Science* 107.

³¹ The following are Gatty's other books for children: *The Fairy Godmothers, and Other Tales* (1851), *Worlds Not Realized* (1856), *Magdalen Stafford* (1857), *Proverbs Illustrated* (1857), *The Poor Incumbent: a Tale* (1858), *Legendary Tales* (1858), *Aunt Judy's Tales* (1859), *The Human Face Divine and Other Tales* (1860), *Aunt Judy's Letters* (1862), *Domestic Pictures and Tales* (1866), *Waifs and Strays of Natural History* (1871), and *A Book of Emblems, with Interpretations Thereof* (1872).

physical matter. Though she was a Darwinian thinker and Darwin praised her work, Buckley also sought to demonstrate more altruism in nature than Darwin's theory afforded, and her books found a ready audience of children and their parents. In the late 1870s, Buckley was still thinking about spiritualism, writing "The Soul, and the Theory of Evolution," an anonymously published essay in the *University Magazine* in 1879 (Lightman 244), the same year she wrote *The Fairy-land of Science*. An intangible spirit, power, or life-force—as it appears in various iterations of her text—animates this series of lectures, even as she conveys the most up-to-date theories of physics as possible. Buckley's subsequent popularizations emphasized the parental fostering of offspring, not just the mechanisms of natural and sexual selection. Her book *Life and Her Children* (1881) reveals such a stance even in its title, a book that discusses six divisions of animal life, while *Winners in Life's Race* (1883) discusses vertebrates. In her correspondence with Darwin, Buckley kept her religious and spiritual beliefs to herself; she was more akin to Charles Lyell, who remained a Unitarian and accepted evolution as a mode of Providence, and she became friends with Wallace, with whom she investigated spiritualism (Lightman *Victorian Popularizers* 242-43). Buckley was also a vocal proponent of teaching concepts over examination skills, an argument she makes explicit in an article published in *The Sheffield & Rotherham Independent* on January 30, 1882, entitled "Science in Elementary Schools."³² In 1884, she married a widowed medical doctor twenty years her senior, Thomas Fisher. She published *Through Magic Glasses*, the sequel to *The Fairy-Land of Science*, in 1890. Buckley died of influenza at her home in Devon on February 9, 1929.

³² As electronic databases continue to index nineteenth-century periodicals, more writings by non-canonical writers are being recovered. I am not aware of any scholarship on Buckley to date

When Gatty and Buckley appear in the pages of recent scholarly articles and chapters on literature and science, critics commonly mention the two writers' shared view of science's harmony with religious belief, a sense in divine purpose and design. For this reason, their books are sometimes categorized together under the umbrella of natural theological texts. Gatty would have readily accepted the label: the early decades of the nineteenth century saw no disharmony between studying natural philosophy or natural history and a belief in a divine creator, and it was the norm rather than the exception to write otherwise. By the time Buckley began writing, however, evolutionary thinking had come to pervade Victorian culture, whether or not there was consensus on the matter. Because of her association with Lyell and Darwin, though, Buckley kept her private beliefs in spiritualism under wraps. Yet her notions of an "Unseen Power" at work behind the invisible forces pervade her book and shape the style in which she would deliver *The Fairy-Land of Science*. In both cases, spiritual belief and scientific practice shaped how these writers approached teaching children and the forms their books would take.³³

Very few scholars, however, have concentrated on matters of form when examining Victorian women's science writing. Or rather, scholars have considered writers like Gatty and Buckley within the category of children's or juvenile literature, but not necessarily with an eye to a rhetorical analysis of the genre and the transformative effects it had on both scientific writing and fantastic tales for children. Bernard Lightman, for instance, includes Margaret Gatty among a lengthy list of female popularizers within the "maternal

that has cited or discussed this newspaper article, for instance.

³³ In highlighting Buckley's spiritualism and her personification of "life" and "winners" in evolutionary theory, my reading of Buckley contrasts significantly with Laurence Talairach-Vielmas's contention that Buckley, along with Charles Kingsley, offered her readers "a highly atheistic view of nature" (111).

tradition,” discussing the deference many female popularizers showed toward male scientists and their conservative views of women’s authority to speak out publicly on social matters and their opposition to the women’s movement (*Popularizers* 154-159). Alan Rauch discusses Gatty in a number of essays on women science writers, arguing Gatty chose children’s literature as a way of reaching across audiences in order to counter secular, materialist thought not only for the child reader’s benefit, but also that of his or her parents (140-141). Tess Cosslett argues Gatty deploys voices of children, animals, or adult women to counter “secular naturalism and its attendant disbelief,” especially as articulated in poetry by Alfred Tennyson and Matthew Arnold (140). Barbara Gates is an exception here, identifying Gatty’s choice of form as an important feature and noting that Gatty “was eager to find the old and new literary forms that were best suited to her scientific purposes—and to her moral purposes as well. ... Acutely aware of the limitations of children’s understanding of the natural world, she believed that her parables could bridge the gulf between animal life and the human species” (*Kindred Nature* 221). Gates astutely pinpoints here one efficacy of the parable: its thematic linking of human and nonhuman species. I propose the genre did even more expansive work for Gatty than just helping children think analogously of themselves with their animal counterparts. The parables also guide conceptual thinking about natural processes like weather, and further, they yoke together the scientific and spiritual as compatible. While the moral didacticism of her tales cannot be disconnected from the science, other structural and generic features of the fable also inform these parables of natural history and shape how readers could interpret their meaning.

About Buckley, Gates argues that Buckley's choice of a fantastic, rather than realistic, narrative mode in *The Fairy-Land of Science* (1879) helped her get around difficulties Darwin faced in narrating an evolutionary theory that was predicated, in part, on the fallible, temporally limited vision and memory of human beings (*Natural Eloquence* 170-172). "Transgressing the borderlands of acceptable scientific forms," she writes,

Buckley defied the limitations of both realistic language and the human sensory experience. In *Fairy-Land*, she could comfortably use the language of illusion to describe the invisible world of forces, and then in *Magic Glasses* she could reinforce the importance of access to humanly designed machines that help correct for flawed human vision. (172)

Fictional lands, especially fantastic ones, are not limited by the world available to our limited senses. In Gates's reading, the discourse of magic and illusion could represent the real, but invisible, forces of magnetism, evaporation, or electricity. Like Gates, Laurence Talairach-Vielmas argues that the fairy tale mode "mediates between magic and evolution thus bringing to the fore new scientific methods resulting from the advent of Darwinism" (112). Richard Somerset argues that Buckley's narrative recasts natural history in "matronly tones," seeking "a compromise outlook that would balance and reconcile the virile virtue of activism with the feminine virtues of love and devotion" (n.pag.). He also identifies an ethos of romanticizing science that had taken root in the nineteenth century:

The fact is that the Romantics' effort to redeem Man's soul from the mechanising clutches of the Enlightenment had become so thoroughly integrated as to become

a commonplace of Victorian ethics, and was routinely displayed by mainstream writers and novelists such as Thomas Carlyle or Charles Dickens. British natural science therefore sought to rid itself of potentially damaging associations with materialism and mechanistic philosophies, and by the end of the century, this value system had become so pervasive that the promoters of Science were more or less obliged to find ways of selling their goods in essentially moral terms. This is why we find Buckley assuring her readers that learning science, if only we do it according to the proper method, will not only make us wise and knowledgeable, but strong and good too. (N.pag.)

Somerset's focus on Buckley's position as one of compromise is important, though I posit her "feminizing" nature may have resulted from the lingering exigencies of Victorian gender expectations for women writers, rather than Buckley's submission to the market forces that called for all works to voice rebuttals to materialist science if they were to find an audience. Buckley's texts still fit within the generic tradition of maternal tales of morality, but I do not read her as a radical moralist seeking to reform Darwinian theories for the young generation.

Writing about women's popularizations of science in the early nineteenth century, Greg Myers's "Science for Women and Children: the Dialogue of Popular Science in the Nineteenth Century" (1989) focuses on the dialogue form many popularizations took. Though the dialogue form had a long history for discussing scientific topics in a way that could distance the writer from controversy (the dialogues of Galileo, for example), Myers demonstrates how later forms of dialogue divide public and scientific knowledge, creating a "lower form of science" for women and children (173). Instead of being

dialectical and exploratory, debating two sides of an issue, the kinds of dialogues women wrote—coming by way of French dialogues that were more like catechism—instead suggested a hierarchical relationship between knowledge and ignorance. Myers shows the dialogue sets readers up to be the consumers of scientific knowledge.

Not so Gatty and Buckley, however. Gatty's child characters are observers and investigators who ask questions; examine plants, animals, and insects of the fields; and look through microscopes at tiny organisms. Buckley's students watch her demonstrations and are prompted to try their hands at the experiments as well. The passive dialogue form would have been ill-fitting if they had chosen it, even if it was falling out of fashion as well.

Margaret Gatty and Arabella Buckley diverged from the previously popular “familiar format” found in governess books, and instead introduced their audiences to scientific study using the conventions of fable and fairy tale, narrative strategies that would have been familiar to young readers and adults alike. A fantastical literary genre could serve as entry into a way of thinking about nature via metaphor, a mode of critical thought crucial for understanding invisible physical forces and the actions of nature over unfathomable spans of time. Models and metaphors have long been vital tools for scientists trying to discern the causes and effects of natural phenomena.³⁴ Through such analogical thinking,

³⁴ During his days as a Cambridge Apostle in the early 1850s, James Clerk Maxwell, for example, considered physical analogies to be critical to exploring epistemological possibilities. In his essay “Analogies in Nature,” Maxwell describes the importance of physical analogies as a way not just of describing scientific knowledge, but of discovering it. For Maxwell, poetry and punning, too, were means of meditating on physical analogies within a non-scientific discourse. See Daniel Brown, *Poetry of Victorian Scientists*, pages 56-58. Jeanne Fahnestock traces how metaphor as an epistemological construct came to dominate rhetorical studies of science in *Rhetorical Figures in Science*, 4-6. In examining other rhetorical figures that appear in Gatty's and Buckley's tales, I am heavily indebted to Fahnestock's book.

scientists and popularizers alike forged connections between seemingly unrelated branches of physical science.³⁵ First, then, these fables and fairy tales offer one insight according to the metaphors and analogies they use to frame scientific inquiry; that is, using fairies as an analogy helps young readers begin to find similarities in function or operation. These analogies are important, and the present chapter will consider many of them in the pages to follow: for example, the efficacy of likening fairies to forces, or a microscope's literal use in seeing organisms otherwise invisible to the naked eye and the instrument's figurative importance in suggesting one should believe in more than simply what one can see. Yet while examining such analogies proves useful in outlining how Gatty and Buckley highlighted similarities in scientific and religious enterprises using fable and fairy tale, the frictions that emerge when applying these genres to science are likewise illuminating, shedding light on what the generic conventions were and how ill-fitting they might be for scientific instruction. That is, finding moments of disjunction and tension likewise point to the difficulties Victorian scientists and science writers faced when explaining new knowledge to wide audiences.

³⁵ "Popularizer" and "popularization" are vexed terms within the history of science, connoting not simply science aimed at the broad public—hence popular in the most democratic sense as science "for the people"—but also watered-down science, bereft of some of its accuracy and rigor. When I use the term popularizer, I use it in the first sense of someone who speaks to an audience outside the scientific community. Some famous scientists were popularizers as well, like John Tyndall; some popularizers were also scientists or mathematicians, like Mary Somerville. When speaking of the texts themselves, I will most often use the term "accommodation," a word Jeanne Fahnestock suggests in its less pejorative meaning as a work that tailors the delivery of a scientific concept for a particular audience. Ralph O'Connor advocates for the rehabilitation of the terms "popular science" and "popularization" within the history of science community, arguing that "popular science" is an umbrella category, not a heuristic tool, and serves as a helpful shorthand for representing material to be "analyzed, defamiliarized, made richer" (340). For O'Connor, the problem lies not in the terminology itself but the "inflexible manner in which we often use it" (342).

Gatty's *Parables* are a clear application of natural theology, yet in form the stories depart from established texts within a tradition established in the eighteenth century. Gatty's parables rework the fable genre because for her, it was the most salient genre for combining natural history and moral instruction, with the change—from the dialogue format—that the audience was invited to compare the behaviors of the animals depicted with their own observations, observations that they could in turn apply to themselves to guide behavior and help make moral decisions. In turn, Gatty's influence can be traced in books by successors like Lewis Carroll, Charles Kingsley, and Rudyard Kipling, whose stories feature animal protagonists that make sense—or nonsense—of their surroundings or defining characteristics. Similarly, Buckley's *Fairy-Land of Science* demonstrates how the fairy tale genre could help young students make sense of an increasingly complex and professional realm of physical science. Consistent with her spiritualist ideas, *Fairy-Land* offered Buckley's readers a magical setting in which to compare how invisible forces act. Though Buckley's text is similar to numerous earlier texts aiming to evoke wonder as an affective appeal for the study of science, it likewise illustrates the changing format science texts would take in later decades, using diagrams not just of organisms or light through a prism, but illustrations of the laboratory demonstrations themselves. The illustrations importantly suggest how students might conduct these experiments themselves, thus pointing them down the road to becoming practitioners in adulthood. A marked feature of *Parables* and *Fairy-Land* is the participatory quality of the scientific study both texts describe.

Historians of science have long realized that popularizations of science were influential: as critics like Greg Myers have argued, popularizations “shaped the non-

scientists' knowledge of science more than the original works of scientists; more than that, they shaped non-scientists' views of scientific authority" (171). The importance of Gatty and Buckley to historians of science, then, are the nuances of texts that blur the lines between natural theology to secular science. While most British women science writers were more aligned with clergymen than with secular science (Lightman *Victorian Popularizers* 97), Gatty's and Buckley's approaches likewise find common ground with secularly-minded scientists like John Tyndall in their evocation of wonder and the use of the imagination so that reason and observation will follow. To educators, then, their work can be valued for their keen insight into the practice of teaching itself, of a pedagogy capturing students' interest, asking probing questions, requiring abstract thought as well as concrete observation or deduction, and synthesis. To feminist literary critics, Gatty's and Buckley's importance stands within their contributions to an understudied genre of writing within the nineteenth-century literary tradition. These texts belong in a literary history of scientific education, marking both consistencies and departures from earlier works and signaling directions instructive texts would take thereafter. These works stand out not only among male science writers but also among female popularizers frequently read during the nineteenth century.

Nature's Parables

Called one of the most popular series of books in the latter half of the nineteenth century,³⁶ *Parables from Nature* first appeared in 1855 as a collection of eight tales featuring caterpillars and crickets, bees and birds, a bookworm and a will-o'-the-wisp, flowers, seaweed, and a handful of human characters, both children and adults. Four

more series of new tales followed in 1857, 1861, 1864, and 1871, containing a total of thirty-seven stories by the time Gatty concluded writing them (just two years before her death). The first, third, and fifth series each contain eight stories; series two contains just six, and series four comprises seven. Many collected editions containing multiple series also went into publication, while some organizations like the Society for Promoting Christian Knowledge (SPCK) chose smaller selections of the most Christian tales for publication under their own auspices.³⁷ Likewise, American publishers made their own editorial selections. While Gatty illustrated the first series of *Parables* herself, later editions feature illustrations by notable Victorian artists, including John Tenniel and Pre-Raphaelites William Holman Hunt and Edward Burne Jones. In later editions of the *Parables*, Gatty began adding explanatory notes containing descriptions of natural history at the ends of the volumes.

These explanatory notes raise a number of questions about how to characterize the *Parables* as a work of scientific accommodation and what factors prompted the notes' inclusion. Their addition suggests a change in the exigencies of writing natural history stories for an audience of children and their parents or guardians. A number of editions are available digitally for scholarly study, yet it remains difficult to trace when Gatty began appending these natural history notes to her volumes without traveling to a number of international archival collections. I believe such a study would prove fruitful, yet a full history of the book lies beyond the scope of this chapter. For the present, however, I can locate Gatty's appended notes in volumes published by Bell and Daldy as early as 1865, containing the stories from the third and fourth series (GoogleBooks), and an 1868

³⁶ See, e.g., Barbara Gates, *Kindred Nature*, 50.

edition containing stories from the first and second (HathiTrust).³⁷ When discussing the impact of the notes, I use the textual evidence I have gathered to date and limit the application of my argument to the mid-1860s and thereafter.

In form, Gatty's *Parables from Nature* combine two genres that in the nineteenth century would likely have been understood as distinct: parables and beast fables (also known as apologues). Some present realistic human situations in which the lesson comes via tacit analogy—as found in parables, while other tales display an abstract moral thesis or principle of human behavior via talking, anthropomorphized animals—as found in beast fables. Often the essence of the lesson is stated more or less explicitly in the characters' dialogue, but it is not styled in verse like the *Fables* of La Fontaine nor delivered in Aesop's epigrammatic form or in a list of intended lessons like those one finds regularly, for example, in the pages of Harriet Martineau's *Illustrations of Political Economy*. Readers might also surmise the moral with the help of the stories' epigraphs, many of which are Biblical passages or lines of poetry, especially by Tennyson, with some also by Milton, Goethe, and Pope. Some of Gatty's tales are closer to a traditional parable form: they do not involve animal characters, they maintain a realistic setting and characters, and they respond to a specific situation, though Gatty relates the narrative in an allegorical fashion.

The importance of moral instruction to Gatty is clear when a reader today considers the five series of *Parables* as a whole, for each tale includes a lesson readily accessible to young children. Like many of her predecessors who wrote for juvenile audiences since

³⁷ See Lovell-Smith 50 n. 13.

³⁸ Unless otherwise stated, citations to *Parables from Nature* are keyed to the facsimile text of the complete edition of all five series of stories, published by George Bell and Sons, 1880.

the eighteenth century, Gatty conforms to a tradition in which women—mothers, to be more precise—were considered the fount of moral knowledge and the seemingly “natural” source for such wisdom. But Gatty’s choice of parables as her preferred genre for moral instruction represents a departure from one tradition just as she turned to another for inspiration. That is, in applying the conventions of beast fables to her *Parables*, Gatty takes on more from the realm of fairy-land than from the catechism-like dialogues used by many women writers who preceded her. In her preface to the first volume of *Parables*, Gatty confesses the influence of Hans Christian Andersen, saying her first story, “A Lesson of Faith,” was written

in an outburst of excessive admiration of Hans Andersen’s *Fairy Tales*, coupled with a regret that, although he had, in several cases, shown his power of drawing admirable morals from his exquisite peeps into nature, he had so often left his charming stories without an object or moral at all. Surely, was the thought, there either is, or may be devised, a moral in many more of the incidents of nature than Hans Andersen has traced; and on this view the “Lesson of Faith” was written—an old story; for the ancients, with deep meaning, made the butterfly an emblem of immortality—yet, to familiarize the young with so beautiful an idea seemed no unworthy aim. (1855 ed., x)

While Gatty points here to Andersen, her adherence to Paleyian natural theology is likewise evident in her suggestion that morals might, indeed ought to, be drawn from such “exquisite peeps into nature.” Such moral instruction is present throughout Gatty’s corpus. Her career in fiction began, in fact, in 1851 with a tale titled “The Fairy Godmothers,” a story about the individual gifts bestowed by fairies on three little girls

and culminating in the lesson that “love of employment” was the best gift to receive; and her last publication was *A Book of Emblems, with Interpretations Thereof* (1872). Morals, though, were but half of Gatty’s aim in the *Parables*: virtue was to be found likewise in the study of nature, a manifestation of divine creation.

Gatty’s text thus aims to achieve a dual purpose: the parables instruct children toward virtuous behavior while providing fragments of accurate natural history and summaries of current debates, such as whether a zoophyte was a plant or animal. Many parables explain curious, commonly misunderstood phenomena like the light of an *ignus fatuus*, or will o’ the wisp in the first series; or the red algae found in remote, snowy regions like the heights of Mont Blanc in the third series. Throughout the *Parables*, sight is paramount in learning about the natural order. Crucial to all of the lessons is the message that good children, especially those aspiring to becoming scientists, must learn *how* to see the world, and that a scientist’s vision involves not just physical, but also metaphysical sight. Natural theology is a dominant theme: reading nature carefully and in detail helps the naturalist discern divine order and moral law, both of which can help the learner grow closer to the divine creator—or at least try to.

But while identifying natural theology within Gatty’s *Parables* may be a commonplace within circles of Victorian literature and science scholars, the importance of the Gatty’s chosen genre for her spiritual-scientific instruction has not been fully appreciated. Certainly Gatty appears within histories of Victorian scientific popularization, but our accounts need to consider more closely how her books engage within the scientific debates of the period. Examining her scientific fables as parables shows her orthodox religious views; examining them as scientific texts illuminates the

nuances in this kind of transmission among nineteenth-century audiences, and it shows the degree to which Gatty grew uncomfortable with secular scientific explanations. In years following the publication of Darwin's *Origin*, Gatty's *Parables* favor moral education over and above the delivery of scientific lessons.

To illustrate what kind of stories these *Parables* are, I have selected two: "A Lesson of Faith," the tale that opens the very first series in 1855 and shows quickly the kind of moral lessons Gatty contains elsewhere; and "Inferior Animals," a story found in the third series of 1861 that, while still allegorical, most explicitly engages with the evolutionary controversy of the day. "Inferior Animals" is striking for ways it exceeds the kinds of generic boundaries Gatty adheres to elsewhere and drifts even into the realm of fairy tale, not unlike the nonsensical Wonderland of her contemporary, Lewis Carroll, or the allegorical satire found in George Orwell's *Animal Farm* in the twentieth century. Both of the selected series of *Parables* originally appeared without explanatory natural history notes appended, so I will also examine how the selected fables change for a reader when notes are present. We might surmise that Gatty added them to augment the reader's knowledge and provide paths for additional study, but by including them in her volumes, the tensions between religious and secular science become increasingly visible.

"A Lesson of Faith" tells the tale of a young caterpillar who unexpectedly finds herself a nursemaid to a butterfly's eggs in response to the latter's dying request, having given no helpful instructions about their care before she passes away. With seemingly no option now but to watch over the eggs, the young caterpillar decides to ask the advice of the wisest animal she can think of, a lark, musing "that because he went up so high, and nobody knew where he went to, he must be very clever, and know a great deal; for to go

up very high (which *she* could never do) was the caterpillar's idea of perfect glory" (3). The lark travels far and wide, returning with the surprising knowledge that the young eggs will in fact hatch into caterpillars—not butterflies, which had been both the dying butterfly's and caterpillar's expectation—and that they will find nourishment on the very cabbage leaves where the caterpillar has been standing vigil over her charges. Even as she learns this fortunate news, the eggs hatch and the tiny caterpillars happily begin munching away at the plant. The nightingale continues to relay the knowledge he's gleaned on his travels and informs the caterpillar that she, too, will someday transform into a butterfly. The caterpillar is incredulous at first, but upon seeing the hatched young caterpillars, "shame and amazement filled our green friend's heart, but joy soon followed; for, as the first wonder was possible, the second might be so too" (6). For the rest of her days as a caterpillar, she talks about how she will someday become a butterfly, despite her relations' disbelief. The story concludes with the caterpillar-turned-butterfly's continued faith facing her own death, and her trust that more wonders might yet be possible.

The story's moral is clearly outlined in the trope of transformation from caterpillar to chrysalis to butterfly. In essence, this is a conversion story: it follows in the same vein, for example, as Saul's conversion to Christianity to become St. Paul. For a young reader, the butterfly is an accessible emblem of faith and resurrection, and the butterfly's lines concluding the story make the message explicit: "I have known many wonders—I have faith—I can trust even now for what shall come next!" (6). Gatty's epigraph, too, articulates the notion of resurrection. The quoted lines come from Job 14:14: "If a man die, shall he live *again*? All the days of my appointed time will I wait, till my change

come” (1). Thus the natural theological interpretation of the tale is apparent in the reading of caterpillar/butterfly metamorphosis as symbol of mortality and afterlife in the Christian belief system. One reads the butterfly in nature as a means to discover or discern a divine plan for human existence and trust in the promised afterlife of Christian theology.

But what of this tale’s instruction in natural history? In the 1855 volume, the only textual clues a young reader might notice about caterpillars and butterflies are the former’s choice of cabbage-plant leaves for food versus the butterfly’s nourishment in “honey out of flowers,” and the presence of “gold dust” the butterfly mother shakes off as compensation for the caterpillar for caring for the eggs. The dying butterfly tells the caterpillar to expect young butterflies to hatch, but of course her supposition is false. The life cycle of butterflies is an inherent, integral part of the narrative, but its importance lies in its allegorical meaning rather than in a close study of the creatures themselves.

More becomes clear with Gatty’s appended notes, which transform this tale of natural theology into a complement for natural history, even a mnemonic device a young reader might recall in later studies. The notes are keyed to specific passages in the text, so they appear as technical annotations. In the notes to “A Lesson of Faith,” a reader learns the butterfly in question is the female *Pieris rapae*, the common “cabbage butterfly,” whose wings are “of a creamy white color outside; the front ones with two largish black spots upon them, the hind ones with one. There is also a dark patch at the outer corner of each front wing, and both wings are speckled into a grayish hue near the body. Underneath, the hind wings are a pale yellow, and there is a yellow patch in the outer corner of the front ones” (423). Gatty also tells her readers about the color composition of the caterpillar,

which is the larval stage of the cabbage butterfly; that the food plant of this species is the cabbage; how these larvae differ in food sources from other species; that readers might find additional knowledge about a butterfly's physiology—including its ability to suck juices from flowers—from William Kirby and William Spence's *Introduction to Entomology* (1815); and how the "gold dust" of the story is actually composed of the rubbed off, minute scales that cover a butterfly's wings and are the source of the scientific name *Lepidoptera*, meaning "scaly-winged" (424-5). Gatty also anticipates a reader's possible objection that a lark might, in fact, eat a caterpillar like the story's heroine. On this point, Gatty defers to ornithologist John Gould, who asserts that while larks do eat very small insects and larvae, they would "certainly" not eat "a large one." When giving additional information about the lark, Gatty also directs her audience to Gilbert White's *Natural History and Antiquities of Selbourne* (1789). Finally, Gatty ends her notes with a passage returning to the moral lesson undergirding the parable, quoting lines by Sir Thomas Browne in his *Religio Medici* (1642) about the "two books": the book of God and the book of Nature.

