“SYMPATHY FOR SCIENCE”: PRACTITIONERS, PROSE, AND PUBLIC FEELING IN LATE-VICTORIAN SCIENCE

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Abstract

This dissertation Victorian practitioners of science and two things they wanted for the public: to learn things, and to feel things. "Sympathy for Science" takes three generic approaches to the rhetorical project of "sympathy" as it was employed in the writing of late-Victorian scientific practitioners. Taking a concept typically associated with the fictional and moral imagination, I attend to how "sympathy" played a guiding rhetorical and pedagogical role both in the quest to engage the Victorian public imagination in, and to give voice to the phenomenological experience of, what John Tyndall called having "sympathy for science" in a naturalistic universe. My chapters address a number of sympathetic modes and manifestations: the first addresses the paradigmatic negotiation between scientific naturalism and Romantic supernaturalism in *Nature* magazine (1869-1875) and how it sought to model the ideal scientific persona, while the second approaches the scientific lecture as a site of case-based sympathy, where disparate scientific objects were brought into human fellowship in a "community of matter." The final chapter takes T. H. Huxley as a single-author case study, arguing that Huxley constructed a physiological sympathetic rhetoric the automatic quality of which could accommodate the pressures of Darwinian doubt.

"Sympathy for Science" aims to contribute to burgeoning scholarly attention to scientific prose as a literary mode, and argue how sympathetic rhetorics might have fortified or re-engineered a novel sense of natural unity in a post-Darwinian paradigm. In re-adjusting the realm and terms of "sympathy," writing practitioners may not have been able to re-weave the natural theological rainbow, but in its place they were able to suggest more flexible imaginative pathways towards feeling connected with the physical universe.

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Introduction: The Linked Purpose of the Whole

In a prefatory note to his *Fragments of Science for Unscientific People*, John Tyndall expressed a hope that his work would bring people to science. "My motive in writing these papers," he says, "was mainly that which prompted the publication of my Royal Institution lectures; a desire, namely, to extend sympathy for science beyond the limits of the scientific public."[1] It was a fitting sentiment for a man who superintended that institution, which like him aimed to expand scientific interest to a wider public. Tyndall's scientific publishing, and his initiating gesture here, reflected the educational energy of the 1860s and 1870s. Throughout these decades the issue of government support of science, long a niche cause, rose to national concern.[2] British practitioners, seeing the universities of their German colleagues organized like smoothly-running engines, worked to reform their nation's educational landscape into one more hospitable, more sympathetic, to science as a foundation of knowledge and of human welfare. In this, Tyndall's utterance of "sympathy" at the beginning of his popular book channeled the spirit of reform: the wish that that the British public, too, would support the expansion of an institution which promised to radically improve their lives.

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[1] John Tyndall, preface to *Fragments of Science for Unscientific People: A Series of Detached Essays, Lectures, and Reviews* (London: Longmans, Green and Co., 1871).

[2] Britain's "mania" for exams in the 1850s, symptomatic of a desire for standardization and fairness in education, nurtured the reforming efforts of the scientific men (many of whom got their start in administering exams) who would go on to form and sit on government commissions for the development of scientific inquiries into national industries, including urban development, husbandry and agriculture, and public education. For an overview of the transformation of the educational landscape see Peter Alter, *The Reluctant Patron: Science and the State in Britain, 1850-1920* (New York: Berg, 1987) and Roy M. MacLeod, "The Support of Victorian Science: The Endowment of Research Movement in Great Britain, 1868-1900," *Minerva* 9 (1971): 202-203; Bernard Lightman, "Huxley and the Devonshire Commission," and James Elwick, "Economies of Scales: Evolutionary Naturalists and the Victorian Examination System," both discuss the scientific naturalist's particular involvement in this movement in *Victorian Scientific Naturalism: Community, Identity, Continuity*, eds. Bernard Lightman and Gowan Dawson (Chicago: University of Chicago Press, 2014), 101-130, 131-156.

But Tyndall's "sympathy" was about something more than the political or cultural "support" connoted by its usage above, though it was about that. It was also, in the sentimental sense, about feeling. Presented as a sampling of highlights from the physicist's corpus as a practitioner and publicist of science, *Fragments* exhibited formally and rhetorically a particular strategy for facilitating a decidedly emotional "sympathy" for science. An epigraph from Ralph Waldo Emerson's early poem "Musketaquid" heads the first in this essay collection, most of which is of "a purely scientific character":

> The gentle Mother of all
> Showed me the lore of colours and of sounds,
> The innumerable tenements of beauty,
> The miracle of generative force,
> Far-reaching concords of Astronomy
> Felt in the plants and in the punctual birds;
> Mainly, the linked purpose of the whole,
> And, chiefest prize, found I true liberty
> The home of homes plain-dealing Nature gave.[3]

[3] John Tyndall, *Fragments of Science,* 8. I am thus far unsuccessful in tracing the bibliographical consensus on this poem. Tyndall seems to be quoting an alternative version of "Musketaquid," which appears in a London edition (if not other places) of *Poems* (London: George Routledge, 1850), 183. Most other versions of the poem, including the one referenced by the 2001 Norton Critical, read as Emerson's original from 1847:

> "The gentle *deities*
> Showed me the lore of colours and of sounds,
> The innumerable tenements of beauty,
> The miracle of generative force,
> Far-reaching concords of *astronomy*
> Felt in the plants and in the punctual birds;
> *Better*, the linked purpose of the whole,
> And, chiefest prize, found I true liberty,

Emerson's paean to the transcendent unity and liberating truth of Nature sets a deliberate tone for *Fragments,* which includes several lectures on radiant heat and magnetism (both areas where Tyndall made serious scientific contributions) that convey "a plain statement of the elementary facts," and read like sprightly, if spare, school primers. In casting these pursuits of Nature as a communion, a miraculous initiation, the poet does some serious philosophical work for the physicist.[4] Tyndall affirms as much in the "Address to the Students of University College, London" (1868) included in this volume. He remarks that without "the American Emerson" and without Thomas Carlyle, "I should never have gone through Analytical Geometry and the Calculus…I never should have become a physical investigator, and hence without them I should not have been here to-day."[5] The Romantic, transcendentalist Emerson reminded the secularist, naturalist Tyndall that "the circle of human nature…is not complete without the arc of feeling and emotion," and that the contemplation of the universe—the "linked purpose" therein— could not only expand the mind but "elevate the heart."[6] This episode typifies a negotiation between spiritual connection and empirical precision that would permeate the popular discourse of the second half of the nineteenth century, and with which this dissertation is concerned.

My dissertation is about Victorian scientists in this moment and two things they wanted for the Victorian public: to learn things, and to feel things. By extension, this project is also about

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In the glad home plain-dealing Nature gave."
Tyndall is clearly quoting the spirit rather than the letter of the poem, so for his purposes the version is immaterial. See Ralph Waldo Emerson, *Poems* (Boston: J. Munroe, 1847), 230. Editors Joel Porte and Saundra Morris reference an 1876 edition of Emerson's *Selected Poems* that also reproduces the above. See *Emerson's Prose and Poetry* (New York: W. W. Norton and Co., 2001), 476.

[4] The particulars of the poem evince Tyndall's characteristic playfulness: *Fragments* literally contains lectures on both "force" and "colours", and one of Tyndall's most popular tomes was a series of lectures on "sounds."

[5] John Tyndall, "Address to the Students of University College, London" (1868) in *Fragments of Science,* 102.

[6] Tyndall, "Address," 104.

the tension between those two poles of experience, as well as how their respective powers might be directed to facilitate each other. Surveying a period of roughly 1860-1890, I argue that "sympathy," in all of its strong and weak senses, functioned as a significant, traceable rhetorical and ideological device in the public writing of scientific practitioners who desired to engage the Victorian public with science. If one question asked by this project is pedagogical: How did Victorian scientists cultivate a "sympathy for science"?— then another equally important question is philosophical or phenomenological: What *is* sympathy for science, and how does one represent it? These two queries parse what was in fact a unified mode. Sympathetic pedagogy was often catalyzed by and coincided with the project of theorizing, articulating, and expressing the sympathy that scientific practitioners themselves professed to feel for the objects, or process, of empirical discovery. In the chapters that follow I examine this two-pronged question as it manifested in a variety of markedly Victorian media: the periodical, the public lecture, and the corpus of the "sage." The generic foci of these chapters— *Nature* magazine (1869–), the Manchester Science lectures (1866-1879) and the Royal Institution Christmas lectures (1860–), and the public corpus of Thomas Henry Huxley—shared a rotating cast of characters and subjects, but most importantly they shared an educational mission. I uncover how in the midst of their "trained and organized common sense" (a Huxleyan term), practitioners in these initiatives relied on various rhetorical "sympathetic" stratagems in order both to explain their own scientific experiences and to cultivate the Victorian public's intellectual and especially affective investment in science and in the physical world.

While my project doesn't deal exclusively with scientific naturalism, my investigation into a mode at once pedagogical and precise and yet appealing to the sensibilities means that the bulk of my dissertation's material depends upon that oft-paradoxical philosophy and its relationship to

scientific information.[7] By the 1860s, scientific naturalism had become a competitive voice in the public sphere.[8] Proponents of this secular vision of nature, among them Huxley, Tyndall, Herbert Spencer, and mathematician W. K. Clifford, argued for the importance of seeing the world through scientific eyes. Disavowing any manner of supernatural influence in nature, they also positioned themselves in contrast to practices, venues, and figures that the aspiring professional *Nature* magazine would have viewed as "Science-so called" —below the level of "legitimate" scientific discourse, and without the vetted educational guidance of initiatives like the ones in this project.[9] Bernard Lightman, Gowan Dawson, James Secord, and Aileen Fyfe among others have rehabilitated how widely influential and loosely regulated "popular" science

[7] "Scientific naturalism," sometimes here abbreviated to "naturalism," should not be confused with the literary movement, or with the cataloguing naturalist. Though the two share a certain methodological parity in their embrace of detachment and scientific objectivity— Zola "propos[ed] himself to be more true to nature than his predecessors," and felt himself to be writing a more scientific type of fiction— literary naturalism does not figure significantly in this study, B. W. Wells, "Zola and Literary Naturalism," *The Sewanee Review* 1, no. 4 (1893): 399; Ruth Barton, *The X-Club: Power and Authority in Victorian Science* (Chicago: University of Chicago Press, 2018) actually prefers "naturalism" to "scientific naturalism," so as to leave open the question of scientific status while defamiliarizing the older term (22).

[8] Frank Turner's seminal volume *Between Science and Religion: The Reaction to Scientific Naturalism in Late Victorian England* (New Haven, CT: Yale University Press, 1974) has been foundational to the critical landscape on scientific naturalism.; More recent work following Turner has included *Victorian Scientific Naturalism: Community, Identity, Continuity,* eds. Lightman and Dawson; *The Age of Scientific Naturalism: Tyndall and His Contemporaries,* Eds. Bernard Lightman and Michael Reidy (Brookfield, Vermont: Pickering and Chatto, 2014); A. J. Meadows gives a succinct gloss of the general transformation of science from amateur pastime to laboratory profession in *The Victorian Scientist: The Growth of the Profession* (London: British Library, 2004).

[9] The idea of "legitimate" science, as countless critics and historians have noted, was a somewhat artificial distinction until close to the turn of the century. Nevertheless, I trust my readers to understand the qualitative difference between the gentlemanly or dilettantish scientific practices of the earlier century and those values— accuracy of measurements, prose of "mathematical plainness," laboratory research, formal training, observation and replicability—that have effectively come to define what we understand as "professional" science today.

practices were in this period.[10] In some ways, amateur competitors shared with scientific naturalists and professionals the same goal: an engagement with science that touched the sensibilities. Arabella Buckley once asked, "Now do you believe in, and care for, my fairy-land?"[11] All popularizers, regardless of provenance, sought such "belief and care." But many did so at the expense of accuracy, or in violation of the scientific naturalist principles that eschewed the supernatural as a legitimate force in nature.[12]

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[10] See Bernard Lightman's *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago: University of Chicago Press, 2007) and *Victorian Science in Context*, ed. Lightman (Chicago: University of Chicago Press, 2014), and Aileen Fyfe and Lightman's *Science in the Marketplace: Nineteenth Century Sites and Experiences* (Chicago: University of Chicago Press), which critically survey the multifarious print and performance landscape of Victorian popular science; Gowan Dawson, *Show Me the Bone: Reconstructing Prehistoric Monsters in Nineteenth Century Britain and America* (Chicago: University of Chicago Press, 2016); James Secord's monumental *Victorian Sensation: The Extraordinary Publication, Reception, and Secret Authorship of Vestiges of the Natural History of Creation* (Chicago: University of Chicago Press, 2000) clearly traces the tenuous line between science and "sensation" as well as how such "sensations" often had as much if not more cultural authority than their more accurate counterparts. In that spirit Martin Willis, *Mesmerism, Monsters, and Machines: Science Fiction and the Cultures of Science in the Nineteenth Century* (Kent, Ohio: Kent State University Press, 2006) reminds us that science itself encapsulated areas of understanding now not given such status— mesmerism, phrenology, and spiritualism (10-11).

[11] Arabella Buckley, *The Fairy-land of Science* (London: E. Stanford, 1880), 12. Buckley's "Fairy Land of Science" lectures, as it happens, are often distilled summaries of Tyndall's work, which was another frequent move of more amateur popularizers— though Buckley was in a privileged position, having been Charles Lyell's secretary for many years and thus a reliable interpreter of scientific discourses; Jessica Straley, "Of Beasts and Boys: Kingsley, Spencer, and the Theory of Recapitulation," *Victorian Studies* 49, no. 4 (2007) discusses how Charles Kingsley's *The Water-Babies* aimed, through its childlike play and nonsense, to reconcile evolution with natural theology in an affective embrace acceptable for children (585-586).

[12] In *Victorian Popularizers* Lightman explores a spectrum of these amateur interpreters of nature who had an enormous impact on the cultural landscape: some were sensationalists who simplified, bastardized, and even countermanded the vision of science promoted by elite scientists; some Anglican parsons or women, continuing the tradition of looking to nature for theological instruction (39-42, 95). Much of scholarship in the past two decades has focused on the extra-textual production of scientific knowledge, and the wide variety of media through which the Victorian public directly (or, often, very indirectly) engaged, and sympathized with, scientific matters. Besides Lightman see Carla Yanni, *Nature's Museums: Victorian Science and the Architecture of Display* (New York: Princeton Architectural Press, 2005); Barbara Black, *On Exhibit: Victorians And Their Museums* (Charlottesville: University of Virginia

In pursuit of a better understanding of affect as an aspect of professional, naturalistic knowledge, this dissertation narrows in particularly on the "popularizing" work of ascendant scientific practitioners.[13] In short: how did practitioners find "sympathy" within the strictures of the rules that they themselves were creating? I argue that amid what Robert M. Young called the Victorian "fragmentation of the common context," the literary activity of such practitioners in fact resisted the so-called "disenchantment of the world" wrought by knowledge developments that, like evolution, destabilized a once stable universe.[14] Bernard Lightman has rightly suggested that figures like Huxley and Tyndall tended to expunge the more elaborate affective narrative devices used by amateur popularizers to keep in line with a secularizing and professionalizing mission.[15] But, just as George Levine reminds us how the nineteenth century struggled to balance the objectivity of science with the subjectivity of the scientist, my dissertation urges that subjective experience and its emotional and imaginative purchase

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Press, 2000); and Joe Kember, John Plunkett, and Jill A. Sullivan (eds.) *Popular Exhibitions, Science, and Showmanship, 1840-1910* (London: Pickering and Chatto, 2012).

[13] What I'm understanding as an affective, or feelingful, mode of scientific communication was a familiar part of the conversational, maternal-toned narratives of many Victorian women popularizers, what Greg Myers, *Writing Biology: Texts in the Social Construction of Scientific Knowledge* (Madison: University of Wisconsin Press, 1990) would call the "narrative of natural history"— as opposed to the "narrative of science" that are committed to model-building for a discipline (142-43, 194-96). In *Victorian Popularizers* Lightman also notes this tonal distinction (36). The long association of the "narrative of nature" with feminized, natural theological writing in part explains the discursive wariness on the part of practitioners anxious to build a profession to adopt that mode, though my project clearly illustrates that they were not ideologically opposed to it.

[14] Robert Young, "Natural Theology, Victorian Periodicals, and the Fragmentation of the Common Context," paper presented to the King's College Research Seminar on Science and History (Spring 1969), 10; Thomas Kuhn's foundational work, *The Structure of Scientific Revolutions* (Chicago: Chicago University Press, 1962) gives us the language to discuss the kind of paradigm-shifting (rather than gradually accumulative) effects that things like deep time and evolutionary changed enacted within the Victorian cultural consciousness; See also Christopher Herbert, *Victorian Relativity: Radical Thought and Scientific Discovery* (Chicago: University of Chicago Press, 2001); Works documenting Darwin's contribution to the disruption are almost too numerous to count.

[15] Bernard Lightman, "The Story of Nature: Victorian Popularizers and Scientific Narrative," *Victorian Review* 25, no. 2 (2000): 3, 5.

continued to be critical in the public discourses of even the staunchest defenders of objectivity.[16] Buckley's "belief and care" and the language that accompanied them, were not expunged from practitioners' public discourses. Rather, these connective, sympathetic rhetorics were sublimated, re-schematized, and re-codified in subtler ways. Even as practitioners drew lines in the sand between the burgeoning scientific infotainment of the era, and their own brand of (to their minds) staunchly educational and empirically faithful discourse, figures like Tyndall rejected the idea that a naturalistic universe was either a bleak or a broken one. Their faith showed in the quality of their prose.[17]

For the secular philosophy of naturalism, and for the pieces in this project, an empirical paradigm still promised a "linked purpose of the whole" even if that purpose no longer conformed to the comforting telos offered by the natural theology of the first half of the century. I draw on the foundational work of Frank Turner, Ruth Barton, and Adrian Desmond as I uncover rhetorical and conceptual links between their subjects, the better-known naturalists, and more marginal and even (in the case of Michael Faraday) non-naturalistic figures who shared a common purpose in promoting sympathy for science.[18] But in sticking to culturally recognized "professionals," I prefer Adrian Desmond's term "publicist" over "popularizer" in referring to

[16] George Levine, *Dying to Know: Scientific Epistemology and Narrative in Victorian England* (Chicago: University of Chicago Press, 2002).
[17] George Levine discusses this in "Paradox: The Art of Scientific Naturalism," in *Victorian Scientific Naturalism,* 79.
[18] See Ruth Barton, *The X-Club: Power and Authority in Victorian Science* (Chicago: University of Chicago Press, 2018) and "Men of Science: Language, Identity, and Professionalization in the Mid-Victorian Scientific Community," *History of Science* 41 (2003): 73-119; Bernard Lightman, *The Origins of Agnosticism: Victorian Unbelief and the Limits of Knowledge* (Baltimore: Johns Hopkins University Press, 1987); Adrian Desmond, *Huxley: From Devil's Disciple to Evolution's High Priest* (Reading, Massachusetts: Addison-Wesley, 1997).

practitioners gone public, as a matter of semantic convenience.[19] The works of professionals-cum-educators entailed a certain degree of self-critique and meta-reflection, as practitioners were always in the act of practicing what they preached, and of shaping the experience of science even as they attempted to describe it.[20] They adopted their own methods of expressing what twentieth-century astronomer Carl Sagan identified in the physical universe as a "recognition he could only compare to falling in love," and testified through their own lived experience that such "recognition" was still possible even in the absence of a divine order. It merely required a readjustment of the terms by which that "recognition" could occur.[21] This project attends closely to the strategies verbal, linguistic, textual and referential that practitioner-publicizers deployed to assuage the anxieties of fragmentation that attended the disappearance of a providentially holistic framework. With their rhetorical arsenal practitioners forged new bonds and offered their audience new palpable connections to a growing, changing cosmos; moreover, they theorized the kind of scientific people they wanted themselves and others to be, and what the right kind of scientist actually looked like.

"Sympathy," as a philosophical principle, supplies a comprehensive framework by which to understand the terms in which practitioners represented imaginative, affective relationships to nature and to the physical sciences. In moving through different generic modes, the three chapters of this project focus on different valences of the mutable concept of "sympathy." A term that already had enormous purchase on the Victorian consciousness, "sympathy" as a concept has had surprising little coverage outside studies of Victorian medicine and, of course,

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[19] Lightman in *Victorian Popularizers* notes the multiple valences of the idea of "popularizer" as a problematic, often pejorative term (9-11), a notion cemented by James Secord's preference for "commercial science" in his study of Chambers' *Vestiges* in *Victorian Sensation,* 437.

[20] Perhaps even meta-meta-reflection, as I myself am writing from the paradigm of student/teacher.

[21] Levine, "Paradox," 81.

the novel.[22] Sally Shuttleworth and Rae Greiner, for example, have shown us how realist novelists like George Eliot performed the imaginative labor of helping readers think into the other or otherwise broaden sympathies for social causes.[23] My project contends that, like the novelists, writing scientists relied on similar kinds of rhetorical and imaginative structures that revealed likeness, promoted case-based thinking, and provoked the sentiments, in order to vitalize the connections that existed not just between people but among people and disparate scientific practices, objects, subjects, and indeed, the cosmos itself. Anne DeWitt's study of science in the realist novel proceeds from the premise that science taught ways of thinking that promoted moral behavior; a claim which all the more licenses "sympathy," an erstwhile moral sentiment, as a way of understanding the pedagogical logic of discourses that framed the pursuit of natural knowledge as a moral and affective as well as intellectually edifying enterprise.[24]

In adopting a close-reading, historicist methodology and in engaging a mode of reading and feeling traditionally associated with novels, my project revisits a well-charted and ever-growing

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[22] The sympathy between doctor and patient, for example, and the case-based thinking required therein is a common topic of analysis in Victorian literature and medicine— often with a gendered bent. See Rob Boddice, *The Science of Sympathy: Morality, Evolution, and Victorian Civilization* (Urbana: University of Illinois Press, 2016); Meegan Kennedy, *Revising the Clinic: Vision and Representation in Victorian Medical Narrative and the Novel* (Columbus: Ohio State University Press, 2010); Athena Vrettos, *Somatic Fictions: Imagining Illness in Victorian Culture* (Stanford: Stanford University Press, 1995); Janis McLaren Caldwell, *Literature and medicine in nineteenth century Britain: from Mary Shelley to George Eliot* (New York: Cambridge University Press, 2004).

[23] I also owe something to James Chandler's *An Archaeology of Sympathy: The Sentimental Mode in Literature and Cinema* (Chicago: The University of Chicago Press, 2013) and his figuration of how case-based sympathy functioned both in the novels of Laurence Sterne and Charles Dickens and in the spectator experience of Frank Capra's sentimental film; See Rae Greiner, *Sympathetic Realism in nineteenth-century British Fiction* (Baltimore: Johns Hopkins University Press, 2012) and "Sympathy Time: Adam Smith, George Eliot, and the Realist Novel," *Narrative* 17, no. 3 (2009): 291-311, and "Thinking of Me Thinking of You: Sympathy Versus Empathy in the Realist Novel," *Victorian Studies* 53, no. 3 (2011): 417-426; Sally Shuttleworth, *George Eliot and Nineteenth Century Science: The Make Believe of a Beginning* (Cambridge: Cambridge University Press, 1984).

[24] Anne DeWitt, *Moral Authority, Men of Science, and the Victorian Novel* (Cambridge: Cambridge University Press, 2013).

field. Science and literature studies, pioneered by Gillian Beer and George Levine, explored the way Victorian novelists used their fiction to test, process, and generally weigh in on scientific ideas.[25] Recent and innovative work from the likes of Devin Griffiths, Jesse Oak Taylor, and Anna Henchman continues to probe the permeable line between scientific discourses or problems and their literary discussants during this age of scientific growth.[26] My project flips the script on the general trend of science and literature scholarship (though I too am interested in the power of literature to turn our imaginations to nature in this Anthropocene age). I stick with non-fiction productions of scientific writing, frequently attending to the way poetry, philosophy, and fiction supplied writing scientists with an ideological lexicon for exploring relationships of connection in and through science (rather than the other way around.) I believe this approach provides a dearly-needed supplement to a relationship between scientific and literary studies that often comes off as a kind of "diffusionist model"— that is, one in which fiction, having absorbed a

[25] George Eliot and Thomas Hardy are two frequent subjects of examination for literary experimentation with scientific thought, particularly Darwin's. See Gillian Beer, *Darwin's Plots: Evolutionary Narrative in Darwin, George Eliot, and Nineteenth Century Fiction* (New York: Cambridge University Press, 1983) and *Open Fields: Science in Cultural Encounter* (Oxford: Clarendon Press, 1996); George Levine, *Darwin and the Novelists: Patterns of Science in Victorian Fiction* (Cambridge, Massachusetts: Harvard University Press, 1988).

[26] These are just a few of many excellent scholars working in science and literature today, and to my eye their approaches capture the general idiom of the field. They begin with a scientific problem(s) or field(s) and major texts related to that field, historically situate said science in relation to literary production, and then follow with several chapters (often author-specific) on how that science/problem was incorporated into or responded to in a literary mode. Anna Henchman, *The Starry Sky Within: Astronomy and the Reach of the Mind in Victorian Fiction* (New York: Oxford University Press, 2014) looks to how developments in astronomy opened up new understandings of space, motion, and perception for writers like Hardy, Eliot, De Quincey, and Tennyson. Jesse Oak Taylor, *The Sky of Our Manufacture: The London Fog in British Fiction From Dickens to Woolf* (Charlottesville: University of Virginia Press, 2016) examines the London atmosphere as seen through the eyes of Dickens, Eliot, Stevenson, and Woolf, revealing the resonant connections between fiction and the understanding of "climate shift" on a literal and metaphysical level. Devin Griffiths, *The Age of Analogy: Science and Literature Between the Darwins* (Baltimore: Johns Hopkins University Press, 2016) takes a new interdisciplinary look at Erasmus and Charles Darwin and their influence on literature, following problems of comparative history from *Zoonomia* and Walter Scott to Tennyson, Richard Owen, and Eliot (15-24).

scientific principle, is given pride of place for doing imaginative theoretical labor.[27] In attending to the rhetorical structures that managed the imagination as well as the feelings, I urge that public science writing had the potential to perform subtle connective work which shared the goals of fiction: namely, to develop in readers a more sensitive, flexible, capacious understanding and acceptance of the world.

Privileging scientific prose as text further allows me to bring rhetorical nuance to the flourishing historical discourse on Victorian public and popular science culture, from which I draw critical context and terminology. In exploring how the ideologically linked *Nature*, lectures at Manchester and Royal Institution, and the scientific corpus exemplified by Thomas Henry Huxley rhetorically—not just philosophically—grappled with what it was to have "sympathy" for science, I naturally suggest ways of reading science more generously than as products or indicators of certain material and social conditions (as is often the case in historical scholarship on scientific literature).[28] I also abut certain discursive paradoxes at the margin between rhetoric and philosophy, for I maintain that most science and culture studies, whether they employ the term or not, are "rhetorical studies."[29] But considering the lingering divide between "rhetorical

[27] See Roger Cooter and Stephen Pumfrey, "Separate Spheres and Public Places: Reflections on the History of Science Popularization and Science in Popular Culture," *History of Science* 32, no. 3 (1994): 237-267; Ralph O'Connor, "Reflections of Popular Science in Britain: Genres, Categories, and Historians," *Isis* 100, no. 2 (June 2009) summarizes the situation nicely: "Most literary scholars still use scientific writings chiefly as intellectual "contexts" for illuminating Literature with a capital L…while most historians of science treat novels, plays, and poetry as second-order cultural background for the explication of scientific debates" (338). Exceptions are becoming increasingly numerous, but now as then this remains a general rule.

[28] Melinda Baldwin's excellently comprehensive *Making Nature: The History of a Scientific Journal* (Chicago: University of Chicago Press, 2015) for example, privileges *Nature* as a documenter of political and scientific trends rather than as a vehicle of literary production.

[29] That is, rhetoricians are essentially cultural critics who in viewing language as stable are interested in how language constructs, sustains, and transforms cultural forms and ideologies. I extrapolate this idea from Richard Lanham, *The Electronic Word: Democracy, Technology, and the Arts* (Chicago: University

criticism," which to date is mostly the purview of communications scholars, and criticism that deals with rhetoric, like English, linguistics and religion, my project must fall in the latter category.[30] Thus, while my primary analysis dwells on the shape and meaning of verbal structures and on the formats and media conveying them to the public, mine is still fundamentally a Victorian project, conceptually focused on how practitioners spoke and altered the language and ideas of their culture to stir the feelings as well as the intellect, and to "leaven the mass of the community with a love of science." In attending to and deliberately merging so many discursive paradoxes, it almost goes without saying that I likewise formally chip away at the monolithic specter of C. P. Snow's "two cultures."[31] I suggest instead, in the spirit of E. O. Wilson, a rhetorical consilience.[32]

Like novel sympathy, the sympathy employed by the writers in this project, and the rhetorical vectors through which they operated presupposed a combination of old and new cultural structures that privileged the concept of "unity." From the past came, foremost, the ideological debt that scientific practitioners together with British Romantic poetry owed to German

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of Chicago Press, 1993); William V. Bartlett, *Preaching Science: John Tyndall and the Rhetoric of Victorian Scientific Naturalism,* PhD. Dissertation, Rutgers the State University of New Jersey, 1995.

[30] Herbert A. Wichelns' is considered the inaugural voice of "rhetorical criticism" which in a 1925 essay called "The Literary Criticism of Oratory" in *Methods of Rhetorical Criticism: A Twentieth-Century Perspective,* ed. Bernard L. Brock and Robert L. Scott (Detroit: Wayne State University Press, 1980) he categorized as the branch of communication studies which dealt with "the analysis and appreciation of the orator's method of imparting his ideas to his hearers" (67). While Richard Enos, "Introduction: The Inclusiveness of Rhetorical Criticism," *Rhetoric Review* 25, no. 4 (2006) has noted how contributions to rhetorical criticism have extended into fields like English, linguistics and religion (357), Jennifer DeWinter, "A Bibliographic Synthesis of Rhetorical Criticism," *Rhetoric Review* 25, no. 4 (2006) confirms an observation which I too made when researching this project, which is that "almost all of the journals and books" are still "written by and for speech communication scholars" (388); See also Robert H. Ellison's editor's introduction to *A New History of the Sermon: The Nineteenth Century* (Leiden: Koninklijke Brill NV, 2010), 2-5.

[31] C. P. Snow, *The Two Cultures and the Scientific Revolution* (Cambridge: Cambridge University Press, 1959).

[32] See Edward O. Wilson, *Consilience: The Unity of Knowledge* (New York: Knopf, 1998).

Naturphilosophie and particularly to Alexander von Humboldt. The German naturalist was the first to consider physical nature not as multifarious and discrete units of zones and taxa, but as a "Cosmos, or harmoniously ordered whole."[33] "In considering the study of physical phenomena," Humboldt wrote,

> We find its noblest and most important result to be a knowledge of the chain of connection, by which all natural forces are linked tighter, and made mutually dependent upon each other; and it is the perception of these relations that exalts our views and ennobles our enjoyments.

Humboldt's idea of a proto-ecological mutuality in nature informed the "unity in diversity" realized in Emerson's "far reaching concords of Astronomy/Felt in the plants and in the punctual birds" and the wider reading public would come to feel this cosmic inheritance in public science as well as in the poetry of the Romantics.[34] Humboldt's unity of nature spoke to the sensibilities as well as to the intellect for, like Wordsworth, the naturalist recognized the deep affective resonance that the experience of nature had on the soul (though, unlike Wordsworth, he

[33] Alexander von Humboldt, *Cosmos: A Sketch of the Physical Description of the Universe, Volume 1* trans. E. C. Otté (Baltimore: Johns Hopkins University Press, 1997), 24; Alice Jenkins discusses Humboldt's ideological influence on Victorian science in *Space and the 'March of the Mind': Literature and the Physical Sciences in Britain, 1815-1850* (New York: Oxford University Press, 2007), 20-22. See also Andrea Wulf, *The Invention of Nature: Alexander von Humboldt's New World* (New York: Alfred A. Knopf, 2015), 1-9.

[34] In their introduction to a special issue on science and poetry, Gowan Dawson and Sally Shuttleworth review a substantial body of critical literature that traces the mutual influence of Victorian science and poetry, particularly Romantic poetry: *Victorian Poetry* 41, no. 1 (2003): 1-10; In *Invention of Nature* Wulf records Humboldt's direct impact on the British Romantics, particularly Wordsworth and Samuel Taylor Coleridge, who shared Humboldt's insistence on truth in the physical experience of nature, and his resistance to the division of scientific knowledge—preferring instead a unified whole. Wordsworth used Humboldt's *Personal Narrative* as source material for his sonnets, and Coleridge encountered Humboldt's work directly through his brother Wilhelm, whom he met at a salon at the Humboldts' home in 1805 (168-170).

maintained that increased knowledge did not decrease wonder).[35] "Communion with nature"—that is, the experience of the cosmic whole—could "calm the storm of passion" and "soften the heart." "The earnest and solemn thoughts awakened by a communion with nature intuitively arise from a presentiment of the order and harmony pervading the whole universe," he writes. In other words, Humboldt seemed to acknowledge that emotional stimulation— a kind of experiential harmony or sympathy— was somehow a function of the larger harmony of the cosmos. We continue to see the expression of a certain Romanticized brand of emotional sensitivity in late-century public discourse, for while Romanticism may have been methodologically out of vogue, practitioner-publicizers in fact rhetorically overlapped with and owed a great debt to the languages and ideologies of Romanticism.[36]

Humboldt's mutually affected, mutually affecting system also laid the ideological groundwork for the "new" terms of affinity by which practitioners would weave their sympathy for science. Matthew Stanley has illustrated how the principle of uniformity united the scientific practices of theism and naturalism under shared "valence virtues." Both paradigms maintained that all forces were the same, everywhere, whether they sprang from divine or mechanistic

[35] Humboldt would not have agreed with Wordsworth that we "murder to dissect": see "The Tables Turned: An Evening Scene, on the Same Subject," *Wordsworth's Poetry and Prose* ed. Nicholas Halmi (New York: W. W. Norton and Co., 2014), lines 25-28. In *Cosmos*, he is earnest and fervent in his argument that the scientist's labor after knowledge "can not surely fail to produce on the minds of these laborious observers of nature an impression more imposing and more worthy of the majesty of creation than on those who are unaccustomed to investigate the great mutual relations of phenomena. I can not [sic], therefore, agree with Burke when he says "it is our ignorance of natural things that causes all our admiration and chiefly excites our passion" (40). We continue to hear echoes of this commonplace in twentieth-century science writers like Richard Dawkins, Carl Sagan, Edward O. Wilson and Richard Feynman.