In short, Gatty's notes provide considerably more detail than the original story, and they incorporate a number of other sources a reader might consult to study the topics further. Paired together, the story and the notes supplement each other, working in tandem to provide both spiritual and scientific instruction. Yet they do not rest easily next to each other, as the presence of Gatty's last note indicates. After providing details from authorities in entomology and ornithology, Gatty returns to Early Modern physician and philosopher Thomas Browne's confessional memoir to reassert the religious exigencies for naturalist study. Gatty reminds her reader that this was St. Paul's method, too, who

used the analogy of a seed's decay before germination as indicative of the possibility of resurrection (426-7). Thus both her story and her notes conclude with a moral lesson, emphasizing the objective in looking to nature as a means of studying the divine. Gatty quotes Browne's lines, "There is in these works of Nature, which seem to puzzle reason, something divine, and hath more in it than the eye of a common spectator can discover" (426). Browne's lines encapsulate the paradox with which Gatty's parables and notes grapple: a tension between getting "closer to God" through an understanding of nature, yet finding oneself at an even greater distance because of an inability to bridge the gap between human and divine. Gatty's *Parables* are invested in perpetuating this paradox, rather than resolving it, however. Gatty's tales refuse the notion that empiricism and scientific theories might ever fill the gap between human experience and the divine.

Gatty's story "Inferior Animals," found in her Third Series of 1861, illustrates this refusal well. Beginning with an epigraph containing lines from Goethe ("How? when? and whence? The gods give no reply. / Let *so it is* suffice, and cease to question why"),³⁹ the story describes a congregation of rooks who gather together in an open field and debate the origin of man. Unlike "A Lesson of Faith," the narrative of "Inferior Animals" has a complicated structure that blends fairy tale elements with an intrusive, editorializing narrative voice, sometimes addressing an implied reader, and other times speaking to that reader as if he or she is a companion in the tale itself. The story begins *in medias res*, asking "What do they say?—what do they say?—what do they say?—" (213). The opening of the story sets the scene, but rather than begin with the creatures' conversation, as happens in many other tales within the *Parables*, the opening pages compare the noisy

cawing of rooks with the “noise” of human debate and suggest that the latter is, in fact, the more discordant of the two. “If you never thought of this before O reader,” Gatty writes,

Think of it now, and take an early opportunity of listening, and judging for yourself. Listen, not as listening to the meaning of what is uttered, but to the mass of noise as mere noise. Listen to it, as you might imagine a rook to do, ignorant of human speech, and judging only of the hubbub of sounds; and then own to yourself—for conscience will force you to do so—that there is neither sweetness nor sublimity, neither melody nor majesty, in the shouting, and piping, and whistling, and hissing, and barking, of closely intermixed human voices and laughter. (214)

The narrator asks this comparison of the reader to demonstrate that however much our human instinct is to forge bonds and communicate with other species, our efforts will be for naught. Gatty’s speaker argues, “Alas, for the barriers which lie so mysteriously between us and the other creatures among whom we are born, and pass our short existence upon earth!—Alas!—for a desire for intercommunion is one of the strong instincts of our nature, and yet it is one which, as regards all the rest of creation but our human fellow-beings, we have to unlearn from babyhood” (214). The story asserts a hierarchy between human and nonhuman animals, suggesting there is little surprise that lower species cannot understand the higher, yet it seems incredible that a higher species should never be able to cross the chasm of understanding one lower. To illustrate this

³⁹ There may be an error in Gatty’s quotation here. A GoogleBooks search for the lines finds the following in *The Wisdom of Goethe* instead: “How?—when?—and where?—the gods give no reply;/ What they will do, they do: nor heed your Why?”

lesson, then, Gatty provides the story of the rooks, an allegory of the evolutionary theory debates in which the rooks conclude that man, “a featherless, thin-skinned biped,” is but a degenerate rook: “Like us they were covered with feathers, like us lived in trees, flew instead of walking, roosted instead of squatting in stone boxes, and were happy and contented as we are now!” (223). Gatty’s satire is two-fold: first, she targets evolutionary theory itself; second, she refutes the greater premise that knowledge of species development would be possible, dismissing the value even of asking such a question. The timing of Gatty’s Third Series of *Parables* in 1861, and its frequent inclusion of skeptical human characters rather than Christian believers, places it in a cultural moment that not only saw the publication of Darwin’s *On the Origin of Species* in 1859 but also the 1860 Oxford meeting of the British Association for the Advancement of Science (BAAS), where T. H. Huxley famously attacked Bishop Samuel Wilberforce during a debate about human evolution (Weber 428). The raucous debate among the rooks, with their cawing interruptions and hopping, coupled with the rook-speaker’s references to his colleagues present in the group, “Mr. Grey-legs,” “Mr. Yellow-beak,” and “Mr. Raven-wing,” also suggest Gatty had a professional science meeting like the BAAS in mind.

Where the imagined world of other parables is consistent and readers are invited to immerse themselves in the conversations of animals, “Inferior Animals” betrays the generic boundaries of a true fairy story. Her speaker is first simply an editorial voice, offering a decided opinion on the question of epistemology: “from the first moment of waking to conscious thought, we find ourselves in a country where all utterances but our own are to us a blank; all the creatures strange; all life unintelligible, both in its beginning and its end: all the present, as well as the past and future, a mystery” (216). This mystery

is, for the speaker of “Inferior Animals,” the ultimate answer toward which inquiry will end, and the reason for which faith, rather than science is needed. Only children, Gatty’s speaker suggests, can cross the gulf between species and commune with animals in their imaginations. Thus the speaker addresses her audience, whom the following summons identifies not as children but fellow adult readers:

Reader, can you hear this and remain unmoved, or shall you and I become children in heart once more? Come! Own with me how hateful were the lessons which undeceived us from our earlier instincts of faith and sweet companionship with all created things: and let us go forth together, and for a while forget such teaching.

Hand in hand, in the dear confiding way which only children use, let us go forth into the fields, and read the hidden secrets of the world. Clasp mine firmly as I clasp yours. See, there is magic in the action itself! So we placed our hands in those of our parents; so our children love to place theirs in our own. So, then, even so, let us two walk trustingly and lovingly together for a while, and join again the broken threads of old feelings, wishes, friendships, and hopes. (216)

Gatty invites the adult reader to imagine herself the narrator’s companion in a return to childhood. In reaching out her hand, Gatty’s narrator asks the reader to be on her side, an ally in the debate that follows. The pair move toward the congregation of rooks in the field, with the narrator suggesting the reader “cower down here...by this hole in the hedge” where “the honeysuckle is twined in the thorn above our heads, and is giving out its scent around us, as if to bid us welcome” (217). At first, the human pair makes no sense of the gathering, and the speaker laments that “nature remains mute” and enjoins

philosophers to answer the seemingly simple question of what the rooks are saying. The narrator's words to such philosophers become heated: "—you lights of the world, with your books and papers and diagrams, and collected facts, and self-confidence unlimited! You who turn the bull's eye of your miserable lanthorns upon isolated corners of the universe, and fancy you are sitting in the supreme light of creative knowledge!... Tell me what the rooks are doing and saying; those inferior animals about whom you, in your wisdom, ought to know everything" (217-18). Then, in a passage full of repeated (anaphoric) phrases, Gatty's speaker commands the philosopher to respond to a series of inquiries about the behavior of these rooks:

Tell me what these grand assemblies are for; tell me how they are called; tell me how they are conducted; tell me by what message the distant colonies are warned of the particular spot and hour of meeting. Tell me by what rules the place is chosen. Tell me how the messenger is instructed. Tell me by what means he delivers his message. Tell me why they meet on level ground and walk like men, and not rather in their own deep woods, where they might fly and roost on branches, and run no danger, and need no guard?

Tell me what do they say, what do they say, what do they say, when they meet at last, and whether they are there for business or for play. Tell me these things, and then I will listen to you when you point out to me the counsels and the workings of the Creator of rooks and men. (218)

The repetitions of "tell me" and "what do they say" serve both as emphasis for effect, but they also mimic the noise of the rooks: repeated again and again, the phrases might begin to lose their meaning beyond the sounds of the words. Gatty's questions are rhetorical,

too, though readers today might recognize them as typical of anthropological and zoological field research. But to Gatty's audience, they may have seemed beyond the realm of study.

Thus the main body of the story, where the rooks debate the development and degeneration of humanity, is framed in the style of fairy-story as the narrator suddenly hears what the birds are saying and enters into a new, dream-like realm: "Have my senses left me, or have I received another? Any how the spell is broken at last, and language, language, language resounds on every side!" (219).⁴⁰ Yet Gatty's story inverts fairy tale convention here, suggesting the veil between human and rook communication was the enchantment, now broken, rather than a fairy tale hero's more typical entry into a fantastical realm via the *introduction* of magic. By the end of the tale, the narrator loses her sense of reality and fantasy. Her first-person speaker becomes overwhelmed at the rook's argument, which causes her distress and eventually rouses her from her daydream: "What silence is this, which has cut short the sentence, and which neither their caws nor the voice of the speaker break again? How is this?—where am I?—Do I wake or dream?" (233). In waking from her reverie, Gatty's speaker echoes Keats's concluding lines in "Ode to a Nightingale": "Was it a vision or a waking dream?/ Fled is that music:—Do I wake or sleep?" Instead of following Darwinian evolutionary theories, Gatty's tale looks back to Romantic notions of nature and a contemplation of birdsong that encourages self-reflection and consolation. Though unlike the sublime imagery of Somerville and Byron,

⁴⁰ In the twentieth century, J.R.R. Tolkien would argue that use of a dream-like state to explain away an encounter or experience in fairy-land transgresses the genre of a true fairy-story: "But if a waking writer tells you that his tale is only a thing imagined in his sleep, he cheats deliberately the primal desire at the heart of Faërie: the realization, independent of the conceiving mind, of imagined wonder" ("On Fairy-Stories," 116).

Gatty's tale hearkens back to Romantic notions of science. Interestingly, too, Gatty's perspective of holding on to both empiricism and faith seems to be in accord with Keatsian negative capability: there seems to come point in her sense of natural history knowledge when one must accept a sense of ease with uncertainty and not to reach for certitude.⁴¹ Each of the three volumes following publication of *Origin* emphasizes religious faith when faced with unknown circumstances, yet while empiricism never truly dominates, neither does it fall by the wayside: the *Parables* encourage observation and measurement. In Gatty's tales, empiricism must, however, yield when human perception reaches its limits and then trust in a higher purpose. "Inferior Animals" brings this perspective into sharp relief.

Given the anti-evolutionary stance and opposition to materialist science undergirding "Inferior Animals," it is not surprising that the explanatory notes differ markedly from the kind Gatty provides for "A Lesson of Faith." Here, it would seem that Gatty's notes pointedly avoid providing too much detail about the physiology and behavior of rooks. To do so would seem counter to the impact of her long sequence of rhetorical questions in the tale itself. Instead, the notes describe an anecdotal story about the care of rooks and give just a passing description containing the binomial nomenclature of Linnaean taxonomy: "The rook (*Corvus frugilegus*) is considered the chief English representative of the crow race (*Corvidae*), as the Hooded Crow (*Corvus cornix*) is in Scandinavia and the Isles of Scotland" (476). Gatty then acknowledges her story's similarity to the writings of John Henry Newman but affirms she had not had them in mind at the time of writing the story. She concludes the notes with the passage

⁴¹ See Keats's letter to George and Thomas Keats, 21, ?27 December, 1817.

from Newman. Thus again, Gatty's notes conclude with a religious element rather than a scientific one.⁴²

Gatty's natural theology consistently asserts the existence of an impermeable boundary between the natural and spiritual worlds; consequently her stories feature the trope of the eye: the importance of both physical and metaphysical, or spiritual, vision appears throughout the course of the *Parables*. The spiritual vision she seeks to inculcate in her readers becomes, too, part of her form insofar as she uses animals as her interlocutors. Readers must imagine such fantastical scenes playing out, just as the creatures themselves imagine worlds beyond their own limited sensory perceptions. In presenting the conversations of animals, however, Gatty's human characters are never truly auditors of what the natural world's speakers are saying. In exceptions like "Inferior Animals," the ability is explained away as a dream-state. By giving creatures like birds and insects, or inanimate objects like water vapor or the ocean speech, Gatty's text suggests that nature is always communicating—but not via language. As in William Cullen Bryant's "Thanatopsis" (1811), which opens with "To him in the love of nature holds/ Communion with her visible forms, she speaks a various language," Gatty's nature communicates through the visible. Her text must constantly—if not consistently—mediate between the auditory and the visual. Though her readers may learn via the language of her text, the natural world must be interpreted by other human senses, usually sight.

⁴² Given Newman's controversial reputation as one of the leaders of the Oxford Movement and his shift from the Church of England to the Roman Catholic church, the religious element is a highly fraught one as well.

Turning now to Arabella Buckley's *The Fairy-Land of Science*, a very different shape to scientific education appears, one still saturated with vision and wonder yet far more expansive and technical in its delivery.

Science's Fairy-Land

In the spring of 1878, Arabella Buckley delivered a series of lectures on science to an audience of children in St. John's Wood, London. Receiving a favorable response to the lectures and numerous requests to commit them to a printed book, she published *The Fairy-Land of Science* in 1879. Buckley's innovation in this book was the conceit of a fairy tale frame: a conceptual linking device that would figuratively materialize the invisible, excite curiosity, and stimulate an affectionate desire to learn more about science. The volume contains ten chapters, or lectures: "The Fairy-Land of Science: How to Enter It; How to Use It; How to Enjoy it"; "Sunbeams and the Work They Do"; "The Aerial Ocean in Which We Live"; "A Drop of Water on Its Travels"; "The Two Great Sculptors—Water and Ice"; "The Voices of Nature and How We Hear Them"; "The Life of a Primrose"; "The History of a Piece of Coal"; "Bees in the Hive"; and "Bees and Flowers." Illustrations and diagrams appear throughout the volume. The book's frontispiece shows a dramatic glacial moraine with three tiny figures in the foreground, suggesting the magnitude of such a scene. Each chapter begins with an illustration that is rather more fanciful: the opening chapter's vignette, for instance, juxtaposes two images within a single frame: a frozen landscape on one side, and in the other, a scene depicting a knight awakening a maiden in her chamber—the awakening of Sleeping Beauty. The significance of this illustration will be discussed in greater detail below. In adapting her oral lectures to written lessons, Buckley found she needed to rewrite them entirely to be

effective on the page (Gates, “Introduction” vi). Most chapters follow a similar structure: an opening illustration; then metadiscourse reviewing the previous lectures and previewing what will come in the next five lectures, namely the effects of physical phenomena on living creatures; and then a transition to the subject of the current lecture. The text also demonstrates thereafter the kind of science classroom pedagogy a reader today would also recognize: preliminary questions, a physical demonstration (shown via illustrations in the printed text) as a model, then an explanation and expansion of that model to apply to phenomena on the macro scale.

Both the prose style and arrangement of the text demonstrate Buckley’s aims in transcribing her lectures for a wider public: to be both “a source of pleasure to a wider circle of young people” and to “awaken in them a love of nature and of the study of science” (v). “Love” is the key element here. Buckley ardently hopes her audience will develop an affection for the natural world and, by extension, pleasure in studying natural laws. In other words, Buckley uses affect—here, the evocation of wonder—as a pedagogical strategy to interest her readers. In evoking an excitement about learning science, Buckley’s use of fairies as characters to represent forces is foremost a tactic of metaphor, yet it also suggests readers should become aware of a kind of magic in the laws of the universe: the invisible forces of heat, evaporation, conduction, magnetism. That tactic of metaphor is crucial for developing students’ capacity for understanding analogy and developing models. Though Buckley’s fairy-land is a fanciful metaphor, the potential to shape a scientific acumen—helping children develop the capacity for abstract thought—is a pressing need in a science classroom. Modern (i.e., twentieth and twenty-first century) science relies on the use of theoretical models to consider the physical

operation of phenomena that cannot be apprehended by naked human senses. So Buckley's introduction to *The Fairy-land of Science* is her way of providing an entry point into new material: practicing the rhetorical strategy of known-new argument, that is, starting with known information as a means of familiarizing the audience with the new material to come.

In *The Fairy-Land of Science*, Buckley relies upon the conventions of fantasy and folk tale, primarily the notion of invisible fairies. In choosing fairies as her conceit, Buckley may have been trading on Victorian popular appetites for fairy tales. Christina Rossetti's "Goblin Market" had appeared in 1862, and *Macmillan's Magazine* published her poem "The Prince Who Came Too Late" (later, "The Prince's Progress") in May 1863, three months after it had concluded the serialization of Charles Kingsley's *The Water-Babies*. John Ruskin had written the introduction to the Grimms' *German Popular Stories* in 1868; his own *The King of the Golden River* was published in 1851. The magazine *Good Words for the Young* began publication in 1868 and included tales like Lady Frances Verney's "King Arthur's Boar Hunt: An Ancient British Fairy Tale" and George MacDonald's "The Princess and the Goblin" in the same 1871 volume. Dinah Mulock Craik's "Last News of the Fairies" was published here in 1870. George MacDonald's fairy tale novella, *The Princess and the Goblin* was published in 1872.⁴³ With an abundance of fairy stories in print, Buckley could be confident in her audience's familiarity with the conventions of the genre.

⁴³ For more on late-Victorian fairy-tales, see Caroline Sumpter, *The Victorian Press and the Fairy Tale* (2008) and Jason Marc Harris's *Folklore and the Fantastic in Nineteenth-Century British Fiction* (2008).

The Fairy-Land of Science takes its inspiration from fairy tales, yet it is not a work that actually fits within the genre; like Gatty, Buckley adapts form to her own ends. The folkloric definition of fairy tale, what the Germans call Märchen, is a folktale that involves a succession of motifs or episodes. These episodes take place in an unreal world lacking a definite locality and time—the “once upon a time, in a land far, far away” opening, for instance—and the tales are populated with character types who often have magical powers or experience marvelous encounters (Harris 4). In *Folklore and the Fantastic in Nineteenth-Century British Fiction* (2008), Jason Marc Harris distinguishes between motifs and tale-types: a fairy godmother is an example of a motif; “Cinderella” is a tale-type. He also uses the term “folk metaphysics” to describe “folkloric assumptions about how the supernatural engages with the material world” (viii). What is supernatural in a fairy tale becomes the explained physics in Buckley’s volume. She does not rely on the genre of fairy tales—fairy tales do not guide the structure or contain motifs except for fairies—but rather on folk metaphysics: “the rules, behaviors, powers, tendencies, and borders of the spiritual world implied by popular beliefs” (Harris 5). That is, Buckley observes that the enchantment a fairy tale offers is the notion that magical things can happen without human intervention or beyond sensory experience. Gatty, on the other hand, includes the motifs of fairy tale and fable: the trickster, mentor, mother, or villain. The difference between Gatty’s and Buckley’s chosen genres, then, is a difference between the familiar and the strange: Gatty’s tales include familiar motifs so that the moral questions and their implied responses are clear; Buckley’s lessons instead highlight the unexpected and mysterious workings of invisible laws and forces.

Put into today's understanding of fairy tales, which we most often think of as taking place in unfamiliar, distant realms, where the laws of nature seem to work differently, Buckley's volume—especially her introduction to the lectures—both familiarizes and defamiliarizes the physical world. In comparing forces to fairies, she acknowledges they are immaterial. Yet in asking students to imagine fairies—diminutive pixie-like creatures with wings, invisible yet active and revealing their work by their effects—she also materializes such forces.⁴⁴ Barbara Gates, too, has argued that *Fairy-Land* offered Buckley the means to “comfortably use the language of illusion to describe a palpable world. In this way she could induce her readers to visualize the unseeable” (“Introduction” vii). Once her students could visualize the phenomena in question, they could then begin to interrogate its workings and understand it.

The first and sixth lectures illustrate best how Buckley's *Fairy-Land* follows a pattern of first evoking wonder and curiosity, and then satisfying the student's desire to learn the reason behind an initially perplexing phenomenon. The first, “The Fairy-Land of Science: How to Enter It; How to Use It; and How to Enjoy It,” demonstrates how Buckley shapes the fairy-story to her purpose and prepares her audience for the lessons to follow: this lecture provides the template for all of the subsequent chapters. The sixth, “The Voices of Nature, and How We Hear Them,” is both a typical lesson for the volume in its style and delivery, but as the halfway point in the volume, it also serves as Buckley's pivot between lessons on pure physical science to lectures on animal life. It is also a marked contrast to Gatty's “Inferior Animals” in its portrayal of what happens when one listens to sounds in nature.

⁴⁴ On this point, I owe thanks to Professor Meegan Kennedy for a question she asked about this seeming “materialization” of fairies following a paper I delivered at NAVSA at the 2013

Buckley begins her volume with an introduction that aims to awaken her audience's sense of wonder, the kind of childlike curiosity and awe felt when experiencing something magical. It is this affect—a combined feeling of curiosity, interest, and excitement—that Buckley suggests will support and guide a young student's continued progress through scientific inquiry. She acknowledges that many children might look on science as “a bundle of dry facts,” rather than a fanciful tale they associate with fairy tales. But, Buckley contends,

science is full of beautiful pictures, of real poetry, and of wonder-working fairies; and what is more, I promise you they shall be true fairies, whom you will love just as much when you are old and greyheaded as when you are young; for you will be able to call them up wherever you wander by land or by sea, through meadow or through wood, through water or through air, and though they themselves will always remain invisible, yet you will see their wonderful power at work everywhere around you. (2)

Here Buckley harnesses together the invisible and the visible: the actions of such “fairies” or forces like magnetism and heat, and the physical materiality of nature. The invisibility of forces makes them suited for Buckley's metaphor as fairies, and what will endear her readers to these science-fairies, she hopes, are the wonderful and beautiful effects that humans might observe every day, wherever they may be.

To illustrate her fairy-land of science conceit, Buckley's prose next explains the presence of the double vignette of frozen landscape and Sleeping Beauty. Describing the fairy tale, Buckley asks her audience to recall the story:

How under the spell of the angry fairy the maiden pricked herself with the spindle and slept a hundred years? How the horses in the stall, the dogs in the court-yard, the doves on the roof, the cook who was boxing the scullery boy's ears in the kitchen, and the king and queen with all their courtiers in the hall remained spell-bound, while a thick hedge grew up all round the castle and all within was still as death. But when the hundred years had passed the valiant prince came, the thorny hedge opened before him bearing beautiful flowers; and he, entering the castle, reached the room where the princess lay, and with one sweet kiss raised her and all around her to life again.

Can science bring any tale to match this? (2)

The question is a rhetorical one, for the “magic” of winter’s ability to freeze the motion of even the busiest river is Buckley’s answer in the next paragraph. Prompting her readers to imagine a frozen winter scene—the “fixed and motionless” wind-ripples of a pond, the “beautiful crystal fringe” of icicle-bedecked eaves, the “fern-leaves of ice” on a window-pane—this is also a spellbound scene, “the enchantments of the frost-giant who holds it fast in his grip and will not let it go” (3). In the frozen scene, the “brave sun” is the hero, “and when the sun-beam gently kisses the frozen water it will be set free. ...Is this not a fairy tale of nature? and such as these it is which science tells” (4). Buckley begins her volume with an implicit question: what is magical about science? The motive behind asking such a question for Buckley lies in the affective appeal that such fairy tales elicit in young readers, an appeal that she believes science can match, if one approaches with a similar attitude. If it is not a “willing suspension of disbelief” a reader might adopt for the fairy tale, it is, perhaps, an open curiosity to discern the invisible workings of the

physical world. So when Buckley asks her readers, “Tell me, why do you love fairy-land? what is its charm?” she suggests, “Is it not that things happen so suddenly, so mysteriously, and without man having anything to do with it?” (5). The mystery, the suddenness, and the lack of human intervention in nature’s actions are the basis of the appeal, the wonder, Buckley believes lies at the core of readers’ fascination with fairy stories, and, by extension, will hold true when one considers the operation of natural laws.

The only necessary mental tool or prerequisite attitude required to know nature’s fairies, Buckley suggests, is the imagination. “I do not mean mere fancy,” Buckley clarifies,

which creates unreal images and impossible monsters, but imagination, the power of making pictures or *images* in our mind, of that which *is*, though it is invisible to us. Most children have this glorious gift, and love to picture to themselves all that is told them, and to hear the same tale over and over again till they see every bit of it as if it were real. This is why they are sure to love science if its tales are told them aright; and I, for one, hope the day may never come when we may lose that childish clearness of vision, which enables us through the temporal things which are seen, to realize those eternal truths which are unseen. (7-8)

In this Coleridgean distinction between imagination and fancy, Buckley states an idea that is as much spiritual as it is physical and temporal. Unseen eternal truths might be divine in their origin, or they might be immutable physical laws, but the importance Buckley places here is on the “childish clearness of vision” that can perceive what is intangible, ethereal.

The fanciful, affectionate prose style Buckley adopts at the outset of her text appears regularly throughout *The Fairy-land of Science*, but predominantly only at the beginnings and ends of the lectures. In between, Buckley shifts to an assured tone of instruction, full of first-person descriptions of the demonstration and imperatives for children to watch, observe, and listen. But woven throughout these lessons are the exhortations to her reader to love nature: at the end of chapter one, for instance, she writes,

We are all groping dimly for the Unseen Power, but no one who loves nature and studies it can ever feel alone or unloved in the world. Facts, as mere facts, are dry and barren, but nature is full of life and love, and her calm unswerving rule is tending to some great though hidden purpose. You may call this Unseen Power what you will—may lean on it in loving, trusting faith, or bend in reverent and silent awe; but event the little child who lives with nature and gazes on her with open eye, must rise in some sense or other through nature to nature's God. (25)

Buckley's diction echoes Carlyle, but it also aims to banish charges of science's being too boring, too "dry and barren" (or "dry-as-dust," as Carlyle would put it). The child Buckley describes "gazes...with open eye" on a nature that provides solace because it is not empty; personified as female and maternal, Buckley's nature here is benevolent, a key feature she emphasizes throughout *The Fairy-Land of Science*.