[36] Levine, "Paradox," 81-82; Peter Dear, "Romanticism and Scientific Naturalism," *European Romantic Review* 26, no. 3 (2015) reminds us of the theoretical parity between Romanticism and scientific naturalism, noting Darwin's infatuation with Humboldt (330) and suggesting that the sublimity of naturalism was "arguably Romanticism's legitimate offspring" (338).

sources.[37] The other two loose tenets of naturalism—the conservation of energy and the theory of evolution—likewise proceeded as a theoretical consequence of Humboldt's "web of life." All three consistently implied a united permutability of all of the basic terms of physical existence; and this, I argue, offered to interlocutors a bigger, wider, deeper way that science might touch the public imagination. One of this dissertation's theoretical contributions, indeed, is in using the productions of practitioner-publicizers to draw out the way in which "sympathy" not only forms an important corollary to the idea of "uniformity," but in its productive history as a physical, physiological, moral, and social term melds physical uniformity with other forms of connection—including intermingling affective response with scientific phenomena and the contemplation thereof.

John Edward Morgan's Manchester lecture on "Elementary Physiology I" (1867) provides a convenient metaphor for how a properly scientific view, in this case chemical, might elicit new ways of imagining attachment:

> Chemistry enables us to separate these minerals from the tissues with which they are united. I have been told that on one occasion a Frenchman, deeply affected by the loss of a relative, ordered the remains to be burnt, and after separating the iron from the rest of the ashes, had it moulded into a mourning ring; the ingenious foreigner, not content with wearing mourning for his friend, actually made mourning out of him.[38]

Morgan here merges the principle of the conservation of energy and matter with the sympathetic attachment of friend to friend. He collapses the distinction between the two as the fellow-felt entity's matter transforms, and the friend's physiological body becomes a metallurgical one. The

[37] Matthew Stanley, *Huxley's Church and Maxwell's Demon: From Theistic Science to Naturalistic Science* (Chicago: University of Chicago Press, 2014).
[38] John Edward Morgan, "Elementary Physiology I," in *Science Lectures for the People, First Series* (Manchester: J. Heywood, 1867), 125.

idea or feeling of "mourning" becomes a concrete object: "mourning"—a physico-chemical take on that already iconic Victorian practice of wearing one's grief as a physical ornament. Affect moves between the abstract and concrete alike, diffusing like gases off combusted iron. Such collapses help me theoretically link historical work like Stanley's with novel theory work like Greiner's, suggesting productive ways in which scientific literature participated in constructing philosophical magisteria similar to those of fiction and poetry, rather than approaching the science and literature relationship as, again, a study in purely unidirectional textual influence.

The complex and often contradictory relationship between Romanticism and naturalism forms the focus of Chapter One, which looks to *Nature* magazine as a case study in the kind of associative sympathy evoked by Tyndall's quotation of Emerson. In considering the confluence of several prominent Victorian textual trends—poetic quotation, book reviews, and serial publication—this chapter recovers important Romantic connotations in the early years of a generalist periodical ostensibly devoted to defending the bastion of professional science. Non-discipline-specific, practitioner-run, and generalist, *Nature* embodied the educational goals of its naturalist theorizers who envisioned uniting both lay people and scientific professionals on, as the magazine's Wordsworthian epigraph put it, "the solid ground of Nature." The predominant historical trend has tended to gloss over *Nature's* early miscellaneity, but I argue that the imaginative and often effusive prose tucked into *Nature's* reviews and articles reflects a serious examination of the relationship between scientific fact and scientific feeling. I close-read the pride of place accorded to poetry by William Wordsworth, Johann Wolfgang von Goethe, and Samuel Taylor Coleridge in the company of book reviews and editorial articles which balanced wonder and enchantment with technical detail and empirical accuracy. *Nature*'s embrace of Romantic reference gives important context to the way professionals represented and suggested

the "correct" way to cultivate the scientific attitude of mind, as they subtly invited public sympathy by fronting "serious" science with the emotional pitch of Romanticism.

For public pedagogy at the height of the period, public speaking reigned supreme. *Nature* issued weekly agendas of scientific lectures in and around London, frequently praising events which hit the dual targets of education and affect. Chapter 2 turns to the intricacies of such orations. I argue that in the performative format of the lecture, practitioner-publicizers took advantage of rhetorical structures that mimicked the case-based reasoning of moral sympathy, and that they did so in order to facilitate community between audiences and scientific subjects. I focus on material from the Christmas Lectures and the Manchester Science Lectures for the People, two cultural institutions headed by scientific professionals that promoted lay-education. I look at three major rhetorical themes and structures within the lecture which, like the Frenchman and his iron ring, worked in some fashion to coerce the sympathetic imagination into a broader range of attachment. I begin with the beautification of common objects, in which lecturers gave aesthetic designations to unconventional objects (rubber bladders, fluke worms, coal derivatives), capitalizing on the trust between amateur and expert as they re-oriented beauty in terms of scientific "truth." I then move to a narrative action that I call the "Cosmos metonyms," a mode of object lesson in which lecturers teased out the webs of connection (like Humboldt's "web of life" or Emerson's "Far-reaching concords") material or procedural, between people and things, which I argue evoke Smithian sympathetic "cases" that bring the conclusions of science "home" to the reader or audience. The final turn of this chapter looks at the lecture's specific engagement with the Victorian discussion of science as a source of morality, as the conclusions

of these "lay sermons" (Huxley's term) promote science as a vocation adjacent to religion which "[purified] the heart."[39]

Chapter 3 explores "sympathy for science" through the study of a single author: Thomas Henry Huxley. Though Huxley remains honored as a Victorian intellectual, it has been quite some time since any scholarship has attended to him as a literary producer.[40] His fame as a stylist and his centrality to Victorian public science and education make him a dynamic case study in the dual understanding of building and having uncompromising "sympathy" for science. This chapter gives particular attention to Huxley's seminal *Lay Sermons, Addresses, and Reviews* (1870) as it surveys his broad public corpus. I argue that Huxley relied on familiar imaginative and linguistic structures furnished by the field of physiology in order to represent an autonomic mode of being "in sympathy" with the universe, one unconstrained by the burden of ulterior motivation or moral approval. Huxley's self-proclaimed identification as foremost a physiologist— not a naturalist— is critically inscribed in the way he conceptualized humankind's "place" in harmony with a natural system. Huxley's externalized idea of harmonic entanglement becomes particularly important to his defense of an evolutionary paradigm, the embrace of which required, as George Levine puts it, "a willingness to suffer the consequences of finding out that the world is not only not made for us, but that it may well be without

[39] Henry Roscoe, "Spectrum Analysis," in *Manchester Series of Science Lectures for the People, second series* (Manchester: J. Heywood, 1870), 200.

[40] Cyril Bibby, Paul White, James Paradis, and especially Adrian Desmond have all produced memorably thorough work on Huxley, though the most recent is nearly twenty years old. Attention to Huxley as a literary producer has been, at best, eclectic and sporadic— see George Levine, "Huxley, the Most Powerful Sage of Them All," *Victorian Studies* 42, no. 1 (1998): 101-119; Bernard Lightman, "Huxley and Scientific Agnosticism: The Strange History of a Failed Rhetorical Strategy," *The British Journal for the History of Science* 35, no. 3 (2002): 271-289; Joseph H. Gardner, "A Huxley Essay as 'Poem'," *Victorian Studies* 14, no. 2 (1970): 177-191; Robert Szymczak, ""Darwin's Bulldog" as a Man of Letters: Thomas Henry Huxley and the Crusade for Science in Victorian England," *Confluence*: *The Journal of Graduate Liberal Studies* 14, no. 2 (2009):109-111.

intention, meaning, or direction."[41] While most scientific publicizing tended to minimize unsavory realities or metaphysical quandaries, Huxley was "willing to suffer the consequences," and envisioned an inviolable sympathy that could accommodate them.[42] By locating the harmony in nature in a physiological rather than purely emotional source, he was able to reconcile the attraction of scientific wonder with the repulsion of existential suspicion. Huxley's depersonalized sympathy could flex, rather than fracture—as we see it do, under the pressures of Darwinian doubt, in his final works "Evolution and Ethics" (1893) and the "Prolegomena" (1894).

I end with a brief coda that looks forward to the contemporary avenues of "sympathy for science" with a particular eye to ecological consciousness, linking environment and Victorian cosmopolitanism to the truly cosmic sympathy in one of the most recognizable voices in twentieth century public science, the late astronomer Carl Sagan. Soaring, flexible, and existentially conscious, Sagan's writing evinces a simultaneously intellectual and affective embrace of the unity of nature amid the complexities of the nuclear age, and finds in that affect a life-saving purpose, which I suggest posits how sympathy might add to a planetary—or indeed, interplanetary—preservation ethos in the Anthropocene epoch.

[41] Levine, *Dying to Know,* 4.
[42] Tyndall, *Fragments of Science,* quoted by Levine 4.

Chapter 1: Back to Nature: The Romantic tutelage of *Nature* magazine

> *Each of her works has an essence of its own; each of her phenomena a special characterization: and yet their diversity is in unity.*
>
> Johann Wolfgang von Goethe (1780 "or thereabouts"), translated by T. H. Huxley for *Nature*, 1869

Introduction: "To live always in it!"

In a late 1872 book review, sandwiched between an article on "The Potato Disease" and letters to the editor on "American Arrowheads" and "Hutton's Trigonometric Tables for 'Arcs expressed as portions of the radius,'" readers of *Nature* magazine were treated to a tableau of electric joy. The biography of Michael Faraday here under review, we are told, is a special one. "A delightful freshness and personal interest are…given to the narrative," thanks to the personal collections and private material access of author John Hall Gladstone, Faraday's friend and colleague. The resulting book is a series of portraits of the great and good experimentalist that can only be likewise called delightful, and reviewer W. F. Barrett has his pick of fine moments. The resulting review, earnestly wrought, paints a man who looks as much like a prophet as he does like a physicist. "We are told that a new fact," Barrett writes, "'seemed to charge him with an energy that gleamed through his eyes and quivered his limbs,' and on an occasion where he witnessed 'some lovely experiments with vacuum tubes',

> Faraday literally danced with delight round the electric discharge, exclaiming, as he gazed at the moving arches of light, "Oh! to live always in it!"[1]

Faraday's brief but striking music resonates at a dual frequency. On one bright wavelength, a Newtonian Faraday reads the principles of electromagnetism in the moving arches

[1] "Gladstone's Life of Faraday," *Nature* 6 (September 19, 1872): 412.

of light, a man literally and metaphorically illuminated by the blinding essence of his labors. Read this way, his exclamatory desire to "live always in it" rings metaphorical, his "it" gesturing to a referent of a higher magnitude than the material display before him: the light of scientific truth. Yet to read Gladstone's Faraday purely in this way is to ignore the secondary frequency of his scientific ecstasy— the quiver of the limb in response to a fact, the delight of experimental discovery that finds its outlet in spontaneous dance. Faraday's desire to "live always in it" conveys a sense of physical transcendence even as his joy takes over his physical form. This Faraday desires not just knowledge, but affective connection—to vibrate with a beam of light, to feel a oneness with elemental nature. Both of these orders of ecstasy identify a superstructural interconnection in the investigation of natural phenomena, part empirical, part metaphysical, and Barrett makes little secret as to which facet he finds most remarkable. The review goes on to cite other evidences that Faraday's relationship to physical nature surpassed the purely intellectual. "A thunderstorm," Barrett writes, "was no mere affair of positive and negative energy… but something infinitely beyond all this—a window through which he looked into Infinitude itself." This moment connects Faraday, the scientist surrendering to the storm and witnessing eternity, to another Romantic tableau of man amid the electric element: Byron's Childe Harold and his conference with the "thunder" upon Lake Leman. Readers of Gladstone's book will learn that Faraday loved to read aloud this very passage, bringing tears to his eyes as so many things did when "anything touched his feelings."[2] The great "Natural Philosopher" who shattered with his

[2] John Hall Gladstone, *Michael Faraday* (London: Harper and Brothers, 1872). Gladstone includes an account by Faraday's niece, Miss Reid: "But of all things I used to like to hear him read 'Childe Harold:' and never shall I forget the way in which he read the description of the storm on Lake Leman. He took great pleasure in Byron, and Coleridge's 'Hymn to Mont Blanc' delighted him. When anything touched his feelings as he read—and it happened not unfrequently [sic]—he would show it not only in his voice, but by tears in his eyes also" (57).

penetrative experimentation the "new metaphysical shibboleths" in fact manifested a relationship to nature that was decidedly extra-natural—even, supernatural.[3]

In terms of scientific conduct, *Nature* liked to teach by example. In the above and in many other instances the journal elevates Michael Faraday as a certain type of natural investigator.[4] An unparalleled experimentalist on the one hand, and a man who for all his "stern reality" had in his heart a "fine poetic fancy" on the other, Faraday represented the acme of scientific virtues. Beyond his manifold laboratory achievements, he was a model of Smilesian self-help, a "bright and joyful" transcendental genius with whom contact "warms and elevates the heart."[5] He was the first figure featured in the journal's series on "Scientific Worthies," and many a laudatory book review begins with the acknowledgment that an author's knack for instruction is very good, but "not everyone can be a…Faraday."[6] He was a legendary speaker, and a rigorous defender of the scientific methodologies that made his many discoveries possible.[7] "Keep your imagination within bounds," Faraday cautioned a juvenile lecture audience in 1853, "taking heed lest it run

[3] "Professor Helmholtz on Faraday" *Nature* 3 (November 17, 1870): 51-52.

[4] When Lord Kelvin in his address to the British Association meeting in August 1871 cries that a "monument to Faraday…Britain must have," he is quick to point out that a monument is not *necessary* to commemorate Faraday's glory. "Thou," he writes, quoting Milton, "in our wonder and astonishment/Hast built thyself a livelong monument." See "The British Association Meeting at Edinburgh," *Nature* 4 (August 3, 1871): 262.

[5] Helmholtz refers to him as "this unlearned son of a smith, who held fast throughout his life to the pious creed of his fathers…" "Professor Helmholtz on Faraday," 51-52; John Tyndall, "Life and Letters of Michael Faraday," in *Fragments of Science for Unscientific People* (New York: D. Appleton and Co., 1871), 351.

[6] Richard Holmes, *The Age of Wonder: How the Romantic Generation Discovered the Beauty and Terror of Science (*London: HarperPress, 2008). For figurations of Romantic science see also Jan Golinski, *Science as Public Culture, 1760-1820* (Cambridge: Cambridge University Press, 1992); Andrew Cunningham and Nicholas Jardine, *Romanticism and the Sciences* (Cambridge: Cambridge University Press, 1990).

[7] For more detailed attention to Faraday's oratorical renown, see Chapter 2.

away with your judgment," explaining that all scientific discovery must have its roots in observation, not fancy.[8]

Faraday's continual presence in the journal's pages was itself not fancy, but in fact a pointed rhetorical choice. If *Nature* had wished simply to elect a professional exemplar based on public pedagogy and commitment to the scientific method, it could have picked many men other than Michael Faraday. The late-Victorian scientific community boasted a number of admirable scientific men who fit this description. Many of them, like Thomas Henry Huxley, John Tyndall, and Richard Proctor, contributed to *Nature.* Some, in the case of J. Norman Lockyer, even edited it. And certainly just as many may have been more on-message than Faraday for a project which staunchly rejected a theological universe. Tyndall was a dynamic lecturer and scientific champion, but unlike the Sandemanian Faraday, Tyndall (sometimes too aggressively) promoted science as the only legitimate system of knowledge and proclaimed his own growing agnosticism.[9] There was something unique about this Michael Faraday. *Nature* repeatedly recurs to the "great and childlike man" as the pinnacle of scientific sensibility—elevating his "face-to-face, heart-to-heart inspection of things," exulting that "to him, the Universe was no machine."[10] Even Barrett's review textually places Faraday in a supernatural relationship with the physical elements. He gives a poetic fancy, from *Julius Caesar,* the final word*:*

> His life as gentle; and the elements
> So mix'd in him, that Nature might stand up
> And say to all the world, 'This was a Man'!

[8] Geoffrey Cantor, *Michael Faraday: Sandemanian and Scientist: A Study of Science and Religion in the Nineteenth Century* (London: Palgrave Macmillan, 1991), 196.
[9] Michael S. Reidy, "Introduction: John Tyndall, Scientific Naturalism and Modes of Communication," in *The Age of Scientific Naturalism: Tyndall and His Contemporaries* (New York: Routledge, 2016), 2.
[10] "Tyndall's Fragments of Science," *Nature* 4 (July 27, 1871): 237-238; "Gladstone's Life of Faraday," *Nature* 6 (September 19, 1872): 412.

This Shakespearean coda follows five brief sentences on the tableau of Faraday mixed amid beams of the electric element, and the spirit of the verse mirrors that sight: Faraday intertwines with the external elements, and the elements knit together with him, animating his body, charging his atoms. The evocation of Nature seems almost too well-placed, a reminder that like Nature the entity, *Nature* the magazine enjoins its readers to stand up in chorus and proclaim: 'This was a Man!'" Here again Faraday is highly romanticized, and in terms highly Romantic: "Man" and "Nature" enjoy a kind of mystic communion, and the scientist acts Nature's prophet, a person whose science is "felt in the blood/And felt along the heart" as much as seen through the eyes. [11]

This chapter seeks to naturalize the often supernatural sympathy facilitated among the pages of a journal which, though it has achieved due pride of place in the history of science, has received little in the way of literary attention as a distinctly Victorian periodical. As *Nature,* starting in 1869, staked its claim for civically engaged and factually motivated professional science, both direct and indirect Romantic negotiation were anything but anathema appearances. The magazine was symptomatic of a broader Romantic paradox in scientific naturalist discourse, a fact which stood as both one of its major contradictions and one of its biggest attractive forces.[12] "Romantically," George Levine affirms of this mid-century trend, "but with the

[11] William Wordsworth, "Lines written a few miles above Tintern Abbey" (1798) *Wordsworth's Poetry and Prose*, ed. Nicholas Halmi (New York: W. W. Norton and Co., 2014), line 29.

[12] Romanticism has a long history of generative entanglement and co-development with the sciences of the late 18th and early 19th century, the co-influence of which can be felt, among other places, in the commingling of Humphrey Davy's and Wordsworth's views of the poet and the scientists in the 1802 preface to *Lyrical Ballads,* in *Wordsworth's Poetry and Prose,* 86-89, and the galvanic attentions in Mary Shelley's *Frankenstein,* which Richard Sha discusses in "Volta's Battery, Animal Electricity, and *Frankenstein," European Romantic Review* 23, no. 1 (2012): 21-41. Holmes' *Age of Wonder* likewise documents the wide reach of these mutually constitutive cultures. See, most recently, Richard Sha, *Imagination and Science in Romanticism* (Baltimore: Johns Hopkins University Press, 2018), but also *Romantic Science: The Literary Forms of Natural History* ed. Noah Heringman (Albany, State University

instruments of science, [scientific naturalist writers] evoke the world in progress narratives as a place of wonder, but…insist that science is only organized common sense."[13] As such a forum, in which public engagement and entertainment, professional and pleasure reading, and educational and social reform mingled in tones dulcet, wondrous and authoritative from some of the leading voices of naturalistic science, *Nature*'s early years are a prime focal point for investigating this philosophical paradox. In an age searching for a place to re-anchor an unmoored supernatural Nature, *Nature'*s rhetorical practice promoted a kind of affective, if not intellectual, sympathy with a vision of scientific naturalism.

Nature's very name signaled an implicit insistence on its mediatory potential. "'Nature' pure and simple" was sure to resonate with Victorians, invariably calling to mind a number of powerful associations.[14] We see a predictable if hyperbolic example in mathematician J. J. Sylvester's response:

> What a glorious title, *Nature*— a veritable stroke of genius to have hit upon. It is more than Cosmos, more than Universe. It includes the seen as well as the unseen, the possible as well as the actual, Nature and Nature's God, mind and matter. I am lost in admiration of the effulgent blaze of the ideas it calls forth.[15]

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of New York Press, 2003); Noah Heringman, *Romantic Rocks, Aesthetic Geology* (Ithaca: Cornell University Press, 2004). Adrian Desmond, *Huxley: From Devil's Disciple to Evolution's High Priest* (Reading, Massachusetts: Addison Wesley, 1997) notes that for the sciences by the 1860s, Romanticism as an actual scientific paradigm was considered somewhat passé, giving, as this chapter and project at large argue, new metaphorical prospect to the language of older philosophies (187).

[13] George Levine, "Paradox: The Art of Scientific Naturalism," in *Victorian Scientific Naturalism,* eds. Gowan Dawson and Bernard Lightman (Chicago: University of Chicago Press, 2014), 79-97.

[14] A.J. Meadows, *Science and Controversy: A Biography of Sir Norman Lockyer* (Cambridge, Mass: MIT Press. 1972); T. H. Huxley to Lockyer, July 16, 1869 (Imperial College London, Huxley Archives), quoted in Meadows, 26.

[15] T. M. and W. L. Lockyer (Eds.) *The Life and Work of Sir J. Norman Lockyer* (London: Macmillan, 1928), 48; Melinda Baldwin, *Making "Nature": The History of a Scientific Journal* (Chicago: University of Chicago Press, 2015), citing Meadows, records that it is unclear how Lockyer ultimately settled on the

"Nature" was sure to conjure a torrent of Romantic associations, from the *Naturphilosophie* and *Universalwissenschaft* of German Romantic philosophy to the British Romantic constellation. While some scholarship has been content to read *Nature*'s title as an ornamental flourish, Sylvester's effervescence exposes the philosophical volatility of the term: "Nature" was an electric word, a protean term for a protean concept.[16] Scientific men like Sylvester might read "Nature" in a metaphorical spirit, an emblem of the unified physical system of which humankind was a part, and which could be studied and understood through the instruments of science. But the generalist readership that *Nature's* editors targeted could find, if they willed, a theistic touchstone as well— less "Nature," more "Nature's God," a spiritual, mystical, beneficent entity.[17] Among other things, this chapter aims to expose *Nature's* acute consciousness of the great instability that Romantic invocations like its title could effect in a scientific naturalist project. To that end, the journal spent its first two issues engaged in a vivid theoretical struggle to clarify and contain the vision of Nature that its title precipitated, and that the very evidences by which it tried to explain itself complicated.

Three significantly-positioned Romantic excerpts in these inaugural issues negotiate much of that struggle. A trio of poetic figurations of "Nature" by three titanic Romantic poets—Johann

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name "Nature" for his periodical, but agree that the title would have resonated strongly with Victorian audiences, conjuring as it did associations with Romanticism and *Naturphilosophie* (33). Victorian scientific texts often employed "Nature" as the guide to all true scientific knowledge—a trend that Sylvester's enthusiastic reaction seems to verify.

[16] Baldwin, *Making "Nature,"* glosses *Nature*'s introductory article and its rhetoric as a "flowery" piece (33-34).

[17] The Victorian conflict between "Religion and Science—the two mightiest antagonists" according to George Henry Lewes (*Problems of Life and Mind, 1874)* has generated a body of scholarship almost too capacious to tally. The controversy involved the struggle over intellectual authority, materialism versus metaphysics, absolute versus contingent knowledge, and so on. For contemporary examples see, for instance, Tyndall's inflammatory "Belfast Address" (1874). For a summary of the intricacies of the Victorian conflict, see for example Frank Turner, "The Victorian Conflict Between Science and Religion: A Professional Dimension" *Isis* 69, no. 3 (Sept, 1978): 356-376.

Wolfgang von Goethe, William Wordsworth, and Samuel Taylor Coleridge—"brand" the journal and thereby introduce a broader pedagogical intention.[18] Their presence signals a mode of instruction that relied on sentiment as much as logic to "urge the claims of Science to a more general recognition in Education and in Daily Life," and the journal continued to recapitulate these intentions in a rhetorical range that steadily oscillated between intellectual attention and emotional delight. Formally inspired by other science-specific journals, *Nature,* as its name implies, resisted discipline specificity in favor of disciplinary unity.[19] The magazine featured sections ranging from reports on fields such as astronomy, ethnography, biology, geology, physics, and physiology, to, as we will see momentarily, book reviews on subjects as diverse as art and antiquities, travel narratives, picture books for children—even such trivia as the design of school desks and domestic fireplaces.[20] Throughout a generalist period of roughly 1869-1875, *Nature*'s book reviews, editorials, and feature articles express an intention beyond the scientific

[18] Caley Ehnes, "Inaugural Poems: Branding the Mid-Victorian Literary Periodical," *Victorian Review* 43, no. 2 (2017) has most recently attended the semiotic weight of what she calls "inaugural poems" across Victorian periodicals, arguing that poems which "brand" the periodical and introduce a specific set of editorial aims can be found anywhere in the periodical's first issue (185). Considering that *Nature* publishes its formal 'Aims and Intentions' in its second issue, I'd argue that this inauguration reasonably extends, at least for this periodical, to the second issue. For discussions of the general importance to inaugural poetry in the Victorian periodical as a whole, see Linda K. Hughes, "What the *Wellesley Index* Left out: Why Poetry Matters to Periodical Studies," *Victorian Periodicals Review* 40, no. 2 (2007) 91-125 and Alison Chapman, "Inaugural Poems in Victorian Periodicals," *Victorian Poetry Network,* 7 October 2017, http://web.uvic.ca/~vicpoet/2014/10/.

[19] Baldwin notes in *Making Nature* that even when *Nature* shifted direction towards largely the same audience as the specialized journals of its age, its lack of association with a scientific society, its weekly short format, and its lack of disciplinary specificity continued to make it unique among periodicals for Victorian men of science (37).

[20] Baldwin, *Making Nature,* 27; "The Arts in the Middle Ages, and at the period of the Renaissance" "Descriptive Travel and Adventures, or Hubert Preston Abroad" *Nature* 3 (March 23, 1871): 404; "Our Dumb Neighbors; or, conversations of a father with his children on Domestic and other animals" and "The Romance of Natural History," *Nature* 1 (December 30, 1869): 236; "A New Form for Schools" *Nature* 1 (November 11, 1869): 56; "Our Domestic Fireplaces" *Nature* 1 (April 21, 1870): 624-625.

reform and education which were its especial concern.[21] Rather, the journal intended to "[leaven] the whole mass of the community with a love of science," a goal which it achieved in large part by amending earlier cultural models of natural feeling. Somehow, the magazine had to deal with the spiritual myths of "Nature" that were alive and well in its late-Victorian culture. Instead of rejecting them outright, *Nature* took a synthetic approach: it put its vision of science, its vision of itself, in conversation with Romantic Nature.

The result was, unsurprisingly, not a total reconciliation of ideals, since *Nature* rather quickly abandoned a generalist project to become the research flagship it remains to this day. But in the half decade after its debut in 1869, when it concurrently invited a broad audience and broad scope, *Nature* illustrated the theoretical work of bringing into a kind of associative sympathy the vectors of fact and feeling which were (and are) simultaneously dialectical and co-dependent.[22] In an era where popular science books and journals flooded the presses— produced by authors who, as a disgruntled reviewer remarked, "[did] not understand the first principles of the science with which [they dealt]"—*Nature* sought to walk the line between entertainment and education.[23] Its engineers and contributors were deeply enmeshed in the mid-century project of delivering

[21] Many of *Nature*'s most prominent contributors were also among the most active members of the scientific community, including Huxley, Tyndall, William Thomson (Lord Kelvin), P. G. Tait, J. J. Sylvester, John Lubbock, Alfred Russel Wallace. By the mid to late century this collection of thinkers were largely at the forefront of scientific reform— many, like Huxley, heading committees like the Devonshire Commission which investigated government reform of science. Much of the professional content of *Nature* reflects this occupation— see as a typical example "Government Aid to Science," *Nature* 1 (January 13, 1870): 279-280; See also Bernard Lightman, "Huxley and the Devonshire Commission," in Dawson and Lightman, *Victorian Scientific Naturalism.*

[22] See David Roos' "The 'Aims and Intentions' of Nature," *The Annals of the New York Academy of Sciences* 360, no.1 (April 1, 1981): 159-180 and Ruth Barton, "Lockyer's Columns of Controversy in *Nature,*" *History of the Journal Nature* (2007) (doi: 10.1038/nature06260); Melinda Baldwin sees the beginning of a shift in contributor priorities towards research publication even as early as 1872, but certainly by 1875 *Nature* had dispensed with its generalist aims. See Baldwin's chapter on *Nature's* shifting audience, *Making Nature,* 21-47.

[23] "The Romance of Motion," *Nature* 4 (May 18, 1871): 45. At the initial time of publication, an issue of *Nature* cost a relatively inexpensive 4 pence. See Barton, *Making Nature,* 27.

control of scientific information to the hands of its practitioners, and *Nature* was concerned to differentiate rhetorical showmanship from scientific substance, giving ideological primacy to "thorough teaching, and not entertainment, of however high a kind."[24] It was quick to bring a harsh word down on "Science so-called," in which fact, fancy, and fallacy commingled under artful presentation. Such "rubbishy books," as another 1871 *Nature* review lamented, were a blight upon the minds of "beginner[s] full of enthusiasm" who "[knew] not…to distinguish the wheat from the tares which surround it."[25] Nevertheless, the journal simultaneously exhibited a vested interest in promoting and producing discourse with distinctly poetic and at times even empurpled formal features, when it facilitated an affective attachment in favor of science. The particular production of such a quality of affinity forms the subject of this chapter, and we see *Nature'*s promotion thereof in the praise one reviewer gave to Philip Henry Gosse's popular *The Romance of Natural History,* which stood *"*as a protest upon the common opinion that the exact study of nature is inimical to a poetic conception and a romantic love of nature."[26] The magazine continually showed itself to be involved in that protest.

In tracing such involvement this chapter makes a contribution to our increasingly nuanced view of scientific naturalism, more full of transitional figures and forms than earlier scholarship has discerned or indeed than some of its own practitioners avowed.[27] *Nature* was not a perfect project, and from its beginning was plagued by tensions of purpose between its pantheon of

[24] "Lectures to Ladies," *Nature* 1 (November 11, 1869): 45-46.
[25] "Popular Ornithology," *Nature* 3 (March 23, 1871): 402-403.
[26] "The Romance of Natural History," *Nature* 1 (December, 30 1869): 236. The reviewer recommended the book as a "delightful new year's gift."
[27] Michael Reidy, "Introduction," notes that not all scientists who we would call "scientific naturalists" agreed upon the same definition of science— see the differences between Tyndall's secular spiritualism and Spencer's evolutional deism—and that, furthermore, most scholarship on scientific naturalists has focused on natural historians, neglecting physical scientists like Tyndall (8-9). Some of *Nature's* most evocative passages deal with the physical sciences.

scientific naturalist captains, trained up in an age and spirit of generalized discourse, and a growing body of younger contributors with a desire for professional fellowship, not public dissemination.[28] The project experienced growing pains: a rough start after the collapse of Lockyer's previous magazine, the *Reader;* low circulation (a cost offset by the charity of its publisher, Macmillan, who believed in the project); a tendency in spite of its generalist aims to specialized jargon, to the extent that even Charles Kingsley, well-versed in many scientific subjects, gently suggested to Lockyer in 1872 that *Nature* had lost touch with lay-men— he himself could no longer understand much of it.[29] Lockyer was accused (somewhat unfairly) of bias in refusing to police the debates which arose within the "Letters" section, but the magazine certainly did have a polemical agenda, and its secular bent minimizes the impression of what was in fact a persistent, if waning, presence of theological science in the second half of the nineteenth century.[30] And if the journal critically communicated a joyfully progressive vision of a

[28] Ruth Barton, "Just Before *Nature:* The purposes of science and the purposes of popularization in some English popular science journals of the 1860s," *Annals of Science* 4 (1998): 1-33; Baldwin, *Making Nature,* 134.

[29] Lockyer edited the weekly science section of the *Reader,* which like the later *Nature* featured a mix of popular and professional articles, reports from scientific societies, and abstracts from specialist journals. The *Reader* went under and was sold in 1865, but it attracted interest from many of Lockyer's X-Club contemporaries, including Huxley, who continued to see an opportunity in a weekly science journal that would allow men of science to promote their work for a lay audience. See Baldwin, *Making Nature,* 25; Ruth Barton, "Huxley, Lubbock, and Half a Dozen Others: Professionals and Gentlemen in the Formation of the X-Club, 1851-1864," *Isis* 89, no.3 (1998): 410-444; Ruth Barton, "Lockyer's Columns of Controversy," records that *Nature* ran at a loss for decades, surviving because of Macmillan's willingness to absorb the cost— he even turned down a buy-out from Cassel and Co in 1889 (n. pag.); Kingsley's remarks to Lockyer foresee the journal's veer away from generalism: "I trust that Macmillan did not say that I have a 'bad' opinion of *Nature.* On the contrary, I have the highest respect for it, and I wish I were wise enough to understand more of it. But I fear its circulation must be more limited than you would wish." Charles Kingsley to Normal Lockyer, November 8, 1872, Norman Lockyer Papers, MS 110 quoted in Baldwin, *Making Nature,* 38. Some of Kingsley's lectures figure in the second chapter of this project.

[30] Though we can see the remnants of natural theological formal and rhetorical structures in many natural history tomes reviewed by the journal, and in the language used by some of the journal's main contributors, like Alfred Bennett. For overlapping rhetorical and theoretical ground of secular and

Romantically inflected, empirically rigorous science of its time, it likewise reflected the contradictory nature of that egalitarian scientific spirit. The rhetoric of "science for all" that drove public school reform and publicly-accessible science initiatives (expressed explicitly later in this chapter) was often insensible of the material and gendered realities that barred much of the "public" imaginary from actually engaging in scientific labor.[31] Exceptional Victorian women were beginning to trickle into the medical field, and in *Nature'*s pages we frequently see female-authored books on the "Bookshelf"—usually manuscripts for children or families, relaying a domestic or theologically-inflected portrait of Nature —but *Nature's* rhetorical content, and the science therein, was overwhelmingly produced by men.[32] The magazine was not completely unaware of the strictures on un-leisured people's time, but at the end of the day, it

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theological scientists, see Matthew Stanley, *Huxley's Church and Maxwell's Demon: From Theistic Science to Naturalistic Science* (Chicago: University of Chicago Press, 2014).

[31] For more on the rhetorical posture of the egalitarian vision of the "Republic of Science," see Bernard Lightman, *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago: University of Chicago Press, 2007), 296-297. Barbara Gates, "Ordering Nature: Revisioning Victorian Science Culture," in *Victorian Science in Context,* ed. Bernard Lightman (Chicago: University of Chicago Press, 1997) notes the inherently bourgeois program of much of the scientific publicizing ostensibly directed to the working classes (183).

[32] Though the magazine did appear to theoretically support science for women to at least a moderate degree: "We do not propose now to argue the question whether it is desirable that women should learn science—that we take to be already decided," "Science for Women," *Nature* 5 (November 23, 1871): 57-58. *Nature's* masculine slant was partially due to the fact that *Nature,* like the rest of the scientific community, increasingly put a premium on original scientific research in order to be qualified to comment on scientific issues. Women began to gain ground in original scientific research by the end of the nineteenth century, and found an ally in Lockyer, whose second wife was a noted suffragette. See Baldwin, *Making Nature,* 78; Meadows, *Science and Controversy,* 280-283; Scholarship has well established the long history of women and botanical culture and the feminized delineation of that field. Ann B. Shteir, "Elegant Recreations? Configuring Science Writing for Women," in *Victorian Science in Context,* notes that female-authored popular science in the Victorian period tended to a maternal and domestic tradition of natural history (241-244). See also Shteir's *Cultivating Women, Cultivating Science: Flora's Daughters and Botany in England, 1760-1860* (Baltimore: Johns Hopkins University Press, 1996); Adrian Desmond in *Huxley* notes that Huxley had a woman demonstrator in physiology by 1874, and in the same year, the women sitting in the London University medical classes had successfully petitioned to take the degree (448-449).

was a magazine of the middling classes with concerns befitting its station. While "men of science" operated as a general term in the absence the late-coming "scientist," and while I use it as a neutral referent here, we must not ignore that the moniker meant just that: *men* of science.[33] *Nature,* like Victorian culture, was a work in progress.

In both its shortcomings and its strengths, the inaugural issues of *Nature* showcase a culture in conversation with itself: striving to reconcile the Nature of its past with the science of its present, and seeking to model the ideal affective posture of a scientific citizen, lay or professional, in their new republic. We see this dialogue in the range of Victorian voices that, in the journal's early years, were called upon to negotiate the boundaries of *Nature.* Huxley debated with Lewes in the letters column; Kingsley's travelogues were reviewed with the same reverence as Darwin's *Descent of Man;* Don Juan and Hamlet arise as figures of as certain referentiality as Mary Somerville and Charles Lyell, and in the same articles; for authorities on celestial phenomena, a quiet Jesuit writing from Stonyhurst College, Gerard Manley Hopkins, would do just as well as the astronomer Richard Proctor.[34] The tensions among these multitudinous voices enacted a protracted meditation, recapitulating the central question: How did one maintain feeling for Nature while dissecting nature? And how could men of science teach others to love Nature in the scientific way?

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[33] William Whewell coined the term "scientist" in the 1830s, but it didn't pick up popular circulation until the end of the 19th century. See Gowan Dawson and Bernard Lightman's introduction to *Victorian Scientific Naturalism*, 3; Baldwin notes in *Making Nature* that it was "no accident that most (male) nineteenth-century scientific workers preferred the term *man of science* as a descriptor—the term, like its parallel *man of letters* was quite deliberately gendered (78).

[34] George Henry Lewes, "Kant's View of Space," *Nature* 1 (January 13, 1870): 289 and Thomas Henry Huxley, "Kant's View of Space," *Nature* 1 (January 30, 1870): 314; "The Scenery of England and Wales," *Nature* 1 (January 20, 1870): 306-308; Richard A. Proctor, "Where Are the Nebulae?" *Nature* 1 (February 10, 1870): 384; Gerard Hopkins, "The Remarkable Sunsets," *Nature* 29 (January 3, 1884): 222-223.

Nature was not out to disenchant the world or unweave the rainbow, and did not desire a populace merely saturated with facts. Rather, as in its portrait of Faraday, *Nature* sought to build a community of people that maintained "relations with the universe around [them]" in a *feelingful* as well as factual way. *Nature*'s impressionistic approach to fomenting these "relations" signals the first and most generalized sense of "sympathy" in this project: a non-specific affinity among and for scientific subjects, a favorable attitude of mind combined with an agreeableness of feeling, a generalized goal suited to a generalized project.[35] Beginning with its careful recalibration of Romantic poetry, the journal offered readers a model for how they might use older Romantic feelings in a new, scientific world, a generalist project in which a "sympathy for science" would harmonize in many tones and many keys a generalized sense of feelingful and intellectual engagement. Nowhere was that tension between thought and feeling more palpable than in the journal's first issue, to which we now turn.

"The vision of the poet": Goethe's "progress of science"

Thomas Owen writes that "today…at least as many literary scholars as scientists would be surprised to learn of the pride of place once accorded a Wordsworth poem on the most internationally prestigious interdisciplinary publication in science."[36] *Nature* has honored its fair

[35] "Sympathy," as this project attests, is a protean term, but *Nature*'s approach to "sympathy for science" appropriately involves the least theoretically complex iteration of the idea. The OED seems to locate the 3.d. definition of "sympathy" as a "favorable attitude of mind towards a party, cause, etc.; disposition to agree or approve" as a Victorian phenomenon, its cited usages in this sense restricted to dates between 1823-1893. "sympathy, n." OED Online. July 2018. http://www.oed.com.proxy01.its.virginia.edu/(accessed November 14, 2018). *Nature* obviously sought this generalized sense of favor, but the significatory blurriness enacted by both its Romantic preoccupations and the frequent formulation of a "love of science" clearly activate sympathy's emotional potential as well.

[36] Thomas Owens, "Nature's Motto: Wordsworth and the Macmillans," *Notes and Queries* 62, no.3 (2015): 430-435.

share of remarkable scientific achievements, announcing Watson and Crick's "Molecular Structure of Nucleic Acid" in 1953 and the birth of Dolly the cloned sheep in 1997.[37] But for nearly a century, week after week, it honored the sage of the Lake District.[38] Modern subscribers now accustomed to the user-friendly digital subscription of *Nature* would be generally surprised by the face that the journal presented on November 4th, 1869. For a project that sought to position itself against both the "sheerest mountebankery" of sensational popularizers and the theological overtones that commanded much of popular natural history, *Nature* makes a surprisingly spiritual first impression.[39] Readers on that Thursday in November saw the word "Nature" in dark, spindling, letters, "the twiggy calligraphy of a rustic gazebo" floating in a

[37] J. D. Watson and F. Crick, "Molecular Structure of Nucleic Acids: A Structure for Deoxyribose Nucleic Acid," *Nature* 171 (April 25, 1953): 737-738; Dolly was cloned early in 1997, followed by several other successful transgenic cloning attempts— see "Polly Joins Dolly in Record books," *Nature* 388 (July 31, 1997): 414-415.

[38] Owens, "Nature's Motto," 435.

[39] "Magnificent spectacular effects" catch criticism from a note in *Nature* 2 (January 26, 1871) criticizing the flash-bang theatrics and overwrought rhetoric of popular lectures that communicate nothing of intellectual value (253); theological encroachments of the philosophical and rhetorical variety were particularly pernicious in works of popular natural history, not least because it was a genre traditionally espoused by clergy and women; many popularizers were Anglican clergymen in the style of Gilbert White, including the highly popular Rev. John George Wood. Bernard Lightman discusses the commonality between women and clergyman popularizers in their alignment with natural theology against scientific naturalism (see Lightman's chapters on "Redefining the Maternal Tradition" and "The Showmen of Science" in *Victorian Popularizers of Science*, 163-164; Barbara Gates, "Retelling the Story of Science," *Victorian Literature and Culture* 21 (1993) notes the particular influence of William Paley's *Natural Theology* (1802) on women's popular writing on science (mostly botany), which she claims for half a century produced narratives of natural theology in their popularizations of natural history (289-290). We still see a persistence of this tradition in many of the books reviewed by *Nature* in the years between 1869-1875, some quite positively (ex. "Country Walks of a Naturalist with his Children" by Rev. W. Houghton in *Nature* 1 (January 6, 1870): and "Strange Dwellings" by Rev. J. G. Wood in *Nature* 3 (March 9 1871): 366. Others like "On the relations of chemical change, heat, and force" by the Rev. H. Highton in *Nature* 3 (March 2, 1871) "leave the reader with no uncertain impression that if one cannot write properly about such things, one should not do it at all" (344).

celestial field, a full and rising moon half-shrouded in a sea of clouds.[40] "A Weekly Illustrated Journal Of Science," it reads below, then the epigraph:

"To the solid ground

Of Nature trusts the mind which builds for aye."— WORDSWORTH

The homily derives from one of Wordsworth's lesser-known sonnets, "A Volant Tribe of Bards on Earth Are Found." The sentiment, in isolation, seems a fitting mantra for a scientific journal. Interested in building a lasting system of knowledge— "for aye," or "forever"—it prompts scientific inquirers to rely on the "solid" observations they take from the physical world.[41] But from the pen of the poet of Nature, such an expression primes the appetite for spiritual fare.

With this gesture *Nature,* like poetry, appears to "[create] the taste by which it is to be enjoyed," and the brief taste of Wordsworth lingered on the palates of readers as they took to the first article of their new Weekly Illustrated Journal of Science: "Nature: Aphorisms by Goethe." The headline message of the new project spoke in tones of *Naturphilosophie,* an odic call. "NATURE!" it begins,

> We are surrounded and embraced by her: powerless to separate ourselves from her, and powerless to penetrate beyond her.
>
> Without asking, or warning, she snatches us up into her circling dance, and whirls us on until we are tired, and drop from her arms.
>
> She is ever shaping new forms: what is, has never yet been; what has been, comes not again. Everything is new, and yet nought but the old.

[40] Martin Kemp, "Noticing Nature" *Nature* 25 (May 7, 1998): 393.

[41] In fact the neat excerpt misrepresents the relationship of man to Nature that is given in full poem— a decidedly shiftier ground which will be addressed in the following section.

> We live in her midst and know her not. She is incessantly speaking to us, but betrays not her secret. We constantly act upon her, and yet have no power over her.[42]

For three long columns, Goethe's translated words weave a vision of a fitful, capricious but affectionate goddess Nature, a spirit that having "neither language nor discourse...creates tongues and hearts, by which she feels and speaks." This Nature is a cosmic enormity of contradictory tensions, at one immense and intimate. "She is rough and tender, lovely and hateful, powerless and omnipotent," but she is also loving, "her crown is love… [and] she is beneficent." "I trust her," Goethe concludes, "She may scold me, but she will not hate her work. It was not I who spoke of her. No! What is false, and what is true, she has spoken it all. The fault, the merit, is all hers."

Goethe's pantheistic chant concludes with a meditation by its translator, who writes that when solicited by his friend, the Editor, to write an opening article for the first number,

> There came to my mind this wonderful rhapsody on "Nature," which has been a delight to me from my youth up. It seemed to me that no more fitting preface could be put before a Journal, which aims to mirror the progress of that fashioning by Nature of a picture of herself, in the mind of man, which we call the progress of Science.

The translator, who is also the article's author, expresses his concluding wish that "long after the theories of the philosophers whose achievements are recorded in these pages, are obsolete, the vision of the poet will remain as a truthful and efficient symbol of the wonder and the mystery of Nature." He signs off— "T. H. HUXLEY."

If the ideological contradiction of this pairing between Huxley and Goethe gave readers pause, they were in good company. Even Darwin commented that this purple-prosed opener seemed "as if written by the maddest English scholar," and Huxley, always out to confound,

[42] Thomas Henry Huxley, "Nature: Aphorisms by Goethe," *Nature* 1 (November 4, 1869): 9-11.

appeared to be delighted by the perplexity that such a fanciful production would evoke in readers.[43] He wrote to a friend on January 30th, 1870 that his version of Goethe's *Aphorisms on Nature* "astonished the British Philistines not a little. When they began to read it they thought it was mine, and that I had suddenly gone mad!"[44] Huxley was clearly aware that the Aphorisms appeared incompatible with his reputation. He was by this point thoroughly cemented in the public imagination as Huxley "Eikonoklastes," tearing down the edifices of natural theology and preaching an evolutionary universe with all the inverse force of an evangelical firebrand.[45] The view of "Nature" evinced here by Goethe's aphorisms shared the symptomatic failings of much amateurish, theologically-inflected scientific practice in its slippage between fancy and fact. It transmuted a scientific system into more palatable terms of natural theology, industry, and domesticity, and in its composition, as a review on February 15th 1872 put it about a stylistically similar work, "accuracy has evidently been less carefully studied than what is termed sensational effect."[46] Though Goethe's purpose, as poet and philosopher, differed in kind from Dr. Hartwig's in *The Subterranean World,* the anthropomorphic telos of his aphorisms embodied the very

[43] Darwin to J. D. Hooker, November 19, 1869, "Lord what a rhapsody that was of Goethe; but how well translated— it seemed to me, as I told Huxley, as if written by the maddest English scholar. It is poetry, & can I say anything more severe?" https://www.darwinproject.ac.uk/letter/DCP-LETT-6997.xml Web. May 21 2017; on Huxley's response, Desmond, 372.

[44] Huxley to Anton Dohrn, Leonard Huxley, *Life and Letters of Thomas Henry Huxley* (London: Macmillan and Co., 1913), 2:8. Huxley will paraphrase this sentiment again when discussing the episode, 25 years later, in another *Nature* editorial "Past and Present" *Nature* 51 (November 1, 1894): 1-3.

[45] The title of Adrian Desmond's landmark biography of Huxley captures the parodic evangelical spirit of his scientific dissemination. See especially his section in *Huxley* "1858-1865: The New Luther," Desmond 251-335; An engraving from *The Daily Graphic* in 1876 depicts Huxley battering Michelangelo's statue of Moses with a bust of Milton, Desmond, fig. 27; Huxley stood as a kind of anti-papal figure against theological science figures like Bishop Samuel Wilberforce, with whom Huxley famously traded quips about preferring an ape over a bishop for a grandfather (279).

[46] "Hartwig's Subterranean World," *Nature* 5 (February 15, 1872): 305-307.

species of factual drift that Huxley's activities as a scientific crusader were designed to limit, and against which, as a public symbol, he commonly stood.[47]

If the "Philistines" were astonished, it was no doubt because they perceived the a-scientific associations that shadowed Goethe's symbolic power. Goethe was a mighty poet, but his aphorisms espoused a view of Nature imprecise and otherworldly by any metric of Victorian empiricism.[48] His was a seer's experience which wrapped its imaginative tendrils around reality to create a spiritual unity in all things.[49] For Goethe, Carlyle wrote, "the world [lay] all translucent…encircled with WONDER; the Natural in reality the Supernatural, for to the seer's eyes both become one."[50] He looked "not at a thing, but into it, through it," However, despite Huxley's secular pragmatism, his use of the word "Philistines" implies that he considered those who marked a rigid opposition between Romantic and agnostic Nature to be philosophically unsophisticated, an implication recapitulated throughout Huxley's broad and nuanced corpus.[51]

Some earlier scholarship has misguidedly argued that in this piece Huxley fell victim to the "widespread addiction to the pathetic fallacy" of the era, so pervasive that "even scientifically

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[47] Paul White, *Thomas Huxley: Making the Man of Science* (Cambridge University Press: New York, 2003) discusses Henrietta Huxley's relationship to her husband's scientific ideology as an exemplar of this kind of "scientific conversion", as she transmuted her experience of his "fairy land" of science into something commensurate with her domesticity and spirituality— in other words, turned it into something less than scientific (28-31); Desmond, *Huxley,* 377.

[48] Goethe was an earnest if imperfect scientist, though as I note in chapter 3, Huxley thought highly enough of him as an early morphologist to frequently include the poet in his historical accounts of worthies in that field.

[49] Henri Borloft, *The Wholeness of Nature: Goethe's Way Toward a Science of Conscious Participation in Nature* (Hudson, New York: Lindisfarne Press, 1996), 24.

[50] Thomas Carlyle, review of *Goethe's Works, complete and final edition, Foreign Quarterly Review* vol. 10 (1832): 40.

[51] See T. H. Huxley "On Science and Art in Relation to Education," *Collected Essays* (New York: D. Appleton and Co., 1897).

minded people like Huxley fell under its spell."[52] Such an interpretation gives little credit to Huxley's masterful, calculated command of language (and, as another chapter will show more fully, his own contradictory but comprehensive relationship to a Romantic sense of Nature).[53] Both his private letter and the concluding message of his editorial affirm that between metaphor and Huxley, it was Huxley, as usual, who was in control. He professes as much in his discussion of the aphorisms, proleptically acknowledging the "reckoning" they invited with the "British public, who dislike what they call 'Pantheism' almost as much as I do."[54] Huxley might speak in Paley's language of natural theology, might co-opt Goethe's Romantic metaphors, but those actions were tools as much as creeds.

David Roos has argued that Huxley's use of Goethe was a reminder to the public (and his colleagues) of the Kantian lesson that "some intuitive and affective response to nature must always supplement any method of explanation," for the methodology of science never entirely captures the "wonder and mystery of Nature."[55] But I would argue that here on the first page of *Nature,* Huxley's deliberate recourse to a Romantic pathetic fallacy evokes more than a simple reminder of "the wonder and mystery of Nature." Rather, in risking specificity to evoke familiar affective touchstones, Huxley gives himself an opportunity to alter the terms and associations that "Nature" evokes. While his article textually declares an intention to preserve a non-reductive conception of science, it rhetorically models the affective mode that *Nature*'s readers are urged

[52] Oma Stanley, "T. H. Huxley's treatment of 'Nature'," *Journal of the History of Ideas* 18, no. 1 (1957): 120-127. Paul White also discusses Huxley's affinity for the "man of feeling" and the influence that reading Goethe as well as eighteenth century sentimental novels had on a young Huxley cooped up on the H. M. S. Rattlesnake, though he sees this as a beneficial nuance to Huxley's scientific persona, not a problem, White, *Thomas Huxley,* 9-11.

[53] See Desmond, *Huxley,* 27—"His was a nobler vision of harmonious order."

[54] Huxley, "Aphorisms," 10.

[55] Roos cites Huxley's review of Chamber's *Vestiges of the Natural History of Creation* in *The British Foreign Medico-Chirurgical Review* 13 (1854): 425-439, as emblematic of Huxley's insistence on a certain irreducible sublimity in nature even within the bounds of scientific rigor.

to adopt. He tames the perpetual form-shaping Nature of the "vision of the poet" into a developmental metaphor for the early ambitions of *Nature*. Huxley creates textual analogy between a transmutational mother-goddess-paramour "always new, always renewing" and a periodical which "aims to mirror" that mythic figure by shifting, changing, offering up new vistas week after week into the "progress of science."

In crafting this analogy, Huxley plucks the elevated spirit evoked by Goethe and allocates it to a more grounded purpose— we might say he naturalizes the supernatural. By linking the goddess who is "ever shaping new forms" with the genre that is "ever shaping new forms," Huxley is able to color *Nature* with Goethe's affective glow without literally condoning the poet's factually volatile pantheism. In modulating Goethe, Huxley subtly models a more moderate posture: a spirit of wonder towards the things of Nature which, he has just argued, are what we call "the progress of science." He also assumes the same order of hazardry which *Nature* will continue to take on in its quest to reeducate readerly tastes, a gamble which bespeaks the seriousness of this philosophical project. Like its first headliner, embracing the significatory hazards of Goethian personification for the greater benefit of its harmonious truth, *Nature*, the journal which saw itself as a bulwark against the myth, error, and folksiness of "popular" knowledge, conversed with the pantheistic poetry of Romanticism and with the spiritualized rhetoric of natural theology despite the risks, in order to re-order the emotional vision of the readers it hoped to initiate into its republic.[56]

[56] We see a pleasant imitation of Nature's poetical rhetorical move in a letter from a reader. "A Student of Nature" reporting to the journal from Selkirkshire in June 1871 illustrates a responsiveness to *Nature's* Romantic refit. He conjures Sir Walter Scott's "Marmion" to refract an enchanted affect onto his prosaic concern: the task of assessing St. Mary's Loch as a municipal water source. Like Huxley with Goethe, this "Student" employs Scott's affective Romantic connotations to energize his more prosaic description (and defense) of the Loch: *Nature* 4 (June 15, 1871): 122-123; As I note in my introduction, "popularizer" was a loaded term even in the nineteenth century, and while the distinction between "professional" and

The "progress of science" that unfolds in the remainder of the first issue tacitly mimics Huxley's benediction. As each aphorism is simultaneously individual and conceptually linked to a natural whole, so too is each journal article both entire and entirely part of a conceptual whole: *Nature* magazine.[57] Goethe's rhapsody and Huxley's homage are followed abruptly by a prosaic piece on "The Fertilization of Winter-Flowering Plants" by Alfred W. Bennett. *Nature* starts off strong with articles by no less than five eminent scientific men and public figures: besides Huxley's and Bennett's pieces, we glimpse an astronomical report on "The Recent Total Eclipse of the Sun" (Lockyer's specialty); a review of the archaeological "Madsen's Danish Antiquities" by Sir John Lubbock, X-Clubber and early founder of the field of archaeology; an obituary of "The Late Profession Graham" by the chemist A. W. Williamson, and another piece by Huxley, paleontological this time, on "Triassic Dinosauria."[58] Book reviews punctuate the research material, on subjects ranging from "Exotic Lepidoptera" to "The Physiology of the Human Voice," a letter to the editor on the Suez Canal, and brief subject reports on such miscellaneous

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"amateur" was less clear in the Victorian era than today, there was still a perceptible difference between practitioner-popularizers like Faraday, Lockyer, and Tyndall, and amateur popularizers like the Reverend J. G. Wood. See Lightman, *Victorian Popularizers of Science,* 9-13.

[57] Margaret Beetham, "Towards a Theory of the Periodical as a Publishing Genre," in *Investigating Victorian Journalism,* eds. Laurel Brake, Aled Jones and Lionel Madden (London: Palgrave Macmillan, 1990) notes that in addition to each issue of a periodical being part of a complex process in which writers, editors, readers, and publishers all converged to create meaning, the placement of titles, illustrations, and juxtaposed and sequential editorial matter all belie the dialogic relations of the periodical as a text (23-24).

[58] Bennett was a young botanist appointed as the botanical sub-editor on a recommendation from Joseph Dalton Hooker (Meadows, *Science and Controversy,* 31)*;* Regarding "The Recent Total Eclipse of the Sun," one of Lockyer's noteworthy achievements as an astronomer at this time were his spectroscopic observations which eventually lead to the "discovery" and naming of the element helium, J. Norman Lockyer Observatory, normanlockyer.com. November 21, 2016. For the all articles in this list, see *Nature* 1 *(*November 4, 1869); The X-Club was a dining club formed in 1864 by George Busk, Joseph Dalton Hooker, Herbert Spencer, John Tyndall, Thomas Henry Huxley, William Spottiswoode, Edward Frankland, Thomas Hirst, and John Lubbock. A particularly energetic and motivated faction, the X-Club members became influential forces in the organization of science during the second half of the century. See Ruth Barton, *The X-Club: Power and Authority in Victorian Britain* (Chicago: University of Chicago Press, 2018).

developments of knowledge as "The Color of Wine," "The Preparation of Uranium," and reports from the Manchester Literary Society. Goethe has just assured us that Nature "is ever shaping new forms," and Huxley has just confirmed that those forms now lie before us as all "the progress of science": the vibrant cavalcade of *Nature*'s content colored by the Romantic iridescence that proceeds it.[59] With that coloration comes the suggestion that the "wonder and the mystery of Nature" are not absent from scientific concerns, but rather have been shaped into new forms—sometimes serious, sometimes technical, sometimes mundane—and that the general reader must learn to seek for Nature's wonder in new places, or in new ways

If we take a cue from *Nature'*s increasingly diverse concerns over the course of the next several issues, we see that much of its matter focuses not on introducing revolutionary discoveries to its readers, but on presenting materials pertaining to the world with which they already interact. The journal features articles on improved designs for school desks, furnished with practical images; editorials concerned with public education and dispelling the myth of the "Dulness of Science"; a series of letters confirming and disputing observations about the eggs of birds; books about English plants and engravings of English sights like the night sky over London.[60] All are repackaged and reanimated through the concerns, language, and paradigms of

[59] Aileen Miyuki Farrar, "*Wuthering Heights:* Dreams of Equilibrium in Physiology and Physics," *Victorian Review* 42, no. 2 (2016) notes how mid-century novelists like Emily Brönte took this Goethian spirit "unity in diversity," which Humboldt, likewise from the poet, and applied it to the sense of fragmentation in their fictions (309). Of *Wuthering Heights,* Virginia Woolf, "*Jane Eyre* and *Wuthering Heights*," in *The Common Reader* (1925) (London: Harcourt, 1953) wrote that Brönte "looked out upon a world cleft into gigantic disorder and felt within her the power to unite it in a book" (159-165) which Farrar connects to Humboldt's cosmic sense of harmony across all of Nature. While Huxley himself seemed to be less troubled by the so-called contextual fragmentation of the Victorian era, his Goethian patch-job speaks to a broader cultural desire to hold together the increasingly disparate fragments of the world.

[60] Take, for example, a brief article on November 11th which takes up a most quotidian subject: school desks. "A New Form for Schools" discusses how a new and inexpensive design will help remedy posture problems in children by introducing back support. It is even accompanied by an engraving of the familiar

science. If it was, as an 1874 book review suggests, "the proper function of Science to discover, among the changing phenomena of the world, the permanent relations which are the conditions of reasonable thought," then *Nature* took up the task of discharging that function, weaving relations among subjects familiar and abstract.[61] We might say that *Nature* lifts a veil, but it would be more appropriate, and more in keeping with scientific observation, to say that *Nature* models a way of seeing which has a "sensitive, practiced, and responsive fidelity to its surroundings," ineffably felt as well as cogitated.[62] This mode returns us to Wordsworth, who found a sensitive, practiced fidelity the hallmark of the true poet— though the bard's ideology clashes with *Nature's* representation of him in peculiar but telling ways.

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sight of a young student at a school desk, showcasing the design. It is a sensible, relatable concern, examined through a scientific eye. The same issue features an editorial on "The Dulness of Science", a tongue-in-cheek rebuttal of the myth of science's inherent blandness which is discussed in the following section. *Nature* does its part to give the lie to this myth in the way it either adjusts the discourse around other common objects, or renders those objects in the light of science simply by addressing them at all *Nature* 1 (November 11, 1869): 43-44. An article on "Cuckow's Eggs" set off, for the better part of a year, a series of letters to the editor, with lay persons writing in to confirm or dispute observations on the color, quantity, etc., typical of cuckoo eggs, *Nature* 1 (November 18, 1869): 74-76. The November 25th 1869 issue features another subject close to home: a book review of the "Plants of Middlesex," *Nature* 1 (November 25, 1869): 107-108. Readers purchasing a Christmas-week issue were be treated to, among other things, a beautiful engraving of the night sky over St. Paul's ("The Midnight Sky"), *Nature* 1 (December 23, 1869): 215-216, and a rather charming paean to that festive winter parasite, "Mistletoe".

[61] Review of Balfour Stewart's *An Elementary Treatise on Energy and its Laws, Nature* 9 (January 15, 1874): 198-200. This review also happens to recapitulate *Nature's* Romantic tutorial style, summoning Percy Bysshe Shelley's *Prometheus Unbound* to color Romantically the dynamical ebb and flow of energy through the universe. "We might attempt a description of a world thus recoiling on itself—the rivers running up into the hills, heat flowing from cold bodies to hot, and men passing over the stage of life from their graves to their cradles, ignorant of the past and remembering only the future, as Shelley sings, in his musical delirium:

"We have passed Age's icy caves,
And Manhood's dark and tossing waves,
And Youth's smooth ocean, smiling to betray;
Along the glassy gulfs we flee
Of shadow-haunted Infancy,
Through Death and Birth, to a diviner day."

[62] Owens, "Nature's Motto," 2015.

"The solid ground of Nature": Wordsworth and "states of feeling"

As with all of *Nature*'s Romantic stowaways, Wordsworth's presence draws its power primarily through association. In fact, as the shortest of our three Romantic excerpts, the epigraph from "A Volant Tribe of Bards" is the one most dependent on the cultural capital of its author's corpus, since the line itself is brief and gives little indication of the context, also obscure, whence it hails. The words themselves— "To the solid ground/Of Nature trusts the mind which builds for aye"— relay a certain empirical confidence. Taken in isolation they propose that, like the constituents of *Nature,* those who wish to build a community upon sound scientific knowledge should place their trust only in the "solid" observations they take from the physical world. But, like a chemical catalyst, the application of Wordsworth's name radically modifies the significance of the words "Nature" and "mind." If, as Deidre Lynch writes, "habit enables the reader's naturalizing of the initially arbitrary connection between the verbal sign and what it imports," Wordsworth's name stimulates the readerly habit of connecting "Nature" to what Lionel Trilling called the "myth of animate Nature of which Wordsworth had been the chief exponent."[63] This associative habit has its benefits and its limitations. The shorthand is useful because, while the Romantic's Nature is antithetical to the agnostic's, Wordsworth conjures the habit of associating Nature and the observation thereof with a powerful, often revelatory emotional experience. *Nature* will routinely encourage such a habit, as it does in an 1869 article on "Lectures to Working Men," where the author rhetorically figures the act of cognitively engaging with nature via science as an emotional one, recounting his delight in observing lecture-goers experience "the feeling of seeing…what some thing have to do with one another;

[63] Deidre Lynch, *Loving Literature* (University of Chicago Press: Chicago, 2015), 169; Lionel Trilling, *Matthew Arnold* (New York: 1949), 89.

the feeling, in fact, of making a discovery."[64] Wordsworth's persistent presence confirms and stabilizes such emotional tones, ideologically authorizing, like Huxley's Goethe, association based on feeling as well as knowledge.

But the Wordsworthian habit likewise conjures an image of Nature at odds with *Nature's* intention to promote an empirical vision of the cosmos that is grand and mysterious, but material and "value-free," signifying nothing but itself.[65] For Wordsworth's Nature is less about understanding the cosmos than about understanding man, or about believing that understanding humankind suffices cosmic knowledge. From this Romantic view Victorian writers across the board tended to dissent. Stephen Gill summarizes Swinburne's hostility to Wordsworthianism, expressed just a few years before *Nature*: "As a poet, Wordsworth's 'concentration, his majesty, his pathos have no parallel,' but as a seer Wordsworth peddled illusion, not a saving illusion but one which robbed Man of the strength that comes from knowing and facing the truth: "Man's welfare' is 'not the aim of nature'."[66] Swinburne's account suggests that the Wordsworthian illusion—Nature works to humankind's welfare— prevented meaningful engagement with the new realities presented by an indifferent universe. Some of those realities felt bleak: Matthew Arnold scoffed to a preacher that harmony with Nature was an "impossibility"—"Nature and man can never be fast friends."[67] But "there [was also] grandeur in this view of life," as Darwin wrote of the large, deep, unceasing and unplanned permutations of Nature that preceded and

[64] "Lectures to Working Men," *Nature* 1 (November 18, 1869): 71-72.
[65] Desmond, *Huxley,* 187.
[66] Gill, *Wordsworth,* 172. The quote from Swinburne comes from an article in *The Spectator* on "Mr. Swinburne as Critic," October 5th, 1867.
[67] Matthew Arnold, "In Harmony with Nature" (1867), *Poems by Matthew Arnold* (London: Macmillan and Co., 1877), line 13.

transcended the human experience.[68] The majesty in Darwin's Nature—*Nature*'s Nature—was found by looking outward; in Wordsworth's, inward.[69] The habit of "Nature" thus inherited from Wordsworth's poetry tended towards a brand of knowledge that was ultimately self-interested, or at least self-involved, believing that Nature worked *for humankind*—for its illumination, for its edification—and was therefore *about humankind.* It could not, in this way, be said to be scientifically curious. Many of the more iconic lines of the poet's verse illustrate this self-interest clearly enough. Personal and historical associations animate the Nature of "Tintern Abbey"*;* the source of what is "felt in the blood, and felt along the heart" is not the resonance of the natural landscape as such, but the way that landscape connects the poetic speaker to the feelings of a past version of himself.[70] The Nature that "never did betray/The heart that loved her" is never truly other; but is rather a reflection of the self, in which things are not *things* so much as they are portals to other memories, *human* memories, which allow the poet to self-actualize all the more clearly when they refract back onto him.[71] That impulse from the vernal wood in "The Tables Turned," after all, teaches us not more of nature, but "more of man."[72]

In fact, *Nature*'s mis-quotation of "A Volant Tribe of Bards" highlights the dialectical tension that opposed Wordsworth's presence in *Nature* with the journal's empirical project. In

[68] Charles Darwin, *On the Origin of Species by Means of Natural Selection, or The Preservation of Favored Faces in the Struggle for Life* (1859) 5th ed. (London: John Murray, 1869), 579.
[69] According to Joseph Beach, *The Concept of Nature in Nineteenth Century English Poetry* (New York: Russell and Russell, 1966), Wordsworth's work increasingly recognizes the idealistic implications of this inward-looking— that in so doing the imagination comes to "shape the materials offered by the senses" (206).
[70] Wordsworth, "Tintern Abbey," line 29.
[71] Wordsworth, "Tintern Abbey," lines 123-124.
[72] William Wordsworth, "The Tables Turned; An Evening scene, on the same subject" (1798) in *Wordsworth's Poetry and Prose,* lines 21-24.

the poet's original formulation from 1823, "Mind" is capitalized, while "nature" is not.[73] Martin Kemp had read this as an editorial choice to retain consistency with the mystical Nature in Goethe's subsequent essay, but I want to suggest that such a move, if intentional, signals the possibility of a more pointed poetical awareness on the part of its executor.[74] I agree with Thomas Owen that in shifting the emphasis from "Mind" to "Nature," *Nature* is forcing a reversal of the Wordsworthian priorities just discussed. By contrast, the magazine subordinates the mind to the grander power of "Nature." Unmediated, Wordsworth's "nature" is unlikely to "teach you more of [Nature]," but it may teach you something of what Wordsworth *wants* from nature— a kind of transcendent meditation. In this, the full poem of "A Volant Tribe of Bards" that hangs, shadowy, behind the epigraph, is quite Wordsworthian. More importantly, though, the sonnet in its entirety gives us a sense of what paradoxically makes Wordsworth such a serviceable risk for *Nature.* Although his poem subordinates nature to the "Mind," in so doing it articulates a profundity lurking beneath natural surfaces that science, too, seeks to capture. The full revised 1827 sonnet, from which *Nature* seems to have drawn, reads:

A VOLANT Tribe of Bards on earth are found,
Who, while the flattering Zephyrs round them play,
On "coignes of vantage" [sic] hang their nests of clay;
How quickly from that aery hold unbound,
Dust for oblivion! To the solid ground

[73] A1827 revised edition of the poem which first appeared in a miscellaneous collection edited by Joanna Baillie in 1823, according to Thomas Owens. The poem in *Nature*, as Owens and others have noted, is technically misquoted— in his 1827 revision Wordsworth characteristically capitalizes 'Mind' in his sonnet, 'nature' is in the lower case. Kemp suggests that Wordsworth's capitalization is in keeping with the mystical Nature in Huxley's subsequent essay on Goethe's Aphorisms (25). In any case, the full original line from the 1823 Baillie edition runs "To the solid ground/Of nature trusts the Mind that builds for aye," not "Nature" or "which".
[74] Kemp, "Noticing Nature," 25.