The sixth lecture in Buckley's text, "The Voices of Nature, and How We Hear Them," explains the physics of sound, both the action of sound waves and the anatomy of the human ear. The vignette opening the chapter depicts two scenes arranged vertically: in the top image, a young boy and girl sit on a hill overlooking a stream. Two birds perch on the branches of a nearby bush, while another sits atop a tree growing on the opposite

bank. In the foreground of the image, a frog sits behind and to the side of the children. The bottom image illustrates a coastal storm. Waves crash to the shore with thunderclouds above and lightning flashing in the sky. The opening paragraphs of the chapter call on the student-reader to recall experience, describing noises often heard in a city or town: “the jolting of the heavy wagon or dray, the rumble of the omnibus, the smooth roll of the private carriage and the rattle of the light butcher’s cart, . . . the crack of the carter’s whip, the cry of the costermonger at his stall, and the voices of the passers by will strike upon your ear” (125-6). Buckley then turns to examples of the pastoral countryside, quieter by comparison, but still filled with the nature’s noises: the buzzing of gnats and bees, the chirping of grasshoppers, the rippling sound of a nearby stream, or “the song of the birds, the squeak of the field-mouse, the croak of the frog, mingling with the sound of the woodman’s axe in the distance, or the dash of some river torrent” (126). Unlike Gatty’s “Inferior Animals,” Buckley’s text does not ask why communion with nature must stop at aesthetic appreciation of a divine creation. Instead, Buckley asks her readers, “Now, has it ever occurred to you to think what sound is, and how it is that we hear all these things? Strange as it may seem, if there were no creature that could hear upon the earth, there would be no such thing as sound, though all these movements in nature were going on just as they are now” (127). The question is a provocative one for children and but a variation of the still familiar conundrum, “If a tree falls in the forest and no one is there to hear it, does it make a sound?” The answer, as Buckley illustrates in her chapter, is no: to a deaf person,

A heavy hammer falling on an anvil would indeed shake the air violently, but since this air when it reached your ear would find a useless instrument, it could

not play upon it. *And it is this play on the drum of your ear and the nerves within it speaking to your brain which makes sound.* Therefore, if all creatures on or around the earth were without ears or nerves of hearing, there would be no instruments on which to play, and consequently there would be no such thing as sound. This proves that two things are needed in order that we may hear. First, the outside movement which plays on our hearing instrument; and secondly, the hearing instrument itself. (127)

Buckley chooses her examples and analogies carefully, for the hammer and anvil of this example reappear when she explains the anatomy of the bones of the inner ear. She plants the image early in the chapter so that it is a familiar image later. The “instrument” metaphor likewise lays a foundation for her later demonstrations with bells and tuning forks, and the diagram of the human ear showing the eardrum.

The chapter structure begins with the familiar noises described above, then the question that presents the subject of inquiry: what sound is and how it works. Beginning outside the human ear, Buckley next describes a three-part experiment readers might do in their own drawing or sitting rooms at home: first, to tie a long piece of string around the end of a poker and hold the other end of the string against the ear while hitting the fireplace’s fender with the poker. Buckley suggests then repeating the experiment but this time holding the end of the string in one’s teeth and covering one’s ears. In the third variation, the child ties the other end of the string to the mantelpiece instead of the poker. In this simple experiment, a child reader will be able to tell that the vibrations created when the poker hits the fender travel along the string and register in the ear. Because this chapter follows one on “the aerial ocean,” Buckley calls on a previous lesson’s

knowledge of air and atoms, and she then turns to describe demonstrations carried out in a classroom or lecture hall, presumably demonstrations she had physically done when teaching the lectures in St. John's Wood.

The examples begin with an apparatus John Tyndall had used in his lectures comprising a long box with balls in a row, ending with a bell (Fig. 2), then an analogy of train cars bumping into each other as they come to a stop in a station, with a corresponding illustration modeling atoms in a similar row undergoing collisions like those of the balls or train (Fig. 3), and then a diagram of a compression wave (Fig. 4).

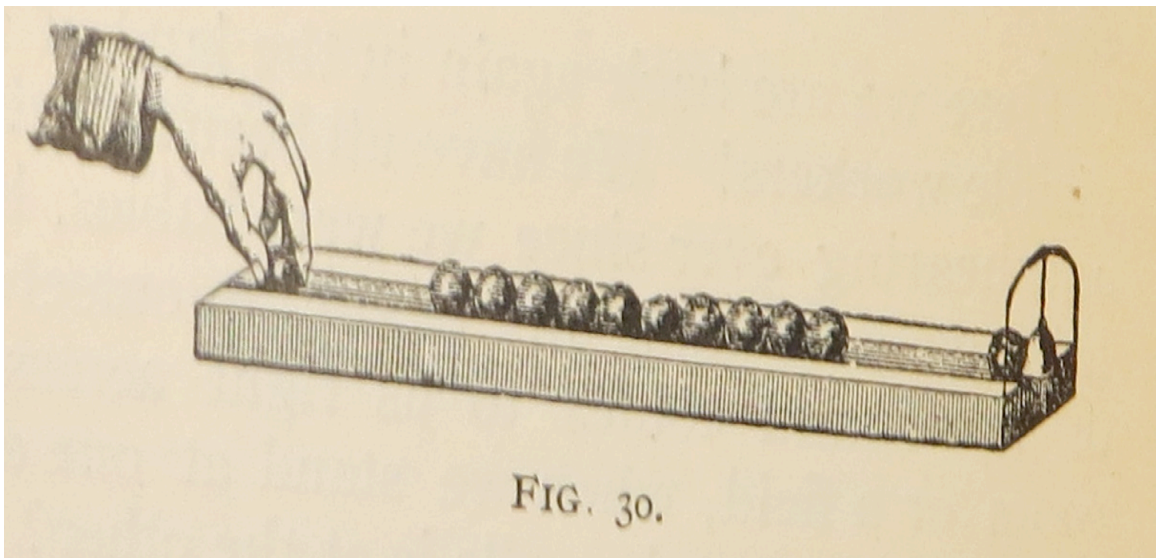


Fig. 2: Tyndall lecture apparatus

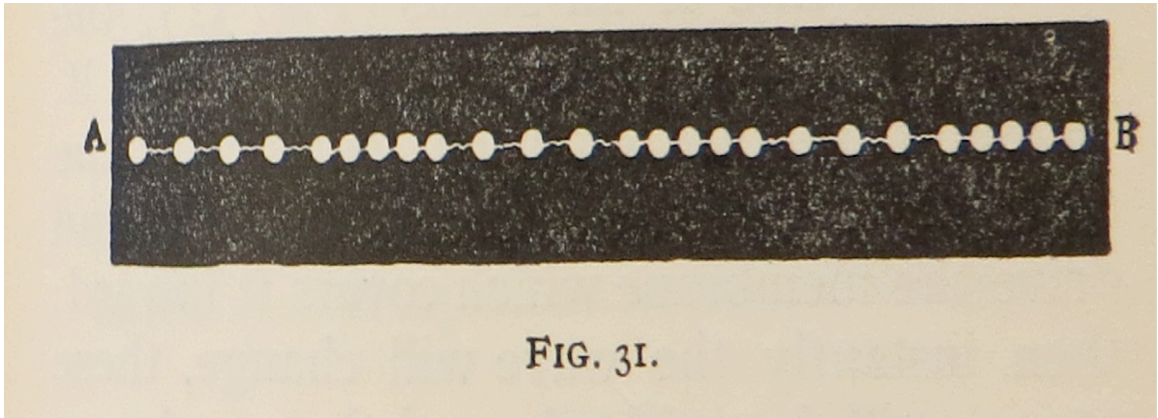


Fig. 3: Idealized drawing of linearly colliding atoms

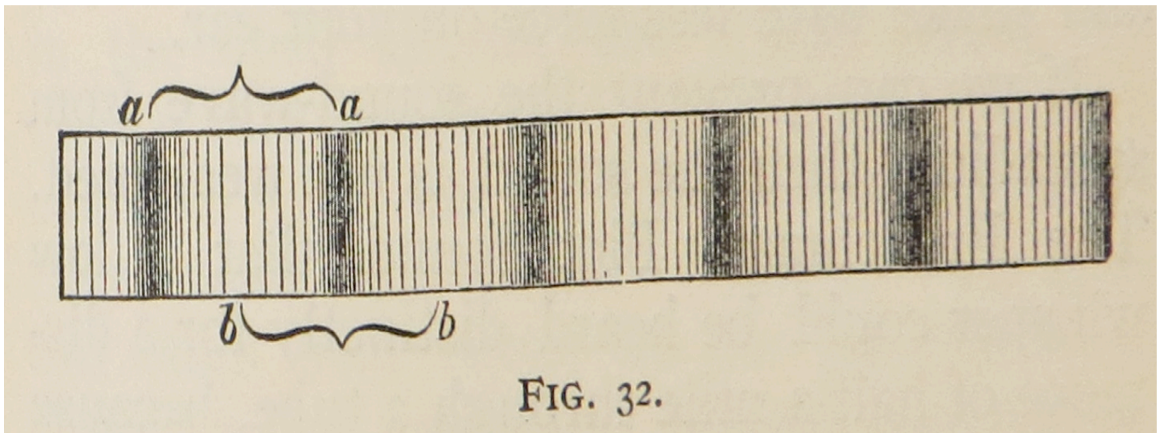


Fig. 4: Compression wave diagram

Buckley explains the difference between the longitudinal light waves she had described in an earlier chapter on sunbeams and the compression waves of sound, identifying the latter as “a set of crowdings and partings of the atoms of air which follow each other rapidly across the air. A crowding of atoms is called a *condensation*, and a parting is called a *rarefaction*, and when we speak of the length of a wave of sound, we mean the distance between the two condensations, *aa* Fig. 32, or between two rarefactions, *bb*”

(131). After these examples and diagrams, Buckley then explains the workings of the human ear, describing the anatomical mechanics with another diagram, Fig. 5.

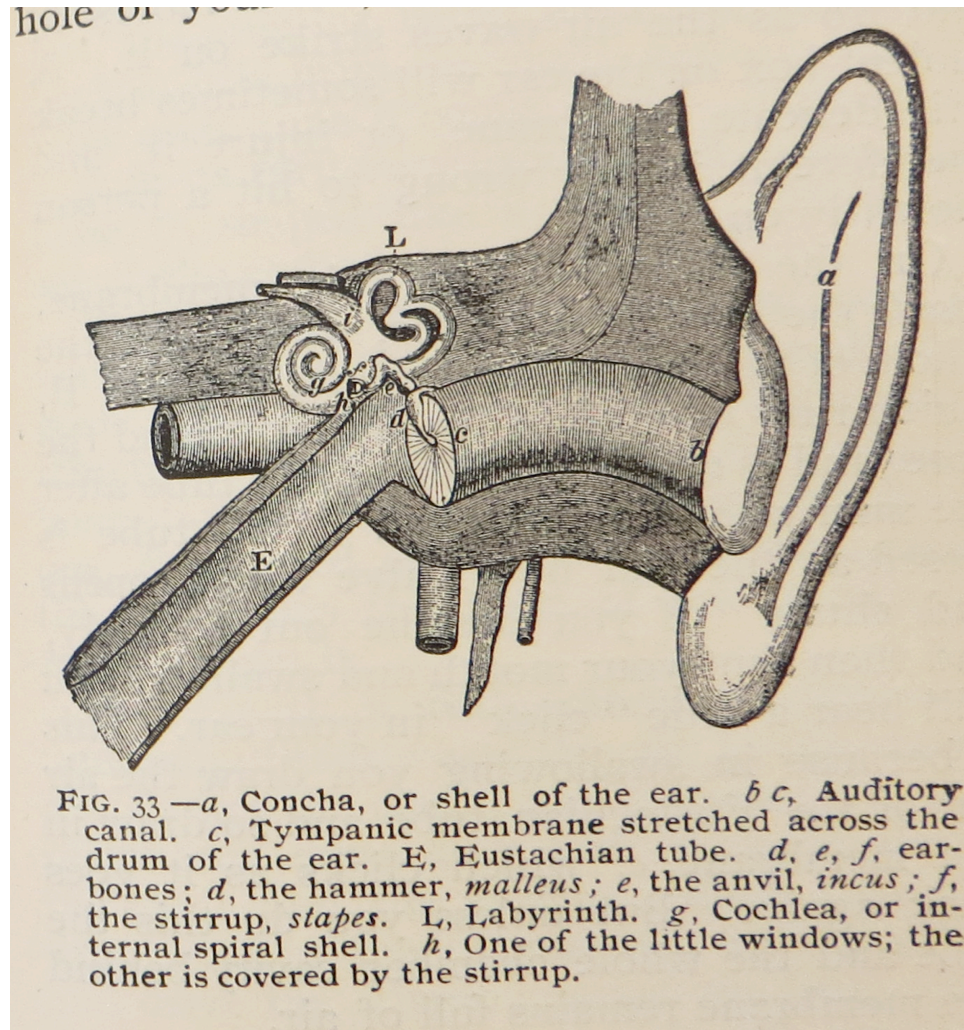


Fig. 5: Drawing of the inner ear

Buckley's explanation stops at the neuroscience of what happens after a sound wave registers on the fine hairs within the Labyrinth, transmitting the information through the nerve (*i* in the diagram). She then describes the difference between sounds heard as music versus noise as one of regularity, using more tuning forks and apparatuses, before turning

the reader's attention outward again to sounds in nature: the regular tones of ocean waves and the differences the size of the stones, gravel, or sand make on the pitch of the resultant sounds; the sublime noises of claps of thunder, cracking glaciers, avalanches; and the small sounds of buzzing insects. She concludes the chapter with the claim that the "sweetest sounds of all in the woods are the voices of the birds" (148). Explaining briefly the physiology of birds that allow for such variety and duration in their song, Buckley closes the chapter with the following passage:

Only think what a rapid succession of waves must quiver through the air as a tiny lark agitates his little throat and pours forth a volume of song! The next time you are in the country in the spring, spend half an hour listening to him, and try and picture to yourself how that little being is moving all the atmosphere around him. Then dream for a little while about sound, what it is, how marvelously it works outside in the world, and inside your ear and brain; and then, when you go back to work again, you will hardly deny that it well worth while to listen sometimes to the voices of nature and ponder how it is that we hear them. (148-9)

Where Gatty's rooks produce nothing but noise—either in the reality of a human auditor who hears only croaking or the imagined discordant debate they have about humankind—Buckley's birds produce music worthy of wonder and contemplation. While Gatty's story had emphasized the disconnect between human and animal, Buckley's chapter on sound unifies human and nonhuman experience within the physics of sound.

Within *The Fairy-Land of Science*, Buckley demonstrates a lingering attachment to teleological explanations of the workings of the universe when she consistently turns to concepts seemingly at odds with empirical methodologies. References to the intentions of

“the Unseen Power” thus appear at the conclusions of lectures devoted to explaining physical concepts like condensation or gravitation, enjoining her readers to wonder at the expansiveness of nature’s complexity. The lecture demonstrations, illustrated visually along with the prose exposition, provide evidence that supports the conceptual instruction. But Buckley’s chapters aim to evoke fascination as much as they exhibit physics. Buckley does not reduce scientific knowledge to fixed categories; instead she enlarges its sublime implications and tethers it to spiritual belief. Poised at the intersection of empiricism, relativism, evolutionary theory, and natural theology, *The Fairy-Land of Science* resists easy classification in its mixing of fairy tale storytelling with scientific demonstrations. To take Buckley’s project seriously is to challenge our established histories of Victorian science and its transmission.

Conclusion: A Scientific Education for the Young

Striving for conceptual accuracy but not mathematical proof or calculation, Buckley’s *The Fairy-Land of Science* gives young readers a solid foundation of the physical world on which to build future study. Hers is not a book keyed to examination results or the pragmatics of job training. Buckley was, in fact, a longtime proponent of teaching concepts over examination skills, an argument she makes explicitly in “Science in Elementary Schools,” a letter she published in both *The Sheffield & Rotherham Independent* and *The Leeds Mercury* on January 30, 1882. Buckley’s proposed course of study begins each module with observation of the natural world and extending the observations to the physical concepts that lie behind observable phenomena. Students at the first level in her proposed sequence would progress from air and wind to pressure, gravitation, and temperature; in the second level, from observations of rain and rivers to

an understanding of the water cycle and temperature, from thunder to sound, and from lightning to electricity; and then in the next level, from basic understandings in minerals to conducting simple chemical experiments. Her course of study ends with astronomy. Taught conceptually, a child would “start on every subject from nature.” Physical science as a subject, then, would not be a monolithic entity to be mastered, but rather:

the handmaid to interpret the facts of daily life and observation. Teachers would not be afraid of it, for it would give scope for the simplest as well as for the highest teaching. True, the children at the end would not have a store of quantitative and qualitative facts, such as our friend the manufacturer found worse than useless; but under a teacher of ordinary powers they would be accustomed to observe and to think, and they would, moreover, instead of the dangerous “little knowledge,” be far more likely to have that humility in the face of nature, and the desire to learn more, which is of far greater importance at the age of thirteen, when they leave school, than a limited, even if it were accurate, knowledge of systematic science.

In today’s educational moment of standardized testing, Buckley’s words still resonate. They signal, too, how long debates about courses of study have been with us. In her own time, Buckley’s methods were evidently popular among professional men of science. At the BAAS meeting in York in 1881, for instance, Buckley’s name came up in a conversation which arose about the teaching of rudimentary science in elementary schools. She was mentioned approvingly as “a lady who made a most favorable impression, and showed much familiarity with the subject in expressing her objections to separating theoretical from practical science” (*Leeds Mercury* 2 February 1881).

One of the foremost debates about education in nineteenth-century Britain was the place of science as a formal course of study within the curriculum. Other disputes about governance and content loomed large over all, mainly about whether the state or the Church of England should administer British schools. This tension between secular and religious thought, playing out at the institutional level of education, was one of the arenas in which the larger intellectual debate between classical and modern scientific modes of knowledge came to blows. Men like Herbert Spencer, Thomas Huxley, and John Tyndall championed scientists as the new model of public intellectual, a kind of social hero markedly different from the sort Thomas Carlyle had advocated. We have come to think that women, however, were largely excluded from these conversations about the value of science, even as they were carrying out their own scientific inquiries or, in the case of Mary Somerville in her *On the Connexion of the Physical Sciences*, providing overviews of the “state of the field.” Fanciful science books for children appear to exist on the fringes of both the intellectual debate about humanities and science, and the administration of a child’s formal education. In fact, however, women with established reputations like Margaret Gatty and Arabella Buckley wrote texts that illustrate the Victorian public’s ambivalence on such matters, and their voices were prominent ones.

While often classified under the broader rubric of “natural theology” because of a consistent ethos of religious belief contained therein, *Parables from Nature* and *The Fairy-Land of Science* demonstrate the diverse ways women writers shaped science’s reception among audiences deemed “outside” the scientific establishment. Yet the topics and debates their books include were highly topical and at the center of Victorian conversations about secular and religious science. Gatty’s emphasis on moral instruction

highlights the utility of fable in serving her purpose. Her science has a moral valence. Buckley stresses the immaterial element of physical science, the invisible forces at work. Thus fairy tales offer the seeming magic of a world populated and influenced by fairies. Her science is a spiritual one, with spiritualist leanings. What Gatty and Buckley share is a similar understanding that stories and narrative offer useful ways of entering scientific inquiry and naturalist study, that these literary forms can help readers recall previous experience or awaken a receptive, excited frame of mind. They differ from their predecessors like Jane Marcet or contemporaries like Mary Ward in selecting these fanciful conceits to convey science. But what the *Parables* and *Fairy-Land* share is the sense that a student of natural history, natural philosophy, physical science—or whatever the common expression for science was at the time—ought to be fully engaged and immersed in the inquiry at hand, that she should be invited into the study, asked questions, and given the conceptual tools to apply in her everyday activities.

Chapter 3:
Novel Natural History:
George Eliot and Narratives of Science

From its opening line—“a wide plain, where the broadening Floss hurries on between its green banks to the sea, and the loving tide, rushing to meet it, checks its passage with an impetuous embrace”—to its violent drowning of the two protagonists in its penultimate chapter, *The Mill on the Floss* (1860) pays keen attention to landscape and to how people grow, mature, and die within it. The opening passage describes St. Ogg’s, a town set alongside the River Floss and surrounded by “rich pastures” and “patches of dark earth,” where beehives rise “at intervals beyond the hedgerows; and everywhere the hedgerows are studded with trees,” and the masts of trade ships bearing lumber, seed, and coal, appear in between the branches of the trees when viewed from the narrator’s vantage point on the stone bridge by Dorlcote Mill (7). Or at least, the narrator remembers this scene, for she finds herself waking from a dreamlike state, the sensation of her arms resting on her chair blending with that of leaning on the stone bridge in her reverie.

The narrative voice who relates the tale of the Tulliver family’s changing fortune is an intriguing presence within the novel, for it is unclear how she knows the story she tells. Perhaps she is a fictional version of the “author”; or perhaps another character, a contemporary of Maggie Tulliver; or the older version of the little girl also described in the opening scene who gazes at the mill in a manner mirroring the narrator. But whomever her identity may be, she is a close observer of both people and place. In this

chapter's reading of the novel, her presence is much like that of an amateur naturalist: an observer of appearances, behaviors, and actions. She is someone who looks back to a moment in living memory, describing it with a keen eye and considering whether the growth and tragic deaths of a brother and sister come at the hand of fate or as a consequence of the seeming cruelty of nature's indifference. In George Eliot's *The Mill on the Floss*, natural history saturates the novel's plot and its prose. Though many readers today might initially associate the novel's natural imagery with Darwinian evolutionary theory because of the timing of its publication, appearing just six months after Darwin's *Origin*, in fact, natural history narratives had been in wide circulation for decades and had gained increasing popularity in the mid-Victorian era.

By the middle decades of the nineteenth century, Britain was alive with science. It pervaded daily life: technologies of travel like steam engines took families to coastal towns where they could collect seaweeds and corals as amateur marine biologists. Photography focused Victorian eyes on the details of portraiture and landscape, informing and responding to the particularities of Pre-Raphaelite art. Printing presses produced masses of books and pamphlets on self-improvement via scientific study. Scientists themselves offered new theories of evolutionary biology, light, magnetism, electricity, navigation, and cognition. All of these developments found their way into the most capacious genre of the nineteenth century, a literary form the Victorian era made famous: the novel. Because of so many variations in its use, style, character, kind, subject matter, and length, the novel has come to seem a genre unto itself. In this chapter, I consider how the novel's form underwent development within the Victorian era, and I define it according to the terms and descriptions offered by a number of contemporary

reviewers, especially those writing in the 1850s and 1860s, the time at which Marian Evans (1819-1880) began a career writing fiction under the pseudonym George Eliot.

As the most widely known author this dissertation examines, George Eliot stands out for her genius as a novelist.⁴⁵ Within the tradition of scientific writing by women, she warrants a place because she embarked on a writing career at a time when the popularity of the novel was reaching a new high thanks to the successful demand created and satisfied by the publishing world in its widest sense: a community of publishers, circulating librarians, booksellers, authors, reviewers, and readers. It was likewise a time when amateur botany and hobbyist natural history saw a similar increase in popularity, again, in part, a phenomenon emerging from the increase in scientific publications for the layperson. This chapter examines what George Eliot's own experiences of amateur marine biology offered her fictional enterprise, and conversely, how her fiction interpreted scientific ideas for her audience of novel readers. If women had previously been known in the scientific community primarily for accommodations of science for children and other women rather than original investigations, they also were considered together in pejorative categories in the literary world as writers of "silly" novels, full of the dramas of a drawing room. George Eliot's fiction represented a departure from the kinds of novels most often associated with women authors, a type she herself critiques in 1856 but that would still find its likeness decades later in Lady Carbury's literary

⁴⁵ "George Eliot" is the pseudonym of a woman who went by many names, and Rosemarie Bodenheimer has written about these various identities in "A Woman of Many Names" (2001). Born Mary Anne Evans, she later dropped the "e" of her middle name, then combined the two into the name Marian Evans, Marian Evans Lewes, and ultimately Marian Cross. Though "Eliot" was never her real surname, I use it on occasion for the sake of avoiding excessive repetition, but I generally will refer to her authorial persona as "George Eliot." I also try to distinguish between the activities of the woman and the writings of the author; that is, Marian Evans goes on holiday

ambitions in Anthony Trollope's *The Way We Live Now* (1875).⁴⁶ These two traditions of women's writing—scientific accommodation and fiction—meet for George Eliot when she goes on holiday with George Henry Lewes to the coastal town of Ilfracombe. In natural history narrative, she finds a tradition that would fit her aims for fiction.

I focus here on a particular moment in the nineteenth century—the middle decades of the 1850s and 1860s—and I do not mean to suggest that George Eliot's sole influence or entry into fiction writing was natural history.⁴⁷ What I do hope to illustrate, however, is how natural history narratives—especially those written at midcentury by women—offer a means of understanding the formal changes the novel underwent as it was used to interpret and make sense of science, even before Darwin forever altered Victorian intellectual life with his publication of *On the Origin of Species* in 1859. That is, the

in 1856 and collects shells, seaweeds, and corals; "George Eliot" is the author Evans creates to voice her criticism and fiction from this point in her career forward.

⁴⁶ In Trollope's description, for instance, Lady Carbury "did work hard at what she wrote,—hard enough at any rate to cover her pages quickly; and was, by nature, a clever woman. She could write after a glib, commonplace, sprightly fashion, and had already acquired the knack of spreading all she knew very thin, so that it might cover a vast surface. She had no ambition to write a good book, but was painfully anxious to write a book that the critics should say was good" (17). The irony of bad books receiving high praise, and vice versa, was well known to George Eliot, who condemns the practice in her "Silly Novels by Lady Novelists" essay in the *Westminster Review*: "No sooner does a woman show that she has genius or effective talent, than she receives the tribute of being moderately praised and severely criticized. By a peculiar thermometric adjustment, when a woman's talent is at zero, journalistic approbation is at the boiling pitch; when she attains mediocrity, it is already at no more than summer heat; and if she ever reaches excellence, critical enthusiasm drops to the freezing point" (161). Even in her review, Eliot draws upon scientific discourse, describing critical popularity with a figure of inverse proportionality resembling Robert Boyle's gas law describing the inverse relationship between the pressure and volume of a gas. Charles's law, describing the proportional relationship between an ideal gas's temperature and pressure, would also be evoked by Eliot's description, where the relationship is a "peculiar" variation. Eliot's rhetorical effect also derives from the antithetical relationship she describes between quality and critical reception.