Of nature trusts the Mind that builds for aye;

Convinced that there, there only, she can lay

Secure foundations. As the year runs round,

Apart she toils within the chosen ring;

While the stars shine, or while day's purple eye

Is gently closing with the flowers of spring;

Where even the motion of an Angel's wing

Would interrupt the intense tranquillity

Of silent hills, and more than silent sky.[75]

Here Wordsworth offers up a poem about poets and poetry, not about Nature, though it moves through the material of Nature to forward his purpose, foremost in his use of the figure of the barn swallow (or martin). Like that undiscerning architect the barn swallow, he suggests this "volant tribe" of poets and poetasters choose easily-gotten or fleetingly fashionable subjects—"coigns of vantage" or convenient corners—rather than sound structures upon which to build their poetic nests. Wordsworth appears to draw a double reference with his metaphorical swallows, the quotations around "coigns of vantage" denoting an allusion to *Macbeth.* The

[75] *The Complete Poetical Works of William Wordsworth, Poet Laureate, Etc. Etc.* Ed. Henry Reed (Philadelphia: Troutman and Hayes, 1851), 221. This is the revised 1827 version of the poem from which *Nature* —probably Macmillan—drew. The 1823 version of the poem excerpted in Joanna Baillie's compilation of poems differs significantly—in fact, the line from which the epigraph is drawn is entirely absent. Lines 4-9 instead read:
"Work cunningly devis'd, and seeming sound;
But quickly from its airy hold unbound
By its own weight, or wash'd, or blown away
With silent imperceptible decay.
If man must build, admit him to thy ground,
O Truth!—to work within the eternal ring."
Joanna Baillie, *A Collection of Poems, Chiefly manuscript, and from living authors* (London: Longman, Hurst, Rees, Orme, and Brown, 1823), 53.

phrase recalls a brief exchange between Banquo and Duncan wherein Banquo reads the swallow's preference to build on every "jutty, friese/Buttress, [and] coign of vantage" as confirmation of the pleasantness of Macbeth's castle's "seat."[76] "Where they most breed and haunt," Banquo affirms, ""I have observed/The air is delicate."[77] Wordsworth draws upon the authority of the Bard of Bards to solidify the argument of his octave, which locates the distinction between bad and good poetry in the source of its building materials. Bad poets choose bad materials. In seeking quick flattery, poetasters indiscriminately construct verses out of inferior fodder, "dust for oblivion" as impermanent and insubstantial as the "procreant cradle" of Banquo's barn swallows.[78] They are, like Macbeth himself, pretenders whose foundations will topple. Good poets, like Shakespeare (and implicitly like Wordsworth) recur instead to the "solid ground/Of Nature" for their poetic materials. The octave proves its own argument by example, grounding its operant metaphor in the swallow, through whose natural body Wordsworth and Shakespeare meet across time on common ground: enduring through literature and through centuries, the bird's industrious actions seem eternal, a secure foundation upon which the good poetic mind can build "for aye."

But we can see very clearly that, just as Wordsworth (and Shakespeare) use a natural object to address a subject *other* than Nature, "A Volant Tribe of Bards" does not claim that immortal poetry must take nature for its subject. It only requires that poetry take Nature as a catalyst, and inspirational mine of raw material, after which the poetic mind may wander where

[76] William Shakespeare, *Macbeth,* in *The Norton Shakespeare* eds. Stephen Greenblatt, Walter Cohen, Jean E. Howard, Katherine Eisaman Maus (New York: W. W. Norton and Co., 2008), 1.6.6-7.
[77] Shakespeare, *Macbeth,* 1.6.8-9.
[78] A "coign" of vantage (coign: properly a projecting corner) is a "position...affording facility for observation or action." *Oxford English Dictionary.* Accessed December 15, 2018.

it will.[79] Thomas Owens has suggested that the phrase "that builds for aye" implies the necessity of a "Mind" with a particular *kind* of purposefulness.[80] This formulation suggests that building "for aye" is the preserve of a special talent—reminiscent of the Romantic genius mode of inspiration that professional Victorian scientists increasingly disliked.[81] Owens argues that *Nature'*s choice to convert the line to "which" democratically implies that *all* minds are capable, with the right guidance, of surveying the "solid ground of Nature." Owen's grammatical reading somewhat misses the mark: the grammatical structure that would confirm his reading would be the placement of a comma before "that," since "which" and "that" are interchangeable prepositions. However, his interpretation of Nature's repurposing Wordsworth as a democratic move is certainly borne out by the journal's contents, which continually uphold an egalitarian standard of learning. We might harken again to *Nature'*s feature editorial, two weeks after its debut, on "Lectures to Working Men."[82] The article celebrates the working man's "true desire for, and…true appreciation of, something genuine in science" and notes how eagerly he consumes scientific information when presented not as "humbug" but as a "piece of real

[79] Jonathan Smith, *Fact and Feeling: Baconian Science and the Nineteenth Century Literary Imagination* (Madison: The University of Wisconsin Press, 1994) has the same reading (56-58).
[80] Owens, "Nature's Motto," 432.
[81] Recall Kelvin's critique in his address to the BAAS: "Accurate and minute measurement seems to the non-scientific imagination a less lofty and dignified work than looking for something new. But nearly all the grandest discoveries of science have been but the rewards of accurate measurement and patient long-continued labour in the minute sifting of numerical results. The popular idea of Newton's grandest discovery is that the theory of gravitation flashed into his mind, and so the discovery was made. It was by a long train of mathematical calculation, founded on results accumulated through prodigious toil of practical astronomers, that Newton first demonstrated the forces urging the planets towards the sun, determined the magnitude of those forces, and discovered that a force following the same law of variation with distance urges the moon towards the earth." See "The British Association Meeting at Edinburgh," 262. Richard Holmes also addresses this mode of the Romantic scientist, like the Romantic poet, as the lone genius of rarified mind in *The Age of Wonder.* For figurations of Romantic science see also Jan Golinski, *Science as Public Culture, 1760-1820 (*Cambridge: Cambridge University Press, 1992); Andrew Cunningham and Nicholas Jardine, *Romanticism and the Sciences* (Cambridge: Cambridge University Press, 1990).
[82] "Lectures to Working Men," *Nature* 1 (November 18, 1869): 71-72.

teaching." "It is a wonderful sight," the editorial reads, "to see so many faces intelligent and seeking for knowledge." Here, as elsewhere, *Nature* insists that science is for everyone, and that the only criterion for its pursuit is a willing curiosity.[83] Faraday, not Newton, remains *Nature*'s Smilesian model.[84]

Nevertheless, Wordsworth's version of "trusting to Nature" implies an act of faith, not experimental certainty. The word "trust" loosens the solidity of "convinced," as together these are terms of persuasion—"trust" is earned through confidence, and to be "convinced" suggests a period, prior to that conviction, of deliberation. As a result, the repetition in "there, there only" gives a sense of the poet speaking to himself, a reminder to himself of where he has chosen to place his trust. In this "A Volant Tribe of Bards" does share a certain parity with the scientific paradigm, albeit with a different philosophical stake. The empiricist places his trust in observable phenomena. He knows that his senses may mislead him, and that the closest approximation to "truth" derives from the "solid ground of Nature" and its peer-reviewable potential. In a similar spirit, Wordsworth mistrusts the individual poet's taste in artistic raw material. Like the empiricist he suggests that the truest truth, what Matthew Arnold called "the permanent sources of joy and consolation for mankind," derive from the constant variable that all men can access: the "solid ground of Nature."

Of course, the ground of nature in "A Volant Tribe of Bards" turns out *not* to be the solid material from which to collect and build scientific knowledge, as *Nature*'s epigraph version suggests. It doesn't appear to be solid at all— at least, not in any philosophical sense. The solid

[83] See "Science and the Working Classes" Nature 3 (November 10, 1870): 21-22; "Science Lectures for the People," *Nature* 4 (June 1, 1871): 81.

[84] Samuel Smiles, *Self-Help* (London: Ward Lock and co. 1859) in fact cites Michael Faraday as an example of a self-made man, one of those "great men of science, literature, and art—apostles of great thoughts and lords of the great heart—[who] have belonged to no exclusive class nor rank in life" (22).

swallow gives way to a softly teeming landscape, alive with a kind of magical power: blinking, twinkling, flickering with potential energy. The poetic Mind, as we see in the sestet, elects nature as its "chosen ring," because beneath the Romantic patina of spring flowers, purple sunsets, silent hills lies… "*more."* This "more" recalls Carlyle's sense of Goethe's world as "fusible," its natural surfaces a film stretched thin over an other-world; "a sense sublime," as Wordsworth writes in *Tintern Abbey,* "Of something far more deeply interfused/Whose dwelling is the light of setting suns,/And the round ocean, and the living air,/And the blue sky, and the mind of man."[85] The Wordsworthian mind rejects nature's things except that they might melt into "more"— a spirit, a thought, a communion, that "rolls through all things."[86] The hills, the flowers, the sky here are "more than silent," whispering the possibility of transcendent communion with a "world-soul," a universal spirit.[87] These are not merely things-in-themselves; these are more than matter— they are enchantment corporealized.[88]

Few of *Nature*'s readers can have felt the same habitual associations with "A Volant Tribe of Bards" as with "Tintern Abbey," "the most comprehensive document of Wordsworth's nature-theory."[89] Nevertheless, Wordsworth's cultural capital was (and surely is) potent enough for his name alone to conjure up a certain image of Nature.[90] The full poetical context of *Nature*'s epigraph here demonstrates the way in which its benign quotability as an isolated line,

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[85] Wordsworth, *Tintern Abbey,* lines 96-100.
[86] Wordsworth, *Tintern Abbey,* 104.
[87] Schelling, quoted in Beach, *The Concept of Nature,* 100.
[88] The sonnet's prosodic form, for that matter, evinces a similar sense of supernatural disruption beneath a natural structure— "tranquility" rhyming visually with "sky" while disrupting "sky's" sonic rhyme with "eye."
[89] Beach, *The Concept of Nature,* 110.
[90] Particularly as Wordsworth, along with Emerson, Tennyson, and Southey, was among those poets deemed knowable "by heart" in the mid-Victorian (through to the early 20th century's) system of rote education. See Catherine Robson's *Heart Beats: Everyday Life and the Memorized Poem* (Princeton: Princeton University Press, 2012), 31-40.

like many of Wordsworth's "Nature"-isms, both obscures and yet remains connected to a highly metaphysical philosophy. Said philosophy evoked a spiritual naturalism, a far cry from the increasingly agnostic perspective of the natural world that *Nature*'s contributors and the BAAS wanted to promote. But *Nature's* return to Romanticism suggests that the journal didn't want to supplant the *Weltseele* entirely. By placing a confession of trust in "the solid ground/Of Nature" at the head of a weekly catalogue of varied but rigorous scientific matter, *Nature,* like Huxley in his editorial, attempts to re-contextualize Romantic feeling, that otherworldliness beneath the hills and sky, into a diffuse sublimity compatible with the experimental science that rather recognized an enchantment in things in themselves.

Nature thus attempts to modulate Wordsworthian Natural Supernaturalism into a scientific receptivity at once interested yet *disinterested*— humbly aware that Nature's performance is not *for* us, but passionate to investigate it all the same. Nature is *about* nothing, but nevertheless is surely worth our attention. *Nature* enacts this modulation of feeling most regularly in its "Bookshelf" section, where it frequently reviews all manner of popular tomes with an eye to a particular equipoise between accuracy and wonder, as it does in a review of French astronomer Camille Flammarion's *The Marvels of the Heavens* in 1871. The book, commended for being "attractive, and yet not at the expense of accuracy," receives most enthusiastic praise for the way in which it textually reproduces the soaring wonder of the feeling of scientific observation.[91] Flammarion "carries the reader with him by his enthusiasm," traversing the solar system with graceful fancy, "[taking] his reader out with him…to behold the

[91] Interestingly, in the 20th century, David H. DeVorkin, *Sky and Telescope* (June 1981): 536-537 would draw unfavorable comparisons between Carl Sagan's *Cosmos* and Flammarion's work, which he described as relying on "lurid Romanticism."

heavens," and weaving in and out between poetry and mathematical demonstration.[92] But Flammarion's vision recommends itself most highly for its feelingful celebration of scientific reality. "But the poetry of the sight of these appearances [of the night sky] will soon be surpassed by the magnificence of reality," he writes:

> let us keep away from the ordinary path, and begin, on the contrary, by raising the veil in order to allow the reality to shine. Poetry, whose harmonious breath has just hushed our suspended souls, will not vanish on that account; it will rather regain a fresh aspect and a new life, and, above all, a greater energy. Fiction can never be superior to truth; the latter is a source of inspiration to us, richer and more fruitful than the former.[93]

Though we may hear a Byronic echo of "Truth is strange; stranger than fiction," Flammarion parallels more essentially with Wordsworth.[94] He depicts an intimate, imaginative engagement with the stuff of the material universe, one in which the feelings heretofore generated by poetry are resurrected and amplified by scientific understanding. In the contemplation of the distant, untouchable cosmos that has no interest in him, Flammarion feels a rapturous warmth--a Wordsworthian process under modification. Wordsworth's Nature, his "more than silent sky" in "A Volant Tribe of Bards," is wondrous as a vehicle for poetic communion; Flammarion's sky is magnificent for the physical laws that make it what it is. The Wordsworthian feeling for Nature,

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[92] B., "The Marvels of the Heavens," *Nature* 3 (February 9, 1871): 285. *Nature* frequently seems to express approval of a style of writing which makes use of the "object lesson" as a pedagogical mode, as Flammarion does here.

[93] Camille Flammarion, *The Wonders of the Heavens,* trans. Mrs. Norman Lockyer (New York: Charles Scribner and Co., 1871), 8. The question has been helpfully put to me of whether the fact that Lockyer's wife translated this piece might have obliged *Nature* to review such a genre when it would not have otherwise done so. As to the individual case—perhaps. But as to the general case, I think the answer has to be "No": Flammarion (who grew quite popular as the century wore on) should be read here as a type, one of many examples of a certain enchanted prose-works for lay people that *Nature* consistently reviewed. I can only say I happened to pick this example because I quite enjoyed it.

[94] George Gordon, Lord Byron, "Don Juan," in *Lord Byron: The Major Works* ed. Jerome J. McGann (New York: Oxford, 1986), canto XVI, stanza CI, line 801-802.

as we saw, has an internal locus, stirring in response to personal memories activated through the vehicle of hardly-hedgerows, or more than silent sky. Flammarion's affective catalyst, by contrast and like Darwin's "grandeur," is externally located.

For all its aesthetic response, Flammarion's vision is defined by its link to the material: his feeling for the cosmos derives from the very fact of cosmic existence. In *Nature's* universe, we find no supernatural beneath the patina. For the double-star Rigel, he proclaims a

> sympathy for which I cannot and will not defend myself. Between the Pleiades and the beautiful Sirius, it presents to me a magnificent celestial region, enriched with varied worlds, which makes one dream of distant life. Between ourselves, I read an astrological treatise of the middle ages: its title was "Flamma Orionis'. Since that time this name is dear to me: I love it! Now, you know what happiness it is to lovers to speak continually of the object of their devotions.[95]

Both Flammarion's figuration of scientific observation as a producer of "sympathy"("sympathie" in the French) and his indication of that same scientific labor as a facilitator of "devotion" remind us again of Huxley's evocation of Goethe, whose linguistic pantheism analogizes the manifold, unifying sense of connection latent in scientific experience.[96] Working each week in visual concert with such scientific paeans, we might say that Wordsworth's presence initiates, and *Nature* continues to modify, the mediative work that the poet did for a young John Stuart Mill. Wordsworth's verse was medicine to Mill's utilitarianist illness, expressing and attending "not mere outward beauty, but states of feeling, and of thought colored by feeling, under excitement

[95] Flammarion, *Wonders,* 94.

[96] Flammarion's use of the idea of "sympathie" to describe his affective entanglement with astronomical discovery has resonances particularly with the collapse between sense and sensibility in French empiricism. See Chapter 3 for a more detailed discussion of the theoretical underpinnings of this manner of sympathy. For the purposes of this argument, however, it is enough to note that "sympathie" connotes a certain unity of resonance among emotional and physical phenomena.

of beauty."[97] In promoting syncretic works like Flammarion's, or another, similar work on *The Midnight Sky* "in which the magnificence of the heavens and the deep teachings of modern science go hand in hand," *Nature* pushed back the horizon of beauty, exposing the new and strange planes of an unfamiliar universe.[98] Beyond the terrestrial ring, the flower eyes and silent hills, lies more heavenly matter, just as enchanted for its natural aspects as Wordsworth's is for its supernatural ones. In praising the view thereof, the magazine demonstrated how an impersonal material reality might yet offer states of feeling comparable to those evoked by the personal and familiar, the localized beauty of the human mind reflected in Nature.[99]

Such a "state of feeling…under excitement of beauty" leads us to Wordsworth's second contribution: the contemplation of the everyday. In its quotidian attentions, Wordsworth's poetic eye shares a certain method with the scientific eye, a method which *Nature* will present initially in its second-week article "The Dulness of Science." A contemporary article on "Peter Bell" from the magazine *The Rose, The Shamrock, and the Thistle* voices a Wordsworthian commonplace: he "sees the beautiful in the common, the sublime in the simple."[100] The poet finds poetry not just in the "far-off heavens" but in "the common incidents and ordinary routine of life." Likewise, *Nature* attempts to direct the vision of the generalist reader to find a higher order of feeling in the ordinary routine and reality of scientific life, not just the magnificent real

[97] John Stuart Mill, *Autobiography of John Stuart Mill* (New York: Henry Holt and Company, 1875), 148.
[98] From a review of *The Midnight Sky: Familiar Notes on the Stars and Planets* by Edwin Dunkin, F. R. A. S. of the Royal Observatory, Greenwich, published by the Religious Tract Society. "The Midnight Sky," *Nature* 1 (December 23, 1869): 215-216.
[99] For a more in-depth discussion of the defamiliarized beauty of the scientific paradigm, see chapter two, especially the section "Beautiful things are common."
[100] S. F. Williams, "Wordsworth's "Peter Bell"," *The Rose, the Shamrock, and the Thistle* 17 (September 1863): 505-512.

like the heavens, but the mundane real, like London's streets and gardens.[101] Witness a *Nature* reader's confidence that a "competent man of science" needn't "[wander] into the remote regions of extraordinary phenomena, but simply [expound] ordinary life laws" in order render a subject like "biology, as it affects our daily existence…refreshingly new and interesting to thousands of City-born and bred toilers."[102] Such "life laws" are offered up in the magazine's reviews of books like Alfred Smee's *My Garden,* wherein the erstwhile inventor of the galvanic battery takes readers on a kindly walk through his Surrey garden, the '"vegetables, flowers, and fruit-trees…blended together in one harmonious whole" that for its simple familiarity invites "a healthy love…of the study of Nature herself."[103]

Nature promotes careful study and observation by presenting institutional and lay reports alike; rhetorically diffusing excitement among all subjects, embracing the urban, mechanical, un-lovely, and not just the aesthetically pleasing. In doing so the journal recapitulates the claims of one of Goethe's many inaugural aphorisms: "That which is most unnatural is still Nature."[104] An article on smelting renders the Bessemer process in igneous brilliance, the common industrial process of tempering steel sublimed—metaphorically, anyway—through language. In the "blow," "magnificent cascades of brilliant coruscating sparks are belched forth, and the dazzling spray as it dashes against the walls of the flame-shaft rebounds with redoubled splendor, each glowing globule being shattered by the shock and

[101] In *Man's Place in Nature,* Huxley uses the term "intellectual sublimity" to describe the state of feeling that arises from the superimposition of scientific knowledge over the automatic reflex of wonder in natural contemplation— in the case of his example, the contemplation of the Alps. "But the geologist is right; and due reflection on his teachers, instead of diminishing our reverence and our wonder, adds all the force of intellectual sublimity, to the mere aesthetic intuition of the uninstructed beholder" (113).
[102] Letter to the editor on "Science Lectures for the People," *Nature* 4 (June 15, 1871): 120.
[103] Alfred W. Bennett, "My Garden," *Nature* 6 (July 4, 1872): 186-188.
[104] Huxley, "Aphorisms," 9.

bursting into rescintillating fragments."[105] Converters pour out streams of "fiery hail," and their flames emit "long streams of ghostly light [that pour] through every opening…in pallid beams." Like Wordsworth, aesthetically elevating old huntsmen and leech gatherers, and enchanting "rocks and stones and trees," *Nature* invigorates the "real work" and real matter of science.[106] It aims to reform the public sentiment not through the "conjuring tricks" of substanceless "Science so-called" but through a conversion of aesthetic principles, enlivening the everyday so that the seeking mind "should let the things grow upon him until there sprang up an actual fondness for plain scientific truth."[107] In fact, *Nature's* descriptive exaltation of the mundane, and its commensurate praise of writers who likewise descriptively exalt the mundane, follows the mandate the journal lays out when its second issue makes a third major Romantic turn in "The Dulness of Science": What is "dull" is not dull— merely incorrectly seen, and incorrectly felt.

Coleridge and "The Dulness of Science"

An editorial titled "The Dulness of Science" heads off *Nature's* second issue on November 11th 1869, addressing directly what the first issue leaves to Romantic suggestion: What is the matter of science, and how to orient oneself towards it? In the course of this discourse a third figure, Coleridge, emerges as an intertext through which to interrogate our "relations with the universe around [us]" and the feelings that should be involved in the process of learning about that universe—which is to say, the intellectual and emotional experience of a foray into science. The title alone indicates a playful, parodic approach to the problem, ventriloquizing a sentiment

[105] "Papers on Iron and Steel No. II: The Bessemer Process," *Nature* 3 (January 12, 1871): 211-212.
[106] William Wordsworth, "Resolution and Independence" (1815), "Simon Lee, the Old Huntsman" (1798), "A slumber did my spirit seal," (1815) all in *Wordsworth's Poetry and Prose,* 397, 23, 115.
[107] From a review of *The Universe: or, the Infinitely Great and the Infinitely Little* by F. A. Pouchet, "The Universe," *Nature* 1 (January 6, 1870): 259-260.

thoroughly antithetical to the spirit so dearly bought by the first issue. "We have all heard," the article begins

> Of the fox who, when he had lost his own tail, tried to prevail upon his comrades to dispense with theirs; and we think it must surely have been in a congress of the blind that the question was first started, "Is it dull to use your eyes and look about you?"[108]

Aesop's fable works in concert with the article's tongue-in-cheek title to neutralize the dissent of science's tailless opponents, to whom we like Aesop's council of foxes might likewise put the question whether that "worthy member that moved against the wearing of tails, gave his advice for the advantage of those that *had tails,* or to palliate the deformity and disgrace of those that *had none?"*[109] Like Aesop's vulpine interlocutor, *Nature*'s readers are cautioned to suspect the faculties, or the motives, of those who find science "dull."

We might well take "Is it dull to use your eyes and look about you?" as the functional thesis of *Nature*'s generalist project as much as of this article. The rhetorical question reduces the primary philosophical tenet and mechanism of empiricism—observation, data collected by the senses—into a personal, familiar, replicable and relatable exercise, equating the act of "doing science" with one of the basic properties of simply being entity in the world. Such a universalizing move ascribes the misconception of science as "dull" work to a "shortsightedness about the scope of scientific concerns"— bad imaginative "vision." Indeed, *Nature* doggedly adheres to the progressive credo, recapitulated both in educational reform and in other public science media, that lay people must only be taught to "make use of [their] eyes" in order for the

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[108] "The Dulness of Science," *Nature* 1 (November 11, 1869): 43.

[109] Samuel Richardson and Aesop, *Aesop's Fables: With Instructive Morals and Reflections Abstracted from All Party Considerations, Adapted to All Capacities, and Design'd to Promote Religion, Morality, and Universal Benevolence…And Life of Aesop* (York, England: Printed for T. Wilson and R. Spence, 1788), 66. Aesop's fables underwent manifold iterations in the nineteenth century alone, but regardless of how the fable of the Fox with No Tail was framed, the moral remained of this spirit.

common matter of the physical universe to reveal its wonders.[110] The journal heartily recounted tales of lecturers and teachers who captured the imagination through showing rather than telling; and it reviewed books like Flammarion's which adopted the same demonstrative pedagogy, books that "[took their] readers out with [them]…to behold the heavens on a starry night" and "tread with a light fantastic mind over the animal and vegetable kingdoms, the formation of the globe…and many other things besides."[111] Such articles gave the lie to "what is commonly called the usual dry scientific literature," and instead modeled expansive, penetrative, and infinitely curious modes of "looking about you" at a physical world which rewarded the looking. Such enthusiastic renderings of nature made the idea of the "dulness of science" preposterous, a self-soothing conspiracy of the uncurious. It could only have been "in a congress of the blind that the question first started."

> For, in fact, what is science but this? We come unexpectedly into a great mansion, of which we know nothing; and if it be dull to seek out the various inmates of the house, and

[110] "Science and the Working Classes," *Nature* 3 (November 10, 1870): 21-22; This issue of vision, or lack thereof, calls to mind Wordsworth's *Peter Bell* (quoted elsewhere in this chapter). Huxley will make reference to Peter Bell in his lecture "On the Educational Value of the Natural History Sciences" (1854) in *Lay Sermons* (New York: D. Appleton and Co., 1870), 91; Arabella Buckley makes the same reference in her lecture on "The Fairyland of Science, Lecture I: How to Enter It; How to Use it; And How To Enjoy It," *The Fairy-land of Science* (London: Edward Stanford, 1880), 7.

[111] See, for example, a November 1870 note attesting to the "great success" of the "series of science lectures addressed to working men at Manchester," which were "literally crowded by most attentive audiences" clamoring to see Huxley, Henry Roscoe, and William Huggins (all subjects of the following chapter) "Notes," *Nature* 3 (November 17, 1870): 53. See also contributor W. Matthieu Williams' many accounts of his students' increased excitement when he began to adopt hands-on lessons— teaching children "four or five years of age" the bones of the skeleton, for example (Letter, August 10, 1871) ; Review of Camille Flammarion's "The Marvels of the Heavens," *Nature* 3 (February 9, 1871):285; Review of "The Universe," Nature 1 (January 6, 1870); review of "Sermons in Stone," *Nature* 1 (December 2, 1869): 130-132. For other instances of *Nature*'s acknowledgement of the cultural rumor of science's dryness, witness a letter to the editor responding to an article on "Science Lectures for the People": "Books are plentiful, but it is very tiresome to wade through dry pages, scientifically dried of their sap by the use of terms which are not commonly understood—especially after the wearying labors of the day…" *Nature* 4 (June 15, 1871): 120.

> to ascertain its laws and regulations, then science is dull; but if this be important and interesting, then so also is science interesting.

Here *Nature* familiarizes science through a domestic metaphor, the house, in order to demystify a process which is available to everyone and whose matter is immediate, all "about you." To such a sensible provocation, the sensible person cannot possibly object. If we are called to "look about us," the Wordsworthian angel just above encourages the direction of this "looking"—to Nature.

"The Dulness of Science" attempts to theorize the ideal scientific disposition, to prod at the question: what is the stuff of Nature to men, and how should we engage with it? It approaches its topic by way of a taxonomic scale of "types" of men, a scale that ascends by degrees of sensory fitness, from the totally blind to the enlightened and penetrative. First, the "animalcule," "ignorant of all laws, civil, religious, physical, moral, social, sanatory: (we had better not inquire too narrowly concerning his profession[!] [He] will be found somewhere in the purlieus of this great city)." Then Farmer Hodge the rustic, speaking in rough vernacular, who while he has "some sense of duty to his neighbor," "maintains no sort of relations with the universe around him."[112] "Cui Bono" follows next, a "very good sort of man," but "short-sighted"— "he sees nothing distinctly that is more than one inch from his face," and values science only as it immediately and practically improves his life. The catalogue up until this point is playful,

[112] Two external poetic figures actualize Hodge, Tennyson and Coleridge. One is a stanza from Tennyson's dialect experiment "The Northern Farmer," the other a synopsis of Coleridge's account of an underwhelming dinner guest from his "Table Talk" from June 24, 1827. The actual account reads, amusingly: "Silence does not always mark wisdom. I was at dinner, some time ago, in company with a man, who listened to me and said nothing for a long time; but he nodded his head, and I thought him intelligent. At length, towards the end of the dinner, some apple dumplings were placed on the table, and my man had no sooner seen them than he burst forth with—"Them's the jockey's for me!" I wish Spurzheim could have examined his head." Samuel Taylor Coleridge, *The Complete Works of Samuel Taylor Coleridge*. New York: Harper Brothers, 1884), 289. Neither reference is explicitly cited, but mentioned in a conversational manner as though the reader and writer are equally familiar and explanations are unnecessary. *Nature*'s trust of its reader here initiates them into a "republic of letters."

reading a little like the beginning of a bad joke ("There are six kinds of people in this world…"), as *Nature*'s gentlemanly priggishness peeks through in its simultaneous caricature and Romanticization of the working person. But the editorial's purpose is serious despite its satire, and will characteristically show itself sympathetic to the intellectual and imaginative needs of everyday people. *Nature* goes on to introduce three more characters from whose respective faculties it tries to ascertain what it takes to affectively or spiritually respond to the experience or contemplation of the universe. Following "Cui Bono" are the "[man] of strong eyesight, but without the leisure to use it" and the "affluent and nobly born" man, with ample leisure but no eyesight. A pointedly-named "Philosophus" will settle the matter, but not before Coleridge enters to negotiate the phenomenology of perception.

Coleridge's "Dejection: An Ode" effects an equipoise between the person with sight but no means, and the person with means but no sight. *Nature* deploys stanza IV of the "Ode" to resolve the divide between these two inverse figures: the layperson, isolated from the natural, whose ears are yet not deaf to the "mighty utterance that nature gives" and the aristocrat with access to the natural and the beautiful, but who can apprehend neither "what is grand in nature" nor what is "great in art." One lacks nature, the other eyesight; and according to *Nature,* "the appreciation of the beautiful and the true," which is to say the philosophical object of science, "is the product of the coming together of [these] two things. In fact, the result is much the same, whether a person with no eyes is carried into a glorious landscape, or whether a person with good eyes is shut up in a dark room." That scientific imagination requires *both* conditions to flourish the article offers to prove by quotation:

> It is of this the poet speaks, when he says,
>
> O Lady! we receive but what we give,

And in our life alone does Nature live;
Ours is her wedding-garment, ours her shroud!
And would we aught behold of higher worth
Than that inanimate cold world allow'd
To the poor, loveless, ever-anxious crowd,—
Ah! from the soul itself must issue forth
A light, a glory, a fair luminous cloud
Enveloping the earth;
And from the soul itself there must be sent
A sweet and potent voice, of its own birth,
Of all sweet sounds the life and element!

Does Coleridge steer aright? *Nature* has just argued that a person requires both strong mental eyesight and access to the natural world in order to "appreciate the beautiful and the true." Concerned with the grandeur of the natural laws made visible through scientific observation—eyesight—*Nature* assumes the existence of a material reality. Coleridge's poem, on the other hand, posits a metaphysical problem. The poet's figuration of our relationship to Nature actively complicates the editorial's philosophical schema. Coleridge, channeling Berkeley's idealism, suggests that Nature exists *only* as we perceive it, and is to some degree constituted by and dependent on the human mind for its character.[113] "We receive but what we give/And in our life alone does Nature live" casts doubt on *Nature*'s Wordsworthian mandate—how can we "trust" to Nature if Nature merely reflects our own minds? This stanza has no belief

[113] See Berkeley's subjective idealism in *Three Dialogues between Hylas and Philonous* (1713) and *Treatise Concerning the Principles of Human Knowledge* (1710); for discussion of this in regards to Coleridge see Beach, *The Concept of Nature,* 123-124.

in the independent "mighty utterance that all nature gives." It sees nothing of "higher worth" in the "inanimate cold world" save what the soul might impose upon it— "must*"* impose upon it, as the poem twice here insists. "Nature" here seems to have little power on its own, and no independent existence. Significant criticism has historically read "Dejection" as an ode of disillusionment, an "irreparable loss of joy and creativity," of that "visionary gleam" recalled by youth in the "Intimations Ode" with which it converses.[114] The process of excerpting on the part of "F. R. S.," the article's author, somewhat mitigates the disillusionment with "Nature" that pervades the larger poem, but that sense of loss is still palpable in the language of this stanza— our "life alone," our life a "shroud," the mass of men far from a harmonious Goethean aggregate, instead a "poor, loveless, ever-anxious crowd." Readers who knew their Coleridge might recall how elsewhere in the poem, the poet gazes "with how blank an eye" at the stars, the wood, the moon; they register, but excite no emotion. "I see, not feel, how beautiful they are!" he laments, for in "Dejection" no "outward forms [can] win/The passion and the life, whose fountains are within." Only the joy he has stored in memory from other sources can imbue Nature with a feelingful aspect, a shadow of the enchantment that youth bestows so naturally. Yet as it has done before, *Nature* will corral its poet by implication and sleight of hand to empirical purpose.

Philosophus, *Nature'*s final type, takes quite the opposite view from Coleridge's poetic speaker. A wise fellow, he inverts the Coleridgean philosophy, extracting joy from outward forms through the application of his scientific eyesight. Philosophus has come to understand the

[114] M. H. Abrams, *Natural Supernaturalism* (New York: Norton, 1971), 448; Coleridge began to draft "Dejection" as his "Letter to——— (Sara Hutchinson)" on April 4, 1802 in response to the draft stanzas of the "Ode" that Wordsworth began to compose on March 26 of that year. See Halmi, Magnuson, and Mondiano's preface to "Dejection: An Ode" in *Coleridge's Poetry and Prose* (New York: Norton, 2004) 143 and William Ulmer, "Radical Similarity: Wordsworth, Coleridge, and the Dejection Dialogue" *ELH* 76, no. 1 (2009): 192-193. For an earlier critical synopsis of "Dejection" see Panthea Reid Broughton, "The Modifying Metaphor in 'Dejection: An Ode,'" *The Wordsworth Circle* 4, no. 4 (1973): 241-249.

laws of energy through the patient study of ordinary occasions—"in the railway carriage, on the thoroughfare, in the study, on his bed, in the night watches; and now that he had come to perceive their exceeding grandeur, and beauty, and simplicity, they were a source of great and continual joy to him, and recompensed him more than a thousandfold for all the trouble he had taken." He uses his eyes to look about him at the "cold inanimate world," and from the process of synthesizing scientific observations into a beautiful "Truth," he derives knowledge, and something greater still: "continual joy." (Philosophus' empirical heart-gladness here stays close to Romantic roots, seeming as it does to riff on the soul-fortifying "joys" of nature and of love so central both to "Dejection" and to Wordsworth's "Intimations Ode.")

Placing Coleridge between the respectively deficient urban and nobly born men on one hand, and Philosophus who sees and feels correctly on the other, *Nature* shunts the poet into a position of brokerage as it reframes a dejected Nature as a hopeful one. If we consider that Philosophus comes to his "great and continual joy" only after the "trouble he had taken" to "patiently pursue" the laws of energy (which are not difficult to grasp, but "merely remote from our ordinary conceptions"), we might then read "We receive but what we give" as a commentary about returns on imaginative investment. Read this way, the seeker of Nature can derive truth—and joy—from the process of science only in proportion to the effort he is willing to expend. *Nature* seems to be finessing a point: firm in a conviction of Nature's inherent worth, the journal likewise accepts the power of the observing mind to "half-create" what it perceives.[115] The ground of Nature may be solid, but the human mind isn't, and so to properly take in that something of "higher worth," the "soul itself" must issue forth with the right attitude: that is, with the belief that to "use your eyes and look about you" is important and interesting, and not dull.

[115] Wordsworth, *Tintern Abbey,* lines 107-108.

Nature seems to confirm its generous Coleridgean reading in various other instances, as it does in an article "On the Study of Science in Schools" in October of 1871. "If, at first, the path of science seems to wind uphill all the way," it reads,

> remember that when the toil is over the view from the summit is very glorious. The sun rises upon a new land infinitely vast, infinitely fertile; full of streams by the side of which you may wander, and see all nature reflected in their pure depths.[116]

*Nature'*s exhortation here contains a few metaphysical stowaways of its own. The author presents a theological sense of science as toiling path to a new "promised land," and this glorious pilgrimage is further intimated by its passing reference to Christina Rossetti's "Up-Hill," a poem that begins by asking: "Does the road wind up-hill all the way?/Yes, to the very end."[117] Like Rossetti's heavenly seeker of comfort and rest, who is promised that "Of labor [they] shall find the sum," the seeker of science is offered recompense which far outweighs the grueling efforts he expends along the way.[118] This article's formulation lacks Coleridge's suspect emphasis on the generative power of the human mind, instead appearing to assume of Nature's promised land an independent—if hidden—existence. Nevertheless, "The Study of Science in Schools" does its part to stabilize the significatory work that Coleridge's early presence initiates. The poet earns his place in "The Dulness of Science" by providing both a vocabulary of emotional relationship to scientific work and, more importantly, a tenet of scientific comportment. He joins Wordsworth and Goethe as *Nature'*s behavioral heralds: Goethe calls for a diffuse, non-reductive wonder; Wordsworth adds to that the vigorous celebration of the

[116] "On the Study of Science in Schools II," *Nature* 4 (October 5, 1871): 455-456.
[117] Christina Rossetti, "Up-Hill," *Poems* (Boston: Roberts 1888), lines 1-2.
[118] Rossetti, "Up-Hill," lines 13-14.

common and everyday stuff of science; Coleridge combines with both the exhortation that that work, once done, shall be repaid.

The figurations of all three poets confirm a belief that Nature—"what we call the progress of science"—can "make a profound impression" not just upon the intellect, but "upon the heart of humanity." "Joy," a later stanza in "Dejection" reads, "is the spirit and the power," and the confluence of Romantic figures amidst *Nature*'s factual presentations suggests that scientific truth can, if primed by joy, be a source of greater joy. But *Nature* does not take the common person alone to task for their lack of vision. If people must be taught to see in this joyful spirit, then some responsibility must lie with their teachers— a group to which this journal and its contributors largely belong. The final turn of "The Dulness of Science" leads readers back to the last prop of the myth of scientific dulness. "No doubt the dulness of science is the cry of the blind," cries Philosophus, "nevertheless, men of science are much to blame." He critiques scientific men not for their instincts, but for their rhetoric. "It is their sense of beauty that leads them to Truth," but they immediately strip her of her glorious garments and dress her in an "antiquated medieval garb….no wonder that in such a guise her beauty is unperceived by those who cannot pierce the veil, and as a consequence she is slightly esteemed." Philosophus places much of the blame for the dulness of science on misguided language and instruction rather than on any inherent lack of faculty in the common person. To become involved with Nature, men and women must surely develop their eyesight, and well they may—but men of science must teach them how. To do this, scientific instructors must "consent to use the vernacular," and in doing so, they will surely "make a profound impression on the heart of humanity."

To this end, generalist *Nature* tries to practice what it preaches, and promotes the materials and activities of practitioners who "consent to use the vernacular." An editorial on "Science and

the Working Classes" on November 10th, 1870 opines that the "error of 'popular' scientific lectures, of evenings with working men at mechanics institutes, is that which is so commonly attributed to clergymen, of speaking over the heads of their audience."[119] On March 7th 1872, *Nature* takes issue with the persistence of the classical approach to education in a reprinted paper on "Science in Plain English"— wherein, the author laments, the populace will never acquire an appreciation or understanding of the natural sciences so long as they lack accessible instructional apparatus— books designed to teach, and teachers to properly teach them.[120] This last bespeaks the more pragmatic facet of the educational credo that *Nature* consistently champions: that practical, involved, show-don't-tell teaching, whether in the classroom or in the lecture hall, will bring science "to the heart of humanity," and that bad teaching, with its "want of sympathy with the learner," can stomp it out. *Nature* retains confidence that language has the power to turn hearts to science. In a letter to the editor on "Science Instruction to Elementary Schools" the correspondent recounts how quickly students' "faces brighten up, and the eyes sparkle…at preparations made for an experimental lesson in physical science, or for one in natural history," confirming an almost instinctive response to scientific issues when made accessible in language they can understand.[121] Wordsworth-like, men of science had to embrace "men speaking to men," and the public would come into the fold.

"Past and Present"

Prophets of Nature, we to them will speak

A lasting inspiration, sanctified

[119] "Science and the Working Classes," *Nature* 3 (November 10, 1870): 22-23.
[120] "Science in Plain English," *Nature* 5 (March 7, 1872): 371-372.
[121] Letter to the editor on "Science Instruction in Elementary Schools," *Nature* 3 (February 16, 1871): 305-306.

By reason and by truth; what we have loved

Others will love; and we may teach them how.[122]

In these final lines of *The Prelude,* Wordsworth turns to his friend Coleridge in joyful homage to the poetic legacy they have left their fellow men. Though ostensibly "Prophets of Nature," their real triumph in Wordsworth's eyes has been that through their poetic labors they have instructed men "how the mind of man becomes/A thousand times more beautiful than the earth/On which he dwells." They have taught this lesson by example, not by polemic. Every moment of natural contemplation, like Wordsworth's meditation upon Mount Snowdon just preceding this passage, models how to approach with love the objects of the universe—not for themselves, but as the raw material through which the "mighty Mind" must pass enter transcendentally. In the contemplation of "sublime and lovely forms" Wordsworth is filled with love: indeed "all grandeur comes/All truth and beauty, from pervading love." This spontaneous overflow of feeling is his pedagogical model.

This loving mode of teaching, we might say, captures the essence of what generalist *Nature* was trying to do, and who its constituents wanted seekers of science to be, for though the goals of the naturalists and of the supernaturalists were opposed, the means by which they approached those goals were in ultimate sympathy. Wordsworth taught how and what to "love" by example; so too did *Nature.* By making this comparison I have of course only done what *Nature* magazine itself did with its Wordsworthian epigraph, or its conjuring of Coleridge: taken a useful poetic model, and reoriented. Adapting such view helps unify much of the affective miscellany explicated in this chapter, in the same way that *Nature* tried to unify the miscellany in its pages week after week. The delight of Faraday, the wavering Romantic negotiation with Goethe,

[122] William Wordsworth, *The Prelude* (1805) in *Wordsworth's Poetry and Prose,* Book XIII, lines 442-445.

Wordsworth, and Coleridge, and the kind of affective modeling done in reviews of books like Flammarion's all evidence an emotional involvement in the acquisition of natural knowledge. We know already that *Nature* was de facto a project of persuasion, yet these textual elements evince a persuasion by sentiment: they reveal a scientific authorship that, by passionately desiring to "leaven the whole mass of the community with a love of science," was itself inspired by love. Perhaps not everyone could be a Faraday, but certainly everyone could aspire to be. *Nature*'s sporadic affective tutelage rendered the real processes of science while suggesting that they were "exalted by an underpresence," and it taught readers how to love by representing, textually, how the scientific world can look when you love it.[123]

The conceit of "teaching to love" might help us further focalize Huxley's Goethe. It illuminates Huxley's stubborn confidence in the ability of Goethe's wonderful rhapsody to frame a journal seeking "to mirror that fashioning by nature of a picture of herself in the mind of man," which we call science— even if twenty-five years later he was to lament, in another headline editorial, that his old aphorisms were unlikely to "be intelligible to more than a small minority; or acceptable to more than a fraction of even that fit though few company."[124] Huxley affirmed

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[123] Wordsworth, *The Prelude.* XIII, line 71.

[124] Thomas Henry Huxley, "Past and Present" *Nature* 51 (November 1, 1894): 1-3. In his reference to "fit though few company," Huxley again exhibits his own multi-layered poetic fluency. The line recalls Book VII of *Paradise Lost*, when the poet calls upon Urania, the muse of astronomy, to aid his song:
"In darkness, and with dangers compass'd round
And solitude: yet not alone, while thou
Visit'st my slumbers, nightly, or when morn
Purples the east: still govern thou my song
Urania, and fit audience find, though few."
Wordsworth will likewise allude to the same passage in his prospectus to *The Recluse,* contained in his preface to *The Excursion,* wherein he hopes to sing:
"Of Truth, of Grandeur, Beauty, Love, and Hope,
And melancholy Fear Subdued by Faith
Of blessed consolations in distress;
Of moral strength, and intellectual Power;

the vision of the poet in the face of resistance not because he was peddling an old philosophy, but because he was peddling a new one. He envisioned neither the supernaturalism of Goethe himself nor the Baconian but fragmented "mutually unintelligible" and "mutually incompatible" disciplinary specialties the sciences were becoming, but both together— a theory of the universe which unified the fragments of the new through the feeling of the old.[125] As a later chapter will show, Huxley would continue to harmonize the elements of the cosmos through the paradigm of his own discipline, the physiological sciences. But in this isolated instance he played to a simpler harmony. Victorian scientific seekers would need guidance through this world, feeling exalted while remaining empirical, and Huxley's "delight" in Goethe would help teach them how.

Nature did succumb to the siren-call of professionalism, and by the time Huxley wrote his anniversary editorial "Past and Present," the journal had long since abandoned its generalist and affective project. A look forward to November 14th 1889 reveals a journal of different proportions from those of November 4th 1869. Wordsworth's epigraph still presides, as it will

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Of jour in widest commonalty spread;
Of the individual Mind that keeps her own
Inviolate retirement, subject there
To Conscience only, and the law supreme
Of that Intelligence which governs all
I sing:—"fit audience let me find though few!"
So prayed, more gaining than he asked, the
Bard—
Holiest of Men. Urania, I shall need
Thy guidance, or a greater Muse, if such
Descend to earth or dwell in highest heaven!"
Huxley characteristically does not call attention to the source of his allusion, but given his general fluency, he is referencing one if not both sources. John Milton, *Paradise Lost* (1667) (New York: J. H. Turney, 1832), 174; William Wordsworth, "Prospectus" to *The Recluse* (1814) in *Wordsworth's Poetry and Prose,* 445.

[125] Huxley, "Past and Present," 1.

for another seventy-odd years, but now over a much shorter weekly.[126] The lead article is no longer geared towards the general public— no provocative "The Dulness of Science," but rather reports on the progress of the disciplines, "Science and the Future Indian Civil Service Examinations."[127] The elaborate engravings meant to whet readerly appetites for "using their eyes to look about them" are subdued, now. Rare are the meteor showers sparking over ships at sea, or balloons suspended forever in a sea of clouds.[128] Readers are far more likely to come across a two-page explanatory proof of Maxwell's equations or some spare diagrams of crystallographic structures.[129] The bookshelf remains, but the concerns of the reviews are somewhat different. Of the titles reviewed on this date, only two are editions ostensibly issued for public consumption, and these are praised for their "lucid exposition of an abstruse subject" and for "not committing the common error of giving a multiplicity of pretty but irrelevant experiments conveying a paucity of information."[130] No ecstasy of Michael Faraday here, or praise for Camille Flammarion's effusive delight, for *Nature* has begun to come into its own— into its success, some historical scholarship has argued— as a scientific periodical.[131] Scientific

[126] Owens, "Nature's Motto," 430. Nature's masthead image would remain until 1958, Baldwin, *Making Nature,* 33.

[127] "Science and the Future Indian Civil Service Examinations," *Nature* 41 (November 14, 1889): 25.

[128] Figure of "Mirage in the sky, as seen from a balloon" from review of *Travels in the Air," Nature* 4 (May 4 1871): 3; Engraving of meteor shower from "The Midnight Sky," 215-216.

[129] "Molecular Physics: An attempt at a comprehensive dynamical treatment of physical and chemical forces" *Nature* 39 (November 15, 1888): 63-67; "Some recent advances in the theory of crystal structure," *Nature* 39 (January 17, 1889): 277-279.

[130] The first quote is from a review of *Time and Tide: A Romance of the Moon* by Sir Robert S. Ball, *Nature* 41 *(*November 14, 1889): 30; the second, from a review of *The Story of a Tinder Box* By Charles M. Tidy, *Nature* 41 (November 14, 1889): 30.

[131] There are of course, many measures of success. Alexander Macmillan indicated concern in 1871— that "a little more something would make [Nature] of success," presumably with reference to the journal enjoying lower circulation than both he and Lockyer would have liked. Additionally, *Nature* did not "successfully" turn a profit for another 15 years. Melinda Baldwin notes in *Making Nature* that it was not until the younger generation of scientists (like E. Ray Lankester and George Romanes) who came after

men, speaking to scientific men, appear to have changed their pedagogical priorities as well as their admissions policies.

This is not to say that scientific discourse had been expunged of feeling, but only that *Nature* no longer saw fit to argue for it. One of the aforementioned works that received a tidy, dispassionate review is *Time and Tide: A Romance of the Moon* by the celebrated popular lecturer, astronomer Robert Ball.[132] In contrast to the review's speedily dispatched "lucid exposition of an abstract subject," an actual look at the contents of *Time and Tide* shows a Faradayan idiom, jovially engaging the reader as "you" with playful asides and grounding analogies. Ball declares that his first lecture is one "in which science and poetry are blended in happy conjunction," and his rhetoric exudes that blended spirit. Practically, he establishes the empiricist's creed: in the course of investigating the geological past we must adhere to observable facts, and not be misled by error or needless speculation. But his poetic delivery evinces an affective purpose: "In our efforts to grope into the dim recesses of this awful past (the 'most primeval of all terrestrial histories') we want the aid of some steadfast light which shall illumine the dark places without the treachery of the will o' the wisp."[133] The earth's orbit is not just a periodic astronomical phenomenon—it "breathes in and out" like a slumbering giant as the planets pull upon it.[134] Ball focuses the imagination on waking the "growing stalactite" and "colossal figure of crystal" from their geological sleep, making "immense ages" pass in but a few moments, exclaiming with reverence that "phenomena of this kind…are the real architects of the

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the X-club generation adopted *Nature* that the journal truly came into its own as an organ of scientific communication, a "successful" publication (46, 48-51).

[132] Ball was one of the successors of the popular mode, being of a younger generation. For longer discussion of one of his more notable lectures for children, see Chapter 2.

[133] Robert Ball, *Time and Tide: A Romance of the Moon (*London: Society for the Promoting of Christian Knowledge, 1889), 9.

[134] Ball, *Time and Tide,* 72.

universe."[135] This last evokes Lyell's "causes now in operation," but with a poetic flair.[136] And Ball, like Tyndall and Flammarion, uses "we" and "you" to bring his audience along with him, as when he takes them to "enjoy a delicious swim in the sea," a practical premise used to introduce and ponder the origins of tidal almanacs.[137] The inviting gestures and the simultaneously familiarizing and defamiliarizing object lessons of popular lecturers like Ball are the subject of the following chapter. Here, it is important rather to note that wonder was still selling— but *Nature* was no longer making a point of selling it.

Formally, Ball's "Romance of the Moon" shares a spirit with the qualities of Camille Flammarion's "light fantastic hand" and with the evocative descriptions like those of the Bessemer process that *Nature* once routinely featured. But by 1889 *Nature* no longer seemed to be making an affective argument, and if impassioned prose-poems arose in its pages, they were more likely to be from subscribers than from contributors (like Hopkins' Krakatoa sunsets) and were in any case few and far between. Huxley sensed this lack.[138] While retaining a private conviction of the affective truth in Goethe's Romantic vision, Huxley sensed that the professional forum that *Nature* had become no longer held a space for it. His "Past and Present," editorial opts for a more prosaic account of the biological issues that have developed in the thirty-five years since the publication of *On the Origin of Species.* Lockyer perhaps felt the same absence. Perpetually committed to a generalist project, and disappointed by the journal's drift towards specialization as a product of the younger generation's desires, Lockyer would publish

[135] Ball, *Time and Tide,* 73.
[136] One of the defining features of Lyell's uniformitarianism was the idea that all geological changes across time could be explained by "causes now in operation": physical processes observable on the modern globe. Charles Lyell, *The Principles of Geology, Being an Attempt to Explain the Former Changes of the Earth's Surface, by reference to Causes Now in Operation, Vol. 1.* (London: John Murray, 1830).
[137] Ball, *Time and Tide,* 25.
[138] Roos, "Aims and Intentions," 176; MacLeod, "The X-Club," 440; *Nature* 224

with his wife Winifred a book on *Tennyson as a Student and Poet of Nature*. If *Nature* had stopped trying to teach a Romantic lesson, it was because the terms of scientific discourse had changed.

One of those terms was the widespread cultural arrival of science as authoritative knowledge. *Nature's* shift away from a more synthetic view of Nature marks most starkly the sea-change from which the other genres and authors treated in this dissertation were not exempt, in which affective strategies waned inversely with the success of scientific reform.[139] "Interest" indicated by attendance at the Manchester Science Lectures for the People was "so far diminished" by their eleventh series in 1879-1880 "that the committee [had] no alternative but to discontinue the Lectures."[140] In 1894, the year of *Nature's* twenty-fifth anniversary, a Huxleyan rhapsody on Goethe or transcendent tale of the life of a piece of Norwich chalk would have been an unusual sight: such object lessons had been replaced by the hard philosophical turn of "Evolution and Ethics." These affective losses signaled ideological gains, for while Manchester's town hall boasted fewer scientific seekers, "similar courses of lectures [had] now been established in every large town in the kingdom; and the publication of the lectures in cheap form…influenced still a wider area." Expositors like Huxley and Tyndall no longer needed to lean hard on rhetorical dynamism to win men of science a place at the table (though both in fact did); by the end of the century, naturalism effectively controlled the scientific establishment.[141] By 1890, the propositions which were sensational in the 1860s— humankind's natural place in a naturally

[139] Royal Commission (including Huxley, Thomson, Tyndall, Tait, Balfour Stewart, William Huggins, Williamson) to interrogate the questions: "I: Does there exist in the United Kingdom of Great Britain and Ireland sufficient provision for the vigorous prosecution of Physical Research? II. If not, what further provision is needed? and what measures should be taken to secure it?" See "Science Reform," *Nature* 1 (December 2, 1869): 127

[140] Henry Enfield Roscoe, preface to *Science Lectures for the People, Eleventh Series* (Manchester: John Heywood, 1880).

[141] See for example Stanley's chapter "How the Naturalists Won," *Huxley's Church,* 242-263.

connected Nature—had become a kind of orthodoxy.[142] The generation of scientists that succeeded to *Nature* inherited the culture that the X-Club had made. In a world where science was a respectable endeavor, younger practitioners felt they had little to prove to the generalist reader.[143]

But reading *Nature's* shift away from generalism as simply a "victory" for naturalistic science privileges a narrative of progress that neglects the other forms of ideological boundary-negotiation that this chapter has, hopefully, done some work in unpacking. Chief among those were the relationships of professionals to public pedagogy, and of education to affect (we might say "fact" to "feeling") which suffered even as science gained traction. Around the time of *Nature's* shift*,* Peter Guthrie Tait accused Tyndall of "martyr[ing] his scientific authority by deservedly winning distinction in the popular field," taking a jab at Tyndall's flamboyant and extravagant discursive style.[144] Tyndall was a dazzlingly popular lecturer, and beginning with his explosive "Belfast Address" he staunchly defended science as the best and only method of arriving at truth, but he did so with a feelingful style that began to leave him open to criticism from peers as much as it entranced the public.[145] Tait's criticism is of a piece with the pantheistic phobia of Huxley's "Philistines" who opined "that much attempt to learn, if not much learning, had made [him] mad." Enthusiastically Romantic or generalist pedagogy had long been lively elements in scientific and public discourse. Now, they hit a false note of amateurism.

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[142] Desmond marks in *Huxley* the relative tameness with which works like Huxley's "The Lights of the Church and the Lights of Science" were received, where thirty years earlier they would have caused a sensation. "By now a scientific world-view had become the *de rigueur* perception for all things" (580).
[143] Baldwin notes in *Making Nature* that "the younger men of science…had reaped the rewards of the older generation's attempts to establish science as a respectable endeavor" and consequently saw less reason to debate scientific questions before a non-scientific audience" (66-67).
[144] Peter Guthrie Tait, "Tyndall and Forbes," *Nature* 8 (September 11, 1873): 381-382.
[145] Reidy, *Scientific Naturalism,* 6.

The modern persistence of a similar brand of discursive bias—a rhetorical iteration of the "two cultures" problem, in concert with the late 20th century and early 21st century appeal of serialized popular science projects like *Cosmos* and *Planet Earth*—further focalize *Nature* as an object lesson in the fortunes of "professional" versus "amateur" language. It is no coincidence, perhaps, that rhetoric of a Romantic cast persists most distinctly in mass-media scientific discourses designed to instruct and to move; and likewise no coincidence that practitioner-authors of such works have been exposed to criticism for the imaginative play of their prose, or indeed, for their very commitment to publicizing itself. We might consider the so-called "Sagan Effect," coined in the wake of Carl Sagan's unprecedentedly popular *Cosmos,* in which a scientist's influence with the general public was thought to inversely reflect the quality and quantity of real science being done.[146] Sagan's biographers have long maintained that the rejection of the astronomer's nomination from the National Academy of the Sciences was a direct result of his public activities— judging "popularization to be an oversimplification—symptomatic of an inadequacy in doing science."[147] In an ironic twist, Sagan's ideological commitment to communicating the scientific experience to the public inadvertently undermined him in the very community for which he spoke— "martyring his scientific authority," as it were, for having won distinction in the popular field. While the "Sagan Effect," as regards Sagan himself was an illusion, the emergence of the concept bespeaks a telling disjunction between discursive arenas and scientific reputations.[148]

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[146] Michael B. Shermer, "This View of Science: Stephen Jay Gould as Historian of Science and Scientific Historian, Popular Scientist and Scientific Popularizer," *Social Studies of Science* 2, no. 4 (August 2002): 490.

[147] William Poundstone, *Carl Sagan: A Life in the Cosmos* (New York: Henry Holt, 1999), 357. See also Keay Davidson, *Carl Sagan: A Life* (New York: Wiley, 1999), 202-205, 389-392.

[148] Shermer was interested to see if the "Sagan Effect" did in fact attenuate Sagan's scientific output. Comparing his 265 page CV with those of similarly recognized scientific contemporaries, including Jared

Likewise, Rachel Carson's assiduously researched *Silent Spring* fell under attack from the scientific community for breaching of "professional" science conventions. Critics held up her opening "Fable for Tomorrow," an environmental allegory of the sort we see in early *Nature,* as evidence that Carson, with a master's degree in marine biology from Johns Hopkins and work towards her PhD, was "a storyteller, and nothing more."[149] Michael B. Smith recounts how reviewers pointed to her use of phrases like "never ending stream of chemicals…now pervading the world" and of verbs like "lurks" and "engulfs" as proof of unseemly sentimentality-- a scientific disqualification.[150] Such contemporary criticisms of Carson's work reveal all too clearly the solidifying discursive division between "rational" and "empirical" discourse on the one hand, and "emotional" rhetoric on the other (to say nothing of the persistently troubled gender dynamics of scientific discourse.) Carson's work, like Sagan's, invited "sympathy for science" and scientific matters precisely *through* the rhetorical demonstration of sympathy that accompanied its empirical evidence; yet her "passion," embodied in a fluid, flexible rhetoric and a Keatsian allusiveness was "considered unbecoming to a scientist."[151]

Diamond, Ernst Mayr, Edward O. Wilson, and Stephen Jay Gould, he finds Sagan's output square in this middle of this group; graphing Sagan's popular output versus scientific output showed that the latter was unfazed by the former, even after his meteoric rise (even though the total volume of papers rose *tremendously* when his popular work is tallied— in 1990, almost 100 popular articles in comparison to 20 scientific papers*)*. From 1957 until his death, Sagan averaged one scientific peer-reviewed paper per month. See especially figure 1 in Shermer, "This View of Science," 493-495.

[149] Michael B. Smith, "Silence Miss Carson! Science, Gender, and the Reception of "Silent Spring," *Feminist Studies* 27, no. 3 (2001): 746.

[150] Smith, "Silence," 739.

[151] Carson had read widely in the British Romantic tradition and her chapter "And No Birds Sing" takes its title from the lines which frame the first and the final stanzas of John Keats' "La Belle Dame Sans Merci," — "The sedge is wither'd from the lake/And no birds sing," See Linda Lear's introduction to Carson's *Silent Spring* (1962) (New York: Houghton Mifflin Harcourt, 2002), xi; *Keats' Poetry and Prose,* ed. Jeffrey N. Cox (New York: W. W. Norton and Co., 2009), lines 3-4, 47-48; Smith, "Silence," 741.

It is perhaps no coincidence either that "passionate" rhetorics like Ball's, Carson's, and Sagan's arose in fictional contexts that aimed to affectively, or morally, instruct and to move.[152] If rhetorics of affect or connection were becoming professionally uncouth, the novel remained a solid ground in which to exercise affective thought-experimentation formerly available to scientific discourse but banished by its late-nineteenth century. We might look at the late-century figurations of sublime emotional involvement with physical nature in Thomas Hardy's *Two on a Tower* where Swithin St. Cleeve's full-souled obsession with astronomy parallels his human love affair as both an act of love and a posture capable of producing love.

> There lay, in the shape of Antinous, no *amoroso,* no gallant, but a guileless philosopher. His parted lips were lips which spoke, not of love, but of millions of miles; those were eyes which habitually gazed, not into the depths of other eyes, but into other worlds. Within his temples dwelt thoughts, not of woman's looks, but of stellar aspects and the configuration of constellations.[153]

Even as Lady Constantine reads Swithin's intellectual devotion as a disposition at odds with love, the rhetorical proximity of one to the other—"love," "miles," "other eyes," "other worlds," "woman's looks," "constellations,"—effects a collapse and commingling of feeling (one which will determine the rest of the novel). If there are only two places to find heaven, "in the skies" or "in the eyes of some daughter of Eve," then Hardy implies that the unfamiliar abstraction exerts a pull comparable to the familiar one. Turning earlier from the "reciprocity of influence" in an exchange of looks with Lady Constantine, Swithin gazes into the cosmic eye,

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[152] For *Silent Spring* in particular as a catalyst for widespread interaction, see Bonnie Foote, "The Narrative Interactions of *Silent Spring:* Bridging Literary Criticism and Eco-criticism," *New Literary History* 38, no. 4 (2007): 743.

[153] Thomas Hardy, *Two on a Tower: A Romance* (1882) (London: Penguin Books, 1999), 39-40.

> Whereupon his face lost the animation which her presence has lent it, and became immutable as that of a bust, though superadding to the serenity of repose the sensitiveness of life. The expression that settled on him was one of awe. Not unaptly [sic] might it have been said that he was worshipping the sun. Among the various intensities of that worship which have prevailed since the first intelligent beings saw the luminary decline westward, as the young man now beheld it doing, his was not the weakest. He was engaged in what may be called a very chastened or schooled form of that first and most natural of adorations.[154]

The affected young man presents the figure of a supplicant of a natural god engaged in a soul-stirring devotion, at once the annihilated observer postulated by theoretical empiricism and a worshipper in Faradayan ecstasy, soothed by supernatural sympathy with the distant sun.[155] So too in a different vein H. G. Wells' Time-Traveller and Edward Prendick ease inner existential turbulence with the contemplation of the stars.[156] Both Wells and Hardy in fictionalized form enact the natural-supernatural attitude echoed years earlier in the pages of *Nature,* in affective tones—"awe," "worship," "adoration"— rendering the man of science engaged in a more-than-intellectual encounter with the object of his contemplations. The language in these types of

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[154] Hardy, *Two on a Tower,* 8.

[155] This concept of "sympathy" with physical forces, particularly those emanating from the sun, form a significant discussion in Chapter 2.

[156] In his concluding thoughts Prendick writes "my days I devote to reading and to experiments in chemistry, and I spend many of the clear nights in the study of astronomy. There is—though I do not know how there is or why there is—a sense of infinite peace and protection in the glittering hosts of heaven. There it must be, I think, in the vast and eternal laws of matter, and not in the daily cares and sins and troubles of men, that whatever is more than animal within us must find its solace and its hope. I hope, or I could not live." H. G. Wells, *The Island of Dr. Moreau (*Toronto: Broadview Press, 2009), 174. Likewise the Time Traveller, distraught by what has become of the human race in the year 802701, finds a sublime moment of perspective in the contemplation of the heavens where "[l]ooking at these stars suddenly dwarfed my own troubles and all the gravities of terrestrial life." H. G. Wells, *The Time Machine (*New York: W. W. Norton, 2009), 49.

fiction shares more with the affective public science of *Nature* and related projects than with professional science discourse. They focus on a feeling effected by looking, with the eye of science, outward into the universe; they invite sympathetic connection, and lean into the power of language to effect it.[157]

This is all to say that the eventual "failure" of *Nature's* affective handbook provides an instructive illustration of the status of feeling at elite levels of discourse. The above examples of Sagan and Carson illustrate in science a pernicious divide and rhetorical partition from which the humanities are not exempt. Deidre Lynch's *Loving Literature* provides an excellent framework through which to consider the figuration between affect and expert culture, locating what she calls the "tendency to identify literary studies with the love of the subject and to identify that love with amateurs not yet subjected to the affective deformation that supposedly comes with formal education.[158]" Though Lynch focalizes literary rather than scientific disciplinization, the affective parallel is virtually exact. She isolates a spirit identical to that which gave rise to the "Sagan Effect," which castigated Tyndall and which viewed Huxley's effusive aphorisms as a fancy "written by the maddest English scholar": the widespread belief that an expression of *love* for a subject is somehow an obstacle to its formal mastery. In literary disciplinization Lynch identifies the same dichotomies that underwrote the splintering of the sciences in the late nineteenth century: "the separation of personal life from public life, feeling from knowing, and recreation from labour."[159]

[157] Barbara T. Gates also notes in "Ordering Nature" how science fiction explored and extended the insights of science in its simultaneous domestication of the unfamiliar and defamiliarization of the domestic (183).
[158] Lynch, *Loving Literature*, 2-3.
[159] Lynch, *Loving Literature,* 4.

Lynch's figuration of literature's "success" in late Victorian scholastic curricula likewise identifies an elegiac quality similar to what *Nature* reproduced for the scientific sensibility, for in literary "love" she recognizes a nostalgia for the affective involvement that is linked with childhood and with youth.[160] This fundamentally Romantic faith in the "true" feeling of the amateur was writ large in *Nature's* early iterations. It tacitly attended the journal's Romantic tutelage, but *Nature's* very enterprise plainly supported—under guidance—the power of amateur or youthful enthusiasm. We see this in the journal's unwavering honor for "great and childlike men" like Michael Faraday, but also in its broad support of a childlike attitude of attention that squared with *Nature*'s poetically buttressed argument for an enchantment and a sympathy in all scientific things. The reviewer of "The Three Kingdoms of Nature" in 1870 reminds readers of the immense power of "sportive, elastic, quick sharp work of the senses of a little child," affirming that men of science must undo all of their rote learnings— what Wordsworth would call their "conned parts" or "endless imitations"— and "become little children again" to become the most creative, perceptive, adaptive version of their scientific selves.[161] In the midst of its professionalizing discourse, *Nature* confirms the power of Lynch's paradox scientifically applied, the license that the unlearned have both to learn and to feel. Lynch's attention to the tensions between the professional and the feelingful helps us think about the cycles of alienation that come with progress, and the repressions that tend to follow from professional advancement. *Nature*'s early attempts to communicate to the scientific amateur a compromise between feeling and knowing, or between recreation and labor, and the ultimate pressure the publication faced to discontinue those attempts, offer us a chance to evaluate what of value is lost in the conventions

[160] Lynch, *Loving Literature,* 274-275.
[161] M. F., "The Three Kingdoms of Nature," *Nature* 1 (March 3, 1870): 456; William Wordsworth, "Ode: Intimations of Immortality," 433.

of “professional” performance— and what of value is gained when a discourse makes the choice to disrupt those conventions.