⁴⁷ Too much scholarship on Eliot exists that would show the limitations and error of such a claim. See, for example, the very useful essays providing overviews of each of George Eliot's engagements with her era's intellectual debates included in *The Cambridge Companion to George Eliot* (2001), including Suzy Anger's "George Eliot and Philosophy," Barry Qualls's "George Eliot and Religion," and Nancy Henry's "George Eliot and Politics."

popularity of natural history among a wide audience of mid-Victorian readers made for a relatively easy transition to the inclusion of organic theories of science in fiction. Description and narration are a naturalist's instruments just as much as they are the tools of the novelist. This chapter traces how the mid-Victorian era was an especially productive moment for natural history narratives to take cues from fiction, and vice versa, and that women were vital voices in both of these discourses.⁴⁸ George Eliot's fiction transformed the prose styles common to the burgeoning natural history craze of the 1850s into her ideal form for the Victorian novel. George Eliot, I argue, becomes the most appropriate case study for this chapter's analysis because her own career as a novelist overlaps with that of women naturalists within the generic boundaries of the natural history narrative.⁴⁹ Her "Recollections of Ilfracombe," along with her *Westminster* reviews, "The Natural History of German Life" (July 1856) and "Silly Novels by Lady Novelists" (October 1856), firmly place George Eliot into a conversation about both natural history writing and women's fiction.

The diversity of reviews of George Eliot's work during her lifetime and the availability of her vast correspondence have been a boon to biographers and literary scholars alike.⁵⁰ Her life has been well documented, her reading habits scrutinized, and

⁴⁸ In *George Eliot and Nineteenth-Century Science: The Make-Believe of a Beginning* (1984), Sally Shuttleworth cogently argues for the ways in which Eliot's novels provide narrative resolution for the organic science and experiment in prose related to psychological sciences (xiii).

⁴⁹ Her use of science was so marked, it became the occasion for criticism among her reviewers. Not only would Henry James take her to task for sounding too much like Darwin and Huxley in *Middlemarch*, but R. H. Hutton would even object, in his view, to her overly-scientific diction. See, for example, Beer's *Darwin's Plots* (139).

⁵⁰ For a wide selection of contemporary reviews of George Eliot's novels, see, e.g., David Carroll's edition of *George Eliot: The Critical Heritage* (1971).

her relationships probed for insight into her novels.⁵¹ Her literary engagement with scientific ideas, especially those of Charles Darwin, and the social philosophies of Herbert Spencer and Auguste Comte, have also been widely discussed.⁵² In placing George Eliot into this dissertation's interrogation of scientific genres used by women, though, I hope to extend the reach of conversations about her in literature and science circles, demonstrating both how her early understanding of the natural and physical sciences was influenced by her reading Somerville's *On the Connection of the Physical Sciences* in the 1840s and how her science studies affected not simply the content of her novels, but also their form.

In this regard, I also draw from the body of George Eliot scholarship concerned with the novel as a genre, including mid- to late-twentieth-century work by Barbara Hardy, Frank Kermode, and J. Hillis Miller.⁵³ In this chapter, I aim to demonstrate the ways

⁵¹ See biographies by Mathilde Blind (1888), Gordon Haight (1968), Ruby V. Redinger (1975), Jennifer Uglow (1987), Rosemarie Bodenheimer (1994), Rosemary Ashton (1996), and Kathryn Hughes (1999) for a range of approaches to George Eliot and her work. Tanya Agathocleous's bibliography in *The Cambridge Companion to George Eliot* concisely assesses the merits of the Haight, Hughes, Bodenheimer, and Ashton biographies in particular (237-8). Though I focus on a specific historical moment in Marian Evans's life, I do not aim to read her fiction through her biography.

⁵² See, e.g., Gillian Beer's *Darwin's Plots* (1983), Sally Shuttleworth's *George Eliot and Nineteenth-Century Science* (1984), and George Levine's *Darwin And the Novelists* (1988) for investigations of Eliot's science; and Nancy L. Paxton's *George Eliot and Herbert Spencer: Feminism, Evolutionism, and the Reconstruction of Gender* (1991) and Suzy Anger's *Victorian Interpretation* (2005) for examinations of Eliot's responses to Spencer and Comte. Anger's analysis of Eliot's understanding of the uses and limits of observation to develop sympathies that would prompt right, moral social actions is particularly relevant for my reading of "The Natural History of German Life."

⁵³ In *The Novels of George Eliot: A Study in Form* (1959), Barbara Hardy corrects what had been a prevailing criticism of Eliot's lack of organization among her contemporary reviewers and a number of readers in the early twentieth century. She argues "the novels of George Eliot depend on the emphasis of formal relations as well as the ordinary interest of the human relations of loving and hating and betraying and serving and so on. Here the formal element binds, unifies, and makes a moral emphasis. Just as it is possible to see the pattern of continued and varied images making part of the form of the novel, so it is possible—and even more important—to see a pattern of symmetry and contrast and repetition forming the tension and irony of action, and

George Eliot might fruitfully be compared to the other women this dissertation studies. The organic, web-like structure that *Middlemarch* derives from evolutionary theory, for example, which Gillian Beer describes in *Darwin's Plots*, might likewise be compared to Somerville's synthesis of the physical laws of nature in *Connexion*. But whereas Somerville's use of Byron's play when describing astronomy prompts comparisons of the two writers' *affective* appeals, George Eliot's use of scientific discourse points to a shared *method* of observation and narrative exposition in fiction. Further, just as Margaret Gatty and Arabella Buckley chose imaginative fantasy settings as their preferred method of teaching children natural history and physical science, both Somerville and George Eliot selected prose forms that would synthesize scientific knowledge for adult readers and offer suggested ways of interpreting it. Yet Gatty, too, was a naturalist, publishing *British Seaweeds* in 1863, and her advice for women embarking on seaside collecting speaks to the very same challenges Marian Evans and George Henry Lewes met with in Ilfracombe. Lastly, George Eliot was the person most often cited in descriptions of

contributing to the definiteness and the mutability of what we call theme or generalization" (10). Hardy continues: "It is because her organization, though complex and sustained, is so embedded in her narrative that it has usually passed unpraised" (11). Hardy finds patterns within Eliot's characters (113-14), her repeated phrases and images (8), in contrasts between seemingly divine coincidences and accidental causes (135), and in the intrusions of the narrative voice (158). Frank Kermode's *The Sense of an Ending* (1966) suggests a common human desire for narrative resolution lay beneath centuries of storytelling: "Men, like poets, risk 'into the midst,' *in medias res*, when they are born; they also die *in mediis rebus*, and to make sense of their span, they need fictive concords with origins and ends, such as give meaning to lives and to poems" (7). In "Narrative and History," J. Hillis Miller examines the ways in which novelists seem to take pains to make fiction seem like a representational form and the various "displacements" it uses, like letters, manuscripts, memoirs, legal depositions, and journalism (456). But "history" becomes the most important masking device in Miller's study, and where he sees the "notions of narrative, of character, and of formal unity in fiction" to be congruent with the concepts comprising Western history, this chapter understands natural history narratives as being fraught with the same challenges faced by writers of history and drawing upon the same narrative devices as the novelists.

Constance Naden, the poet, science student, and philosopher I consider in chapter four.⁵⁴

In their wry humor, wide study of contemporary scientific ideas, and inclusion of those scientific themes in their literary work, Eliot and Naden have much in common.

In the first part of this chapter, I place George Eliot's "Recollections of Ilfracombe" into the context of other mid-Victorian naturalist writings, along with her essays about fiction in order to identify where and how naturalist narratives might seep through their generic boundaries to find new resonances in fiction. I then turn to *The Mill on the Floss* (1860) as the most salient example of how characteristics and methods of natural history appear within George Eliot's early fiction. Maggie Tulliver's trials as a clever young girl whose brother reluctantly receives the education she craves, and the abundance of natural imagery describing Maggie's character, demonstrate how the novel fits within mid-Victorian discourses of natural history. Maggie's inner conflicts, her mistakes, and how the community of St. Ogg's regards her actions are all important, but I focus less on the scandal of her near-elopement with Stephen Guest than on how the novel depicts the wave-like oscillations of her emotions in conjunction with surging of the Floss.⁵⁵ Within my analysis of *Mill*, I also consider how the same themes of a child's experiences in a rural landscape appear differently in Eliot's "Brother and Sister" sonnets, a poem sharing its title with Book I of *Mill*, but offering a different structural form in which to express shared scenes or episodes. In both theme and style, *The Mill on the Floss* most clearly shows an engagement with many of the issues of genre, science, gender, and education

⁵⁴ Herbert Spencer befriended both women, and he is the source of the most frequent comparison of Naden to Eliot.

⁵⁵ In *Sex Scandal: The Private Parts of Victorian Fiction*, William A. Cohen examines both how public opinion shapes expectations for sexuality and gender, and how gender inflects the public in his chapter on *The Mill in the Floss* (138). If the novel subverts the traditional marriage

this dissertation examines. My primary goal is to demonstrate that George Eliot participates in a much broader discourse of naturalist writings by women: though scholars have noted the pervasive presence of science in her novels, they have not yet suggested the ways in which George Eliot might illuminate the questions and challenges other women naturalists faced at mid-century. Though she used her Ilfracombe journal to embark on a career writing fiction, the increased visibility of her natural history narratives may in turn arouse interest in the overlooked naturalist writings by her female contemporaries.

The Wonders of the Shore

On May 8, 1856, Marian and George Henry Lewes packed some belongings—including a selection of deep, empty jars—into a carriage that would take them the first leg of their train journey to Ilfracombe, a small seaside town on the northern coast of Devon. For Lewes, the trip would help facilitate his composition of *Seaside Studies* (1858), and Marian had reviews to write for the *Leader* and the *Westminster Review*. The couple arrived in Ilfracombe at the height of marine botany's popularity as a suitable pastime not just for women but also their families. From the 1840s through the 1860s, numerous marine botanical titles were published, among them Elizabeth Anne Allom's *The Sea-Weed Collector* (1841), Isabella Gifford's *The Marine Botanist* (1848), David Landsborough's *A Popular History of British Seaweeds* (1849), Anne Pratt's *Chapters on the Common Things of the Sea-Side* (1850), Mary Roberts's *Popular History of the Mollusca* (1851), Philip Henry Gosse's *A Naturalist's Rambles on the Devonshire Coast* (1853), Charles Kingsley's *Glaucus: or, the Wonders of the Shore* (1855), Margaret

plot and refuses the "coupling logic of heterosexuality" (Cohen 156), it does so within the context

Gatty's *British Seaweeds* (1863), and Louisa Lane Clarke's *The Common Seaweeds of the British Coast and Channel Islands* (1865) (Hunt 6; Bellanca *Daybooks* 177). This list only comprises the books on marine botany, neglecting other concurrent naturalist fads at the time, including "pteridomania," a term coined by Kingsley in *Glaucus* to describe the craze for fern collecting that had taken the country by storm (Kingsley 4).⁵⁶

Glaucus offers one glimpse of how popular the seaside holiday had become, especially since the advent of railroad transport, and why it might be both an enriching and polite pastime for whole families. His tone suggests that the seaside holiday, however, brings with it a mundane routine—a banality for which his volume offers a remedy. In the opening of his book, Kingsley addresses an audience of fathers, guessing they might be grateful for a seemingly activity to occupy their children:

You are going down, perhaps, by railway, to pass your usual six weeks at some watering-place along the coast, and as you roll along think more than once, and that not over-cheerfully, of what you shall do when you get there. You are half-tired, half-ashamed, of making one more in the ignoble army of idlers, who

of mid-Victorian science, as much as its mores.

⁵⁶ Sarah Whittingham explains how avid interest in ferns seemed to come "out of nowhere" in the 1840s in her detailed—and visually stunning—history, *Fern Fever: The Story of Pteridomania* (2012). At the opening of her book, she writes, "Ferns were not just the obsession of a few professional botanists, nor even of the thousands of amateur gardeners and naturalists, but held a popular fascination for much of society. If you decorated and furnished your house, went to the seaside, strolled in pleasure gardens, patronized the theatre and concerts, visited exhibitions, read novels, played music, or spent time in hospital, you encountered ferns and ferneries" (11). The technology that aided the public's ability to transport and keep ferns so close at hand was the "closely-glazed" case made by Dr. Nathaniel Bagshaw Ward (1791-1868). Whittingham discusses the effect of Wardian cases on the fern craze in *Fern Fever* (16-19), as does David Elliston Allen in *The Naturalist in Britain* (119-122). Kingsley likewise anticipates his readers' daughters "have been seized with the prevailing 'Pteridomania,' and are collecting and buying ferns, with Ward's cases wherein to keep them (for which you have to pay), and wrangling over unpronounceable names of species (which seem to be different in each new Fern-book that they buy), till the Pteridomania seems to you somewhat of a bore" (4).

saunter the cliffs, and sands, and quays; to whom every wharf is but a “wharf of Lethe,” by which they rot “dull as the oozy weed.” (1)

Kingsley’s narrator voices the perspective of a male speaker writing to other men who take their families on a seaside holiday as they likely have in years past. There is sardonic humor here as the speaker invites the “you” reader to remember all the various unpleasant, banal, or boring things he and his family likely do on other trips. The speaker invites the reader to consider having a go at some naturalist pursuits at the shore this time around. After all, the narrator suggests, it has been good for the girls: while they’ve been buying up new books on ferns or boxes in which to store them—which the father has had to pay for—they haven’t been preoccupied with the other typical drawing-room accomplishments that seem to bore the paternal speaker and implied reader.

The idea of embarking on some amateur naturalism serves as an ironic contrast to the uses of other scientific apparatuses that have become popular for something other than their original purposes. Kingsley mentions that one of the likely occupations or recreations, not overly exciting, on this beach holiday would be to stop at a restaurant or pub and casually look out at the sea using a telescope from the window: “You foreknow your doom by sad experience. A great deal of dressing, a lounge in the club-room, a stare out of the window with the telescope, an attempt to take down a bad sketch, a walk up one parade and down another, interminable reading of the silliest of novels, over which you fall asleep on a bench in the sun, and probably have your umbrella stolen” (1-2). The telescope viewing is listed amid a list of other idle activities done not out of real pleasure or interest but rather as the habits or expected pursuits of any beach holiday-maker.

This activity was evidently quite the popular pastime, for just four years later, Mary Ward mentions it in the opening of her 1859 *Telescope Teachings*. Ward's purpose is to correct the direction in which her young readers point their telescopes:

has it been suggested to those who can admire and wonder at the splendour of the firmament, to try how much they can improve their view of star or planet, by examining them with the help of a small telescope, such as one may see, perchance, at every sixth window, on a fine summer's day, at a watering-place, its object-glass, capable of better things, idly directed to fishing-boat or distant steamer, or still more idly, to unconscious group on the pier? (v)

Together, the two suggest how much the telescope had entered into the social milieu of middle- to upper-class Britain, becoming less an apparatus for scientific study and more a prop for social surveillance. Ward, of course, voices stronger disapproval at the use of the telescope for people-watching. But what they also share is a common expression of admiration and wonder for the natural world and the personal enrichment natural history study might provide. So Kingsley urges the vacationer-by-the-sea to find a more worthwhile occupation:

And does it not seem to you that six weeks' rest, free from the cares of town business and the whirlwind of town pleasure, could not be better spent than in examining those wonders a little, instead of wandering up and down like the many, still wrapt up each in his little world of vanity and self-interest, unconscious of what and where they really are, as they gaze lazily around at earth and sea and sky, and have 'No speculation in those eyes/ Which they do glare withal'? Why not, then, try to discover a few of the Wonders of the Shore? For

wonders there are around you at every step, stranger than ever opium-eater dreamed, and yet to be seen at no greater expense than a very little time and trouble” (3-4).

Endorsing amateur naturalism as a worthy alternative to mindless wandering and vacant self-absorption, Kingsley’s *Glaucus* goes on to demonstrate the ensuing delights in collecting “the wonders of the shore.”

These wonders were the subject of many other books and poems. Margaret Gatty’s story in the first series of *Parables*, “Knowledge Not the Limit of Belief” takes place in a naturalist’s library and recounts the conversation among a seaweed, zoophyte, and bookworm about whether the zoophyte is a plant or an animal: in 1855, the year both *Parables* and *Glaucus* were published, the classification of zoophytes as animals was still new. In her third series of *Parables* in 1861, the story “Whereunto” takes place in a coastal tidal pool, where a crab and starfish debate divine Providence when a passing naturalist happens to toss the starfish back into a pool after it had become stranded on the shore and lay in danger of drying out. In Elizabeth Barrett Browning’s verse novel *Aurora Leigh* (1856), Aurora compares her arrival in England to that of a seaweed, cast on the shores and sapped of her vitality:

I only thought
Of lying quiet there where I was thrown
Like sea-weed on the rocks, and suffering her
To prick me to a pattern with her pin
Fibre from fibre, delicate leaf from leaf,
And dry out from my drowned anatomy

The last sea-salt left in me. (I: 378-384)

In Aurora's metaphor, her aunt becomes the pattern-pricking naturalist, creating an ordered design just as she tames Aurora's hair (I.385-6). Conversely, Eliza Cook's poem, "Song of the Sea-weed" (1869), asserts the independent life of the eponymous plant:

I am born in crystal bower
Where the despot hath no power
To trail and turn the oozy fern,
Or trample down the fair sea-flower.
I am born where human skill
Cannot bend me to its will;
None can delve about my root,
And nurse me for my bloom and fruit. (Gates *In Nature's Name* 548)

"Song of the Sea-weed" suggests the seaweed lies beyond the sphere of cultivation and domestication. As a poetic metaphor, then, seaweed could be employed for quite opposite ends.

Seaweed study, though, was not just a source of didactic moralizing or poetic metaphors for women writers. The introduction of Margaret Gatty's *British Seaweeds* (1863), for example, tends toward the practical needs of the marine botanist in addition to commending its pleasures. Listing the necessary tools, "a basket, a bottle, a stick, a strong pair of boots (oiled, not polished with blacking)" and a "strong, friendly, and willing, if not learned companion," Gatty champions the delights of sea-side study as, "an enthusiastic love, which throws a charm over every sea-place on the coast, however dull and ugly to the world in general; makes every day spent there too short, and every visit

too quickly ended” (vii). Gatty’s practical introduction to seaweed collection even includes advice on dress:

Next to boots comes the question of petticoats; and if anything could excuse a woman for imitating the costume of a man, it would be what she suffers as a seaweed collector from those necessary draperies! But to make the best of a bad matter, let woollen be in the ascendant as much as possible; and let the petticoats never come below the ankle. A ladies’ yachting costume has come into fashion of late, which is, perhaps, as near perfection for shore-work as anything that could be devised. ...Cloaks and shawls, which necessarily hamper the arms, besides having long ends and corners which cannot fail to get soaked, are, of course, very inconvenient, and should be as much avoided as possible; but where this cannot be, a good deal may be done towards tucking them neatly up out of the way. In conclusion, a hat is preferable to a bonnet, merino stockings to cotton ones, and a strong pair of gloves is indispensable. All millinery work—silks, satins, lace, bracelets, and other jewellery, &c. must, and will, be laid aside by every rational being who attempts to shore-hunt. (viii-ix)

Gatty’s detailed suggestions on attire would have come out of her fourteen years researching and writing her book, and likely her observations of fellow shore-hunters, too. William Dyce’s painting, *Pegwell Bay—a Recollection of October 5, 1858*, may just be an idealized representation of Dyce’s family on holiday, where the painter’s wife and two sisters appear wearing long skirts, bonnets, and shawls; but it might likewise suggest that many female seaside ramblers needed the practical advice Gatty’s volume would

provide.⁵⁷ In her descriptions of the process of collecting coral with Lewes, Marian Evans likewise learns the practicalities of the endeavor.

I offer these examples to show just a sample of the diversity of responses to marine botanizing that were available to mid-Victorian readers, and how likely it is that Marian Evans was familiar with such texts. Her letters indicate she sought a “smattering of botany from Miss [Agnes] Catlow” (qtd. in Bellanca *Daybooks* 176). Evans and Lewes may even have crossed paths with other aspiring naturalist writers, like Eliza Brightwen, whose journal indicates she visited Ilfracombe on the day Evans and Lewes departed (Bellanca *Daybooks* 177). Within this extensive and varied discourse of natural history and marine botany, Marian Evans and George Henry Lewes, too, offer their own studies. “Recollections of Ilfracombe” is a crafted piece of prose, one which demonstrates Ruskin’s influence on George Eliot and her thinking about observation and realism. In her review of *Modern Painters*, she writes, “The truth of infinite value that he teaches is *realism*—the doctrine that all truth and beauty are to be attained by a humble and faithful study of nature, and not by substituting vague forms, bred by imagination on the mists of feeling, in place of definite, substantial reality” (*Selected Essays* 368). For George Eliot, realism meant both careful observation and emotional authenticity, and its opposite was not idealism but falsity (Levine “Introduction” 7). Her descriptions of the coastal landscape of Ilfracombe show a writer highly attuned to the physical details of her

⁵⁷ A digital image of Dyce’s painting can be found on the Tate Britain museum’s website. This painting is notable not just for its meticulous depiction of women collecting marine samples in the foreground—details like mollusk shells, seaweed, and skate egg cases are visible—but also for the presence of Donati’s comet in the upper center of the painting. An excellent description of Dyce’s painting appears in *Pre-Raphaelites: Victorian Avant-Garde* (2012), the catalog accompanying the Tate’s recent exhibition, edited by Tim Barringer, Jason Rosenfeld, and Alison Smith.

surroundings, observations and details that add verisimilitude to novels like *A Mill on the Floss*.⁵⁸

She begins the Ilfracombe journal as a narrative, giving it a beginning as if it were a chapter: “It was a cold unfriendly day—the eighth of May on which we set out for Ilfracombe, with our hamper of tall glass jars, which we meant for our sea-side Vivarium” (*Selected Essays* 215). The opening lines personify the day, verging on a pathetic fallacy. If the day weren’t exactly unfriendly toward the travelers, it at least made them feel such a chill reception. The first hint that the holiday might be slightly unusual is the fact she and Lewes pack a hamper not of picnic items or food stores, but instead of empty jars. Her activities in Ilfracombe consisted of seeking out coral, seaweed, and anemones and collecting them for further observation. At the same time, she writes she “had a great deal of work before [her]—the writing of an article on Riehl’s books, which I had not half read, as well as the article on *belles lettres*—but my head was still dizzy and it seemed impossible to sit down to writing at once in these new scenes, so we determined to spend the day in explorations” (“Ilfracombe” 217). Her daily activities alternated between her own writing and these explorations, and the two endeavors mutually influence the other.

⁵⁸ In “Modeling Natural History: George Eliot’s Framings of the Present” (1983), Suzanne Graver demonstrates at a formal level how Eliot’s fiction operates within a natural historical register. She begins by examining Eliot’s relations of time at the openings and conclusions of her fiction. Rather than setting the action at a historical remove, Eliot places the action at times within living history, within the memory of much of her readership. Doing so, Graver argues, promotes a sense of historical connectedness, of seeing the present as a current condition which has emerged out of a combination of traditions, happenings, and circumstances. Graver also notes that Eliot and her contemporaries were beginning to call for just such cultural histories—evolutionary histories—rather than just records of sequential political history and the actions of a powerful few.

The trip offered Evans and Lewes a chance to experiment, and the pair often discovered errors in their initial guesses about the equipment they would need. About their “first zoophyte hunt” she writes:

It is characteristic enough of the wide difference there is between having eyes and seeing, that in this region of sea-anemones, where the *Mesembryanthemum* especially is as ‘plenty as blackberries,’ we climbed about for two hours without seeing one anemone, and went in again with scarcely anything but a few stones and weeds to put into our deep well-like jars, which we had taken the trouble to carry in a hamper from London, and which we had afterwards the satisfaction of discovering to be quite unfit for our purpose. (219-20)

Citing the difference “between having eyes and seeing,” she acknowledges the difficulties amateur naturalists face before their eyes have been “trained” to find their intended specimens, just as experience teaches them the proper equipment to carry and use.

The spring and summer of 1856 were also the seasons in which she read John Ruskin’s *Modern Painters*, books III and IV. Her descriptions in both her Ilfracombe journal and in “The Natural History of German Life” show her desire to enact the same fastidious attention to realism in art. When she arrives in Ilfracombe, she turns a keen eye to the details of the area and describes the landscape with terms of art evocative of Ruskin:

From this end of the Capstone we have an admirable bit for a picture. In the background rises old Hillsborough jutting out far into the sea—rugged and rocky as it fronts the waves, green and accessible landward; in front of this stands

Lantern Hill, a picturesque mass of green and grey surmounted by an old bit of building that looks as if it were the habitation of some mollusc that had secreted its shell from the material of the rock; and quite in the foreground, contrasting finely in colour with the rest are some lower perpendicular rocks, of dark brown tints patched here and there with vivid green. (218)

Not unlike the tendency today of looking at scenery with an eye to what composition would make for a good photograph (and indeed, that art was emerging in the mid-nineteenth century as well), Eliot's passage here is striking for its discussion of landscape in terms of the art used to represent it. A vista has no absolute background or foreground except as it is translated to canvas or paper. Colors are "tints patched here and there" as by an invisible brush. In order to describe a scene to her reader, Eliot must rely on the mediating language of art, a representational medium itself. This reversal between external object and the medium used to represent it is mirrored by yet another inversion of a typical binary, that of human versus animal. When Eliot describes a building looking "as if it were the habitation of some mollusc that had secreted its shell from the material of the rock," she thwarts what might be the more typical readerly expectation of anthropomorphism, here not describing a mollusk in terms of its similarity or difference from human features, but instead illustrating the human habitation's shared function with that of any other creature's protective shelter. Eliot's equating of humans with other animals continues,

In hilly districts, where houses and clusters of houses look so tiny against the huge limbs of Mother Earth one cannot help thinking of man as a parasitic animal—an epizoon making his abode on the skin of the planetary organism. In a

flat country a house or a town looks imposing—there is nothing to rival it in height, and we may imagine the earth a mere pedestal for us. But when one sees a house stuck on the side of a great hill, and still more a number of houses looking like a few barnacles clustered on the side of a great rock, we begin to think of the strong family likeness between ourselves and all other building, burrowing house-appropriating and shell-secreting animals. (218-19)

Personifying the earth as a mother, perhaps with arms outstretched to her human offspring, Eliot quickly shifts to a more pejorative comparison: “man as a parasitic animal.” Eliot kicks out the pedestal, dropping humans from an elevated perspective to one on par with epizoa, barnacles, and “all other building, burrowing house-appropriating and shell-secreting animals.” Eliot’s observation realigns, or recalibrates, a reader’s human perspective on her species’ position in a supposed hierarchy or link in the “great chain of being.”