Chapter 2: A "community of matter": Structuring the Sympathies in the Scientific Lecture

> *In considering the study of physical phenomena, not merely in its bearings on the material wants of life, but in its general influence on the intellectual advancement of mankind, we find its noblest and most important result to be a knowledge of the chain of connection, by which all natural forces are linked together, and made mutually dependent upon each other; and it is the perception of these relations that exalts our views and ennobles our enjoyments.*[1]
>
> Alexander von Humboldt, "Introduction" to *Cosmos: A Sketch of the Description of the Physical Universe* (1849)

Introduction: Science lecturing for the people

John Tyndall knew how to win an audience's sympathies: with candy. Or at least, with talking about candy. He began his working men's lecture on "Crystalline and Molecular Forces" (1874) with an anecdote that brought to bear on the subject of sweets the molecular attraction that underlies all material forces. "A few years ago," he said, " I paid a visit to a large school in the country, and was asked by the principal to give a lesson to one of his classes." Tyndall agreed, and "after casting about in [his] mind as to what could be said to the little fellows," he bought a large quantity of sugar candy as a teaching apparatus.

> When the time for assembling the class had arrived, I began by describing the way in which sugar-candy and other artificial crystals were formed, and tried to place vividly before their young minds the architectural process by which the crystals were built up. They listened to me with the most eager interest. I examined the crystal before them, and

[1] Alexander von Humboldt, *Cosmos: A Sketch of the Description of the Physical Universe,* Volume 1, trans. E. C. Otté (1858; Baltimore, The Johns Hopkins University Press, 1997), 23.

> when they found that in a certain direction it could be split into thin laminae with shining surfaces of cleavage, their joy was at its height. They had no notion that the thing they had been crunching and sucking all their lives embraced so many hidden points of beauty. At the end of the lesson I emptied my pockets among the class, and permitted them to experiment upon the sugar-candy in the usual way.[2]

Tyndall's delicious anecdote marks but the beginning of a larger process of revelation in his lecture. He goes on to reveal how the molecular forces that govern the formation of the sugar-crystal which we eat "advance from the crystalline through the vegetable and animal worlds as an unbroken process of natural growth, thus grasping the world, inorganic and organic, as one vast and indissolubly connected whole."[3] Provocatively, Tyndall suggests that in this network of molecular force, candy is not only of concern to us the candy-eaters, but in a certain way, *like* us as well.

As a popular lecture given by an eminent man of science, which not only highlights the intellectual beauty in a common thing but emphasizes our own marvelous material relationship *to* that thing, Tyndall's charming oration focalizes the essence of this chapter. In the years following the scientific *annus mirabilis* of 1859, the scientific lecture, long a mode of casual education for adults, took on an urgent new role in what *Nature* magazine called "leavening the whole mass of the community with a love of science."[4] It existed as an increasingly vital varietal

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[2] John Tyndall, "Crystalline and Molecular Forces, " in *Science Lectures for the People, Sixth Series* (Manchester: J. Heywood, 1874), 141.

[3] Tyndall, "Crystalline and Molecular Forces," 151. Tyndall's "indissolubly connected whole" recalls the language of Humboldt's *Cosmos,* wherein Humboldt writes "one sole and indissoluble chain brings together all nature" (27).

[4] Ian Inkster, "The public lecture as an instrument of science education for adults: the case for Great Britain, c. 1750-1850" *Pedagogica Historica* 20 (1980): 80-107; "Science Lectures for the People," *Nature* 4 (June 1 1871): 81.

of public speaking, itself a central part of the international literary world.[5] The lecture became an important platform for scientific naturalists to promote both their conviction of the benefit conferred on culture by a scientific community, and their vision of a certain essential unity in nature.[6] That idea of uniformity and the representation thereof, as we will see more clearly in the course of this chapter, bore an important relationship to the cultivation of a "love of science." Cultivating such "love" involved rhetorically representing, as Tyndall would go on in this lecture to do, the many valences of aesthetic, material, and processual relation that bound people to the physical universe by laws that could be discovered and articulated. Equally important, it involved representing how a recognition of those relations could in turn elicit an affective connection— a mode of concern that was emotional as well as intellectual.

Over and above its popularity as a public entertainment, lecturing remained for many of its practitioners a serious educational vehicle. On the stand, the lecturer could not only promote scientific knowledge, but also raise a sensible awareness of how Victorians of all classes were involved in their material universe. Success in this matter of intellectual and emotional education

[5] And shared the arena critically, as we will see later in this chapter, with the sermon. For an overview of the arenas of Victorian public speech, see Joseph S. Meisel, *Public Speech and the Culture of Public Life in the Age of Gladstone* (New York: Columbia University Press, 2001); Walter Ong describes the "heavy residue" of orality in the 19th century in "Agnostic structures in academia: past to present," *Daedalus* 103 (1974): 229-38.

[6] Turner's definition in *Between Science and Religion* states that a scientific naturalist can be identified by a "commitment to explaining the workings of nature through natural, empirically observed causes and a scientific world view centered on atomism, the conservation of energy and evolution," (9-35). See Robert Smith's summary in "The 'Great Plan of the Visible Universe': William Huggins, Evolutionary Naturalism and the Nature of the Nebulae," *The Age of Scientific Naturalism: Tyndall and His Contemporaries,* ed. Bernard Lightman and Michael S. Reidy (London: Pickering and Chatto, 2014), 130; Matthew Stanley, "Where Naturalism and Theism Met: The Uniformity of Nature," in *Victorian Scientific Naturalism: Community, Identity, Continuity,* eds. Bernard Lightman and Gowan Dawson (Chicago: University of Chicago Press, 2014) states that "uniformity is the claim that the laws of nature are the same everywhere and everywhen in the universe, and that these laws do not break down or lapse anywhere in time and space" (243). The "indissolubly connected whole" that this uniformity makes possibly allowed for a certain posture of sympathy towards the universe— which was always already connected to us.

depended on more than just personal charm, though Tyndall had that in spades. Lecturing was a calculated rhetorical performance; Tyndall's ability to manipulate language in the service of making scientific information accurate, intelligible, and generally relatable was a talent, whatever detractors might say.[7] T. H. Huxley submitted a characteristically snappy defense of the genre in which he earned such renown. "For I have not been one of those fortunate persons," he writes, "who are able to regard a popular lecture as a mere *hors d'oeuvre,* unworthy of being ranked among the serious efforts of a philosopher; and who keep their fame as scientific hierophants unsullied by attempts—at least of the successful sort—to be understanded [sic] of the people."[8] Huxley's career gave the lie to a certain persistent institutional prejudice against "popularizing" as being somehow beneath the "true" scientist's notice.[9] On the contrary, Huxley saw the popular address as a task requiring all the best skills of the scientist and of the orator. He found that

[7] Like P. G. Tait in his letter to *Nature,* quoted in the previous chapter, "Letter to the Editor, on Tyndall and Forces," 382. For more on Tyndall as researcher and popularizer see Ursula DeYoung, *A Vision of Modern Science: John Tyndall and the Role of the Scientist in Victorian Culture* (New York: Palgrave Macmillan, 2011), 55-56.

[8] Thomas Henry Huxley, preface to *Discourses Biological and Geological* (New York: D. Appleton and Co., 1900), v. Huxley's unusual participle was a riff on some specific language in the 39 Articles: Article XXIV, "Of Speaking in the Congregation in such a Tongue as the people understandeth," states that "It is a thing plainly repugnant to the Word of God, and the custom of the Primitive Church to have public prayer in the Church, or to minister the Sacraments, in a tongue not understanded of the people," *The Book of Common Prayer (1571)* (New York: Church Publishing Incorporated, 2007), 872.

[9] See above. An article on "The British Association" in *The Saturday Review* 44 (August 18 1877) defended Huxley and Tyndall against long-standing accusation of being "popularizers," taking much the same tack as Huxley: "The gift of interpreting the results of highly specialized researches for the benefit of those who are not prepared beforehand by special knowledge is by no means a common one—in fact, is itself a specialty which very few have mastered; for which reason people who are anxious to parade themselves as [professionals] in science are much in the habit of cheapening it. The notion that Professor Huxley and Professor Tyndall are mere popularizers—because, forsooth, they can expound as well as discover—has almost attained the rank of a vulgar error" (196).

> the task of putting the truths learned in the field, the laboratory and the museum, into language which, without bating a jot of scientific accuracy shall be generally intelligible, taxed such scientific and literary faculty as I possessed to the uttermost.[10]

Huxley knew that the best scientific "popularizing" was governed by a careful equipoise between scientific information and rhetorical prowess. But he also allowed that a certain ephemeral quality was what gave the form a unique power within the repertoire of other modes of learning. "If the popular lecture," he writes, "finds one moiety of its justification in the self-discipline of the lecturer, it surely finds the other half in its effect on the auditory."[11] Huxley knew that scientific speech impressed itself intangibly upon the sensibilities far more than it ever left upon the mind a total understanding of what had been said—and he suspected the case was no different at the House of Commons, the hustings, even the pulpit, those most iconic of the myriad sites of discursive exchange in which lecturers vied for Victorian ears and minds. The public who came in droves to hear Huxley and men like him speak may not have always retained the entirety of his cuttingly clear arguments, but they liked the way the experience made them feel.[12] If one in ten were gratified by a lecture's enlargement of their intellects, far more were driven, held, and gratified by the lecture's effect on their *sympathies*.

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[10] Huxley, *Discourses,* v.

[11] Huxley, *Discourses,* vi.

[12] Adrian Desmond, *Huxley: From Devil's Disciple to Evolution's High Priest* (Reading, Mass: Addison-Wesley, 1997). Desmond writes of "A Piece of Chalk" a mode which described Huxley's lectures in general: "Huxley's best lectures were odysseys…It had an impact on this workers' stronghold [in Norwich]. The Professor was like the Methodist fanatics, playing to the bushy beards. They yearned for an emotionally expansive science in their secular world, and he was a fisher of souls," (366). See also 309, 345, 367-68 in Huxley; Jill Howard, "Physics and Fashion: John Tyndall and his audiences in mid-Victorian Britain," *Studies in History and Philosophy of Science* 35 (2004): 753; David Riley tells us that by the second series of Manchester Science lectures, attendance per lecture averaged about 1,000 people. David Riley, "The Manchester Science Lectures for the People, c. 1866-1879," *Bulletin of the John Rylands University of Manchester,* 85: 1 (2003): 140.

This chapter focalizes that genre of public lecture made so famous by Huxley and Tyndall, and investigates the way in which that form took on the task of cultivating "sympathy for science." In doing so I take a cross-section of the far broader cultural practice dominated by some of the most notable voices of the nineteenth century. I center my analysis, with some relevant exceptions, around two major scientific initiatives for lay pedagogy: the urban Christmas Lectures at the Royal Institution, and the rural Manchester Series of Science Lectures for the People, from which Tyndall's "Crystalline and Molecular Forces" hails.[13] Both of these initiatives were founded in the name of education with the aim to afford "instruction, as well as amusement" to lay audiences.[14] These were specifically elementary audiences: "juveniles," in the case of the former, and predominantly working men and women in the case of the latter.[15] These

[13] Huxley and Tyndall were such prolific and frequently anthologized lecturers that I have variously sampled from their repertoires provided, as with "On a Piece of Chalk" (1868) and Tyndall's "Matter and Force," that the addresses were given to working-class audiences and have not been too heavily edited into an essay format. Amanda Adams notes in her *Performing Authorship in the Nineteenth-Century Transatlantic Lecture Tour* (Burlington, VT: Ashgate Publishing Company, 2014) that the idea of making educational lectures available to working men saw its origin in the early 19th century institutes like the British Mechanics' Institute and the London Mechanics' Institute (3). See also Carl Bode's *The American Lyceum: Town Meeting on the Mind* (New York: Oxford University Press, 1956), 6.

[14] This was part of a larger effort on the part of lecture culture, both in England and in the United States, to democratize knowledge, as the lecturer both theoretically spoke to a general audiences and was kept in "business" so to speak only by the pleasure of those audiences, as "[t]he people hear a second time only those who interest them." See Josiah Holland, "The Popular Lecture," *The Atlantic Monthly* 15 (March 1865): 365. The reality, as Angela Ray, *The Lyceum and Public Cultures in the Nineteenth-Century United States* (East Lansing: Michigan State University Press, 2005) has pointed out, was that while middle class attendance was common, the poor were, save in rare instances, priced out (24); the Manchester Lectures were, as a result, "Penny-lectures."

[15] Henry Wace, "Scientific Lectures—Their Use and Abuse," *The Quarterly Review* 145 (1878): 37; Frank J. L. James notes in his introduction to *A Chemical History of a Candle* that one of the Royal Institution's original missions was "communicating science to a general audience (xvi)" and that the Christmas Lectures in particular were geared towards juveniles, which originally meant those in the age range of 15-20 (xviii); Sophie Forgan notes that this age likely went down in later years (we can be pretty sure that Ball's 1889 lecture was addressing children), "The Royal Institution of Great Britain, 1840-1873," unpublished PhD thesis, (University of London, 1977), 191-192; Riley, "Manchester Science Lectures," 129-130.

lectures were given by active practitioners—"real students" of science, as *The Quarterly Review* put it—taxing their "scientific and literary faculties to the uttermost" in the service of Tyndall's "extend[ing] sympathy for science beyond the limit of the scientific public."[16] In contrast to some of their more theatrical peers—say, John Henry Pepper at the Royal Polytechnic—these practitioner lecturers aimed to be not "mere exhibitors of wonders," but educators of the senses as well as of the sensibilities.[17]

The initiatives under discussion, furthermore, were increasingly supported and driven by a late-century cohort of scientific naturalists (like Tyndall) and as such were intellectually involved in the paradox of promoting a view of the universe at once absolutely naturalistic and sensibly enchanted.[18] As we began to see in the introduction of this dissertation, Tyndall's "sympathy for science" conceived of a public response to science that surpassed simple interest. His idea of "sympathy" suggested the possibility of an actual identification with, or feelingful response to, the objects and processes presented in popular scientific discourse. This sympathy was something like the "joy" that his young students exhibited in response to the "hidden

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[16] John Tyndall, preface to *Fragments of Science for Unscientific People,* (New York: D. Appleton and Co.1871).

[17] Howard, "Physics and Fashion," 745; James Secord, "Quick and magical shaper of science," *Science* 297: 5587 (2002) 1648-1649; See especially Bernard Lightman's chapter on "The Showmen of Science: Wood, Pepper, and Visual Spectacle" in *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago: University of Chicago Press, 2007), 167-218; Wace, "Scientific Lectures," 37.

[18] After Faraday's last lectures in 1860, the Christmas lectures were heavily weighted by Tyndall and Edward Frankland (another scientific naturalist). "History of the Christmas Lectures," The Royal Institution, October 31, 2017, <http://www.rigb.org/christmas-lectures/history>; Tyndall assumed the chair of Professor of Natural Philosophy at the RI in 1853 and his career there spanned 34 years: Ursula DeYoung, *Vision of Modern Science,* 14-15. Riley in "Manchester Science Lectures" reminds us how Roscoe's friendships with the X-Clubbers, among them Huxley and John Lubbock as well as support from Society and Arts and the BAAS, were instrumental in helping restart the Manchester lectures in 1870 (the BAAS, like many scientific and educational institutions at the time, was increasingly controlled by scientific naturalists) (137). See also George Levine, *Darwin Loves You: Natural Selection and the Re-Enchantment of the World* (Princeton: Princeton University Press, 2006), 28 and "Paradox: The Art of Scientific Naturalism," in Dawson and Lightman, *Victorian Scientific Naturalism,* 81.

beauty" of their sugar candy, a joy that seemed to emanate, as this chapter will explore, from a confluence of experience and knowledge: That is, a joy whose cause is simply the existence of a thing, because that thing represents a broader scientific knowledge, and because with that scientific knowledge we understand ourselves to be involved with that thing. And nowhere was sympathetic identification more feasible than through the lecture, for it was the "special office of the lecturer" to "bring home the truths of Science to the people at large"— a rhetorical construction which itself suggests a reliance on the sympathetic imagination in keeping with the preponderant Victorian domestication of the affections.

Sympathy in this sense is a key investigative issue in this chapter. As a necessarily interpersonal event, the lecture is an ideal format by which to understand how scientific practitioners exerted their scientific and literary faculties towards creating an amended idea of sympathetic recognition. We can usefully approach the lecture through the theoretical structures of sympathy that we inherit from Adam Smith, which rely on using the imagination (rather than the senses) to conceive of the situation of another person and to bring that "case home to ourselves" to thereby achieve a state of sympathy.[19] By "changing places in fancy," as Smith says, using the example of the suffering man upon the rack, "we come either to conceive or to be affected by what he feels."[20] While we are more accustomed to discussing the sympathetic "case" in the context of the novel, the sermon, or the theatre, scientific lecturers too engaged, under modification, a similar form of the same imaginative process.[21] ("Bring[ing] the truths of

[19] Adam Smith, *The Theory of Moral Sentiments* (1759; New York: Dover Philosophical Classics, 2006), 3.
[20] Smith, *Theory,* 2.
[21] See Rae Greiner, *Sympathetic Realism in Nineteenth Century British Fiction* (Baltimore: Johns Hopkins University Press, 2012), "Sympathy Time: Adam Smith, George Eliot, and the Realist Novel," *Narrative* 17, no. 3 (2009): 291-311, and "Thinking of Me Thinking of You: Sympathy Versus Empathy in the Realist Novel," *Victorian Studies* 53, no. 3 (2011): 417-426. See also Rob Boddice, *The Science of*

science really home" to eager auditors sounds like a page right out of Adam Smith's playbook.) James Engell provides us with a useful summation of the functions and results of such Smithian sympathy when he defines it as "that special power of the imagination which permits the self to escape its own confines, to identify with other people, to perceive things in a new way, and to develop an aesthetic appreciation of the world that coalesces both subjective self and objective other."[22] Through the combined power of their oratorical "effect on the auditory" and the carefully crafted content of their lectures, scientific lecturers fundamentally aimed to do these very things, and more.

There is no doubt, as Huxley asserted, that "the living voice has an influence over human action altogether independent of the intellectual worth of that which it utters."[23] In this, at least, he was in accordance with his father's most famous pupil, John Henry Newman, when the cardinal claimed that it was persons, voices, looks, and deeds, that inflamed human feelings—not conclusions.[24] Historical scholarship on this genre agrees that lecturers aimed to "[win] the full sympathy of auditors" and "[stimulate] an emotional affinity for scientific truth."[25] However, such arguments tend to favor reconstructions of space, author intention, audience attendance, and general overview of lecturing activities, in no small part because these are the historical data that

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Sympathy: Morality, Evolution, and Victorian Civilization, (Chicago, University of Illinois Press, 2016) and James Chandler, *An Archaeology of Sympathy: The Sentimental Mode in Literature and Cinema* (Chicago, University of Chicago Press, 2013).

[22] James Engell, *The Creative Imagination: Enlightenment to Romanticism* (Cambridge: Harvard University Press, 1981), 144.

[23] Huxley, *Discourses,* 6.

[24] Huxley's father was a teacher of mathematics at Ealing School, where a young John Henry Newman had been one of his pupils. Desmond, *Huxley,* 4; John Henry Newman, "Secular Knowledge not a principle of action," in *The Tamworth Reading Room* (London: J. Mortimer, 1841). Joshua B. Held focalizes Newman in his discussion of the voice of the orator and its relationship to modeling and moving the internal "voice" of the conscience in "Conscience, Voice, and Presence: Newman's *University Sermons* and Victorian Platform Culture*," Victorian Review* 40, no. 1 (2014): 211-231.

[25] Diarmid Finnegan, "Finding a scientific voice: performing science, space, and speech in the 19th century," *Transactions of the Institute of British Geographers* 42, no. 2 (2016): 197, 200.

have stood the test of time.[26] If such accounts elide the specifics of how that sympathy was constructed on the level of the text, it is largely due to the fact that faithful transcripts of even the most popular lectures are at best hit-or-miss resources. We know, for example, the subject of every Royal Institution lecture and who gave it from 1825 to the present— yet even the Royal Institution has only a handful of notes from over a century of notable performances, and even less were printed (we have William Crookes to thank for many of the ones that were).[27]

Practitioners and audiences alike felt truth in the idea that public sympathies were most readily attracted during the ephemeral moment of performance. The transcriber for Henry Roscoe's first Manchester lecture on the "Indestructibility of Matter and Energy" (1866) even makes apologies to that effect, taking an introductory moment to pointedly note that "[Roscoe's] lecture will necessarily lose some of its force and freshness when put into matter of fact type."[28] Much of the scholarly literature likewise notes a self-awareness about the connective loss effected by transcription, which fragmented the group spirit and dulled the force of charm. Frank James records Faraday's aversion to printing his lectures, lest the affective bloom go off their

[26] J. N. Hays, "The London lecturing empire, 1800-1850" in I. Inkster and J. Morrell (eds.), *Metropolis and province: science in British Culture, 1780-1850* (London: Hutchinson, 1983), 91-119; Bernard Lightman, "Lecturing in the spatial economy of science," and ""The Voices of Nature: Popularizing Victorian Science," in *Science in the Marketplace: Nineteenth Century Sites and Experiences,* eds. Aileen Fyfe and Lightman (Chicago: University of Chicago Press, 2007), 97-132, 187-211; D. N. Livingstone, "Science, site, and speech: scientific knowledge and the spaces of rhetoric" *History of the Human Sciences* 20, no.2 (2007): 71-98; Frank J. L. James, "Reporting Royal Institution Lectures, 1826-1867," in Cantor and Shuttleworth *Science Serialized: Representations of the Sciences in Nineteenth-Century Periodicals,* (Cambridge MA: MIT Press, 2004); Simon Naylor, "The field, the museum, and the lecture hall: the spaces of natural history in Victorian Cornwall," *Transactions of the Institute of British Geographers* 27, no. 4 (2002): 494-513; Howard, "Physics and fashion," 735-741.

[27] I owe much thanks to Jane Harrison at the Royal Institution for making the fact of this paucity known to me— Edward Frankland's lectures, despite his relative prominence and years of tenure at the RI are all but impossible to find in their entirety. Crookes was responsible for bringing to print Faraday's *The Chemical History of a Candle* and *On the Various Forces of Matter* and William Odling's *A Course of Six Lectures on the Chemical Changes of Carbon.*

[28] Henry Roscoe, "Four Lectures on Elementary Chemistry, Lecture One: Indestructibility of Matter and Energy," in *Science Lectures for the People, First series* (Manchester: J. Heywood, 1867), 10.

work and the "vivacity of speaking" be lost.[29] My survey departs from both previous scholarship and Faraday's fears in suggesting that the guidance of the best lectures, which Huxley believed could "awaken a sympathy for abstract truth" in attentive listeners, was embedded not merely in the performative format of the lecture but equally in the *formal* qualities of lectures themselves.[30] That is, I argue that the confluence of information *and* how it was presented retained the power to impact the sympathies, and that this confluence is worth attention despite the methodological difficulties it poses. As my larger conceptual goal is to better understand the labor of representing "sympathy for science" in a particular cultural context, this project takes an admittedly British and scientific cross section of a multi-generic font of literary production in its time more generally associated with an American idiom.[31] My hope is that in attending to this scientific subset, my discussion will connect this more concentrated British enterprise to the trans-Atlantic and trans-generic lecture circuit of the nineteenth century in general which courted

[29] Frank J. L. James, *Correspondence of Michael Faraday* (London: Institution of Electrical Engineers, 1991-2012), 5:476; Finnegan, "Finding a scientific voice," 198-199; Howard, "Physics and Fashion," 738-730.

[30] Huxley, *Discourses,* v. While I am primarily interested in disinterested, or at least non-utilitarian, affective attachment, the truth (which I have previously addressed in another capacity in my notes to Chapter 1) was that scientific lecturing—and the marshaling of public sympathy for which it angled—played a role in the larger nation-enhancing commercial enterprise that was the lecture circuit in both Britain and America. Not only was scientific knowledge *itself* seen as a key to enhancing the nation (and the wealth of the nation); the lecture was one of the ways interlocutors (like scientists) made money and created demand for knowledge. See Aileen Fyfe's and Bernard Lightman's editors' introduction to *Science in the Marketplace: Nineteenth-Century Sites and Experiences* (Chicago: University of Chicago Press, 2007), 9-14.

[31] In *Performing Authorship* Adams notes that "while the British may have laid the foundation for the useful, public lecture," the institutionalized lyceum and lecture culture were generally recognized as an American phenomenon for much of the nineteenth century (6). For more on this trans-Atlantic culture see also Tom F. Wright, *Lecturing the Atlantic: Speech, Print, and the Anglo-American Commons* (New York: Oxford University Press, 2017); Margaret Rossiter, "Benjamin Silliman and the Lowell Institution: The Popularization of Science in Nineteenth Century America," *The New England Quarterly* 44, no. 4 (Dec. 1971) likewise emphasizes the "uniquely American" idiom of public lectures and the special status of scientific lecturers like geologist Benjamin Silliman in 19th century America, which had "great 'grass roots' interest in science but [lacked] adequate schools or an important scientific press" (625).

the public sympathies for causes light and heavy—art and aesthetics, education and economy, suffrage and slavery.[32]

After all, the enterprise that taxed Huxley's "scientific and literary faculties to the utmost," however tied to the moment of presentation, was on both its scientific and literary accounts a linguistic one. While we cannot, to our great loss, recreate the oratorical performances of practitioner lecturers, in what remains behind—their transcripts— we can see rhetorical markers of *how* that crucial but ephemeral feeling of sympathetic connection could be constructed on the level of language. We see this clearly enough in the bracing pathos of Frederick Douglass' orations, or in the spiritual benediction of Newman's sermons.[33] The same logic surely applied to the sciences as well. Consider our introductory voice, John Tyndall, who grasped the necessity of such a rhetorical power. "A thoughtful and competent teacher," opined Tyndall, had the knack for formally presenting and arranging scientific objects and information in a way that excited the interest of pupils—or in the case of lectures, audiences. Such instructors "cause[d their] logic to run like a line of light through these images," moving listeners to respond "with a profit and a joy, which the mere exhibition of facts without principles, or the appeal to the bodily senses and the power of memory alone, could never inspire."[34] Following Tyndall, I suggest that attending those linguistic "lines of light" which elevated fact and accompanied

[32] Adams' *Performing Authorship* surveys some of the major voices that defined the trans-Atlantic lecture tour, beginning with Frederick Douglass and including Margaret Fuller, Harriet Martineau, Harriet Beecher Stowe, Charles Dickens, Oscar Wilde, Matthew Arnold, and Henry James (1, 21-32, 33-35, 57-59, 85-88). The list of Victorian literary and cultural figures who made at least one highly-publicized lecture tour is exhaustive.

[33] I think of the language of Douglass' famous "The meaning of the Fourth of July for the Negro" speech at Rochester 1852, *Frederick Douglass: Selected Speeches and Writings,* ed. Philip S. Foner and Yuval Taylor (Chicago: Lawrence Hill Books, 1999) where with Ciceronian skill he vividly, painfully reconstructs the case of the American slave, the grips for the imagination clearly etched in every injunction to "see" their broken bodies and their crying children (197-198).

[34] John Tyndall, "An Elementary Lecture on Magnetism (1861)," in *Fragments of Science for Unscientific People* (New York: D. Appleton and Co., 1871), 379.

charismatic performance can help us track the many vectors of sympathy that lecturers sought to facilitate, though I acknowledge that the deficit of printed material can at best yield only an incomplete picture of a far more complex reality.

The three sections of this chapter explore three rhetorical modes that each in their way give us a sense of how lecturers approached the larger issue of carving footholds amid "abstract truth": the beautification of the common, the metonymic narration of object "cases," and the moral punctuation of the scientific vocation. Such strategies helped bring people into closer imaginative contact with the world of physical things even as they represented various emotionally-charged [manners] of relating to those things.[35] The first section addresses how lecturers approached the sympathies through an aesthetic vector. In it we examine a rhetorical gesture toward the "beautification" of common or conventionally "ugly" objects, such as Michael Faraday's description of an India-rubber bladder as "very beautiful although very common (most beautiful things are common)."[36] Faraday's is a literal example of this common variant, which lecturers employed for the purposes of defamiliarizing the objects under scrutiny. Tyndall's crystal candy and its "hidden points of beauty" afford another such example of unsettling aesthetic conventions. Both illustrations show how lecturers approached the scientific

[35] These are by no means the only rhetorical strategies at play that bound audience in sympathy to lecturer, or to nature, or to a combination of the two. My personal favorite, unexplored in this chapter, is the comic anecdote. For example, Thomas Alcock takes a break from his lecture on "Zoology III," in *Science Lectures for the People, First Series* (Manchester: J. Heywood, 1866-67) to regale his audiences with tales of the crab fights that have taken place on his watch. One crab had attacked another crab while molting, and "Shortly afterwards it came to be the other crab's turn to cast its shell, and then the ingratitude of that wretch was at once seen. No sooner did this second crab cast his shell than he rushed at him and ate him up! I am happy to say, however, that it was not many days before justice overtook him, and he died, either from a bad conscience, or—what is perhaps more likely—indigestion" (87). Stories like these showed that, despite all of their knowledge, men of science were not without the common touch of humor and, furthermore, that the study of nature was not sobering, but joyful. These anecdotes broke the ice, and at the same time called out the "childlike" mind of the student of nature.

[36] Michael Faraday, *On The Various Forces of Matter and their relations to each other,* (London: Spottiswoode and Co., 1860), 12.

aesthetic of beauty as truth, and thereby push the limits of possibility for what kinds of things can provoke aesthetic responses.

This chapter moreover argues that the formal choices made by lecturers, besides bringing audiences into an abstract sympathy with science, specifically guided those audiences through imagining a sympathetic recognition in the physical universe *itself.* The second section approaches a more complex rhetorical operation that I have chosen to call, in the spirit of efficiency, the Cosmos metonyms. I use this moniker in homage to Alexander von Humboldt's influential conception of the total interconnectedness of the universe.[37] This section explores how the lecture adapted the familiar case-based sympathy of Adam Smith and applied it to a more cosmic fellowship. Cosmos metonyms are narrative moments that typically proceed from something common (like Huxley's famous piece of chalk) to reveal networks of relationship among object, listeners, lecturer, and all manner of related familiar and unfamiliar objects and processes (for Huxley these include Norwich miners, nations and continents, tea kettles and sea mud, ichthyosaurs and the Battle of Hastings).[38] Such metonymic networks are community-

[37] "The knowledge of the laws of nature, whether we can trace them in the alternate ebb and flow of the ocean, in the measured paths of comets, or in the mutual attractions of multiple stars, alike increases our sense of the calm of nature, while the chimera so long cherished by the human mind in its early and intuitive contemplations, the belief in a "discord of the elements," seems gradually to vanish in proportion as science extends her empire. General views lead us habitually to consider each organism as part of the entire creation, and to recognize in the plant or the animals not merely an isolated species, but a form linked in the chain of being to other forms living or extinct. They aid us in comprehending the relations that exist between the most recent discoveries and those which have prepared the way for them," Humboldt, *Cosmos,* 42.

[38] Thomas Henry Huxley, *On a Piece of Chalk* (1868) (New York: Charles Scribner's Sons, 1967), 23, 25, 29,38, 47, 63. It is perhaps no coincidence that most of the examples of case-based identification in this chapter fix on natural-historical objects, and that the case-based mode of identification has particular purchase in the Victorian novel, for according to Lynn Merrill natural history and the Victorian novel share an important ideological trait. She argues that natural history appealed to the Victorian imagination in a manner that mirrored the structure of literature, for "natural history writing is the link that connects popular natural history—with its love of physical objects— to Victorian literature, with its lexicon of

oriented in the most capacious sense, for they help us understand how lecturers tried to involve their audiences imaginatively in a "community of matter." Tyndall's candy also pertains to this second category, metonymizing the powers of molecular force that, in recombination, hold all existing bodies together. By exploring "likeness" in all forms of matter, lecturers used Cosmos metonyms to expand the range of where identification could happen, and therefore where some degree of sympathy could attach.[39]

Sympathy is, as we know from Adam Smith and his many nineteenth-century successors, a moral sentiment; and in the last section this chapter will turn to examine the lecture's gravitation toward moral conclusions – a tendency reminiscent of the formal connection that the genre shares with its Victorian sister, the sermon. In this culminating section we see how the lecture keyed into a moral and spiritual wavelength, and how its rhetorical appeal to the exercise of the sympathies fostered habits of mind that reformists like Huxley and Tyndall believed made science a highly moral enterprise. The concluding remarks of scientific lectures capitalized on the familiar sermon structure in order to evoke spiritual sympathies, as lecturers attempted to naturalize the irreducibly spiritual experience that they found in scientific insight.

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particularity." Lynn Merrill, *The Romance of Natural History* (New York: Oxford University Press, 1989), 5, 13, 17, 19.

[39] The idea of familiarization as a catalyst for sympathy is a well-known one in the realm of novel studies. We see, as early as Samuel Taylor Coleridge, "On the Slave Trade" (1796) in *The Collected Works of Samuel Taylor Coleridge,* ed. Lewis Patton, *The Watchman* (London: Routledge and Kegan Paul, 1971) a recognition of the limits of human sympathy when confronted with distant or depersonalized human multitudes and tragedies (in Coleridge's example, slavery in the West Indies, where "the miseries of our fellow creatures dwindle into pigmy forms, and are crouded [sic], an innumerable multitude, into some dark corner of the heart" [2:139-140]). The same could only be said to hold more true for the non-human entities and issues of science. The processes of imaginative familiarization, in this chapter but in this project as a whole, help to hold that door open against what we now know to be an established human cognitive limitation, by making nature— in some small way— like the self; Elizabeth Coggin Womack, "Nineteenth-Century Auction Narratives and Compassionate Reading," *Victorian Review* 43, no. 2 (Fall 2017) likewise notes how novelists like Dickens and Thackeray regularly used individual cases to call out "selective compassion" and to build a generalized sympathy for a given situation (230-231).

"Beautiful things are common": sympathy and the scientific aesthetic

John Keats affirmed that "A thing of beauty is a joy forever," but so did James Dewar when he addressed a Christmas audience at the conclusion of his 1878-1879 series of Royal Institution lectures on "A Soap Bubble."[40] Lecturers frequently gestured towards beauty in their scientific ministrations, in often surprising ways. In this section we address the rhetorical function of the identification of beauty, its relation to scientific truth, and how the presentation and explication of beauty angled to model and produce a more capacious attitude of receptivity to science and the things it studied.

Small, smooth, symmetrical and colorful, Dewar's soap bubble probably was beautiful. Plenty of moments from the lectures cited in this chapter offer up similar appraisals of beauty, reassuring audiences that between the scientific person and themselves there remained a common aesthetic ground upon which they could all stand. In the domain of beauty lived the rainbow in all of its iterations, along with the plumage of hummingbirds and kingfishers, the scintillating sparks of a fire, and the inviolable diamond.[41] But we regularly see lecturers apply this designation in more eccentric ways. For example, in a lecture on "The Force of Gravitation" (1859) Michael Faraday gives a demonstration of the "most simple exertion of this power of matter called *weight* or *gravity*." Before performing his demonstration, he introduces his objects: a weight, and

[40] John Keats, *Endymion: a Poetic Romance* (1818) in *Keats' Poetry and Prose* (London: W. W. Norton and Company, Inc., 2009) 148, line 1; James Dewar, "A Soap Bubble" lecture VI 1879, File bDEWAR/DIVb, The Royal Institution, 16.

[41] Henry Enfield Roscoe, "The Rainbow," in *Science Lectures for the People, Fourth Series* (Manchester: J. Heywood, 1872), 157-158; Richard Bowdler Sharpe, "The Birds of the Globe," in *Science Lectures for the People, Seventh Series* (Manchester: J. Heywood, 1875), 58, 62, 64; Faraday, *Forces of Matter,* 94.

> One of those little inflated india-rubber bladders, which are very beautiful although very common (most beautiful things are common), and I am going to put the weight upon it…[42]

In the midst of scientific explanation, Faraday makes an aesthetic judgment of the rubber bladder—and a rather unconventional one at that. These staple experimental items were at the time made of a dull, brownish vulcanized rubber. While certainly a *common* scientific material, they likely never inspired a consensus on beauty. Faraday's evaluation clashes with an intuitive expectation of what is "beautiful," even adjusted for a scientific context. His atypical expression here defamiliarizes what is at best a neutrally attractive object, one which falls short of many of the criteria that someone like Edmund Burke might say sparked an intuitive understanding of beauty.[43] Burke might argue that we can intuitively sense the disjoint between Faraday's bladder and something like James Dewar's soap bubble, with its crystal delicacy and "depth and variety of colours," even if we cannot fully explain the quality of this difference.[44] Faraday's declaration suggests a capaciousness to the scientist's taste for beauty, which, in a kind of Romantic affirmation of the commonplace, seems to include vulcanized rubber.

Faraday stretches the categories not only of beautiful things, but of common things as well. His "although" presents a contradiction to his claim that "beautiful things are common." It implies an awareness that beautiful things by definition ought *not* to be common—whether common signifies "commonplace" or the more derogatory "ordinary or low"— or that the quality of being common is somehow antithetical to beauty. Faraday's parenthetical, however, confirms that in elevating his sphere of brown rubber, he does not mean to overturn beauty, but

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[42] Faraday, *Forces of Matter,* 12.
[43] Edmund Burke, *A Philosophical Inquiry into the Origin of Our Ideas of the Sublime and the Beautiful* (1792; Philadelphia: J. Watts, 1806), 170-171, 178
[44] Dewar, "A Soap Bubble," 15.

rather to expand it. "Most beautiful things are common" does not mean that that which his audience understands to be "classically beautiful" is in fact *merely* common. Far from denigrating the beautiful, this expression suggests beauty can be the product of *familiarity* instead of, or perhaps in addition to, rarity.[45] Faraday seeks to add to the pantheon of beauty. Commutatively, "most beautiful things are common" must necessarily mean that many common things are, in fact, beautiful.

This "beautification" of the common, neutral, or even ugly thing was, well, *common* in the scientific lecture. In one form or another, as we shall see, lecturers employed this rhetorical tool to urge audiences to amend their previous conceptions of beauty. "We are apt to overlook the wonderful," says Tyndall, "when it becomes common," and men of science were out to combat that impulse.[46] In these expressions, lecturers essentially performed one of many ways of having a "love" of science, which meant finding beauty in unexpected and unlikely places as well as in expected ones. Such a broad aesthetic receptivity harmonizes with the scientist's drive through theory and towards law, both because the formulation of a theory requires attention and openness to unexpected sources of data, and because physical law applies uniformly in places common and rare (and as the expression of truth is itself a thing of beauty.)[47] These rhetorical moments of

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[45] John Hall Gladstone, *Michael Faraday* (London: Macmillan and Co., 1872) notes how Faraday loved to walk in the country watching the birds build nests and the young lambs grow up, and how "he took great pleasure in Byron, and Coleridge's 'Hymn to Mont Blanc' delighted him. When anything touched his feelings as he read—and it happened not infrequently—he would show it not only in his voice, but by tears in his eyes also," (56-57).

[46] John Tyndall, "Matter and Force: A Lecture to the Working-Men of Dundee" (1867), in *Fragments of Science*, 83.

[47] "Everybody knows," writes T. H. Huxley in "On Science and Art in Relation to Education" (1882) *Collected Essays* (New York: D. Appleton and Co., 1897), "mathematicians speak of solutions to problems as "elegant," and they tell you that a certain mass of mystic symbols is 'beautiful, quite lovely.' Well, you do not see it. They do see it, because the intellectual process, the process of comprehending the reasons symbolized by these figures and these signs, confers upon them a sort of pleasure such as an artist has in visual symmetry" (3:176-177).

"beautification" angled to reprogram aesthetic feeling and thereby allow audience sympathy, redefining rather than gas-lighting the beautiful.

The above interpretation gives the lie to those opponents of the "scientific spirit of the age" quick to accuse a scientific habit of mind as antithetical to an appreciation of beauty, which they felt reduced this and other higher senses to mere mechanisms of "utility" or "fitness" that answered an evolutionary demand.[48] While that pervasive detraction was tacitly and overtly rejected by the scientific naturalists, it is worth taking the time to debunk it here in the context of public lecture, where lecturers celebrated beauty in earnest.[49] In the thrall of unlikely objects, they neither fudged nor cheapened beauty by, as Elaine Scarry would put it, "over-valuing" it. Rather, lecturers were instead reshaping an idea of what makes something beautiful, rescuing listeners from *under-valuing* beauty, and in doing so shaping the subjectivity of their auditors. While lecturers could not *prove* beauty, they could reframe the prospect that all manner of things may elicit that same feeling elicited by beauty—"love, or some passion similar to it" —if viewed through the beautifying lens of scientific knowledge. In the hands of the scientist, the silent song of the Grecian urn—"beauty is truth; truth beauty"—takes on a renewed clarity.

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[48] Frances Power Cobbe's "The Scientific Spirit of the Age" *The Scientific Spirit of the Age, and other pleas and discussions* (Boston: George H. Ellis, 1888) almost too perfectly embodies every stereotypical accusation against scientific inquiry that figures like Huxley exasperatedly combatted for their entire careers. Witness, for example, her claim that "Of the two sides of life, his scientific training will compel [*sic*] him to think always in the first place of the lower. The material (or, as our fathers would have called it, the *carnal*) fact will be uppermost in his mind, and the spiritual meaning thereof more or less out of sight. He will view his mother's tears not as expressions of her sorrow, but as solutions of muriates and carbonates of soda, and of phosphates of lime" (12); Equating beauty with its fitness or utility is in fact still a common fallacy of evolutionary psychology. See Abigail Zitin, "Fittest and Fairest: Aesthetics and Adaptation before Darwin," *ELH* 82, no. 3 (2015): 845-868.

[49] By which I mean to make a distinction between earnestness and sleight of hand. Calling a rubber bladder, or an ugly but expensive pair of shoes "beautiful" because you want people to buy it, for example, is a very different thing from calling the same thing "beautiful" because it represents a "beautiful" truth.

Let us first dispatch the utilitarian problem: the argument that the "beauty" of the things under scrutiny in the public lecture is due to their utility. Faraday's bladder, the coal and coal products in A. H. Green's and William Odling's Manchester lectures, and the yeast which Huxley takes as a Manchester subject, all look suspiciously useful.[50] They naturally suggest the possibility that a scientific aesthetic conflated "beauty" with "usefulness," and as such was fundamentally utilitarian— or worse, materialist, one of the gravest insults that scientific opponents could muster. This common caricature of scientific punditry as bloodless, amoral, and aesthetically insensitive reflects a broader tension over the status of cherished human concepts like morality, goodness, meaning— and of course, beauty—in a naturalistic paradigm. To interlocutors like Cobbe, a paradigm that privileged the material threatened to reduce all phenomena to sum of their "usefulness," disenchanting human life, and robbing beauty of its essence. But though they relied on materialist terminologies, practitioners were largely wary of mistaking, as Huxley put it, those clinical "x's and y's with which [they worked their] problems, for real entities."[51] Huxley himself shared some of the same metaphysical cautions as his detractors, pointedly proclaiming that "the errors of systematic materialism may paralyze the energies and destroy the beauty of a life."[52] Beauty was in no danger from him.

Yet if the beautiful and the common make a happy empirical pairing, "beauty" and "use" must likewise bear some relation. A certain attraction inhered to the useful for the Victorians, and on a basic level lecture subjects were often chosen for the recognizable utility they held for

[50] Burke, "Inquiry," 13; A. H. Green ""How Coal and the Strata in Which it is Found is Formed," in *Science Lectures for the People, Second Series* (Manchester: J. Heywood, 1871); William Odling, Lecture V, in *A Course of Six Lectures on the Chemical Changes of Carbon* (London: Longmans, Green, and Co., 1869); T. H. Huxley, "On Yeast," in *Science Lectures for the People, Third Series* (Manchester: J. Heywood, 1873).
[51] Thomas Henry Huxley, "On the Physical Basis of Life" (1868) in *Lay Sermons, Addresses, and Reviews* (New York: D. Appleton and Co., 1870), 146.
[52] Huxley, "Physical Basis," 146.

audiences (a recognition that in itself provided a familiar, sympathetic touchstone). For his Manchester audience W. Boyd Dawkins chose to speak "On Coal" (1870), the substance being the "great centre of our prosperity," for "upon it depends nearly all the success of our manufacturing enterprise."[53] A wondrous potential emanated from common useful things thanks to advances in technology that linked the arts and manufactures. The vulcanized rubber of Faraday's bladder was invented in the 1840s, and the numerous Manchester meditations on coal and the "beautiful…substances" which derived from it relay the "great excitement" generated by the "economical and social implications of [these] now forgotten chemical discoveries."[54] But we can clearly see an extra-utilitarian aim in the lecturers' rhetorical treatments of even these useful things, when the speakers plainly state an investigative intent or a metric of appreciation that surpasses utility. "If coal is important in this direction [i.e. use]," Dawkins continues, "it is no less important from a purely scientific point of view, apart from any mercantile end or aim."[55] Dawkins's "scientific point of view" will go on to assess the aesthetic potential of "the black substance which you burn," seeing the simple lump of coal as evidence of "what beautiful things there are in nature," "lying at your very doors."[56]

Furthermore, many of the common things or creatures "beautified" by the lecturer's rhetoric appear to possess no practical utility at all. Witness Thomas Spencer Cobbold's lecture on "Parasites, and their Strange Uses" (1873)— a "really quite attractive" subject—in which

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[53] W. Boyd Dawkins, "Our Coal Fields" (or "On Coal") in *Science Lectures for the People, Second Series* (Manchester: J. Heywood, 1870), 222. Sir William Boyd Dawkins was a geologist and early paleontologist, and a well-known professor at the University of Manchester. He was the first lecturer in geology at Owens College in 1872. See Geoffrey Tweedale and Timothy Proctor, "New Documentary Evidence on the Career of Sir William Boyd Dawkins, F. R. S. (1837-1929)," *Notes and Records of the Royal Society of London* 45, no. 2 (July 1991): 193, 194.

[54] Asa Briggs, *Victorian Things* (London: B. T. Batsford Ltd, 1988), 20-21. See coda of this project for discussion of the intersection between scientific development and national identity.

[55] Dawkins, "Our Coal Fields," 222.

[56] Dawkins, "Our Coal Fields," 235.

Cobbold displays a series of drawings of the fluke worm.[57] The lecturer signals the familiar nature of this parasite, a frequent blight on cattle and sheep. "You will recognize in this drawing the common fluke," he says, before proceeding to readjust his listeners' relationship to these "horrible-looking" creatures:

> Here is another pretty little fluke, called *Polystoma,* which has a lot of little suckers…Here, again, is a beautiful little parasite, residing in the frog. Put it on a slide under the microscope, and you would exclaim, "What a charming creature." It is an exquisite object, only about one-fourth of an inch long.[58]

Through his quick succession of positive aesthetic adjectives—pretty, beautiful, charming, exquisite—Cobbold seeks to beautify not just a common object, but a decidedly *un*beautiful thing. (This is doubly interesting insofar as the fluke itself is not actually a bad-looking creature—we find them "ugly" because of the quality of their "utility," not their appearance.) Unlike Faraday's aesthetically neutral but experimentally useful object, Cobbold's is a common pest which actively generates disgust (though a bladder, in another context, does put us in mind of digestive waste). The fluke's "uses" to us, such as they are, are decidedly negative. "[H]undreds and thousands of people in Germany are trichinised and scores of persons have perished of late from the *Trichina,"* a type of fluke found in the pig.[59] "I do not think there is any necessity that we should be trichinised," says Cobbold, and states that "there is no evidence to show that any one of the numerous creatures which infest these various hosts is in any way

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[57] Thomas Spencer Cobbold, "Parasites, and their Strange Uses," in *Science Lectures for the People, Fifth Series* (Manchester: J. Heywood, 1873). Cobbold was Britain's leading parasitologist, a Sunday Lecture Society contributor, and scientific naturalist. See Ruth Barton, "Sunday Lecture Societies: Naturalistic Scientists, Unitarians, and Secularists Unite Against Sabbatarian Legislation," in Dawson and Lightman, *Victorian Scientific Naturalism,* 203, 213.

[58] Cobbold, "Parasites," 44.

[59] "Trichinize" being the verb form of "to be infested with *Trichina,"*— in other words, to contract trichinosis. Cobbold, "Parasites," 50.

beneficial to them." The fluke is pretty unequivocally a blight. And yet Cobbold maintains that the fluke is beautiful, while actively rejecting the idea that utility to humankind is an adequate premise for scientific interest. He entreats that his audience "must not, if you please, hold [him] responsible for the precise title of the lecture this evening," as it "may have been a little misleading." He sees the phrase "their strange uses" as a "concession to popular ideas." When people who already want to believe that everything "has been made especially for man's benefit" see such a phrase, "they perhaps think there must, after all, be…some special purpose in man's favor," an idea that Cobbold rejects factually as well as aesthetically.[60] If he finds the fluke beautiful, it is certainly not because of its use to humankind, or to any other creature, but because of some other intrinsic property

This brings us to the second theoretical detraction: the conflation of "beauty" with a fitness to fulfill adaptive purposes. We understand this best, of course, in the Spencerian mantra of "survival of the fittest," but in its essence the concept preceded Darwinian thought. A certain strain of moral sense philosophy from the early eighteenth century anticipated post-Darwinian sociobiology in its desire to rationalize apparently contrapurposive (or purposeless) behaviors or attributes, like beauty.[61] In this view all form, behavior, and so on, of living organisms must be explicable in terms of the calculable advantage those attributes gave to that organism. We see this in William Hogarth's *The Analysis of Beauty* (1753), in which he extrapolates the rationale for judgments of beauty in terms of erotic desire. A serpentine line, for example, is "beautiful"

[60] Cobbold, "Parasites," 50.

[61] Zitin, "Fittest and Fairest," 853. The modern iteration of sociobiology, and the idea that all human traits (including aesthetic behavior) can be explained as an advantageous selective outcome comes to us from Edward O. Wilson, *Sociobiology: The New Synthesis* (Cambridge: Harvard University Press, 1975). See Stephen Jay Gould's opposition to purely adaptationist sociobiology in Gould, "More Things in Heaven and Earth," in *Alas, Poor Darwin: Arguments against Evolutionary Psychology.* ed. Hilary Rose and Steven Rose (New York: Harmony Books, 2000), 105.

because it suggests the curve of a woman's body, and the curvaceousness of a woman's body is beautiful to us because it suggests sexual reproduction.[62] Elsewhere we might consider Joseph Addison's pronouncement that beauty performed a sorting function among animals, allowing them (and us) to distinguish their own conspecifics from those of other species and thus ensure reproduction.[63] This kind of purpose-seeking rationale gained momentum with the advent of an evolutionary paradigm, which furnished the older aesthetic problem with more sophisticated scientific vocabulary. Beauty's "apparent purposelessness"—even its counter-productivity—"posed a problem for a "rationally ordered universe," in this view, could only be rationalized if it gave an adaptive or reproductive advantage. While scientific skeptics like Cobbe were happy to attribute such a mechanistic attitude to *all* scientifically-minded persons, the lectures at hand demonstrate how untrue that accusation was. [64]

Nevertheless, the argument bears some consideration: some moments of common "beautification" in lectures do initially strike adjacent to mechanistic logic. The fluke may not be useful to us, but it is extremely fitted to its parasitic purposes in life. Is this why Cobbold found it such a pretty, exquisite creature? Or consider another possible example. In regards to the circulation of the blood through a frog's foot in a lecture on "Elementary Physiology" (1867) John Edward Morgan concludes that "[i]t is a most striking and beautiful sight to see blood corpuscles hurrying along like so many little ants, fulfilling the work which may be assigned to

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[62] William Hogarth, *The Analysis of Beauty* (1753) ed. Ronald Paulson (New Haven: Yale University Press, 1997), 49. Zitin notes that this is the view of theories that define beauty in terms of eros: "We find things beautiful, the argument would go, because they evoke things we find sexually attractive." She notes that this is a version of what Elaine Scarry means when she describes beauty as inspiring the desire for "replication," and suggests that Scarry's evocation of Plato pinpoints an important but uncredited source for Addison, Zitin, "Fittest and Fairest," 867-68.

[63] Joseph Addison, *The Spectator* 413 (June 24, 1712): 545-46. A "conspecific" is a member of the same species.

[64] Zitin, "Fittest and Fairest," 855.

them in the body."[65] The valves of the heart are likewise a "very perfect and beautiful contrivance."[66] His phrasing opens up the possibility that the scurrying cells and the locking valves are a "beautiful sight" because of their fitness to perform their physiological purpose—conditions which someone like Burke would adamantly reject as criteria for "beauty." If fitness, or "a part's being well-adapted to answer its end…[were] the cause of beauty, or indeed beauty itself," then

> The great bag hanging to the bill of a pelican, a thing highly useful to this animal, would be likewise as beautiful in our eyes. The hedgehog, so well secured against all assaults by its prickly hide, and the porcupine with his missile quills, would be then considered as creatures of no small elegance…How well fitted is the wolf for running and leaping! how admirably is the lion armed for battle! but will anyone, therefore, call the elephant, the wolf, and the lion, beautiful animals?[67]

One has only to look at any of the various popular natural history tomes to give the lie to Burke's assessment. John George Wood found the Simpai monkey a "beautiful little animal," the lion, tiger, and all manner of big cats "beautiful and graceful creatures" (no word on wolves, though this, even more than the fluke, seems a problem of reputation more than of form).[68] And while series like the Christmas and Manchester Lectures skewed more towards physical and chemical subjects than towards pure natural history, they still present us with many examples that appraise beauty as distinct from fitness. We've seen this with Cobbold, but we also find it with zoologist Thomas Alcock and the "beautiful little bells" of his infusoria that eat decaying matter, or with P.

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[65] John Edward Morgan, "Elementary Physiology Lecture II," in *Science Lectures for the People, First Series* (Manchester: J. Heywood, 1867), 140.
[66] John Edward Morgan, "Elementary Physiology Lecture III," in *Science Lectures for the People, First Series* (Manchester: J. Heywood, 1867), 155.
[67] Burke, "Inquiry," 154-55.
[68] John George Wood, *Popular Natural History* (Philadelphia: Porter and Coates, 1885), 17, 57.

Martin Duncan's attention to the "exceeding beauty" of the tail of a giant, armadillo-like creature called the glyptodon.[69] Certainly the scientific eye is not blind to the marvelous fitness of adaptations. All of these lecture examples acknowledge fitness even as they appraise beauty. Thomas Alcock exclaims over the "back of the crab," noting "how beautifully it is arched to resist force."[70] Duncan notes of the glyptodon's "beautiful ending" that the "only way of accounting for its use" is in supposing it to be part of a lekking behavior.[71] And S. M. Bradley supposes that in the domain of animal mechanics, it is the "flight of a bird" which is "perhaps the most beautiful, as it is the most complicated."[72]

But equating correlation with causation is a mistake for the amateur scientist, and just because beauty is found alongside an appraisal of fitness does not mean that fitness is the cause of beauty. In the first place, lecturers were perfectly capable of signaling when they *meant* to attend to fitness and utility, and did so quite regularly. They chose their words carefully—often agonizingly so (Huxley called Tyndall's fretfulness over the composition and presentation of his orations "lecture fever").[73] In this case, Duncan turns his audiences attention to the glyptodon's tail first because of its beauty. Beauty initially commands attention; only after he notes the tail's

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[69] Thomas Alcock, "Zoology I," in *Science Lectures for the People, First Series* (Manchester: J. Heywood, 1866), 64-65. Alcock was a physician who appeared to have a strong interest in natural history, was employed by Owens College to teach evening zoology lectures to students, and for several years curated the Museum of the Manchester History Society; P. Martin Duncan, "The Great Extinct Quadrupeds," in *Science Lectures for the People, Seventh Series* (Manchester: J. Heywood, 1875), 82. Duncan was a well-known paleontologist and a professor of geology at King's College London, a lecturer to the India Civil Engineering College, as well as the editor, translator, and author of quite a few books on natural history, including *The Transformations or Metaphorphoses of Insects* (London: Cassell, Petter, and Galpin, 1870). See "Notes," *Nature* 5 (November 9, 1871): 31.

[70] Alcock, "Zoology III," 85.

[71] Duncan, "Extinct Quadrupeds," 82. A lekking behaviour is a competitive male breeding display intended to entice females of a given species into copulation (some familiar examples would be the tail display of the male peacock and the plumage and auditory display of the male sage grouse).

[72] S. Messenger Bradley, "Animal Mechanics," in *Science Lectures for the People, Fifth Series* (Manchester: J. Heywood, 1873), 77.

[73] T. H. Huxley, "Professor Tyndall," *The Nineteenth Century* (January 1894): 5.

beauty does he also pause to speculate how the "beautiful ending" might have been useful to the animal to which it was attached. At no point does Duncan directly connect the tail's beauty to an adaptive use. The tail perhaps is *for* something, but it is also beautiful. The circulation of the blood is likewise obviously *for* something, but it does not have to be beautiful because of that. To the empirical eye, at least, the beautiful and the useful are not mutually exclusive—I tease them apart because neither are they identical. We see this in Alcock's and Bradley's respective signals of an aesthetic response that surpasses an appreciation of fitness, indicating attunement to some other irreducible quality in nature's objects. And the Burkean objection sounds rather silly when applied to non-living phenomena. Tyndall's explication of ice crystallization might inspire us with an "exquisite sense of the beautiful," but to claim that this is because it is fit for its purpose is no more than to say that ice is good at being ice.[74] Kant might offer a partial antidote to the dilemma: the conflation of beauty and use arises because the pleasure of beauty derives from its "apparent purposiveness" despite having no discernible purpose.[75] But I think the tautology inspired by Tyndall's ice crystals productively prompt us to consider a more comprehensive unifying aspect of this scientific beauty and the feeling it inspires. It may not be a result of a part's fitness or function, but our ability to apprehend the scientific beauty of a feature, as we shall see in a moment, depends on our *knowing something about it.*

Bradley resists the tyranny of fitness and use in his conclusion to "Animal Mechanics" (1873). He quotes at length from Thomas Carlyle: "This world, after all our science and sciences,

[74] Tyndall, "Crystalline and Molecular Structures," 149.

[75] Kant theorizes in his *Critique of Judgment* (1790), trans. J. H. Bernard (London: Macmillan, 1914) that in our judgment of the beautiful we intuit only a *formal* purposiveness, that is "purposiveness without purpose," as opposed to an objective purposiveness (external or internal) or utility (77-80). In other words, human judgment imposes an a priori telos on all things it considers—the beautiful, capturing our attention, therefore feels like it must be *for something* (formally purposive) without actually being discernibly for anything (objectively purposive).

is still a miracle; wonderful, inscrutable, *magical,* and more, to whosoever will think it."[76] Bradley gently reassures his listeners that in spite of his technical examination, they "ought not to dream for a moment that Nature is rifled of her treasures." In doing so he affirms a persistent belief in some powerful quality that inheres in the things of the physical world, one which incites a response or understanding that scientific lecturers signal through the use of the word "beauty." If Cobbe thought science had blinded Darwin to beauty, she neglected to understand how the mere facts and things of nature fed the spirit of the "born naturalist" in the same manner as a poem, or a beautiful painting, or religion itself.[77]

All of the "beautiful things are common" examples—the rubber bladder, the fluke worm, coal and corpuscles and crab's backs—share an important quality. They are sufficiently diverse to confound accusations that scientific lecturers were attempting to supplant beauty with ideas of "use" or "fitness." None of them, however, actually *prove* that their objects are beautiful, in the manner that in the next section, lecturers offered—to the extent that they could—*proof* of mankind's material involvement in the physical world. Instead these appraisals, which angle for an expanded aesthetic/emotional interest in "common" things, rely to a degree on a trust established through the rhetorical strategy of *argumentum ad verecundiam* (similar to the Aristotelian *ethos*), an argument that addresses itself to the audiences' sentiment of reverence or respect for the speaker. "Whenever an audience require conviction that cannot be produced by the most diligent direction of their attention to the subject treated of, as it already exists in their

[76] Bradley, "Animal Mechanics," 95.

[77] Cobbe, "Scientific Spirit," 31-32. Of nature sufficing to feed the "instinct for beauty and instinct for conduct," Matthew Arnold, "Literature and Science," in *Discourses in America* (London: Macmillan and Co., 1894) wrote of Darwin: "…"Mr. Darwin once owned to a friend that for his part he did not experience the necessity for two things which most men find so necessary to them—religion and poetry; science and the domestic affections, he thought, were enough. To a born naturalist, I can well understand that this should seem so" (113).

own minds" writes Benjamin H. Smart, Faraday's oratorical instructor, "our proof must either be *experiment* addressed to the senses, or *argumentum ad verecundiam* derived from the testimony of the scientific man…."[78]

No experiment could prove the beauty of the fluke. Lecturers were left with the authority of their testimony to warm the sympathies to an unusual scheme of beauty— a testimony which gained authority as much through their credentials as through their enthusiasm. Lecturers proved their trustworthiness as "eminent scientific men" to the extent that they could evidence many of their claims about scientific phenomena.[79] As we'll see in the next section, practitioner-lecturers gave proofs, diagrams, specimens, and experimental demonstrations to accompany assertions that coal could produce striking colors, yeast produce gases that suffocate a flame, bacteria were everywhere and visible under a microscope. In establishing their reliability in these matters, lecturers gained a credit of trust for other claims—that common things are beautiful, or that, as we'll see later, scientific knowledge was the foundation of "our social and moral well-being." Even if these convictions did not "already [exist] in their own minds," audiences were given narrative "proof" of the viability of those convictions in the mind of somebody else.

In this view, it ultimately does not matter if the audience accepted the rubber bladder as beautiful. But it is important that they understood and accepted—that they sympathized with—the fact that the lecturer believed it was. They didn't have to share the lecturer's view, but they did have to trust *his* claims that that all manner of common or mundane objects can provoke an emotional response similar to, if not identical to, the emotional response solicited by beautiful things—that "love, or some passion similar to it." The fact that we track (to a degree) these

[78] Benjamin H. Smart, *A Manual of Rhetoric* (London: Longman, Brown, Green, and Longmans, 1848), 5.
[79] Henry Enfield Roscoe, preface to *Science Lectures for the People, Second Series* Manchester: J. Heywood, 1871).

sympathetic appeals formally nuances our sense of how lectures, in Huxley's words "awaken[ed] the attention and excite[d] the enthusiasm of the student." "The personal influence of a respected teacher" could be established over the course of a single lecture, in the way that teacher structured his explanation, and verbally expressed his scientific/aesthetic feeling. These small rhetorical gestures, towards beauty, charm, exquisiteness, accumulate in big ways. They are subtle but persistent reminders that others see may see (or feel) in a manner different from ours, and as such offer a different, but equally legitimate way, of aesthetically experiencing the world. "Beautiful things are common" then, meant for men of science that things that can arouse our sympathies in the manner of beauty, are all around us—and *are* in fact beautiful, if not incontestably for their physical qualities, then because of their relationship to truth.

In his lecture on "Matter and Force," Tyndall suggests that scientific beauty achieves its status precisely because of its relationship to knowledge, a knowledge audiences gained over the course of the lecture. He pauses to meditate on the molecular structure of the ice crystal, "the beauty of which would delight and astonish you." Why? Not for use, or fitness, but because, "[to] use the language of an American poet," he says, referring to Emerson,

> "[T]he atoms march in tune," moving to the music of law, which thus renders the commonest substance in Nature a miracle of beauty to the mental eye. It is the function of science, not as some think to divest this universe of its wonder and its mystery, but as in the case before us, to point out the wonder and the mystery of the common.[80]

The commonest substance may touch our feelings like a "miracle of beauty" simply because it *is,* and in being affirms, illustrates, and reminds us that Nature *works* and exists. Tyndall's expression is one of many like it, which defend Herbert Spencer's assertion that "those engaged in scientific researches constantly show us that they realize not less vividly, but more vividly,

[80] Tyndall, "Matter and Force," 84.

than others the poetry of their subjects."[81] If the fluke, or the bladder, or the piece of coal was undervalued at first, lecturers have shown how that beauty and the feeling it evokes may be rendered visible under the influence of knowledge. In other words, they are beautiful, because the accumulation of scientific knowledge shows that they reflect what is *true* about the universe—"the beauty and the truth," says Alfred W. Bennett, "that surround us on every side*."*[82] Elaine Scarry reminds us that historically beauty "has been perceived to be bound up with truth," regardless of who is doing the appraising, and that this is why even in our modern moment "the vocabulary of beauty…has been openly at play in those fields which aspire to have "truth" as their object—math, physics, astrophysics, chemistry, biochemistry."[83] Lecturers' expressions of beauty ultimately exploited this link between the beautiful and the true, awakening a sympathy for things which involved a further "sympathy for abstract truth." Dewar expresses a hope to his juvenile audience that the soap bubble "will not be with you an ephemeral thing or a fleeting object of curiosity or interest, but that you will retain something permanent." It is only after this that he goes on to say that "what I have said about the Soap Bubble will show that a thing of beauty really is a joy forever," indicating his own conviction that legitimate beauty is conferred, even upon "beautiful" objects, by the truths to which they lead.[84] Like the "things of beauty" in Keats' *Endymion* (1818)*,* "the sun, the moon,/Trees old,

[81] Herbert Spencer, "What Knowledge is of Most Use?" in *Education: Intellectual, Moral, and Physical (1878)* (London: Williams and Norgate, 1919), 57.
[82] Alfred W. Bennett, "How Flowers are Fertilized," in *Science Lectures for the People, Fifth Series* (Manchester: J. Heywood, 1873), 23.
[83] Scarry, *On Beauty,* 31, 52.
[84] Dewar, "A Soap Bubble" VI, 16.

and young," scientific things of beauty too, in their way, "bind us to the earth,"— because, to call "Ode on a Grecian Urn" once more into noble service, "Beauty is truth; truth beauty."[85]

"Study them and they will interest you," says William Crawford Williamson of the "common and familiar" things of the world, "examine their products and they will repay you."[86] Williamson's exhortation highlights the relationship between intellectual "interest" and its monetary connotation: "paying" attention accumulates its own kind of wealth.[87] The general conceptual linkage among beauty, truth, and knowledge points us to our next rhetorical strategy, for the truth that makes Tyndall's ice crystal beautiful and incites the feeling of "love, or some passion similar to it" is a reality elucidated by the lecturer's narration of the governing laws and "community of matter" that are the purview of the Cosmos metonyms.

Cosmic metonyms: revealing communities of matter

The various rhetorical devices upon which I loosely hang the moniker "Cosmos metonyms" come in all manner of forms. There is no discrete word, like "beauty," that signals cosmic metonyms, which are instead distinguishable by a shared stratagem that we saw in the introductory example of Tyndall and his sugar candy. Not all are even properly metonymic—

[85] Keats, "Endymion," lines 13-14, 7; John Keats, "Ode on a Grecian Urn" (1819) in *Keats' Poetry and Prose,* 462, line 49.

[86] William Crawford Williamson, "The Natural History of Paving Stones," in *Science Lectures for the People, Second Series* (Manchester: J. Heywood, 1871), 275.

[87] It also accumulates the *regular* kind of wealth, as scientific education was a nation-building enterprise as much as a morally fortifying one. The conclusion of Henry Roscoe's lecture on "Spectrum Analysis," in *Science Lectures for the People, Second Series* (Manchester: J. Heywood, 1867), quoted in part at the end of this chapter, makes this link abundantly clear, when Roscoe notes "how in England political power is being gradually transferred to the masses of the people," and how "a people whose masses are without knowledge and without tastes for highest things than the mere struggle for existence can come to no good" (200). This idea of recompense for interest is not unlike the Coleridgean turn of "receiving what we give" in chapter 1.

some are synecdochic, others are metaphoric.[88] I have adopted the term "metonym," lacking a better handle, to highlight the fact that the narratological phenomena in this section do what metonyms essentially do: describe relationships both of resemblance and of cause and effect. The sites of scientific narration that follow here tease out the material or procedural relationships between and among people and things. Some are discrete, some sprawl several pages and some, like Tyndall and his candy or Huxley and his chalk, endure for the entire lecture; but regardless of length these rhetorical moments typically center on a familiar thing and build outwards.