Eliot, of course, never published this journal in her lifetime, and perhaps the notions she proposes here would have batted nary an eyelash. Posing such similarities did not upset the whole system in the way that Darwin’s *On the Origin of Species* would in a just few years’ time. But the comparisons are crucial to the habits of mind, description, and thinking about her human subjects that Eliot later develops in her *Westminster* reviews and her later fiction.

Marian Evans’s journal in Ilfracombe became a space in which she could safely practice writing dramatic action as well as landscape description. Without dating the incident, she records a “favourite walk” she and Lewes took through a wood to a lane off Braunton Road. This route leads the pair to a ravine with a stream at the bottom, which

they elect to try to walk along. They approach a cottage situated near the beginning of the ravine and evidently associated with “a rather important looking farm-house standing near” (227). There they encounter one of the farm’s four-legged residents:

As we approached this cottage, we were descried by a black pig, probably of an amiable and sociable disposition. But as unfortunately our initiation in porcine physiognomy was not deep enough to allow any decisive inferences, we felt it an equivocal pleasure to perceive that piggie had made up his mind to join us in our walk without the formality of an introduction. So G. put himself in my rear and made intimations to piggie that his society was not desired, and though very slow to take a hint, he at last turned back and we entered the path by the stream among the brushwood, not without some anxiety on my part lest our self-elected companion should return. Presently a grunt assured us that he was on our traces; G. Resorted in vain to hisses,⁵⁹ and, at last, instigated as he says by me, threw a stone and hit piggie on the chop. (227-228)

Eliot’s account inflects the meeting with humor, imbuing “piggie’s” character with amiability and sociability but an unfortunate obtuseness about social niceties. The passage also evinces amusement and a tongue-in-cheek bit of self-mocking in Eliot’s fear and the passive syntax in relating how Lewes’s unceremonious dismissal of the pig by throwing a stone at him, was “at last, instigated as he says, by me.”

The action has its intended effect, but it elicits very different feelings in Lewes and Eliot:

⁵⁹ The OED defines the verb “hish” as “to make a hissing noise to hound on a dog.” It likewise cites a scene in Book V of *The Mill on the Floss* as its example for usage, where Bob

This was final. He trotted away, squealing, as fast as his legs would carry him; but my imagination had become so fully possessed with fierce pigs and the malignity of their bite, that I had no more peace of mind until we were fairly outside the gate that took us out of piggie's haunts. G.'s peace of mind was disturbed for another reason: he was remorseful that he had bruised the cheek of a probably affectionate beast, and the sense of this crime hung about him for several days. I satisfied my conscience by thinking of the addition to the pig's *savoir-vivre* that might be expected from the blow; he would in future wait to be introduced. (228)

Eliot's description paints a colorful scene, depicting both the action of her characters and suggesting their varied personalities with the account of each's "disturbed" peace of mind. The decidedly ironic tone here mitigates any inept lapses into pathetic fallacy. Eliot's selection of elevated diction throughout the episode ("porcine physiognomy," "equivocal pleasure," "malignity of their bite," "*savoir-vivre*") underlines the vast difference between simply meeting a pig on a wooded lane and the formality of introductions in high society. It also diffuses the fear Eliot very likely did feel in the situation itself; the care of omnivorous hogs unfortunately may have brought a number of provincial pig farmers to gruesome ends.⁶⁰

This episode is a writing exercise for Eliot, a moment recorded not for immediate consumption in a letter or essay, nor for a planned fictional scene. It is an experimental

Jakin describes the docility of his bull-terrier, Mumps, to Mrs. Glegg: "I might hish at him by th' hour together, before he'd fly at a real gentlewoman like you" (316).

⁶⁰ The danger of tending hogs is improbable, but not implausible. When I was first drafting this examination of the "piggie story" in 2012, I ran across an article about an Oregon pig farmer who had been devoured by his hogs that very week (see, e.g., the BBC news article from October 2, 2012, available online). George Eliot's portrayal of the episode may be told in an ironic tone, but beneath it lies some validity to her fear at being bitten.

sketch for her own pleasure, yet it is crafted by an able hand, achieving its dramatic effect and readerly amusement.⁶¹ Additionally, readers today should be reminded that portions of the Ilfracombe journal were published as passages in Lewes's *Seaside Studies*. The Ilfracombe trip merits attention both for the effect of these excursions on George Eliot's understanding of natural history and her practice in narrating them. Eliot did not simply record the days' activities in her diary, but rather she constructed a version of the trip through her letters and journal to create an idealized narrative.⁶² In her journals of this trip, one sees the writer beginning to practice her craft. Marian and Lewes went on numerous nature walks, seaside rambles, and "expeditions" in the tide pools to collect specimens. Though she did not admit to a significant sense of accomplishment on this trip, Marian completed a good amount of writing: she worked on her Riehl essay for the *Westminster*; she wrote some descriptions that showed up uncredited in Lewes's *Seaside Studies*, and her "Recollections" of the trip clearly show her appreciation of Ruskin's *Modern Painters*, Vol. III, about which she had recently written a favorable review. Her diary for 20 July records that besides her review for the *Leader*, her journal, and another piece she'd begun in April, she felt she had done very little: "I have done no *visible* work. But I have absorbed many ideas and much bodily strength; indeed I do not remember ever feeling so strong in mind and body as I feel at this moment" (Haight 206). As Haight comments, "her creative life was about to begin" (206). Despite the fact that she had not yet chosen her pseudonym, Marian was beginning her career as George Eliot.

⁶¹ Mary Ellen Bellanca argues Eliot "takes advantage of the journal genre's flexibility, flourishing in the safety of privacy while exploiting serviceable ideas from periodical nonfiction, popular natural history books, and imaginative reflection" ("Recollecting Nature" 33).

⁶² See Mary Ellen Bellanca's "Recollecting Nature: George Eliot's 'Ilfracombe Journal' and Victorian Women's Natural History Writing" (1997) and her chapter on Eliot's Ilfracombe journal in *Daybooks of Discovery: Nature Diaries in Britain, 1770-1870* (2007).

Transformations of Genus and Genre

The trip was important to Eliot as a prose stylist, a crafter of prose, and formative in the experience of practicing the trade, as she saw it through Riehl, of being a novelist. Eliot did not consider natural history from a distance, as a theory. In Ilfracombe, she literally rolled up her sleeves and got her hands dirty: "When we put our anemones into our glass wells, they floated topsy-turvy in the water and looked utterly uncomfortable; and I was constantly called upon to turn up my sleeve and plunge in my arm up to the elbow to set things right" ("Recollections" 220). Natural history required observation of flora and fauna close up, of being in the tide pools, the woods, the fields. To describe human beings was no less theoretical or abstract. Surely one could describe characters as they sat in drawing rooms, but so too must a writer find them in the fields, factories, mills, alleys, sick rooms, hospitals, nurseries, pubs, libraries, and athenaeums where they toiled or relaxed. For Eliot, the setting could not be an idealized creation—it must be an environment in which the inhabitants were born, raised, educated, married, and deceased. Reading Riehl amid close encounters with marine life and the locals of Ilfracombe set the stage for the position she'd take when writing her reviews for the *Westminster*.

Looking to Eliot's essays in the *Westminster Review* for clues to her fiction is not new. Gordon S. Haight exhorted all scholars to read "The Natural History of German Life" if they wished to understand the origin of her novels. "Any one who wishes to understand the origin of George Eliot's novels," he wrote, "should read the essay on Riehl" (202).⁶³ My examination of Eliot in this chapter delves into this notion of an

⁶³ Fionnuala Dillane critiques prior work on Eliot that fails to interrogate the site of her publication when marking the essays as the origin of her "mission statement" for fiction. She argues that Marian Evans's voice is mediated through the political stance of the periodical and its

“origin” for Eliot, and I focus less on Riehl as Eliot’s model for a proto-sociological approach to observing a people than on the methodology of natural history she applied to her fiction after 1856. As Mary Ellen Bellanca has noted, scholars have read Eliot’s “Ilfracombe Journal” as the threshold of her fiction; a sign of her interest in science; textual evidence of her uncredited assistance of George Henry Lewes in his *Sea-side Studies*; an effusive response to the ideas Ruskin promoted in *Modern Painters*; and a space in which her interest in observation assisted her development of her “realist” fiction (“Recollecting Nature” 20). Bellanca’s own take on the “Ilfracombe Journal,” however, suggests that the journal was a formal strategy of Eliot’s to engage in a dialogue with other female Victorian natural history writers, and that her text shows innovation within the genre. “Eliot draws on the diverse languages used by women writers of popular natural history,” Bellanca argues, “joining in their celebration of nature yet eschewing the theological and didactic orientation of many of their works” (28).

In July 1856, the *Westminster Review* published George Eliot’s article, “The Natural History of German Life.” Eliot had just returned from her holiday in Ilfracombe with Lewes. Featured prominently are the effects of a sojourn during which the pair’s activities were so focused on marine botany and natural history: Eliot’s descriptions include various optical metaphors and tropes of observation, beginning with her

editors, and that her claims are therefore far more vexed than critics like Haight or Shuttleworth allow. Dillane calls “The Natural History of German Life” “an oblique piece of writing that is anything but a transparent representation of George Eliot’s views on fiction, though Evans’s controlled turn of phrase...is of course both affecting and effective” (248). She calls Evans by turns “an evasive reviewer,” and “a rather uncontroversial, unoriginal, and somewhat spineless critic” (250). These characteristics are what Dillane uses to refute readings that unquestioningly cite Eliot’s artistic practice as lying within the bounds of this article. While I agree that the journal/periodical should be considered because it reminds one of the rhetorical situation in which the essay was both composed and read, the element that Dillane omits is the experience of

discussing of the relative knowledge people gain, for instance, in their experience of railways, whether as passengers, engineers, directors, shareholders, and so on. Each individual brings a particular way of seeing the railway's operation, and their degrees of expertise either make them fit or unqualified to make decisions as to its physical operation or its day-to-day management and efficiency.

"The Natural History of German Life" calls for a particular mode or method of writing fiction modeled after the ethnographic writings of Wilhelm Heinrich von Riehl (1823-97). Eliot admires his close examination of the German peasantry, finding his descriptions much more truthful, more accurate than the kinds of romanticized descriptions found in English fiction of the same period. The point for Eliot of such close observation and accurate description is the chance to contribute to the betterment of English society; that is, she hopes fiction could become a helpful guide for reform:

If any man of sufficient moral and intellectual breadth, whose observations would not be vitiated by a foregone conclusion, or by a professional point of view, would devote himself to studying the natural history of our social classes, especially of the small shopkeepers, artisans, and peasantry,—the degree in which they are influenced by local conditions, their maxims and habits, the points of view from which they regard their religious teachers, and the degree in which they are influenced by religious doctrines, the interaction of the various classes on each other, and what are the tendencies in their position toward disintegration or towards development,—and if, after all this study, he would give us the result of

Ilfracombe, a tangible, material moment that influenced her as well, and is part of that rhetorical situation, too, insofar as it shaped the perspective of the writer.

his observations in a book well-nourished with specific facts, his work would be a valuable aid to the social and political reformer. (112)

By “natural history of social classes,” Eliot gestures toward ethnographic study.⁶⁴ Her aim and hope are clear, and it seems she has a solid faith in the accurate observation of a well-intentioned writer. There clearly seems to be an assumption here that the observer is of a higher class than those people who are the heart of the study: a writer who must observe this class of “shopkeepers, artisans, and peasantry” must have no experience of his own from which to derive his understanding. And the purpose of watching them so closely is to discern how they are influenced by “local conditions” and “religious doctrines” and how they interact with other classes. The point is to progress, so the group’s “tendencies...toward disintegration or towards development” are important to note.

How is the reformer to make a change, then? It seems in looking at Eliot’s praise of Dickens earlier in the essay that such fiction—fiction written by the reformer, or by the novelist in the service of reform—is awakening of sympathy in the class of readers for the classes of society described. About Dickens, Eliot writes, “We have one great novelist who is gifted with the utmost power of rendering the external traits of our town population; and if he could give us their psychological character—their conceptions of life, and their emotions—with the same truth as their idiom and manners, his books would be the greatest contribution Art has ever made to the awakening of social sympathies” (111). In Eliot’s view, the novelist must apply keen observation not just to

⁶⁴ In *Disorienting Fiction* (2005), James Buzard considers both Eliot’s ambition for exalting “fellow-feeling” in the essay and the lack of broader historical and political perspectives in the provincial community of St. Ogg’s (287).

describe “external traits,” as we might find in studies such as Henry Mahew’s *London Labour and the London Poor* (1851), but also to evoke their “psychological character.” In developing a character’s mental attitudes and emotions along with their styles of dress, their activities, and their words, the observant novelist can evoke a reader’s understanding for that character, and in turn, shape the reader’s attitudes toward the world outside the book.

The problem that Eliot sees in fiction—a complaint she voices in “Silly Novels by Lady Novelists” as well—is a lack of keen observation and a tendency to romanticize characters: that is, a sense of idealized figures whose speech and character are at odds with their education and experience. For example, in “Natural History,” Eliot writes, “How little the real characteristics of the working classes are known to those who are outside them, how little their natural history has been studied, is sufficiently disclosed by our Art as well as by our political and social theories” (108). She continues, explaining:

The notion that peasants are joyous, that the typical moment to represent a man in a smock-frock is when he is cracking a joke and showing a row of sound teeth, that cottage matrons are usually buxom, and village children necessarily rosy and merry, are prejudices difficult to dislodge from the artistic mind, which looks for its subjects into literature instead of life. The painter is still under the influence of idyllic literature, which has always expressed the imagination of the cultivated and town-bred, rather than the truth of rustic life. (108-9)

Eliot criticizes art here for imitating *art*, instead of imitating life. The problem, as Eliot argues, is that “idyllic literature” has been penned by “the cultivated and town-bred” who have very little if any experience on which to base their fictions and poetry. The “truth of

rustic life” offers more than jokey, healthy-gummed peasants with rosy cheeks and merry hearts. For Eliot, it is incumbent on the artist to show his or her subject in harsh, glaring light if need be, rather than to falsify, embellish, or shadow. She writes,

Art is the nearest thing to life; it is a mode of amplifying experience and extending our contact with our fellow-men beyond the bounds of our personal lot. All the more sacred is the task of the artist when he undertakes to paint the life of the People. Falsification here is far more pernicious than in the more artificial aspects of life. It is not so very serious that we should have false ideas about evanescent fashions—about the manners and conversation of beaux and duchesses; but it is serious that our sympathies with the perennial joys and struggles, the toil, the tragedy, and the humour in the life of our more heavily-laden fellow-men, should be perverted, and turned towards a false object instead of the true one. (110-11)

At the heart of Eliot’s criticism is the failure of art to evoke sympathy for true, lived human experience: “the perennial joys and struggles, the toil, the tragedy, and the humour.” Because art is a “mode of amplifying experience,” any perversion of representation is all the more damaging.

Eliot reads fiction’s purpose—to instill a sympathetic perspective that would augment social and political reform—through natural history’s method. That is, Eliot found that close observation would be the most useful strategy for getting to know others, and by knowing the habits and traditions and values of another person, or another people, one could best serve them politically and socially to better their condition and daily lives. In fiction as well as in the field that would come to be known as sociology, Eliot saw the

potential for evoking sympathy via fictional characterization, a characterization still founded on close description of realistic scenes, conversations, and personas.

An essay long considered an important lens onto Eliot's entry into a career as a novelist, "Natural History" appears just months before Marian Evans begins to write fiction, drafting the opening to "The Sad Fortunes of the Reverend Amos Barton" in September. Critics have looked for evidence of Eliot's philosophy of fiction, as expressed in "Natural History," in her later novels, but I am concerned here with the 1856 moment more specifically as it demonstrates an episode in which Eliot defines disciplinary boundaries as they currently stood and also suggests how and why, at the level of genre, they could be surmounted. One of the "tools" of scaling such disciplinary walls is empirical observation: observation feeds knowledge. Such knowledge varies in degree about any given topic, and the Victorians lived in a milieu of scientific inquiry, social surveillance, imperial expansion, and biological examination, all of which required acts of scrutiny and observation.⁶⁵ The presumed divide between nineteenth-century natural history and fiction is further complicated by Eliot's contemporaneous articulation of fiction's characteristics in "Silly Novels by Lady Novelists." In this latter essay, George Eliot employs natural history's discourse of observation and classification ironically as a

⁶⁵ An analysis of Eliot and observation evokes conversations about objectivity among such scholars as Lorraine Daston and Peter Galison, and about detachment, as described by Amanda Anderson. George Eliot may have agreed that "objectivity" and "detachment" were never truly attainable any more than one could approximate true sympathy with another individual. However, she emphasizes the benefit of trying to do both. See, e.g., Suzy Anger's *Victorian Interpretation*. Anger argues we should understand Eliot as a writer who does not naively imagine the perfect attainment of sympathy, and who "struggles against what she regards as the destructive effects of skepticism about understanding, even as she fully acknowledges the difficulties. Rather than valorizing the impossibility of understanding, or even resigning herself to it, Eliot dramatizes the cost of assuming the passivity of the object of interpretation" (97).

means of underlining the artifice found in the fiction written by so many of her female contemporaries.

Serious Novels by Lady Naturalists

Within eleven days of composing “Silly Novels by Lady Novelists,” an article that would appear in the October 1856 issue of the *Westminster Review*, Eliot began writing “The Sad Fortunes of the Reverend Amos Barton,” a novella serially published in 1857 by *Blackwood’s* and later collected into *Scenes of Clerical Life*. The holiday in Ilfracombe and Tenby, the review of Riehl, and the exercise in writing about women’s fiction all set George Eliot on the path that led to her successful career as a novelist and, with the exception of some of her contemporary reviewers and some Modernists of the early twentieth century, her esteemed critical reputation as perhaps the greatest of all Victorian novelists. “Silly Novels by Lady Novelists” exposes the artifice of many women’s novels in the 1850s.⁶⁶ It is the contrivance of plot and character, and their very superficiality, that make such novels and their authors “silly” rather than any deficiency of intellect or education.

Eliot develops this thesis from the outset of her essay via her layering of the terms of both landscape art and natural history. Opening her essay, Eliot writes:

Silly novels by Lady Novelists are a genus with many species, determined by the particular quality of silliness that predominates in them—the frothy, the prosy, the pious, or the pedantic. But it is a mixture of all these—a composite order of

⁶⁶ Also, putting that artifice alongside the diction of natural history, to call genres of novels “genuses” is to bring in a different tradition entirely, and I might argue that it is not the tradition of her male contemporaries who were evolutionary thinkers, but rather that of the women natural

feminine fatuity, the produces the largest class of such novels, which we shall distinguish as the *mind-and-millinery* species. (140)

Eliot trusts her readers possess at least passing familiarity with the classification system of Linnaean taxonomy, linking literary *genre* with *genus* and varieties—forms, perhaps—within that genre as *species*. Throughout the essay, Eliot applies an ironic tone to what she labels the “*mind-and-millinery* species” and “*oracular* species” of women’s fiction. Doing so suggests that the relationship between varieties of texts might be linked to the organic world. Yet the novels Eliot indicts fail because they are lifeless and inorganic: they resemble nothing so much as a painting full of stock characters in a banal set piece: figures like a “vicious baronet, an amiable duke, and an irresistible younger son of a marquis” compete for the heroine’s affection “in the foreground,” with other rivals in the “middle distance” and “dimly indicated beyond” (140). Using terms of visual art, Eliot links one observational practice with another, and the ultimate effect of such linkage is one of artifice. The people depicted are art objects rather than living beings in a realistic environment.

Elsewhere in the “Silly Novels” essay, George Eliot continues using scientific diction to humorous effect. When she criticizes the author of *Rank and Beauty*, whose protagonist falls in love with the Prime Minister through the medium of print only, she uses parallax as a metaphor to describe this character’s perspective: “This enthusiastic young lady by dint of reading the newspaper to her father, falls in love with the *prime minister*, who, through the medium of leading articles and ‘the *résumé* of the debates’, shines upon her imagination as a bright particular star, which has no parallax for her,

historians and botany-hobbyists. Eliot is bringing *their* practice to bear on fiction, not just the

living in the country as simple Miss Wyndham” (*Selected Essays* 145-146). Her diction makes sense given the context of the novel. The passage she quotes from *Rank and Beauty* tells us that Amy’s expectations of finally meeting the prime minister are not disappointed: “It seemed as if a picture on which she had long gazed was suddenly instinct with life, and had stepped from its frame before her” (146). Using this metaphor, George Eliot suggests no optical distortion between a planet or star’s position and where it appears to the observer. Importantly here, she plays with prose that has nothing to do with Darwin—the figure most often cited when discussing Eliot’s engagement with contemporary science—and everything to do both with the establishment of natural history and amateur astronomy as respectable pastimes for Britons and their emergence as identifiable tropes in the literary marketplace. From Mary Somerville’s *On the Connexion of the Physical Sciences*—which Marian Evans had read in 1840—to Gatty’s *Parables from Nature* or Jane Loudon’s *Modern Botany* (1851), science writing was practiced by men and women, professionals and amateurs alike. What becomes even more intriguing in Marian Evans’s turn to writing fiction in September of 1856, having recently written two articles with natural history as their central theme or motif, is her evident awareness that natural history was a literary tradition women were already practicing. “Silly” novels might best be remedied not by looking to fiction by men, but by applying the skills of observation women naturalists were using in their instructions for practicing marine botany or amateur astronomy.

Scholars have grappled with Eliot’s essay, especially feminist scholars who find in her castigation of a certain kind of “silly” novel a larger indictment of women writers and

an alliance with men against her fellow countrywomen. But as critics like Susan Rowland Tush have pointed out, Eliot's criticism is for the superficial and artificial content of these books, rather than of the character or intellectual capacity of their authors. Like Tush, too, critics have examined how Eliot's novels measure up to the standards she defines in the "Silly Novels" essay. Perhaps it is no great leap to see in *Middlemarch*, for instance, a rewriting of the "mind-and-millinery" elements Eliot sketches in "Silly Novels":

She is the ideal woman in feelings, faculties, and flounces. For all this, she as often as not marries the wrong person to begin with, and she suffers terribly from the plots and intrigues of the vicious baronet; but even death has a soft place in his heart for such a paragon, and remedies all mistakes for her just at the right moment. The vicious baronet is sure to be killed in a duel, and the tedious husband dies in his bed, requesting his wife, as a particular favour to him, to marry the man she loves best, and having already dispatched a note to the lover informing him of the comfortable arrangement. (141)

Dorothea's feelings and faculties, if not her flounces, ultimately carry the day despite her erring assessment of and choice to marry Casaubon; Sir James Chattam is attentive and vain, but not vicious; and while tedious Casaubon dies in his bed, he spitefully denies an easy alliance between Dorothea and Ladislav. Where silly novels might give us a heroine whose fortune guarantees "that whatever vicissitudes she may undergo, from being dashed out of her carriage to having her head shaved in a fever, she comes out of them all with a complexion more blooming and locks more redundant than ever" (141), Rosamond Vincy's marriage to Lydgate fulfills "none of her hopes" (581); she is stung

by Ladislaw's departure from Middlemarch, harboring a secret "belief that he had, or would necessarily come to have, much more admiration for herself" than for Dorothea, "Rosamond being one of those women who live much in the idea that each man they meet would have preferred them if the preference had not been hopeless" (581). George Eliot's eye gives us a portrait of women and men, "warts and all": her narrative voice is not always complimentary, but it is nuanced, and the people who populate her novels are as recognizable for their human frailty as they are for their strength.

In "Silly Novels by Lady Novelists," George Eliot argues that women may equal men in the quality of their fiction, and adds the difference of a woman's experience. She explains, "a cluster of great names, both living and dead, rush to our memories in evidence that women can produce novels not only fine, but among the very finest; — novels, too, that have a precious specialty, lying quite apart from masculine aptitudes and experience" (162). There is no restriction on their doing so, says Eliot, of either education or form. The only difficulty is that of mastering the technique, and it is that pitfall Eliot believes many of her contemporaries fall prey to. A novel, "like crystalline masses...may take any form, and yet be beautiful; we have only to pour in the right elements—genuine observation, humour, and passion" (162). Here, then, Eliot advocates that there should be some rules for fiction, or at least, a technique novelists should follow: observation, humor, and passion, and these are the elements she aims to instill in her own enterprise as a writer.

George Eliot's Novel Genre

The naturalist's eye Marian Evans had developed in Ilfracombe—an eye likewise educated by the varied books of natural history published in the decades preceding *The*

Origin of the Species—becomes omnipresent in the prose of George Eliot. In *The Mill on the Floss*, George Eliot’s characters must figure out how to reconcile their pasts with their living present and their hopes for the future. While on the one hand, the challenges they face are social and economic—Mr. Tulliver’s financial downfall and the loss of the mill to Wakem, for instance—they are also present in the traditions of family history, in gender expectations, and in the common experiences of life, loss, and death. To show the changing fortunes of the Tulliver family, the novel’s formal structure mimics the growth and decline of all living organisms: Eliot traces her characters’ daily lives and growth. Her prose also evokes the feeling of floating down the very river which dominates Maggie’s imagination as a child and influences the family’s financial stability: the novel’s movement, or its pacing, alternately rushes or slows. The novel is filled with a sense of time, growth, change, love, loss, and destruction: the inevitable, common experiences of being human. The novel form allows Eliot to illustrate the workings of heredity and environment together. Most significantly, it offers a way of contrasting a seemingly inevitabilities—fate—with happenstance. In 1869, George Eliot revisits some of the same episodes of Tom and Maggie Tulliver’s childhood—some of which were drawn from her own childhood—in the set of eleven sonnets titled “Brother and Sister.”⁶⁷ The sonnets contemplate these shared scenes in a far more personal voice and tone, and the conclusion of the poem offers a markedly different resolution. In this section, I consider the formal similarities and differences between the eleven sonnets comprising “Brother and Sister” (1869) and Book I of *The Mill on the Floss*. The juxtaposition of the sonnet sequence and the novel highlights the differences in narrative voice: while the

⁶⁷ “Brother and Sister” appears in *The Legend of Jubal and Other Poems* (1874). Citations of the poem in this chapter, however, refer to *The Complete Shorter Poetry of George Eliot*, volume

lyric speaker of the sonnets recalls her youth and finds a peaceful, if melancholic resolution, the novel's narrator tries to remain a detached observer of the action.

Beginning *The Mill on the Floss* with a scene of Dorlcote Mill in the half-sleeping, half-waking memory of the narrator's mind, George Eliot offers the first glimpse of the landscape in which the novel takes place. As readers familiar with the novel know, landscape matters greatly to this tale's climactic scene, and the risings of the River Floss, with the consequent floodings of St. Ogg's, foreshadow the tragic fates of the novel's protagonists. George Eliot associates St. Ogg's with the landscape surrounding it, making the lives of its inhabitants part of the natural history of the area. Later in Book I, the narrator describes St. Ogg's as

one of those old, old towns which impress one as a continuation and outgrowth of nature, as much as the nests of the bower-birds or the winding galleries of the white ants: a town which carries the traces of its long growth and history like a millennial tree, and has sprung up and developed in the same spot between the river and the low hill from the time when the Roman legions turned their backs on it front he camp on the hill-side, and the long-haired sea-kings come up the river and looked with fierce eager eyes at the fatness of the land. It is a town "familiar with forgotten years." (115-16)

In this description, one might hear echoes of the passage in her Ilfracombe journal, quoted earlier in this chapter, where she describes how the building atop Lantern Hill looks "as if it were the habitation of some mollusc that had secreted its shell from the material of the rock" (218). In both descriptions, she naturalizes human habitations,

2, edited by A.G. Van den Broek and William Baker (2005).

making them seem organic and breaking down the presumed boundaries between human and nonhuman dwellings. In *The Mill on the Floss*, the sense of man as “a parasitic animal—an epizoon making his abode on the skin of the planetary organism” (“Ilfracombe” 218), has been replaced by a sense of continuity and community.

Part of this sense of continuity and humankind’s harmonious presence within a natural landscape comes from growing up in such an environment as St. Ogg’s. Tom and Maggie Tulliver spend their childhood in the pastoral landscape of the town, associating its scenes with those they read about: Tom thinks “people were at a disadvantage who lived at another spot of the globe,” and when Maggie reads of Christiana passing the bridge-less river in *Pilgrim’s Progress*, she pictures the Floss. The places where we spend our youth, George Eliot suggests, color our impressions and shape our associations. “Life did change for Tom and Maggie,” explains the narrator,

and yet they were not wrong in believing that the thoughts and loves of these first years would always make part of their lives. We could never have loved the earth so well if we had had no childhood in it,—if it were not the earth where the same flowers come up again every spring that we used to gather with our tiny fingers as we sat lisping to ourselves on the grass—the same hips and haws on the autumn hedgerows—...What novelty is worth that sweet monotony where everything is known, and *loved* because it is known?” (41)

Familiarity breeds affection, suggests the novel’s narrator, a sentiment shared by Margaret Gatty in “The Red Snow,” a tale included in her third series of *Parables*. Set in the Alps, Gatty’s story describes how a little boy’s frequent observation of the nearby mountain leads him to become fondly attached to it: he “never wearied of watching the

huge mountain, but got to love it more and more, with a love mixed with respectful awe, and a feeling as if it had some sort of life and consciousness” (153). To know a place, both Gatty and George Eliot suggest, is to love it.

Not only do these scenes of pastoral beauty inspire love, says the narrator, they likewise stimulate the imagination and are the source of nostalgia in later life. In the same passage describing the changes Maggie and Tom would eventually experience, the narrator continues:

These familiar flowers, these well-remembered bird-notes, this sky, with its fitful brightness, these furrowed and grassy fields, each with a sort of personality given to it by the capricious hedgerows—such things as these are the mother tongue of our imagination, the language that is laden with all the subtle inextricable associations of the fleeting hours of our childhood left behind them. Our delight in the sunshine on the deep-bladed grass to-day, might be no more than the faint perception of wearied souls, if not for the sunshine and the grass in the far-off years which still live in us, and transform our perception into love. (41-2)

Nostalgia is a facet of love, the narrator suggests, and one that is fed by the natural environment surrounding us in our youth. The details of this passage—the description of a sky’s “fitful brightness,” the furrows of the field, the hedgerows—are delivered prosaically enough, unlike the depiction Eliot provides in “Brother and Sister.”

Just as this passage of the narrator’s musings follow a scene in which Maggie and Tom go fishing together, the second sonnet in “Brother and Sister” describes a similar moment:

Long years have left their writing on my brow,
But yet the freshness and the dew-fed beam
Of those young mornings are about me now,
When we two wandered toward the far-off stream
With rod and line. Our basket held a store
Baked for us only, and I thought with joy
That I should have my share, though he had more,
Because he was the elder and a boy.

The firmaments of daisies since to me
Have had those mornings in their opening eyes,
The bunchèd cowslip's pale transparency
Carries that sunshine of sweet memories,

And wild-rose branches take their finest scent
From those blest hours of infantine content.

Here the poem's speaker recollects a scene from her youth that comes back with clarity, for the years "have left their writing on my brow" and bring the sensations of the fresh morning's "dew-fed" beams and the fragrance of the wild roses back to mind. But where the scene in *Mill* offers the free indirect discourse to illustrate both Tom and Maggie's thoughts about their companionship in the outing, the lyric voice of the sonnet remains in the speaker's mind alone.

Both the passage in *Mill* and Sonnet II in “Brother and Sister” relate a similar idea about the associations early experiences create in our minds. But the resolution to the poem varies significantly from the novel’s climax. Despite the fact that both the end of the second book of the novel and the beginning of the last sonnet of the poem share the theme that school time marks a break from their careless rambles as children, Maggie and Tom find a reconciliation at the novel’s end, albeit in a tragic way. When Mr. Tulliver loses his lawsuit, his property, and his health, Tom leaves school and the narrator remarks he and Maggie “would never more see the sunshine undimmed by remembered cares. They had entered the thorny wilderness, and the golden gates of their childhood had for ever closed behind them” (191). Similarly, the last sonnet of “Brother and Sister” begins, “School parted us; we never found again / That childish world where our two spirits mingled / Like scents from varying roses that remain / One sweetness, nor can evermore be singled” (11). If the narrative of *Mill* creates a sense of the transition from childhood to maturity, innocence to experience via the structure of the plot and the formal structure of closing one book and beginning another chapter, the poem imposes its structure through the tight formal elements of the sonnet, adhering to the ABAB rhyme scheme and iambic pentameter.

In addition to these structural devices, the novel and the poem conclude differently: the poem ends in melancholy, the novel in tragedy. In the sonnet, the third quatrain reads, “Till the dire years whose awful name is Change / Had grasped our souls still yearning in divorce, / And pitiless shaped them in two forms that range / Two elements which sever their life’s course” (11). Eliot’s poem employs vaguely scientific diction, “two forms” that “range,” two “elements” that sever whatever force binds them together and move in

different directions. In the poem, the brother and sister never find the same camaraderie and singleness of spirit they enjoyed as children, and while the poem's speaker laments the change, she closes the sonnet with a couplet reaffirming her consolation in the memories shared because she would live it again if she could: "But were another childhood-world my share, / I would be born a little sister there." Poetic structure, here the well-known Shakespearean or English sonnet form, offers the familiarity of a lyric voice, the development of an idea through the three quatrains, and the resolution in the final couplet, including the "turn" or volta in the word "but," providing a satisfying conclusion that finds consolation within the brother and sister's estrangement.

Maggie and Tom Tulliver, however, face a far more violent end in the seemingly unforeseen flooding of the Floss. The question of fate or chance is one of the central tensions with which the novel grapples, suggested by the habits and behaviors of the characters the novel traces in just over a decade. Characters like Mr Glegg find continuities in nature, for example, but not by close observation of organisms and their environment. Mr Glegg adheres to a version of natural theology in his thinking, finding concordances between animal life and notable events. "He surprised himself by his discoveries in natural history," the narrator explains,

Finding that his piece of garden-ground contained wonderful caterpillars, slugs, and insects, which, so far as he had heard, had never before attracted human observation: and he noticed remarkable coincidences between these zoological phenomena and the great events of that time,—as, for example, that before the burning of York Minster there had been mysterious serpentine marks on the leaves of the rose-trees, together with an unusual prevalence of slugs, which he

had been puzzled to know the meaning of, until it flashed upon him with this melancholy conflagration. (120)

Mr Glegg's interpretation of linked events amounts to a kind of augury, of revising his earlier confusion about the increase in slugs and reading them instead as a portent of imminent calamity. The slightly mocking tone of the narrator's parenthetical aside indicates how one might interpret Mr Glegg's causal thinking: "Mr Glegg had an unusual amount of mental activity, which, when disengaged from the wool business, naturally made itself a pathway in other directions" (120). The narrator's remark suggests Mr Glegg is best left to contemplating wool alone. But the novel questions more seriously whether one might predict someone's future via their past actions: would Maggie and Tom have been destined to repeat the same pattern of estrangements and reconciliations because of their character traits? Could surviving the flood have finally reunited them, once and for all? The questions are psychological, but perhaps geological in the novel's plumbing the depths of characters' minds, and in George Eliot's layering of hints about what would come to pass. As much as a flood is an unforeseen event, a consequence of meteorological phenomena over which the residents of St. Ogg's could exert no influence, the narrative makes its arrival almost inevitable.

From Mrs. Tulliver's admonition to her daughter not to play so close to the river—"Maggie, Maggie...where's the use o'my telling you to keep away from the water? You'll tumble in and be drowned some day, an' then you'll be sorry you didn't do as mother told you" (13)—to her prediction both children would drown—"They're such children for the water, mine are...they'll be brought in dead and drowned some day. I wish that river was far enough" (103)—the novel prepares a reader for Tom and

Maggie's downfall. The narrative voice ironizes the seeming inevitability of their fate especially in a moment describing Maggie, the river, and destiny together: "Maggie's destiny, then, is at present hidden, and we must wait for it to reveal itself like the course of an unmapped river we only know that the river is full and rapid, and that for all rivers there is a final home" (402). Unlike the river, Maggie is "mapped" already in the sense that she is a fictional character: just as the "final home" for all rivers is the vast ocean, the conclusion of all lives—and all tragedies—is death.

When George Eliot began writing fiction, the novel had already become one of the most significant literary forms, and critics were largely invested not in defending its importance, but rather in apprising its value in teaching moral and social lessons (Maitzen 14). When the anonymous reviewer of *Jane Eyre* writes in the *Christian Remembrancer*, "The Novelist is now completely lord of the domain of Fiction. Whatever good or evil is to be done in the present day through that medium, must be done by him" (Maitzen 20) for example, it is perhaps no surprise that the reviewer sees responsibility in that role, and a duty he or she evidently finds lacking in Charlotte Brontë's book, where "all virtue is but well masked vice, all religious profession and conduct is but the whitening of the sepulcher, all self-denial is but a deeper selfishness" (Maitzen 18). When he reviews Thackeray and Dickens in *The North British Review* in 1851, David Masson aims to trace the sources of the public's preferences between the two most renowned novelists of the day. He compares the two writers' works to forms of art: the low and the high, the Real and the Ideal. The low school, or the real style of art, has verisimilitude, or resemblance, as its goal; high art gives instead a sense of the ideal, "taking the mind out of itself into a region of higher possibilities, wherein objects shall be more glorious, and modes of

action more transcendent than any we see, and yet all shall seem in nature” (Maitzen 36). He finds the epitome of the real school in Thackeray; of the ideal in Dickens. For each, Masson suggests that the “moral spirit and sentiment of a work of fiction” is the bar by which the novel’s success should be tried (38). The idea of being true to spirit, sentiment, and emotion is a theme of George Henry Lewes’s essay, “The Lady Novelists” (1852) as well. “All poetry, all fiction, all comedy, all *belles lettres*,” he writes, “even to the playful caprices of fancy, are but the expression of experiences and emotions; and these expressions are the avenues through which we reach the sacred adytum of Humanity, and learn better to understand our fellows and ourselves” (Maitzen 46).

Reviews of *The Mill on the Floss* demonstrate readers’ appreciation of George Eliot’s method. An unsigned review in the *Spectator* on April 7, 1860 praises the writer’s “instinctive knowledge of the inner workings of a child’s mind” and parallel George Eliot’s written portrait of Maggie and Tom to that of an artist’s rendering: “the lines are few, the touches seem but mere accidental tints left but he pencil, but the character is painted to the very life” (Carroll 110). Despite taking issue with the novel’s presentation of spiritual conflict and passionate love—“emotions over which we ought to throw a veil”—the critic in the *Saturday Review* admits that “in the description and in the dialogue there are exhibited a neatness of finish, a comprehensiveness of detail, and a relish for subdued comedy that constantly brings back to our recollection the best productions of Miss Austen’s genius” (Carroll 116). If not universally in agreement about the novel’s morality, critics of *The Mill on the Floss* approved of its art and its resemblance to lived experience.

Into the mid-Victorian conversation about fiction's duty to provide moral instruction and its need to be true to the writer's experiences and emotions, George Eliot adds natural history's methods of observation. To understand others is not to romanticize them unduly but to describe their manner and morals, foibles and failings, with equal attention and skill. Her reading of Riehl was but one source of George Eliot's thinking about the aims for fiction. Her own experience in Ilfracombe helped her practice both natural history and narrative, and the trip itself coincided with a burgeoning of natural history texts and amateur naturalist guidebooks. To find natural history parallels in *The Mill on the Floss* is not a new discovery; rather, the experience of reading George Eliot's familiar novel in the context of women's natural history texts illuminates matters of form and the mutual exchange between narratives of natural history and the novel.

Chapter 4:

Evolutionary Erotics and Ethics:

Constance Naden's Philosophical Poetics

By the end of the nineteenth century, young Victorian women had access to higher education and were distinguishing themselves in their classes. Though unable to earn degrees in British universities until the twentieth century, they began work in a variety of disciplines, including the sciences.⁶⁸ Yet one consequence of entry into the professional world of science was that women, too, became subject to the divisions among scientific disciplines. No longer was it feasible for anyone, regardless of sex, to synthesize the most current scientific research the way Mary Somerville had done so concisely earlier in the century. Female students of science, like their male counterparts, began to focus on particular sciences for advanced study.

During the same decades when women began attending Oxbridge, they also entered the various “redbrick” civic institutions, located in Britain’s most industrial cities, that frequently emphasized scientific and engineering studies. Constance Naden (1858-1889), a poet, science student, philosopher, and advocate for women’s rights and charities, entered one such civic institution, Mason Science College in Birmingham (later the

⁶⁸ Women had been accepted into women’s colleges at Oxford and Cambridge since the late 1860s, and while they were able to sit the examinations, the universities would not grant them degrees, in part because the degree conferred a say in university governance. Girton and Newnham Colleges at Cambridge were founded in 1869 and 1871, respectively; by 1874 women could sit for the degree exams. At Oxford, Lady Margaret Hall was founded in 1878, the same year London University began admitting women; Somerville College at Oxford was founded in 1879. Oxford began granting women degrees in 1921; Cambridge not until 1948. For a history of women’s higher education in Britain, see e.g., Carol Dyhouse’s *No Distinction of Sex? Women in British Universities, 1870-1939* (1995). For a Victorian woman’s perspective of women’s

University of Birmingham) in 1881, one year after T. H. Huxley had given his famous address on science and culture at the college's opening. Previously, she had attended botany and field classes at the Birmingham and Midland Institute (Hughes 17). Naden was a gifted student of science, earning first class certificates in botany, organic chemistry, physiology, geology, and physics (Holmes 190). It was at Mason College that Naden composed the poems comprising her two published volumes of poetry, *Songs and Sonnets of Springtime* (1881) and *A Modern Apostle; The Elixir of Life; The Story of Clarice; and Other Poems* (1887). As John Holmes writes, "Tennyson may have been widely regarded by his contemporaries as having the best grasp of science, but of all the Victorian poets it was Naden who had the most comprehensive and up-to-date scientific education" (190). Upon leaving the college, Naden also left poetry behind, "having since then never written a verse even as a pastime" (Daniell xi). She turned instead to philosophy, espousing a secular materialism influenced by her scientific education, Herbert Spencer, and a former army doctor named Robert Lewins, whom Naden had met in 1876.

Naden's poems likewise contemplate the philosophy she adopted and named "Hylo-Idealism," a variation of Lewins's monistic "hylozoism," a theory that proposed matter (*hyle-*), rather than some kind of supernatural or external spirit, animated life and gave rise to consciousness. Under Naden's Hylo-Idealism, each individual forms a subjective universe within his or her own mind. Her philosophy sought to reconcile body and spirit, and so did her verse. Yet few scholars have examined the ways in which Naden's secular and scientific philosophy infused her poetry, deeming their interest only historical

education, see *The Higher Education of Women* (1866) by Emily Davies, a co-founder of Girton

(Holmes 191). In a study of how women used form in various ways to interpret and communicate science, Naden's philosophical poetry and her comedic verse are important. She subtly manipulates poetic conventions to question, if not undermine, Victorian social conventions regarding both gender and theology. This chapter considers the degree to which poetry could satisfy Naden's scientific and philosophical ambitions at a moment when other women poets, too, used poetry to think through scientific questions.

Naden's poetry illuminates a variety of ways a late-Victorian woman could both respond to scientific and philosophical ideas and also express ambitions for women's autonomy, but though Naden's poems have slowly begun appearing in anthologies of Victorian literature, she is still an under-examined Victorian poet in today's scholarship.⁶⁹ Since 1977, scholars have published fewer than a dozen examinations of Constance Naden's writings. These studies of Naden's poetry have most often focused on the progressive feminism found in a group of poems published in *A Modern Apostle* under the heading "Evolutional Erotics." In these poems, Naden humorously skewers the choices of male and female lovers who variously uphold and refute Darwin's theory of sexual selection as it applied to human relationships. While some scholars have discussed Naden's Hylo-Idealism in tandem with her poetry, none of these studies has investigated fully how Naden's chosen forms shaped the delivery of her efforts to unite both reason and emotion, philosophy and poetry.⁷⁰ This chapter places Constance Naden's writings

College, Cambridge.

⁶⁹ See, for example *Victorian Women Poets: An Anthology* (1995), edited by Angela Leighton and Margaret Reynolds; *Nineteenth-Century Women Poets* (1996), edited by Isobel Armstrong and Joseph Bristow; and the online resources for the second edition of *The Broadview Anthology of British Literature: The Victorian Era* (2012), edited by Joseph Black, et al.. Naden's *Complete Poetical Works* (1894) is also available online at the Victorian Women Writers Project.

⁷⁰ Studies of Naden have been published by Philip E. Smith II and Susan Harris Smith, James R. Moore, Marion Thain, Albert D. Pionke, Charles LaPorte, Andrea Kaston Tange, Nour

into a broad tradition of women's choices of form and genre in which to engage scientific ideas in nineteenth-century Britain. Examining Naden's poems in conversation with her philosophical essays also written while at Mason College, I argue Naden employed poetry's formal features as part of her Hylo-Idealist project. Naden used prosodic elements like feminine end rhyme to particular ends, not just to unsettle Darwinian notions of sexual selection but also to underline her atheistic philosophy. But because she, not unlike John Stuart Mill, ultimately saw the aims of poetry and philosophy diverging—poetry might be personal, Naden thought, while only philosophy could be universal—Naden left the former behind. Ironically, though, while Naden's Hylo-Idealism fell into obscurity shortly after her death in 1889, her poems have begun gaining new life in the late twentieth and early twenty-first centuries.

In a study of nineteenth-century women's use of genres to articulate, accommodate, counter, or support scientific ideas, Constance Naden stands out as a Victorian woman who published poetry and science. She illustrates both a culmination and a departure from the emerging tradition of women's scientific writing this dissertation has traced in its first three chapters. As a science student, poet, and philosopher, Naden's career at the *fin de siècle* shows how vastly different women's educational and professional opportunities were from those in the century's first decades. Where her predecessors more often had to learn at home in their families' libraries, Naden received a formal scientific education. Naden, too, published both science and poetry for an audience comprised of male and female peers; she was not a "popularizer" for nonspecialist

Alarabi, and John Holmes. Marion Thain offered the first thorough investigation of Naden's Hylo-Idealistic poetics in "'Scientific Wooing': Constance Naden's Marriage of Science and

audiences. Her writings likewise demonstrate the materialist ideas that gained prominence in the latter half of the nineteenth century: Naden, like George Eliot, gave up her religious faith for a secular philosophy, thus putting her at far remove from religiously-minded women science writers like Mary Somerville, Margaret Gatty, and even her closer contemporary, Arabella Buckley. Reading Constance Naden's poems within a literary history of Victorian women's science writing shows how pervasive the tensions were between religious and secular science even by the end of the century. Coming in the wake of Darwin's *Origin and Descent*, Naden's "Evolutional Erotics" poems tackle these anxieties with humor, thereby diffusing the threatening implications of evolutionary thought. Naden's more earnest efforts to infuse her poems with Hylo-Idealism, however, present her philosophy without ambivalence: her prosodic choices fortify her themes and present a unification of spirit and matter, emotion and intellect, theme and form.

In this chapter, I examine how Constance Naden's secular science and philosophy appear within the lighthearted and serious poems of both *Songs and Sonnets of Springtime* and *A Modern Apostle*. Naden's poems, written during her college years and occasionally published in the *Mason College Magazine*, reveal her experiments in poetic form. In the first half of the chapter, I focus on the comic "Evolutional Erotics" poems to illustrate how Naden adapts her rhythms and rhyme to shape a reader's reaction to recognizable Darwinian theories. I then extend my analysis of the poems' formal features to argue in the second part of the chapter for a deeper understanding of Naden's incorporation of Hylo-Idealism into her poetics. While the tone of the poems discussed in

Poetry" (2003); Nour Alarabi has offered readings of Naden's philosophy more recently in

both halves of the chapter differ dramatically, I show Naden's poems adhere to an internal prosodic consistency. The chapter concludes by suggesting why the results of Naden's poetic experiments led her to leave poetry behind: Naden was not an innovator in Victorian poetics, and her investment was not in adapting a genre to a new subject the way Gatty or Buckley had done with fairy tales for children. Like Somerville, however, she echoes familiar poetic forms—again, including examples from Byron, like the meter of *Don Juan*—to evoke comparisons and subvert her readers' expectations. If she hypothesized she could incorporate science and philosophy into her poems—and despite her ability to do so—Constance Naden ultimately found the genre of poetry ill-fitting for her philosophical ambitions. Yet her method of integrating science and philosophy into poetry illuminates another corner of late Victorian materialist debates for today's readers.

“Evolutional Erotics”

In taking scientific theories as subject matter for poetry, Naden was not alone among her contemporaries, including other women poets. In “The Ascent of Man” (1888), Mathilde Blind (1841-1896), for instance, sought a communion between the individual lyric voice and the community of living organisms united within Darwinian evolutionary theory, as Jason Rudy has argued.⁷¹ In Blind's poetics, her regular meter collides with isolated lyric “spasms” (Rudy 444). A. Mary F. Robinson (1857-1944) offers a contemplative response to evolutionary theory in “Darwinism” (1878? 1902), a poem written in regular quatrains of iambic tetrameter, and suggesting that evolution came in response to an “unborn and aching thought,” an unrest in the human soul (Leighton and Reynolds 547). The poet May Kendall (1861-1943) less frequently

“Constance Naden's Philosophical Poetry” (2012).

⁷¹ See Rudy's “Rapturous Forms: Mathilde Blind's Darwinian Poetics” (2006).

addresses scientific topics in her poems, yet her “Lay of the Trilobite” (1885) imagines a fossil’s rebuke of human hypocrisy:

The native of an alien land
You call a man and brother,
And greet with hymn-book in one hand
And pistol in the other!

You’ve politics to make you fight
As if you were possessed:
You’ve cannon and you’ve dynamite
To give the nations rest:
The side that makes the loudest din
Is surest to be right. (Leighton and Reynolds 631)

As John Holmes has argued, Kendall’s poem cautions against taking humanity’s seemingly esteemed place in evolution too seriously (“Lay” n. pag.). Emily Pfeiffer’s (1827-1890) poem “Evolution” (1880) suggested that hunger—an insatiable longing—rather than an instinct for reproduction, drove the changes in species over time, not unlike the “unrest” in A. Mary F. Robinson’s poem. We should read Naden’s poems interrogating evolutionary theory as part of this larger conversation among women poets at the *fin de siècle*, and recognize that only Kendall and Naden offer their critiques using a comic or satiric tone.

The pliancy of comedy—its ability alternately to entertain, parody, and critique—has long made it a desirable genre for artists of the word, image, and stage.⁷² No less true for nineteenth-century England than for the Athens of Aristophanes, poets and playwrights have often chosen comedy to articulate the vexed social position of women. The implicit purpose and politics behind a comic writing style vary according to the social conditions in which these artists compose. In Constance Naden's case, her comic poems of courtship participate within a larger cultural spirit of Victorian antagonism toward Darwin's theory of sexual selection. Choosing comedy as a genre for critique meant that women like Naden could both defuse and pique readers' disquiet about women's agency and power within the dynamics of sexual selection. Naden's poetics in her "Evolutional Erotics" poems offer, as it were, a comedy of choices: her lovers' selection of potential marriage partners parody the tropes of romantic lyric poetry. Written as "light verse," these poems wryly illustrate how women, not men, select their mates. The poems' humor adds a deceptive air of superficiality to an otherwise incisive commentary on the social dynamics of unmarried men and women.

Naden's section "Evolutional Erotics" in *A Modern Apostle* comprises just four poems: "Scientific Wooing," "The New Orthodoxy," "Natural Selection," and "Solomon Redivivus, 1886." All four are short lyrics voiced by first-person speakers, in marked contrast to the long narrative poems that precede it in the volume ("A Modern Apostle," "The Elixir of Life," "The Story of Clarice"). "Scientific Wooing" describes a young man's desires to woo his intended, Mary Maud Trevelyman, using tropes from chemistry,

⁷² In addition to the vast number of humorous poems published in the nineteenth-century, poetry—the genre and its forms—could become an object for parody as well. Carolyn Williams's essay "Parody and Poetic Tradition: Gilbert and Sullivan's *Patience*" (2008) articulates how

Newtonian physics, botany, and mathematics. “The New Orthodoxy” takes an epistolary format, written as a poetic letter from a scientifically-minded young woman, Amy, to her fiancé Fred, whom Amy fears has lost his faith in secular evolutionary theory. “Natural Selection” again voices the perspective of a scientific young man, this time one who loses the object of his affection, Chloe, to another suitor who dances and sings far better than the speaker. Lastly, “Solomon Redivivus, 1886” recounts the evolution of mankind from the most basic organisms to the highest forms of life, epitomized in the figures of King Solomon and the Queen of Sheba. Each of these poems is witty in tone, exhibits a regular meter and rhyme scheme, and treats its subject lightly: that is, without too deep an inquiry into its subject. The musical, sing-song quality of the poems’ rhythms are playful rather than ponderous.

Naden’s use of rhyme is one of the most striking formal features of her courtship poems. Playful uses of rhyme typically characterize poetry considered “light verse.” Coupled with trimeter or tetrameter feet, end-stopped lines and masculine line endings—where the stress falls on the last syllable of a poetic foot—call attention to unusual rhymes. The distinction of calling rhymes masculine or feminine—meaning rhymes ending with stressed or unstressed syllables, respectively—derives from the entry of French loan words and poetry into the English language. The Oxford English Dictionary traces the idea of masculine and feminine rhymes or endings to sixteenth-century England and texts like Henry Wotton’s *Courtlie Controversie of Cupid’s Cautels* (1578) or Samuel Daniel’s *Panagyricke* (1601), so this gendered notion of rhyme scheme was widespread among poets by the nineteenth century.

parody on stage could humorously skewer both low and high nineteenth-century poetic practices, the idyllic and the aesthetic.

Rhyme, composed of either the stressed or unstressed endings of lines, then, was not a neutral element of prosody: it was fraught with implications of both gender and quality. Some nineteenth-century prosodists paid little attention to rhyme, favoring instead the rhythms of poetic meter. In John Earle's chapter on prosody in *The Philology of the English Tongue* (1873), for instance, he suggests rhyme serves as meter's helpmate:

Rhyme is an attendant upon metre; its office is to mark the 'verse' or turn of the metre, where it begins again. Rhyme is an insignificant thing philologically, as compared with alliteration: for whereas this is, as we have before shown, an accentual reverberation, and rests upon the most vital parts of words; rhyme is but a syllabic resonance, and rests most frequently upon those syllables which are vocally of the lowest consideration. (613)

Earle's chapter discusses far more diligently the sources of alliterative accent in English verse. George Saintsbury (1845-1933) treats rhyme just in an appendix to the third volume of his *History of English Prosody* (1910). In the *Science of English Verse* (1880), American poet Sidney Lanier (1842-1881) explains multisyllabic rhymes as "feminine, female, or double-ending rhymes" (285). By the twentieth century, feminine rhymes were associated with humor, as described in George R. Stewart's *The Technique of English Verse* (1930): "To many people double rime has seemed a debased form fit for comic or burlesque purposes" (169-70). Conversely, Egerton Smith argues in *The Principles of English Metre* (1923) that "the deliberate use of disyllabic rimes in a regular alternating scheme really commences in the early nineteenth century with Scott, Moore, Byron, Shelley, and Praed," and Smith's footnote to this statement criticizes Keats's use of

feminine rhyme for making “the rhythm too effeminate in character” (181). While they are used in contrast to Augustan verse’s masculine endings, says Smith, they were “spasmodically frequent” instead of having an “organic structural function” (181).

While on the surface a pattern of halting or humorous end-rhymes may appear to keep a poem’s message in the realm of entertainment only, Naden’s poems repeatedly assert a female power of sexual selection under the guise of parody. Her satiric rhymes serve as one instrument of resistance. Writing about rhyme as “a performance of resurrection,” Gillian Beer argues that a variety of poets—including Swinburne, Hopkins, James Clerk Maxwell, May Kendall, and Mathilde Blind—used rhyme to question belief, not only what to believe but also the very possibility of believing (193). Beer observes, “belief...has as its corollary resistance to belief, and rhyming light verse in the Victorian period specializes in satiric inversion” (193). When Beer examines Naden’s “The New Orthodoxy,” for example, she reads Amy’s chastisement of her fiancé’s lapsed “faith” in science as one such satiric inversion: the orthodoxy of the poem is not religious faith but rather the notions of secular materialism. Such a reading is clearly evident and compelling. What is more, the poem evinces a subtly shifting power dynamic between the affianced couple as well.

When the speaker in “The New Orthodoxy,” Amy Merton, writes to her fiancé Fred, she first answers the concerns he has expressed about how her studies have affected her feelings toward him. The opening stanza’s lines imply Amy’s efforts to reassure him have failed—“you’re not content / Though I quote the books you lent, / And I’ve kept that spray you sent/ Of the milk-white heather” (139). While she has reciprocated with his romantic gestures, Fred fears Amy is “too ‘advanced’ / To remember all that chanced

/ In the old days, when we danced, / Walked, and rode together” (139). Assuring Fred that “beneath the curls / Of the most ‘advanced’ of girls / Many a foolish fancy whirls,” Amy wryly indicates even educated girls can be romantic. But then she turns the subject to the real source of her misgivings about Fred. She questions whether rumors of her fiancé’s scientific skepticism are true and hints that their engagement may not survive such differing philosophies. The reason for her hesitation appears in the fifth stanza, just over halfway through the poem:

Oh, the wicked tales I hear!

Not that you at Ruskin jeer,

Nor that at Carlyle you sneer,

With his growls dyspeptic:

But that, having read in vain

Huxley, Tyndall, Clifford, Bain

All the scientific train—

You’re a hardened sceptic! (140)

Despite her lover’s hurried requests to marry, Amy pauses. While their hearts had been “so meetly matched” in childhood, their subsequent educations at Oxford and Girton have erected a larger obstacle to marital bliss than his parents’ class-based objections. Here, Amy points out that Fred’s dismissal of secular scientists and intellectuals—biologist T. H. Huxley; physicist John Tyndall; mathematician William Clifford; and pioneer of psychology, Alexander Bain—counts as a far more serious piece of gossip than simply a dismissal of John Ruskin or Thomas Carlyle. The marriage will not proceed without her assent, and she lists her reservations in the subsequent stanzas,

ending the list of rumors with the most weighty accusation, “Something worse they whisper too, / But I’m sure it can’t be true— / For they tell me, Fred, that you / Scoff at Herbert Spencer!” (208). Responding to these rumors with alarm, Amy exhorts Fred to explain:

Write--or telegraph--or call!

Come yourself and tell me all:

No fond hope shall me enthrall,

No regret shall sway me:

Yet--until the worst is said,

Till I know your faith is dead,

I remain, dear doubting Fred,

Your believing **AMY. (141)**

Naden inverts the rhetoric of spiritual faith and belief, making scientific principle the higher authority that would legitimize their union. The final stanza uses diction and rhyme subversively, casting Fred in the Christian role of a doubting Thomas and ominously rhyming his name with “dead,” suggesting the potential end to their engagement. The form of the poem reinforces its sense. Each of the poem’s octaves consists of a pattern of trochaic tetrameter tercets followed by a trimeter line with a feminine ending. (To identify the pattern of stress, I have printed the stressed syllables in boldface.) The symmetry of the poem’s form (eight stanzas of eight lines each), the regular meter, and the heavy aural repetition conveyed by three consecutive rhymes

discourage a reader or listener from taking the sense of the poem too seriously or critically; the sound is too strong, too reminiscent of nursery rhymes or ballads.⁷³

Yet the form of the poem and its satiric inversions are just what demonstrate how Naden is participating in a conversation about sexual selection. Her speaker suggests that while “jeering” and “sneering” at Ruskin and Carlyle could be overlooked, rejecting Darwin and Spencer, the two foremost proponents of natural selection and “survival of the fittest,” respectively, is unacceptable. It is enough to make Amy reconsider Fred as an eligible suitor. Common reasons for breaking an engagement might include infidelity, cooled passions, familial disapproval, or other breaches of trust; here, however, Amy’s reservations suggest a husband would have to agree with *her* scientific worldview. A dismissive skepticism is not, in Naden’s poem, an attractive quality in a mate. Naden’s choice of the poem’s structure and form also underline such a theme: her feminine end rhymes in the fourth and eighth lines of each stanza result from removing the last unstressed syllable of the tetrameter lines. In the parlance of prosody, the feminine stress is missing. This subtraction does not, however, suggest that the female voice is “peripheral in the poem,” as Patricia Murphy argues, “implying only a limited opportunity for a woman to participate in the discourse of science, as well as poetry” (“Fated Marginalization” 121). Rather, the masculine triplet lines suggest excess and, perhaps, Fred’s redundant belaboring of his proposals. Instead of seeing the B-lines as missing the final stress of the tetrameter lines, a reader might instead notice that the tetrameter lines end on the initial stress, snipping off the unstressed second syllable of the trochaic foot. Far from being a “feeble version of its male counterpart,” as Murphy claims

⁷³ The rhyme scheme of these stanzas is AAABCCCB.

(121), Amy's voice—emphasized by the feminine endings of the B-lines—stands out in defiance.

While “The New Orthodoxy” rejects religious faith, Naden's other poems suggest a scientific mind is not wholly a desirable trait. If Amy Merton seeks a husband who will complement her “new orthodoxy,” she still might steer clear of Mary Maud Trevelyhan's suitor in “Scientific Wooing.” This time voiced by an amorous young man, Naden's poem still reveals that in the courtship dance, it is the man who must woo and appear to his best advantage. Unlike Darwin's male peacocks, to court his intended, a human suitor's “strut” should display both his physique *and* his acumen. Yet beneath the humorous facade, the use of rhyme in “Scientific Wooing” reveals the speaker's brash and aggressive personality, a trait that may likely outweigh an attractive appearance.

In “Scientific Wooing,” rhyme again diverts the poem's reader or listener, and the conspicuous changing of registers between love and science create a humorous atmosphere simultaneously with a subversive critique of the speaker's motives. Drawing again upon Gillian Beer's analysis of rhyme, we can consider more fully how Naden's poem negotiates the power relationship between men and women. As Beer writes, rhyme sometimes

trivializes. That may indeed be an important cultural function for rhyme, observable in some of these Victorian verses: trivializing can defuse anxieties-- while at the same time the agitation of rhyme can give expression to anxiety. Anxiety and release are held together, neither negated. Rhyme contaminates. It can cross speech registers and cultural zones kept wide apart. It may, thus, become a form of cultural treachery (or critique), at odds with authority.

...Rhyme's unargued juxtaposition of unlike words can topple all the grave hierarchies of what it is polite (or politic) to couple with what. So 'light verse' may throw light on the dark corners of a culture. (199-200)

In "Scientific Wooing," rhyme throws its light on the speaker's desire to win over—even conquer—Mary. The unusual rhymes almost immediately provide amusement by subverting our expectations:

For when my daily task was o'er
I dreamed of H₂SO₄,
While stealing through my slumbers placid
Came Iodine, with violet fumes,
And Sulphur, with its yellow blooms,
And whiffs of Hydrochloric Acid. (135)

Even a reader familiar with a vast quantity of eighteenth- and nineteenth-century English parodic verse is likely unprepared for "o'er" to rhyme with the chemical notation for sulphuric acid; nor are we likely to expect clouds of gaseous iodine and sulphur to be likened to fragrant "blooms," or to consider the best-fitting rhyme for "placid" to be "acid." Very likely, a reader could quickly read the poem, dismiss it with a laugh as an example of uncomplicated light verse, and move on to Naden's serious sonnets. Instead, I suggest that the speaker's boasting should be read as a parody of male displays of sexual prowess performed to attract a female; here, the speaker thinks his knowledge of science, not attractive physical features, will help him successfully court Mary. However, Naden's rhymes call out to be read ironically; we likely empathize with Mary

Maud, who never actually appears on the poem's stage, and we may believe her to be better off without her ardent suitor.

This "youth of studious mind," the poem's speaker, appears a more narcissistic than dedicated lover; his interest seems to dwell on parading his scientific understanding rather than making more sincere, if less elaborate metaphors for his love. He wishes for a spectroscope that could measure a "pure and incandescent" glow of love in Mary's eyes; he compares his attraction to her using Newton's law of universal gravitation; he imagines singing a "deep Darwinian lay" whose sexually suggestive imagery of "trembling stamens" and stigma-kissing anthers would, no doubt, make his intentions known even more explicitly than he could by floriography. For all of his veiled references to mating (i.e., "sweet communion," "Chemic union," and flower pollination), the speaker fails to see that scientific knowledge alone will not engender healthy offspring. All of these scenarios reveal the speaker's flawed logic and the limitations of his metaphors, for each undermines the legitimacy of his claim to a superior intellect and, by extension, a desirable sex characteristic.⁷⁴

Much to his dismay, the suitor who voices "Natural Selection," for instance, comes to realize that *his* choice of a potential mate matters little in the evolutionary game. Despite his efforts to win over Chloe, he discovers that she prefers "an idealess lad" who knows no science: "He seeks not the How and the Why, / But he sings with an amateur's grace, / And he dances much better than I" (143). Thus the narrator realizes that Chloe

⁷⁴ Naden's choice in naming the speaker's intended partner Mary Maud Trevelyman evokes a real-life counterpart, a woman who was, in fact, more than sympathetic to men of science. Seventeen-year-old botanist Paulina Jermyn (1816-1866) fell in love with Sir Walter Trevelyan at the 1832 meeting of the BAAS. Lady Trevelyan became a patron of the arts, becoming friends with Ruskin, Swinburne, the Brownings, the Rossettis and other members of the Pre-Raphaelite

adheres to Darwinian principles in both philosophy and in practice. She attests to a belief in evolution when she admonishes his desecration of “an ancestor’s grave” by collecting the bones of “cave-men,” and, as “we know the more dandified males / By dance and by song win their wives,” she chooses a suitor who possesses the traits and skills her upbringing, i.e., her own breeding, has deemed desirable (143).

While women do the choosing in Naden’s comic poems, they do not always “naturally select” the best mate possible. Putting into conversation one of Naden’s poems from her earlier volume, *Songs and Sonnets of Springtime* (1881), with “Scientific Wooing” suggests one potential outcome if the latter’s speaker were to successfully woo Mary Maud Trevelyman. In “Love *Versus* Learning,” the female speaker describes her ambivalence about the choice she has made. Even though the poem does not explicitly state that the pair will marry, the final stanza closes off any alternate reading because the speaker puts down the pen with which she has been journaling--presumably her diary contains the “text” of the poem we are reading--as soon as her suitor knocks at the door.

The narrator of “Love *Versus* Learning” admits that her initial impression of her lover was flawed, and at the same time, her confidences allow the reader to question her judgment even further. Basing her assessment on her suitor’s qualifications, she succumbs to her girlish fancies of falling in love with a man of learning:

He promised to love me for ever,
He pleaded, and what could I say?
I thought he must surely be clever,
For he is an Oxford M.A.

Brotherhood. See Holmes 460, and John Batchelor’s *Lady Trevelyman and the Pre-Raphaelite Brotherhood* (2006).

But now, I begin to discover
My visions are fatally marred;
Perfection itself as a lover,
He's neither a sage nor a bard. (89)

Her lover's devotion to learning has lasted only as long as his formal education; now that he's left college behind him, he has decided to leave any new opinions and thought there as well. Thus he likewise discourages the narrator from pursuing any intellectual pursuits, belittling her efforts to discuss logic or science and calling her a "dear little goose" (89). Still, he wins over the narrator with seemingly clever scientific analogies and compliments:

He says that the sun may stop action,
But he will not swerve from his course;
For love is his law of attraction,
A smile his centripetal force.

His levity's truly terrific,
And often I think we must part,
But compliments so scientific
Recapture my fluttering heart. (90)

Curiously, the narrator seems to dismiss his frivolous attitude thanks to a well-timed compliment that may owe something to Shakespeare's *Hamlet*; yet the success of these facile compliments puts the narrator's discernment into question.

“Scoffing at each grave occupation” and calculating “how to make two into one” suggest that the lover’s wordplay is designed only to charm the narrator and retain her affection, not to express sincere feeling. The rhyme and rhythm of the poem also underline the speaker’s limited judgment. The quatrains all contain a regular trimeter composed of an iamb and two anapests, again evoking a child-like adherence to a nursery rhyme beat. Noticeable again is Naden’s inclusion of feminine end rhymes in all of the A-lines, and the consistency with which she clings to the extra syllables here highlights the narrator’s intent to remain with her chosen partner, whatever the cost. Or, perhaps the devotion to a regular rhythm indicates a reluctance to allow any real questioning of her choice; to step out of the rhythm would be to step out of the relationship and admit the possibility of never finding “the sage and the lover combined.” In either case, the poem does emphasize this woman’s choice, and the comic tone glosses over the serious implications of an unequal marriage.

Within these “Evolutional Erotics” poems, Naden has carefully employed comedy to subvert Darwin’s assertion that the human animal has balked at nature and made sexual selection the province of the male. Naden’s poems hold the idea up to ridicule by illustrating how the choice of a partner still resides with women. However, she does not make women the paragon of intellect unilaterally; women are capable of making a poor choice just as well as a wise one, as her earlier poem, “Love *Versus* Learning” demonstrates. Evolution relies on natural selection; one may infer that the weaker unions are not fruitful, intellectually and/or biologically. It seems, however, that ultimately Naden is less concerned with the biological offspring of these pairings. Instead, her poems focus on the philosophical, not just social, marriages of equal individuals, a radical

notion that Naden couches in light verse so that its threat is tempered by the fact that readers can elect to read the message as a facetious one. If the form of the poem must follow the spirit of the theme, Naden's aesthetic features serve her political and social commentary.

Naden's Poems of Hylo-Idealism

In part one of this chapter, I have suggested Naden's engagement with Darwinian sexual selection manifests not only in her poems' themes but also in their poetic form. The rhythms of "Evolutional Erotics" poems conform to features associated with lighthearted verse and ballads, yet Naden's rhymes do more subversive work in maintaining the presence of a female voice. Turning now to her philosophical poems, I demonstrate how Naden's choices in stanza forms, meter, and rhyme again cohere to inform a poetics steeped in a belief of the unity between matter and ideal, body and spirit. My analysis of Naden's prosody is informed by current scholarship in historical poetics written by Kirstie Blair, Jason David Hall, Meredith Martin, Jason Rudy, and others. Blair and Rudy demonstrate the correspondence between poetic form and physiological response; Martin establishes English prosody's concurrent development with narratives seeking to define national culture: meter was not a static and ahistorical form; and Hall describes late nineteenth-century scientific experiments with metrics, acoustics, tonal duration, and stress.⁷⁵ These studies demonstrate the historical and cultural contingency of poetic form, correcting the notion that prosody has always comprised a fixed set of rules abstracted from the lived experiences of poets and their readers. It is this historical

⁷⁵ See, e.g., Kirstie Blair's *Victorian Poetry and the Culture of the Heart* (2006); Jason David Hall's "Materializing Meter: Physiology, Psychology, Prosody" (2011); Meredith Martin's *The Rise and Fall of Meter* (2012); and Jason Rudy's *Electric Meters* (2009).

sense of prosody in Victorian Britain that I apply to Naden's poetics. However, Naden's poetry is less invested either in reflecting or promoting national character, or registering poetic rhythms in the body than it is in demonstrating a unity between matter and phenomena.

Naden's career as a poet and philosopher is notable for this study of the genres of women's scientific writing because she published both poems and scientific essays. Worth noting is how Naden used different names and initials according to the kind of publication. Though she published her poetry under her given name, Constance C. W. Naden, she published her philosophical articles under the initials C.N., sometimes under the name Constance Arden, and sometimes the initials C.A. (Hughes 29). Her articles appeared in journals that discussed both philosophy and the sciences of mind, including *The Journal of Science, Knowledge*, the *Agnostic Annual*, and *London Society* (Hughes 30).

Constance Naden articulated her theory of Hylo-Idealism most explicitly in 1884, when she published "Hylo-Idealism: the Creed of the Coming Day" in *Our Corner*. In this essay, she makes a case for the material origins of consciousness. Central to human perception is sight, Naden argues, and by association, the physiology of both the eye and the optic nerve become paramount. Science, Naden writes,

tells how a myriad ethereal waves, of inconceivable minuteness, enter the tiny window of the eye, and beat against the delicate lining of its darkened chamber.

The pulsations are taken up, and transmitted along the optic nerve to the base of the brain, and thence to the grey thought-cells of the cerebral hemispheres. And in

these grey thought-cells lives the God who says, "Let there be light," and there is light. (276)

She goes on to explain how an injury to the optic nerve would thus impede the messages conveyed to the brain and thus permanently change the scope of that human brain's perception of external phenomena. The cerebrum, Naden argues, "is not a First Cause, since a stimulus is needed to set him into action; but it is certainly the only authentic Creator of the world as yet discovered by science, philosophy, or religion" (276). Naden also discusses how organic life emerges from inorganic elements through chemistry. About cellular renewal and decay, she writes, "the circle from inorganic to organic, and back again from death to life, and from life to death, is never interrupted. Nowhere can we point to a manifestation of energy, and say:—This is the work of pure *nous*, the spirit; *hype*, the physical agency, here finds its occupation gone. The parent of light, sound, odor, also generates the fairest imaginings of the poet, the grandest generalizations of the scientist or thinker, the noblest deeds of hero and saint" (278). Naden's atheistic philosophy allows no supernatural agency in the development of organic life nor the higher forms of sentience, artistic creativity, or intellectual contemplation. In Hylo-Idealism, matter itself generates consciousness: thought is no longer an immaterial essence but a physiological property inherent in higher species.

When she turns her attention to human friendships and sympathy, she acknowledges that no one can truly transgress the boundaries of another individual's personality. Yet she says this inability is true in one sense only. In another sense, such communion transpires constantly:

All with whom we live, all with whom we hold intercourse, all of whom we read, hear, or think, are received into the mind through the portals of the senses, and become actual parts of the ego. We understand them only so far as we are able to identify them with ourselves. Our own thoughts give us a key to their thoughts, and enable us to translate their words and gestures. (279-80)

Naden sees in human relations the analogy of two facing mirrors, where each reflects the reflection of the other. Human sympathy resides in each human mind's ability to recognize the outlines of another's character by comparison with his or her own. Here, Naden suggests, lies the "germ of all altruistic morality" (280). Naden's notions of sympathy appear similar to Herbert Spencer's, whose "Data of Ethics" she likewise discusses in another essay, "Evolutionary Ethics," published in *Induction and Deduction* (1890). There, following Spencer, Naden identifies a scientific basis for sympathy as character trait evolving from social conditions in which it is useful (112). But then she expands on Spencer's epistemological sympathy, or synthetic philosophy, using her own Hylo-Idealism to suggest the material source of thought and the physical "germ" of sympathy: "the thought of a fellow creature carries with it the thought of his feelings; and here, at last, we reach the germ of sympathy" (130).

If monism, or oneness, is the heart of Naden's philosophy, then it inflects the form as well as the sense of her poems explicitly addressing her philosophy's ideals. In the same way that Naden chooses a light touch to satirize the courtship dances of her fellow men and women at Mason College—upholding sexual selection at the same time she undercuts Darwin's diminishing of women's agency—she adopts a serious tone, style, and poetics for her philosophical poems. Yet while she shows herself to be adept at the

formal features of serious poetry as well as those of comic verse, poetry's supposed limitations to subjective experience rendered it unsuitable for her broader ambitions as a philosopher. Yet her choices in form and subject offer today's readers insight into one strain of secular thought that burned brightly for a short time before it was extinguished. Far from becoming the "creed of the coming day," Naden's Hylo-Idealism lingers in her poetry. These poems represent one scientific woman's intervention into the most timely debates of her day.

"The Astronomer" opens *Songs and Sonnets of Springtime* (1881), beginning a section of poems voiced by speakers who each find discord in their beliefs, an opposition between what they believe and what they experience. Despite the religious beliefs possessed by a number of the speakers, none is content and tranquil in his or her current state. Following "The Astronomer," Naden places poems voiced by a young woman going to confession, a Roman philosopher addressing Christian priests, a druid, a Carmelite nun, an alchemist, a sculptor, and many others. "The Astronomer" establishes many of the same kinds of internal conflicts voiced by the speakers of the subsequent poems, and it is notable that the voice opening the volume is that of a scientist. Naden places her secular scientist into the same category as her Christian, pantheistic, and polytheistic speakers. Naden's astronomer voices an awe of the sublime universe he studies—similar to the idea of astronomy proposed by Mary Somerville—but he yet remains troubled about his own prospects in the universe—not unlike the fears expressed by Swithin St. Cleeve in the passage from Thomas Hardy's *Two on a Tower* (1882), with which I began chapter one. The troubled astronomer of Naden's poem finds a sense of the divine that upheld Mary Somerville's pleasure in astronomy, yet he laments a "lack of

earth-born hope” for humanity to find harmony with the wider universe. With “The Astronomer,” Naden begins her poetic efforts to illustrate a philosophy that would unite earthly experience and celestial contemplation.

Describing his “chosen home” in an observatory atop a mountain where he can see uninterrupted vistas of sky, sea, and earth, the opening stanzas emphasize the astronomer’s distance from his fellow men. Though he enjoys the earthly scenes, he has given them up for his star-gazing. “All these I love,” he states, “but only heaven is near, / Only the tranquil stars I know; / I see the map of earth, but never hear / Life’s tumult far below” (3). His chosen path means he only has the stars for company, and he looks at “common fields and trees” in “half-regretful ignorance” (3). The speaker’s choice to forego a social life with his fellow men continues as a theme throughout the poem.

Comparing his work as an isolated astronomer with that of men on the shores and fields below, the astronomer questions their respective choices:

Scant fare for wife and child the fisher gains
From yon broad belt of lucent grey;
Rude peasants till those green and golden plains;
Am I more wise than they?

Oh, far less glad! And yet, could I descend
And breathe the lowland air again,
How should I find a brother or a friend
‘Mid earth-contented men? (4)

A fisherman's labors only yield "scant fare" for his family, and the peasants working the fields are "rude," or primitive compared to the celestial scope of the astronomer's toil. In answering the question ending the previous stanza, "Am I more wise than they?" the astronomer shifts the terms of the query, answering "Oh, far less glad!" Across the space between the stanzas, the speaker associates wisdom with gladness, inverting the sense of wisdom as an intellectual pursuit for knowledge versus the sagacity of lived experience. But in the following lines' turn—"And yet, could I descend / And breathe the lowland air again"—the astronomer demonstrates again his binary thinking: atop his mountain observatory, he misses the social life of laboring men below, but he imagines that if he were to leave his lofty observatory, he would find no true camaraderie among men who didn't share a similar love for the stars.

In the following stanzas, the astronomer continues this train of thought, imagining a married life marred by a similar sense of longing despite the loving caresses of a wife. He fears that however much he might love her, he "needs must break the heart / that puts its trust in me" (4). His consolation as a solitary astronomer comes in the form of his muse, Urania, whom he imagines supporting his steadfast astronomical study. Eventually, Urania grows too brilliant even in his imagination, blinding him so much that he dares not look. Overwhelmed by her radiance, the astronomer asks, "How shall immortal splendour wed the gaze / Of man, who knows but that which seems, / Whose sight were blinded, if the sun should blaze / With unrefracted beams?" (6). Highlighting human limited sensory experience, the astronomer uses the terminology of science to draw an analogy between direct sunlight and a god-like muse.

Yet the astronomer also recognizes that muses, like the legends of gods and heroes, are but the creation of man's brain and thus subject to the whims of human storytelling: "But what is she, whose beauty makes me blind, / Whose voice is like the voice of Fate? / What, save a lustrous mirage of the mind, / My slave, whom I create?" (6). Invoking the muse of astronomy, the speaker turns the terms of inspiration from an external source to an internal creation. The point of such musings, in fact, comes from the fact that "from such dear illusions Wisdom springs, / Though these may fade, she shall not die; / In fabled forms of heroes and of kings, / E'en yet we map the sky" (7). Mythologies serve a practical purpose in the ongoing work of astronomy, naming constellations and charting the skies. But Naden's poem emphasizes the human source of these mythologies.

"The Astronomer" highlights the common bonds between the star-gazing man and the celestial objects that occupy his hours:

Kinsman is he to all the stars that burn
Mirrored in eyes of sleepless awe;
And from his brotherhood with dust, may learn
The heavens' living law. (7)

Naden's lines elegantly figure the stars as a reflection in the astronomer's eyes, metaphorically bringing the stars from the heavens to a human plane, and then reinforcing this unity by emphasizing man's "brotherhood with dust." Likewise, the astronomer discovers profound spiritual union with the universe during his isolated study:

When the skies glitter, when the earth is cold,
In some divine and voiceless hour,
The heavens vanish, and mine eyes behold

The elemental Power.

Now has the breath of God my being thrilled;

Within, around, His word I hear:

For all the universe my heart is filled

With love that casts out fear.

In one deep gaze to concentrate the whole

Of that which was, is now, shall be,

To feel it like the thought of mine own soul,

Such power is given to me. (8)

Naden's astronomer looks to a power beyond the stars and experiences a sublime vision. Though a scientist, Naden's astronomer is religious, using diction in the third stanza—"of that which was, is now, shall be"—that resembles the closing of the Anglican *gloria patriæ*: "as it was in the beginning is now and ever shall be, world without end." Because he has divided his intellectual pursuits from his earthly longings—the poem ends with a wish for "the heights and depths of human joy to come"—Naden's astronomer experiences the same disharmony expressed by the other poetic speakers in this section of the volume. The closer expression of Naden's Hylo-Ideal comes later in *Songs and Sonnets of Springtime* in "Twilight" and "Undiscerned Perfection," but its fullest expression appears in "Das Ideal."

Already a disciple of Lewins's philosophy when she began to write poetry, Naden faced a challenge in many of her verses to discern how one might discover and express

the synthesis of material and ideal that Hylo-Idealism promises. Championing a monistic philosophy, Naden's early poems also reveal an inspiration drawn from German Romanticism. Frequently, her poems assert that the verbal expression of the ideal—i.e., what the Romantics might term the sublime—is a nearly insurmountable challenge. That is, the knowledge of the spiritual in the material, or the figurative “land where poetry and science meet,” cannot be expressed through ordinary human speech. As evening steals across the land in Naden's “Twilight,” for example, the speaker contemplates nature's secrets and demonstrates this same Romantic longing. Just as poets in their verses try to unravel the mysteries locked within “tender buds,” Naden's speaker asks,

What wizard's wand can charm the secret sweetness

From the fair prison, where it lies concealed?

What poet's lay can show in grand completeness

The inmost heart, by human speech revealed?

We twine the spell of rich harmonious numbers,

We conjure up the graceful words in vain:

Our lighter fancies waken in their slumbers;

Without a voice the noblest thoughts remain. (63-4)

The language of neither mathematics nor poetry can penetrate the material world to reveal its soul. The speaker then compares this futile aim of scientists and poets to billowing ocean waves that restlessly ebb and flow and never betray the still quiet of “the tranquil deep,” then to the depths of the earth that rest calmly while men “haste o'er vale and mountain, sea and shore” (64). The deep secrets of nature and the material earth

exist, and one might pursue them, but our comprehension is only an approximation. Yet the importance lies in acknowledging that such a truth exists: “And far beyond the realms of starlight glory / Are mysteries too high for Fancy’s wing” (65). These mysteries cannot be revealed until the human being becomes one with nature; literally, not until death:

For there are griefs, that none has ever spoken,
Joys, that no mortal tongue has power to tell;
The silence of the soul must be unbroken
Till to the speech of earth we bid farewell. (65)

Words cannot get to the spirit of the material; this is the mystery we cannot fathom. Yet if full disclosure of one’s soul or nature’s mysteries is impossible, some kind of semblance may still be proposed. This speculation is what I think Naden tests—through the aesthetic *and* the matter of her poems. If the material of a poem is its words, its rhyme, its rhythm, then each must strive to match the ideal which the poet tries to make them represent. Thus, in “Twilight,” we should note that these are quatrains of iambic pentameter, appropriate for the melancholic tone of the poem. But again, the extra syllables in the A-lines make the feminine end rhymes conspicuous throughout. For Naden, the power of matter—she celebrates the notion of earth as *mater*, mother and material—is paramount. These feminine endings not only add a softening to the sound of these lines when they are spoken, but they suggest the idea of a maternal presence.

Naden’s sonnets, too, affirm belief in this deficiency of language, and they also demonstrate a working-out of philosophical principles in verse form. “Undiscerned Perfection,” for instance, expresses the aims of Naden’s Hylo-Idealism. The “land” where

poetry and science meet is in the union of spirit and material, in the understanding that the two are not two mutually exclusive modes of human experience:

Beyond the realm of dull and slumberous Night
I long have wandered with unwearied feet;
The land where Poetry and Science meet
Streaks the far distance with a magic light:
Fair visions glide before my dazzled sight,
And shine, and change, and pass with motion fleet,
But never clear, and steadfast, and complete
In one transcendent brilliancy unite.
I know, the seeming discord is but mine;
The glory is too great for mortal eyes,
All powerless to discover the divine
And perfect harmony of earth and skies:
I know that each confused and tortuous line,
To fuller sight, in true perspective lies. (129)

In this Petrarchan sonnet's octave, the speaker laments not attaining the ideal, while the sestet offers the speaker's musings on why such would be impossible. The wandering speaker and Naden the writer converge in the dual meanings of "unwearied feet" and "each confused and tortuous line," encouraging us to read the poem as both philosophical and poetic quest. Inevitably, it seems the seeker cannot reach the goal, yet s/he acknowledges, "the seeming discord is but mine." Perhaps the failure is only a personal one, still obtainable to one with "fuller sight."

Interwoven with German Romanticism and a feminist response to Darwinism, Naden's Hylo-Idealist poetics is manifold. Certainly, it takes as a theme the unity of the material and the ideal. The most explicit expression of the theme, unsurprisingly, appears in "Das Ideal," Naden's poem dedicated to her mentor, Lewins, and written in German. Written in the first person, the speaker strives ever toward the ideal:

Ich bin ein Sonnenkind, und strebe immer

Hinauf zum ew'gen Licht;

Der Erdentag, der enge Wolkenschimmer

Stillt meine Sehnsucht nicht. (76)

I am a child of the Sun, and constantly I strive

Upward toward the perpetual Light;

The earthly day, the narrow cloud-luster

*Does not quiet my yearning.*⁷⁶

Here, Naden alternates lines of iambic pentameter and trimeter, again highlighting the feminine endings of the extra-syllable A-lines. Writing in German affords Naden not only the symbolic homage to the German poets she translates elsewhere in this and her later volume of poetry, but also the chance to tie ideas together through rhymes not available in English. In the following stanza, for example, we see Naden forge a close formal bond between the concepts of time and infinity that English rhymes would not afford:

Zerreissen will ich die geträumten Schleier

Des Stoffs, des Raums, der Zeit,

Und mich ergiessen, frei und immer freier,

In die Unendlichkeit. (76)

I want to shred the dreamed veil

Of material, of space, of time,

And pour myself, free and ever freer

Into infinity.

The reflexive phrase, “und mich ergiessen,” or “to pour myself,” is important here in light of subsequent lines. The human poet is his or her own agent for change, as we see in a following stanza: “Ich **bin** noch nicht. Erst kann der Mensch entstehen, / Wenn er als Gott erschafft” (77). The lines translate as, “I not yet *am*. Man can come into being only if he, as God, creates.” The speaker extends the idea by stating that the wind strengthens itself through its own blowing. The ideal, then, can be found not by looking outward, but inward:

Der kühne Dichtertraum ist nicht verloren,

Er war zu eng, zu bleich:

Nur in des Menschen Seele wird geboren

Das Erd- und Himmelreich. (78)

The poet’s bold dream is not lost,

It was too narrow, too pale:

Only in the human soul

Will the kingdom of earth and heaven be born.

If her poems are evidence, Naden strives to reawaken the “poet’s bold dream” in her Hylo-Idealist verse. Within these poems, we see the quest to reconcile earth and heaven, the temporal and the eternal.

⁷⁶ Translations from the German are mine.

To accept both the ideal and the material means that an individual cannot and must not shun either. Such a philosophy underlies even the comic courtship poems discussed previously. The women in those poems face seemingly irreconcilable choices: to marry a bookworm or a fop, to give up a fiancé or to abandon any intellectual endeavors. Aside from undercutting Darwin, however, the parodic tone suggests that these are really false choices for Naden. Conversely, a longer narrative poem, like “A Modern Apostle,” with monistic principles at its core, presents an alternative: the acceptance both of a woman’s heart and her mind, the possibility for a pairing in which her lover will see her as not object but equal.

In her second volume of poetry, *A Modern Apostle, The Elixir of Life, The Story of Clarice, and Other Poems*, Naden moves beyond expressing Hylo-Idealism merely as the subject matter or theme of many of her Romantic lyrics and sonnets and instead puts these philosophical notions into practice within her poetic characters’ lives, such as Alan and Ella in “A Modern Apostle,” or Wilfred and Clarice in “The Story of Clarice.” Placing Hylo-Idealism within the narrative of these poems puts philosophy on stage to let it speak through the characters’ voices and actions. So too, then, Naden enacts a poetics of her philosophy. Thematically, the notion is not so much that humans cannot fathom or express the Hylo-Ideal, but that any rejection of either spiritual or material is a grievous error. Only by embracing both can Naden’s poetical characters find happiness or fulfillment.

Upon opening the volume and reading the first poem, “A Modern Apostle,” Naden’s readers would likely notice the form, ottava rima, and thus perhaps expect something of the “quiet facetiousness” of Byron’s *Don Juan*. Naden, however, subverts

readerly expectations and maintains a generally serious tone throughout, with some light moments scattered in the first two parts. After Alan, the clergyman of an orthodox Christian sect, has a revelatory vision, he embarks on a mission to share his conversion with others. He soon meets Ella, the daughter of “the cleverest member” of a liberal congregation where Alan has found employment. From his friend George, whose language resembles that of Mary Maud Trevelyhan’s suitor, Alan learns of Ella’s cleverness, and George advises Alan to pursue her:

“Then their one daughter--did you meet her ever?

Slim shape, and soft brown hair, and dark-blue eyes,

So gentle, that you scarce believe her clever,

And quite entrancing, were she not so wise:

But oh, beware of Ella’s beauty! never

Let that Madonna fairness win your sighs;

Or, if you should address her, use your tact,

And study first the sciences exact.

“The heavenly host she watches from her attics,

She knows the name and place of every star;

True incarnation of Pure Mathematics,

She cares for all that is abstruse and far:

Go, woo her with Dynamics and with Statics,

And term your love a force molecular;

She then, perchance, may fathom your intention--

Plain language is beneath her comprehension.” (24)

The reader’s introduction to Ella arrives in stanzas featuring feminine end rhymes, which do not appear with great frequency elsewhere in the poem. George reveals his own gender prejudices, commenting that Ella’s beauty is deceptive: it does not suggest her cleverness. George thinks that one would have to court her on her own terms, yet he seems to diminish her intelligence by proposing a few key phrases would be sufficient to win her over.

Though the two eventually meet and fall in love, Ella breaks off the relationship with Alan once she reads his theological writings. The first of the two main emotional climaxes appears when Ella realizes she must leave Alan, and it is this section which, I propose, the poem’s conclusion resolves. As Ella tries to reconcile the warring between her heart and her emotions, the poem’s narrator comments,

What is a woman’s hope when she is torn
By passion and by thought, and cannot cease
To think or love, nor teach herself to scorn
Her deepest life, nor ever win release
From the harsh yoke, too heavy to be borne,
Of iron principles that crush her peace:
Will not some opiate give her dreamful rest
Till She return to the Great Mother’s breast? (38)

Questioning the potential for a woman to choose between love, “her deepest life,” or her reason, “the iron principles,” the poem gives no easy answer. The most troubling and difficult stanza, perhaps, is the stanza that follows:

Nay! rather let her maim her shrinking soul--
That groping she may climb her lame way in
To Life--than down to Death, seeing and whole,
Spring, damned by the inexpiable sin
Of treachery; and in the longed-for goal
Find that fair-seeming Heaven which traitors win
Whose gate is bliss; whose midmost point, a germ
Of Hell, whence issues the undying worm. (38)

The stanza seems to suggest that it is society, rather than her own rational choice, that would have a woman like Ella “maim her soul” by choosing between two halves of herself than to meet her death happy and whole but condemned by her treachery to her sex, and thus ultimately deserving Hell. Read as an ironic moral by the narrator, the stanza suggests that Alan and Ella’s reunion and reconciliation later does not demonstrate Ella’s conversion to Alan’s theistic spirituality, but rather a recognition between the two that her effort to abandon her own desire was mistaken, as was Alan’s flawed understanding of his vision and mission. When they finally meet again on Alan’s deathbed after he has been mortally wounded by a stone thrown at him during a riot, Alan calls Ella “Truth’s radiant herald” and admits his own errors and illusions (61). The two share a kiss and in a silent moment, “the very soul of each / Shone visible, disrobed of veiling speech” (61). Finally together, they achieve a spiritual union surpassing conventions of earthly love. The omniscient narrator concludes with a moral:

For such your grief, what husbands and their wives
Once in long years each other’s soul can see?

But these found all to which high Passion strives--

Perfect communion, from cold symbols free,

The fleeting quintessence of myriad lives,

A concentrated brief Eternity,

The mountain-vista of an endless age

Not known by weary winding pilgrimage. (62)

Ella then becomes the modern apostle of the poem's title as she rises from Alan's bedside, her expression said to mirror her dead lover's, whose "look was fraught / With peace that quenches all desire and dread" (63). In this long narrative poem, an earnest engagement with Darwin's *Descent* is still noteworthy. Ella rejects her chance at romantic, worldly happiness when she rejects her suitor. Ella and Alan's reunion comes too late for their continued earthly journey together, yet they experience a profound, sublime moment before Alan dies. Ella rises to take on Alan's charge, but there is no indication she has given up her previous ideals, and in fact, she more likely will repudiate any suggestion that women should not endeavor to achieve both intellectual and emotional contentment.

Conclusion

Constance Naden's Hylo-Idealist poetics encompasses a complex mixture of philosophical and scientific debates. She offers her readers a proto-feminist, materialist, and non-theistic monism that owed much to German Romanticism, and she playfully antagonizes Darwinian principles of sexual selection. In her form and aesthetics, she deploys feminine end-rhyme strategically to underline women's agency, intellect, and subjectivity, while her comic tone cushions her incisive commentary on Victorian

stereotypes of both men and women. The feature so central to Naden's poetics, yet unremarked upon by scholars, is this very intersection of sexual selection and Hylo-Idealism within poems that pointedly discuss the position of women within Victorian courtship rituals and practices.

Naden concludes my study of nineteenth-century women science writers because she encompasses so many of the characteristics her predecessors strove for in their own work, like the adaptation of a literary genre like poetry for scientific ends. As a Victorian woman at the end of the nineteenth century, Naden epitomizes the heights to which a woman science student might reach in her education, though she died from complications following surgery to remove an ovarian cyst at age thirty-one, thus foreclosing the possibility she could have gone on to even greater acclaim in philosophy, science, or poetry. At the same time, Naden also reveals the paradox of women's entry into formal scientific study at institutions of higher learning: she was a product of the specialization of scientific disciplines, and while she excelled in all of them—her geology professor at Mason College, especially noted her talents in his subject—she could not have united them synthetically except within the larger confines of philosophy.

Neither did Constance Naden continue to use poetry as a means of reaching audiences outside the community of professional scientists. For her, poetry and science were to remain distinct discourses, and perhaps her choices of publishing each under different names suggest the division that existed in her attitudes toward them. Charles Lapworth, Naden's geology professor, writes in his reminiscences of his former student,

Poetry had gradually become to her more or less a recreation. "Clarice," she told me, was written during her convalescence, after a sharp attack of illness, in 1886,

and other poems in similar hours of enforced leisure, when real work, as she termed it, was impossible. (xviii)

Like James Clerk Maxwell, who also made time for lighthearted poetry as a respite from his research and experiments in physics—and for poking fun at his colleagues as well—Naden used poetry as a diversion when more difficult mental work became too taxing.

Ultimately, Naden left poetry behind. In her essay on the philosophy of Thomas Carlyle, she writes, “poetry may be personal; philosophy (world wisdom) must be universal” (*Induction* 144). From her standpoint at the close of the nineteenth century, poetry could not treat universal subjects. Philosophical research instead was “the goal of the sciences, the lodestar of poetry” (Lapworth xviii). Yet in fact, it is her poetry that has lasted, and it is here where tracing the outlines of her Hylo-Idealism rewards a reader seeking to understand one more facet of the religious and secular debates in the latter half of the nineteenth century.

Earlier female popularizers or writers of accommodated science for children faced choices in writing that were circumscribed by societal notions of education and literary outlets appropriate for women. Growing up in the latter half of the nineteenth century, Naden, however, was able to choose the path that suited her best. This is not to say Naden lived in a world where women were considered equal to their male colleagues, but rather that Victorian women’s entry into higher education in the last three decades of the nineteenth century afforded them more liberty in choosing from a greater variety of careers. Constance Naden remains an important figure in Victorian studies not simply because her colleagues and readers ranked her second only to George Eliot in both acumen and talent, but because her poetry reveals a powerful engagement in the

discourses of both evolutionary theory and secular materialism. To assess her only as a droll writer of comic poems of courtship is to fail to see her within a long history of women's multifaceted, literary engagement with science.

In this study of genre and form, women's efforts to interpret and communicate science are of primary interest because they not only were marginalized from science for most of the century, thus writing to nonspecialist audiences out of necessity, but also because their innovations in form led to changes in Victorian literary history as well. Once Mary Somerville had explained parallax in *On the Connexion of the Physical Sciences*, the success of the book meant it found its way into the hands of writers like George Eliot, Alfred Tennyson, and Thomas Hardy.⁷⁷ Just as Byron had been a poetic inspiration for Somerville, parallax in turn became a metaphor for both novelists and poets. When Margaret Gatty offered natural history lessons in tandem with moral tales in her *Parables from Nature*, her stories find echoes in Lewis Carroll's *Alice's Adventures in Wonderland* and *Through the Looking-Glass*, where animals speak and the rules of nature are topsy-turvy. Gatty and Charles Dodgson were friends, corresponding at least as early as 1863.⁷⁸ Arabella Buckley's lectures demonstrate a methodology still practiced in physical science classes and textbooks for children and adolescent students today: a descriptive introduction of phenomena, questions including predictions, demonstrations that illustrate the behavior of the phenomena in question, and concluding remarks about implications and applications of the science. George Eliot's inclusion of natural history's habits of observation and methodical description appeared just as Darwinian evolutionary

⁷⁷ Anna Henchman's new book *The Starry Sky Within* demonstrates just how extensively astronomy infused poetic imaginations about perspective and multiple points of view.

theory would capture the Victorian imagination, suggesting ways the novel could practice and interrogate the methods of scientific inquiry and writing. Constance Naden's poems profited from the popularity of parodic verse, which offered a humorous method of questioning the implications of the theory of sexual selection, but so too could verse be a space in which to test the ability to contain philosophical propositions. But as the boundaries between scientific disciplines became increasingly fixed, generic borders between the sciences and arts likewise seemed to become more rigid, and assumed gender roles were not erased, despite women's entry into higher education.

Though Naden's stance suggests a division between poetry's aesthetics and science's seemingly prosaic logic, many women, especially toward the century's end, sought ways of aestheticizing science. Barbara Gates calls women's practices of seeking out the beautiful in nature the "Victorian female sublime," a form of late nineteenth-century literature in which the woman writer tries to capture nature's beauty and terror, but always finds it escapes the power of the writer's pen (169). I have resisted this particular gendered formulation of the sublime because where Gates notes that the Victorian female sublime emphasizes the power of nature expressed in a rhetoric of absence (170), I have found earlier writers like Somerville, Gatty, and Buckley locate a pleasure in perceiving the pervasiveness of physical laws. Likewise, Gates focuses on women who traveled beyond England's shores and found themselves in places "wild enough to evoke sublime reactions" like the Himalayas (Gates 171). If there is a difference between the Wordsworthian sublime, distilled from Burke and Kant, and the Victorian female sublime Gates describes, it is because the women like Somerville, Gatty, and Buckley find sublimity in the beautiful, and beauty in sublimity. Part of this assurance lies in their

⁷⁸ See Rose Lovell-Smith 51-2 n.16.

spiritual beliefs, of course, and adherents clung tenaciously to natural theology throughout the Victorian era.

In looking forward to the twentieth century, the figure who embodies many of the concerns and themes considered in these four chapters is Beatrix Potter (1866-1943). Potter was an avid naturalist in her childhood, drawing the family's pets and the small creatures who lived in the environs of the Potters' home. In her adulthood, Potter studied mushrooms and fungi, illustrating what she found and writing up her observations.⁷⁹ Today, she is known more for her illustrated stories for children, like *The Tale of Peter Rabbit* (1902), *The Tale of Mrs. Tiggly-Winkle* (1905), or *The Tale of the Flopsy Bunnies* (1909), than she is for her studies in mycology or her conservation efforts. If this project were to develop in the future as a study of how botany and juvenile literature mutually informed each other, Beatrix Potter would become a central figure.

In "Beautiful Science," my ambitions for examining the forms of Victorian women's scientific writing has been two-fold: to discern a sense of how accommodations of science fit into the nineteenth-century literary landscape, and to perceive how understanding the expectations that literary genres bring to scientific writing might inform our historical understanding of nineteenth-century scientific debates. Women's writing offered a way into both of these examinations because their marginalization, due to social expectations and structures that effectively kept the majority of them on the fringes of formal scientific study, opened up the opportunity to find the most fitting genres and forms in which to reach their intended audiences.

⁷⁹ A recent and detailed biography that includes Potter's various pursuits is Linda Lear's *Beatrix Potter: A Life in Nature* (2007).

Today, women's participation in science remains a vexed topic as science departments continue to face the underrepresentation of women within their ranks. The education of girls in science likewise attracts attention, and new initiatives to keep adolescent girls in science classes appear every year. Women have a long history in science, but it is a story infrequently told. In "Beautiful Science," I have offered one more narrative to demonstrate the creative, literary ways in which Victorian women made their way into a discipline that was not yet fully open to their participation.

A.S. Byatt's "Morpho Eugenia" offers one fictional account of Matilda Compton's studies of ants and her fairy tale allegory, shining a light on women science writers who yet remain in the shadows of Victorian literary history and histories of science. Much more recently, Elizabeth Gilbert's new novel, *The Signature of All Things* (2013), now might attract an even wider audience to the work of nineteenth-century women scientists. Gilbert's novel traces the life of an American woman, Alma Whittaker, whose study of mosses takes her on a literal and figurative journey of discovery paralleling Darwin's achievement in describing the process of natural selection. Gilbert's novel, too, is the most recent addition to the discourse I have traced, placing scientific theories and inquiry—and women's important activities within the discipline—at the center of its plot. Among both scholars and novelists, Victorian women scientists, naturalists, illustrators, and writers are becoming the focus of increasing attention. Considering how genre and form functioned as tools of scientific interpretation, accommodation, and communication, "Beautiful Science" knits the literary and scientific discourses of Victorian Britain together, enhancing both science historians' comprehension of how literary genres could

affect the transmission of scientific debate, and literary historians' understanding of how scientific debates altered the Victorian literary world.

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