In this the Cosmos metonyms highlight the heavy formal debt, indicated but not analyzed in the previous section of this chapter, that scientific lectures owed to the tradition of teaching by "object-lesson" in elementary education.[89] "Object-teaching" focused on concrete common objects rather than abstractions to teach scientific principles.[90] The approach boasted merits of immediacy and relevance to daily life, and it appealed to a broad spectrum of intellectual abilities.[91] In a lecture on the subject, John Hall Gladstone showed how object lessons moved learners from the familiar to the unfamiliar. He encouraged schoolteachers to base their object lessons upon "something that is within the comprehension of a child, but which the child does

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[88] Roman Jakobson, "The Metaphoric and Metonymic Poles" (1956) in *Metaphor and Metonymy in Comparison and Contrast,* eds. René Dirven and Ralf Pörings (New York: Mouton de Gruyter, 2003) characterizes metaphor and metonymy as follows: "The development of a discourse may take place along two different semantic lines: one topic may lead to another either through their similarity or their contiguity. The metaphoric way would be the most appropriate term for the first case and the metonymic way for the second…." (42).

[89] This was the mode of education championed by Richard Dawes, the Dean of Hereford and educationalist during the earlier half of the century. See Dawes' addresses on *Mechanics Institutes and Popular Education* and *Teaching of Common Things* (London: Groombridge and Sons, 1854 and 186 respectively).

[90] Similarly, James Paradis, *T. H. Huxley: Man's Place in Nature* (Lincoln: University of Nebraska Press, 1978) has described Huxley's tactic (a tactic shared by many of the lecturers in this chapter, including Ball further on) of energizing common objects as the "dramatization of material entities" (37).

[91] D. R. Stoddart, "'That Victorian Science': Huxley's Physiography and Its Impact on Geography," *Transactions of the Institute of British Geographers* 66, no. 11 (1975): 22.

not fully understand already. If it is something familiar to them, so much the better."[92] This "common object" strategy was also frequently associated with natural theological writings and Bible-teaching, a discursive similarity that, as we will see in the final section, gave lecturers a further sympathetic advantage with still-religious audiences.[93] For both reasons, unsurprisingly, scientific lecturers adapted this pedagogical method to the lyceum with great success.[94] Though for readers of lectures, both then and now, rhetorical patterns remain our primary sources of information, these cosmic metonyms were not solely verbal expositions. They typically accompanied actual object lessons often involving extensive physical experiments, and they offered the imagination a broader view of the phenomena for which the lecturer had already submitted (though limited) physical proof.

If we turn again to Michael Faraday, we can see this gesture in action. In his classic series on *The Chemical History of a Candle* (1860), Faraday presented his juvenile audience with two familiar things: a piece of wood, and a bowl of goldfish. He used these objects to focalize the process of carbonic exchange among plants, animals, people, and inert matter— a process that, over the course of his preceding lectures, he had verified through a series of experiments (some of which involved splitting water into its component parts and then setting hydrogen gas on fire.)[95] Prior to this precise textual moment, he had experimentally demonstrated how human

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[92] John Hall Gladstone, *Object Teaching: A Lecture* (London: Macmillan and Co., 1883), 11. It is fitting perhaps, how frequently lecturers encouraged listeners to adopt "the eye of childhood" in the approach to scientific learning—we are all "children" in our knowledge of the universe. See Dewar, "A Soap Bubble" I, 1-2.

[93] Stanley, *Huxley's Church,* 257; Lightman, *Victorian Popularizers of Science,* 372-77; While Faraday used his candle to teach the principles of combustion, Charles Haddon Spurgeon used the candle in his (really delightful) "Sermons in Candles" to, among other things, allegorize the light of the Gospels, and the brevity of the soul's earthly sojourn.

[94] Stoddart, "That Victorian Science," 22.

[95] Michael Faraday, *The Chemical History of a Candle* (1861) (New York: Harper and Brothers Publishers, 1903), 62.

respiration produces carbonic acid, and he continues with this subject now. "Such fish as I have here," he declares, "respire the oxygen which is dissolved from the air by the water, and form carbonic acid, and they all move about to produce the one great work of making the animal and vegetable kingdoms subservient to one another."[96] The very wood in his hand is one such mutual subservient, sustaining and sustained by piscine exhalation. "Give [trees] pure air like ours," he says,

> and they could not live in it; give them carbon with other matters, and they live and rejoice. This piece of wood gets all its carbon, as the trees and plants get theirs, from the atmosphere, which, as we have seen, carries away what is bad for us and at the same time good for them—what is disease to the one being health to the other. So we are made dependent not merely upon our fellow-creatures, but upon our fellow-existers, all Nature being tied together by the laws that make one part conduce to the good of the other.[97]

It is worth remembering that Faraday was both the last of a Romantic generation and a practicing Sandemanian, and at heart held a theological sense of Nature's mutual beneficence.[98] For him the "goodness" of the cosmic system ultimately derived from a divine source, unlike the

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[96] Faraday, *Candle,* 178-179

[97] Faraday, *Candle,* 179.

[98] Richard Holmes, *The Age of Wonder: How the Romantic Generation Discovered the Beauty and Terror of Science* (London: HarperPress, 2008) has called *The Chemical History of a Candle* "one of the last great documents of Romantic science" (454). The critical jury seems to be out on to what degree Faraday's Christianity influenced his science. Frank James seems to believe that Faraday actively promoted his theology in his public speech (James, *Candle*, xxiii-xxiv) while Geoffrey Cantor, Ursula DeYoung, and even contemporaries like John Tyndall, John Hall Gladstone, and Henry Bence Jones (all Faraday biographers) argued that Faraday kept his private theology distinct and separate from his experimental research, or at least, that whatever constraints his metaphysics placed upon his conception of Nature largely did not interfere with his experimental proceedings. Geoffrey Cantor, *Michael Faraday,* (London: Macmillan Academic and Professional Ltd., 1991) writes, "that Faraday expounded an empiricist view of science all commentators agree" (196).

later practitioners I look at in this project.[99] But despite this disparity, Faraday's Romantic approach and his familiar style served as a model (and in some cases a direct inspiration) for the agnostic generation that followed in his footsteps, most notably Tyndall and Huxley.[100] Huxley called Faraday "that prince of lecturers," and for good reason.[101] But though Faraday's private theism may have divided his idea of a cosmic First Cause from that of the scientific naturalists, it had little bearing on his grasp of *how* things worked, and his interpretations of physical science differed no more or less than was common in the scientific community.[102] In fact this passage, with its stress upon "all Nature being tied together," usefully showcases the common space that the uniform laws of nature provided for theistic and agnostic scientists alike. Whether or not the regular system of nature was regarded religiously, both groups essentially agreed upon the precepts required to actually experimentally pursue science.[103] Faraday's theology in no way

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[99] James, *Candle,* xxiv.

[100] Finnegan, "Finding a scientific voice," 200. In a memorial article titled "Professor Tyndall" in the *Nineteenth Century,* Huxley draws a line of comparison between Tyndall's and Faraday's platform performances. "Davy was before my time, but I have often had the delight of listening to Faraday. An ineradicable tendency to think of something else makes me an excellent test-object for oratory, and he was one of the few orators whom I have heard to whom I could not choose but listen." In following Faraday's position and his style, Tyndall "for more than thirty years…held his own" (5).

[101] Thomas Henry Huxley, preface to *Evolution and Ethics, and other essays* (1894) (New York: D Appleton and Co, 1914), vii.

[102] Compare for example Tyndall and Faraday's congenial disagreement over the magnetic fields of crystals to their much more weighty philosophical divergence over the "causes" in the Universe: God, or "things to things themselves." DeYoung, *Tyndall,* 28, 80-81. DeYoung's account reminds us how normal and non-aggressive these ideological differences could be among scientific colleagues, and in *Huxley's Church* Stanley similarly reminds us of the distinct lack of mutual exclusivity in the realm of Victorian science when he writes, "It is quite remarkable that, despite the jeremiads offered by each side against the other, the scientific community continued to function smoothly. No scientists suggested expelling James Clerk Maxwell from the BAAS; no scientists proposed evicting John Tyndall from the Royal Institution" (254). Charles Kingsley was as frequent and as welcome a presence in *Nature* magazine, a scientific naturalist project, as T. H. Huxley— see, for example, "Kingsley's *At Last," Nature* 4 (August 10, 1871): 282-284. Faraday's near-universal endearment to both religious lay people and a-religious scientists is a testament to the common conceptual ground between the two poles of thinking and the common language that they shared.

[103] Stanley, *Huxley's Church,* 254.

negates the fundamentals of what his metonym represents rhetorically: the connectedness of all physical bodies.[104]

The language and structure of this particular moment in *Candle* focalize everything essential about the rhetorical action that subsequent lecturers will emulate in their Cosmos metonyms. In putting his audience and himself on an equal footing with our "fellow-creatures" and "fellow-existers," Faraday renders visible in a metonymic relationship the intimate connections that bind all forms of matter together. The process of carbonic conversion and exchange places humans, creatures, and "existers" in a natural "fellowship," a word which of course recalls the mutual intercourse and community at play in the lecture hall, and, as we will see later, in the fellowship hall of the church. If communities of fellow men are bound, as Adam Smith theorized, "by the general fellow-feeling which we have for every man merely because he is our fellow creature," then Faraday's formulation—a literal fellowship for the Cosmos metonyms— shows how that fellow-feeling could rest on and was bound up in those most plentiful of "existers," things themselves.[105]

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[104] And, in fact, is an interesting rhetorical study in how scientific naturalism fundamentally coopted the language of uniformity and converted into a secular system— in *Huxley's Church* Stanley reminds us that the tradition from theistic science like Faraday's or Maxwell's changed very little in scientific practice and was in fact made smoother by these kinds of conceptual similarities between the two positions— the worldview might have shifted, but the methodologies did not have to be altered (254). The case of narrations like Cosmos metonyms, they narrate processes of likeness and exchange that are constant regardless of whether God is driving, or nothing is.

[105] Smith, *Theory,* 90. This mode of object-sympathy towards natural things has a certain aesthetic quality to it as well. Lars Spuybroek, *The Sympathy of Things: Ruskin and the Ecology of Design* (2011; London: Bloomsbury Academic, 2016), suggests that sympathy "lies at the core of [our relations with things and each other]" in a way more unmediated than Smith's imaginary transaction. An art object is always sympathetic because it is always a "thing made, taken care of and needing to be cared for," in a Heideggerian sense, and implies the necessity of relation, while natural things, like Faraday's wood and goldfish, "design each other and are formed in relationship to each other, in full sympathy" (129-131). There is accordance among these things because they all exist in a relational entanglement.

Like Faraday's piece of wood, the physical things that lecturers summoned served as anchors for imagining the processes or materials that bound audiences in fellowship with things that seemed unrelated to them. Lecturers wove things and people together into a "community of matter," a metaphor that the astronomer William Huggins used to characterize the elemental relationship between celestial bodies. The stars, says Huggins in a lecture on spectrum analysis, share "a community of matter with the earth," for "the matter of which they are composed is of the same order as that of the earth," and "is subjected to the same force."[106] Huggins' use of the word "community" here has the same unifying effect as Faraday's "fellowship."[107] In using "community" to describe the material intimacy among things, Huggins also recalls the relationships among a community of people, specifically the listeners in the room. By implication, it further suggests the possibility of a merger of the two communities, and thus that "communities" may include not just our fellow men, but our "fellow-existers."

In contrast to the "beautiful things are common" proposition, lecture-goers were not asked to take the fundamentals of cosmic metonyms—that physical things and systems are connected— on the *argumentum ad verecundiam* or testament of the lecturer. Lecturers spreading the gospel of the "community of matter" provided, to the extent possible, ample physical proof of their claims. This was simply good pedagogy in a discipline that demanded proof over received wisdom, but it had the effect of forming a bond of trust with the lecturer. Faraday never "*told* his listeners of an experiment," wrote conchologist Lovell Reeve, "he

[106] William Huggins, "Spectrum Analysis, in its application to the heavenly bodies," in *Science Lectures for the People, Second Series* (Manchester: J. Heywood, 1870), 208.

[107] Smith in "The 'Great Plan of the Visible Universe" writes of Huggins' first scientific paper on 'The Spectra of Some Fixed Stars' which belied his cosmological vision "founded upon a unity of plan and operation, and, although they did not spell this out, of composition too" (123). Huggins' "community of matter" metaphor seems to retain this idea though, by the 1870s, appears to have moved away from his earlier alignment with theology and arguments by design and fit Frank Turner's definition of scientific naturalism (130).

always *showed* it them, however simply and well-known it might have been," and others followed suit.[108] Huggins, for example, went to great pains to showcase and explain how the spectroscope worked, and to show in real time the results of its projections that evidenced the "community of matter" which he claimed was shared by the earth and the stars. To determine the material nature of the stars, astronomers compared the spectrographic signatures of solar bodies, obtained through telescopes rigged with prisms, to the isolated individual signatures of elements on earth.[109] Huggins (with help from his assistant for this lecture, Professor Roscoe) converted the elements sodium and lithium into gaseous form live before his audience in order to evidence this process of verification, showing, rather than simply telling, how material sameness might be reasonably verified through experiment.[110]

Lecturers also encouraged their listeners to verify their claims through observation or replication on their own time, in their own homes. These home experiments ranged from the simple act of visual confirmation (Ball asks his audience to go out to try and count the stars, to impress upon the mind how numerous they are) to more active experiments (Faraday throws zinc

[108] Lovell Reeve, *Portraits of Men of Eminence in Literature, Science, and Art, with Biographical Memoirs* (London: L. Reeve and co., 1863), 1:152. Faraday's show-not-tell prescriptions were so serviceable (even if, as James notes in *Candle*, he did not *always* follow them himself) that they've been extracted into at least two short pamphlets (xxii). See *Michael Faraday: Advice to a Lecturer,* ed. Geoffrey Parr (London: Royal institution of Great Britain, 1960) and *Advice to Lecturers: An anthology taken from the writings of Michael Faraday and Lawrence Bragg,* Eds. George Porter and James Friday (London: Mansell Publishing Information for the Royal Institution, 1974); Faraday's experimental insistence was a fidelity to scientific accuracy, but later resistance to received wisdom would become the Dissenter's bone of contention with clerical and theological authority specifically, not just fact vs. rumor.

[109] Huggins and Roscoe both explain the basic mechanism of the spectroscope in their respective Manchester lectures. Spectroscopy was very much in vogue in the 60s and 70s, and many of the Manchester lectures treat spectrum analysis with experimental approaches similar to that of Huggins. Roscoe lectures on "Spectrum Analysis" in 1870 and "The Rainbow" in 1872 and W. K. Clifford touches basic spectrum analysis in his lecture on "Atoms" in *Science Lectures for the People, Fourth Series* (Manchester: J. Heywood, 1872). J. Norman Lockyer, whose spectrographic research jointly facilitated the discovery of helium in the sun, lectured on "The Sun" in *Science Lectures for the People, Second Series* (Manchester: J. Heywood, 1871).

[110] Huggins, "Spectrum Analysis," 203-204.

filings in the fire to illustrate the combustion of metal, an experiment he does "because you can make it well at home," or calling them to put a towel into the water basin at home to confirm the action of capillary attraction by which the candle also receives its fuel.)[111] Such experiments were performed and subsequently encouraged only within the bounds of safety, but they all worked to show that these material relations were grounded in fact, not merely theory.[112] Tyndall, Roscoe, and W. K. Clifford did not have to merely claim that waves of sound could resonate between people and objects. They could prove it through experiments, singing into flames and wine glasses, and pass those experiments along to their listeners.[113] These kinds of gestures were also another clever way to foment community between lecturer, listener, and topic, for by inviting audiences to perform experiments they were inviting them into a fellowship of science.

The idea of being involved in a community of matter allowed lecturers to bring the case of science, as *The Quarterly Review* suggested lectures should, "really home to the people at large."[114] Accompanied where possible by experimental demonstration, they showed how the "case" of science was, as a matter of material fellowship, the case of the audience themselves. These Cosmos metonyms close the distance between atoms and bodies, for in the community of matter, no human—or candle or fluke or fossil— is truly an island. Such metonyms are

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[111] Robert Ball, "Stars," *Star-land: Being talks with young people about the Heavens* (London: Cassell and Co., 1889), 300; Faraday, *Candle,* 25, 57.

[112] In "A Soap Bubble" James Dewar uses glycerine to help stabilize a bubble experiment in his Christmas Lecture on "A Soap Bubble," and explains how glycerine is materially connected to its products, dynamite and gunpowder. "This is however," he says, "so dangerous I thought I'd better not make it," (Lecture I, 9).

[113] Clifford, "Atoms," 194. Tyndall's sixth lecture in his Royal Institution series on *Sound* (London: Spottiswoode and Co., 1867) was all about "singing" flames, whose resonance he demonstrated by playing notes into them and also by singing (228-229). Roger Luckhurst reminds us of this musical performance in *The Invention of Telepathy 1870-1901* (Oxford: Oxford University Press, 2002), 76.

[114] Wace, "Scientific Lectures," 37.

important for the role they play in the lecture as a genre and as a performance, but also for their parity with a more familiar form of sympathy-generation: realism. Metonymy in realist fiction is connection making, sympathetic because, as Greiner reminds us, the metonym relies "on narrative extension, the building-up of partial connections and the accumulative gathering together of temporally unfolding meanings, to vivify what is absent or unknowable in the present."[115] The Cosmos metonyms that engage the "community of matter" don't so much build, but rather presume to *reveal*, the unseen connections between people, things and processes visible, invisible, past and present, in a kind of "departicularizing technique with sympathetic promise" that, like realist fiction, effectively can "re-create, even [change]…the real."[116] Though we must approach these narrative moments through the act of reading, not listening, close rhetorical attention to the Cosmos metonyms helps us theorize the content sites that, in the moment of experience, produced the feeling of "sympathy" that audiences were most likely to take away with them. As I've suggested, by calling attention not just to information, but to the audience's relationship to the physical universe, Cosmos metonyms show how that Huxleyan "sympathy for abstract truth" could be produced through rhetorical demonstration—through *what* was said, not merely the tone in which it was said and the gesture that accompanied it.

Let us turn to a few examples. Robert Stawell Ball, in his 1889 Christmas lecture on "The Sun," enacts a material community by choosing a few domestic *things* through which to elucidate the matter and force that are shared between the intimate and the distant. In the dark of this English winter, Ball brings light in illustrating to his juvenile audience the myriad ways in

[115] Greiner, *Sympathetic Realism,* 35.

[116] Greiner, *Sympathetic Realism,* 36. Jakobson in "The metaphoric and metonymic poles" also noted the "predominance of metonymy which underlies and actually pre-determines the so-called 'realistic' trend…Following the path of contiguous relationships, the realist author metonymically digresses from the plot to the atmosphere and from the characters to the setting in space and time. He is fond of synecdochic details" (43).

which they are connected to the sun. He invites them to join him in imagining a Christmas tableau, the happy hearth scene that awaits them at home.

> You will gather round a cheerful fire. The curtains will be drawn, the lamps will be lighted, and the disagreeable weather outside will be forgotten in the pleasant warmth and light within. Five o'clock has arrived, the pretty wicker table has been placed near mamma's chair; on it are the cups and saucers and the fancy teapot. Under the table is a little shelf, with some tempting cakes and a tender muffin. Two or three friends have joined the little group, and a delightful half-hour is sure to follow.
>
> But you may say, "What have tea and muffins, lamps and fireplaces to do with the sun? Are they not mere artificial devices, as far removed as possible from the sunbeams or the natural beauties which sunbeams create?" Well, not so far, perhaps, as you might think.[117]

From the heart of ordinary life, Ball weaves a community of solar energy that makes possible all things, and commutes through all things, including our own bodies and the food we eat. That "cheerful fire" is enabled by coal; coal which is "the remains of a vegetation which was formerly growing and flourishing" as an ancient forest; a forest which only grew because "sunbeams abounded in those early times" and nourished its growth.[118] This coal that warms us and heats the water for our tea does so by the power of ancient sunbeams. Our tea itself was not only grown by that same solar energy, but was ferried to us from China on an air current generated by the sun. And our "nice muffin" was not only "made from wheat grown by the sun," but was ground by the arms of the baker who was *himself* powered by the sun. For the "force

[117] Robert Stawell Ball, "The Sun," in *Starland: Being talks with young people about the wonders of the heavens* (London: Cassell and Co., 1889), 10.
[118] Ball, "The Sun," 13.

exerted in grinding with the pestle has been derived from the food that the man has eaten; that food was grown by the sun, and the man received from the food the energy it had derived from the sun."[119] When you eat *your* muffin, or in the words of William Odling, "when we burn coals, or wood, or peat upon our fires, or consume bread, oil and wine in our bodies… we are really manifesting once more, in the form of heat, the sun's rays."[120] Your tea table and your fire power you by an energy that has transmuted through an entire system of matter before passing through you.

Ball here creates a "case" for his subject, the sun. The classic formulation of Smithian sympathy, the imagination of "our brother upon the rack," requires what Smith called an adequate "conception of the circumstances" for sympathetic identification to occur.[121] In order to approve of Ball's implicit argument that we should feel interested in, grateful towards, and involved with the sun and the material community it creates, we must be able to imagine these relationships. The approval of an action, or the implicit knowledge that one should approve of an action, de facto implies sympathy for that action or case.[122] This is the either-or of Smithian sympathy, for the cultural knowledge that one should approve of an action, say, charity, bypasses the necessity of understanding the full case of the charitable person's actions.[123] We take it as an established norm to approve of charity, and therefore have an implicit sympathy for it. But scientific lecturers were still in the process of trying to establish "sympathy for science" *as* an approvable norm, and so had to work double-time to naturalize scientific "conception of the circumstances" in the minds of their audiences. In order to approve of Ball's action, we must

[119] Ball, "The Sun," 16-17.
[120] Odling, *Chemical Changes of Carbon,* 155-56
[121] Boddice, *Science of Sympathy,* 217.
[122] In Smith's words in *Theory*, "To approve of another man's opinions is to adopt those opinions, and to adopt them is to approve of them" (12).
[123] Boddice, *Science of Sympathy*, 2.

understand his view and his reasoning.[124] Most of the explanatory content of any scientific lecture was intended to facilitate understanding, of course— that's the point of an educational lecture. But this factual understanding was also an indispensable precursor to stimulating scientific feeling. Understanding the case makes it possible to imagine our material involvement with, in this instance, the sun. Being shown that material participation allows us to conceive of that involvement *as* fellowship, a precursor to sympathetic feeling.

While many lecturers called attention to the way process bound people and things together through shared material, others focused on the community produced by comparable action. The analogy of respiration with combustion proved to be a common example. Faraday presents this processual likeness in his culminating final lecture of *The Chemical History of a Candle*:

> In every one of us there is a living process of combustion going on very similar to that of a candle, and I must try to make that plain to you. For it is not merely true in a poetical sense—the relation of the life of man to a taper; and if you will follow, I think I can make this clear.[125]

He goes on to demonstrate how the candle, through the action of heat, consumes fuel and exudes elemental by-products in the same way that our bodies do. On the level of mechanical action, our breath is no different from combustion. Henry Roscoe emphasized this very same fellowship when six years later he declaimed to a Manchester audience,

[124] Geoffrey Sayre-McCord, "Hume and Smith on Sympathy, Approbation, and Moral Judgment" in *Sympathy: A History* ed. Eric Schliesser (London: Oxford University Press, 2015), 210.
[125] Faraday, *Candle* ,167.

> You may say, "It is a curious thing if we men are like candles, that we are actually undergoing combustion, that we are actually burning." Yet nevertheless, such is the fact.[126]

Roscoe explains that while, superficially, we don't burn with the "same sparkling" as a candle, "the action which goes on is of the same kind."[127] In this, he plays upon the trope of apparent lawlessness masking unseen uniformity. The idea of a person combusting like a candle *seems* strange, but with a better comprehension of physical law, it is actually shown to be quite "lawful." The dinner that Roscoe ate a short while ago moves his body just as the candle fuel "moves" the candle, or the combustion of coal moves the steam engine to London. Like Ball, he traces the source of all energy back to the sun, but emphasizes the physical-processual sameness of all combustion. Roscoe, and Tyndall after him, will follow Helmholtz—who surely follows Edward Young—in saying of our combustible community,

> In this sense we are all "souls of fire, and children of the sun."[128]

"We must be content," Tyndall will add, "to share our celestial pedigree with the meanest living things. The frog, the toad, and those terrible creatures, the monkey and the gorilla, draw their power from the same source as man."[129] Huxley may not have agreed with Tyndall's negative

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[126] Roscoe, "Elementary Chemistry," 22.

[127] Roscoe, "Elementary Chemistry," 23.

[128] Tyndall, "Matter and Force," 92; Roscoe, "Elementary Chemistry II," 23. A deep referentiality here, as Helmholtz was likely quoting, and putting quite a different spin, on Edward Young, *The revenge: A tragedy adapted for theatrical representation* (London: J. Bell, 1792): "Souls made of fire, and children of the sun/With whom revenge is virtue" (Act V, scene ii).

[129] Tyndall, "Matter and Force," 92. In "The Scientific Use of the Imagination" in *Fragments of Science* he will make a similar formulation: "not alone the more ignoble forms of animalcular or animal life, not alone the nobler forms of the horse and lion, not alone the exquisite and wonderful mechanism of the human body, but the human mind itself—emotion, intellect, will, and all their phenomena—were once latent in a fiery cloud…. Many who [hold this hypothesis] would probably assent to the position that at the present moment all our philosophy, all our poetry, all our science, all our art—Plato, Shakspeare [sic], Newton, Raphael—are all potential in the fires of the sun" (163).

opinion of the gorilla, but he will make a similarly harmonious reduction in "On the Physical Basis of Life," when he shows that in the identical demands of cellular processes "it may be truly said that the acts of all living things are fundamentally one."[130] By basing the definition of material community on processual sameness, these kinds of metaphors open further opportunities for sympathetic attachment. If a candle can be said to be truly like a person, then the case of a candle is like ours, in a way previously unimagined. In the revelation of these mutual dependences, lecturers promoted what George Levine has described as a "new kind of enchantment" in the world revealed through science which. "In the face of the myth of disenchantment," Levine writes, "which implies that meaning and value go out of the world as soon as it can be explained rationally and naturalistically," these practitioner lecturers, like Charles Darwin, instead found enchantment, sympathetic potential, or in Levine's words, "value [inherent] *in* the world so described, just because of our relation to it."[131]

Lecturers further signaled that the community of matter is "good"— and therefore sympathetic— by performing *their* approval for these material entanglements bodily and verbally. A lag in the development of recording technology forces us to rely on imagination and second-hand accounts of the vibrancy of these physical performances. Faraday's were legendary in their enthusiasm. His was "an irresistible eloquence, which compelled attention and insisted upon sympathy," recalled the *St. Paul's Magazine*.[132] Tyndall, too, was known to charm the hearts of his audience, particularly children and ladies who would approach him "with earnest

[130] Huxley was known to gleefully deliver anatomy lectures to students with his arm draped around the neck of a gorilla skeleton. See Desmond, *Huxley,* 540; Huxley, "Physical Basis," 126.
[131] Levine, *Darwin Loves You,* 28.
[132] Gladstone, *Michael Faraday,*51.

eyes" after an oration.[133] In the lecture transcripts we get little more than gestures towards the quality of performance— Roscoe, for example, is noted to have delivered his first lecture on "Elementary Chemistry" "in his happiest style," and transcribers occasionally record [laughter] or [applause] after a humorous comment.[134] Nevertheless, terms of aesthetic assessment ("beauty," "wonder," "magnificence," "exquisite") stand as textual traces of performed verbal approbation—in this case, of the connective, positive charge of the idea of material communities.[135] As we saw in the last section and will see again in the following chapter these kinds of descriptors flagged importance. Given with enthusiasm, they helped audiences determine what things to pay attention to, and what manner of attention should be paid.

Such rhetorical gestures are effective in print, and unsurprisingly are common in popular scientific texts. They are nonetheless uniquely important to the lecture, as we saw in the previous section, for their immediacy. As a trustworthy authority performing live approval of the "community of matter," the lecturer united his audience in a parallel community and gave them, to use Faraday's characterization of the candle, an "open door" to the community of matter by acting as a kind of sympathetic intermediary. Huxley's lecture "On the Physical Basis of Life" (1868) demonstrates how lecturers presented themselves in this role. Huxley emphasizes not just

[133] Tyndall Journal, February 6, 1855, RI MS JT/2.VIa/p. 12, quoted in Howard, "Physics and Fashion," 740.

[134] Roscoe, "Elementary Chemistry III," 38, 39-40.

[135] "Beauty" and "beautiful," as we've seen in the last section, occur in abundance. For examples "exquisite," Tyndall, "Crystalline and Molecular Forces," 149; "wonderful" J. Norman Lockyer, "Why the Earth's Chemistry Is As It Is, I," in *Science Lectures for the People, Eighth Series* (Manchester: J. Heywood, 1877), 107, 109; Bennett, 23; "magnificent," J. Norman Lockyer, "Why the Earth's Chemistry Is As It Is, III," in *Science Lectures for the People, Eighth Series* (Manchester: J. Heywood, 1877),155-156; Williamson, "The Natural History of Paving Stones," 263, 265; Roscoe, "On Coal Colours," 22; Richard Proctor, "The Star Depths," in *Science Lectures for the People, Fourth Series* (Manchester: J. Heywood, 1872) 266-267' Ball, "The Sun," 372; "exquisite," Tyndall, "On Radiant Heat," 223.

his audience's relation to all living matter, but the literal ways that, in this moment, his life and theirs are mutually constituted and impaired by their shared physical processes.

> Every word uttered by a speaker costs him some physical loss; and, in the strictest sense, he burns so that others may have light— so much eloquence, so much of his body resolved into carbonic acid, water, and urea. It is clear that this process of expenditure cannot go on forever. But, happily, the protoplasmic *peau de chagrin* differs from Balzac's in its capacity of being repaired, and brought back to its full size, after every exertion.[136]
>
> For example, this present lecture, whatever its intellectual worth to you, has a certain physical value to me, which is, conceivably, expressible by the number of grains of protoplasm and other bodily substance wasted in maintaining my vital processes during its delivery. My *peau de chagrin* will be distinctly smaller at the end of the discourse than it was at the beginning. By and by, I shall probably have recourse to the substance of mutton, for the purpose of stretching it back to its original size.[137]

Huxley goes on meditate on the recyclability of protoplasm that, like Roscoe's food combustion, converts plant matter to sheep and "transubstantiates sheep into man," and after calling attention to the unity of "fungus and oak, worm and man" in their cellular destiny, Huxley "brings [that] case home" so to speak, signaling the connection between his life and his audience's. They are literally bound by "every word uttered by the speaker," for as Huxley stands before them, they consume his life as he consumes mutton. It is a sublime reminder of the community of matter: the speaker, at once cells and consciousness, is also consumed, enacting the case of all living things for his audience. His body gives them a locus, and his narration gives them a premise,

[136] Balzac's "peau de chagrin" was a piece of rawhide that, when wished upon, both shrank and depleted the wisher's energy in proportion to the size of the wish.
[137] Huxley, "Physical Basis of Life," 132.

through which they can feel themselves incorporated into this network. This moment is an excellent example of the triangulation that is always tacitly occurring in the Cosmos metonyms. The lecturer is always part of the imagined material community, bound in human fellowship to the audience on the one hand, and bound in physical fellowship to the universe on the other.[138] And the sides of the triangle support each other: even if one is not emotionally stimulated by imagining a connection to the community of matter, the lecturer presents—through performance and explanation and metaphor— the "case" of *what it would be like* to experience the universe in that way.

To my mind this seems the most transferable of all of the mental attitudes cultivated by the Cosmos metonyms and, to a similar degree, the beautification of common things. These moments perform the quintessential work of sympathy in their confrontation of difference. They call the audience's attention to the experiential gap that remains between themselves and the lecturer, while creating the opportunity for listeners to "go along with" the lecturer in what Rae Greiner calls "an imagined mental companionship rather than a one-dimensional emotional identity."[139] I do think we have ample evidence to suggest that, ultimately, scientists *did* desire that some day lay people would "feel as they felt" and had a certain faith that that day of scientific sympathy would materialize. But in the interim, the lecturer's work acted like a kind of imaginative stereoscope: it furnished rhetorical apparatuses like colored slides, allowing listeners to try on the experience of a scientific "other." Being asked to see the ugly as beautiful, because of the truth it represented; being asked to feel involved with the universe without, because of the

[138] In this famous lecture Huxley in fact deploys his own terminological take on the "community of matter" as relates to his organic subjects, which are bound also by a "community of faculty" and a "community of form" (121-122). For the specifically physiological aspect of Huxley's constructed "sympathy for science," see chapter 3.
[139] Greiner, *Sympathetic Realism,* 16.

materials and process you share with it: these are thought-experimental glimpses into the phenomenological experience of another person. They call to mind, of course, the rhetorical representation that we as literary scholars— or any expert, or teacher, or professional—perform in the course of representing our affective experience of our work to others. But the expansive habit of "going along with" the views, and feelings, of scientific lecturers becomes particularly important to the matters in this chapter's final section, which are concerned with the reform of attitudes far more consequential to the Victorians: the moral, and the spiritual.

Lay sermons: moral sentiments and scientific spirituality

Formally, the sermon and the lecture were tangled up in many ways for the Victorians.[140] They were wont to occur not only in overlapping spaces, but on overlapping days, could treat overlapping subjects and sometimes, in the case of figures like the John George Wood and Charles Kingsley, they even came from the lips of the very same person.[141] Sunday may have been the day of worship, but it was also the appointed day for the activities of Sunday Lecture Societies, and mornings with the Gospel were likely to give way to evenings in the lecture hall

[140] Lightman reminds us in his chapter on "Anglican Theologies of Nature in a Post-Darwinian Era," in *Victorian Popularizers,* 39-94 that natural science already had a long history of popular promotion from the mouths of the clergy. See, for example, Gilbert White's *The Natural History of Selbourne* (1789; London; Printed for J. and A. Arch, etc., 1822.)

[141] Both Spurgeon and Huxley gave sermons, lay and otherwise, in St. Martin's Hall, Long Acre: George John Stevenson, *Sketch of the life and ministry of the rev. C. H. Spurgeon* (New York: Sheldon, Blakeman and Co., 1857), 9:45, while both Spurgeon and Tait gave sermons in the secular venues of Exeter Hall, the Surrey Gardens Music Hall, and the Crystal Palace (Meisel, *Public Speech,* 120, 128-29). Diarmid Finnegan, "Exeter-Hall Science and Evangelical Rhetoric in Mid-Victorian Britain," *Journal of Victorian Culture* 16, no. 1 (2011): 46-64 notes that Exeter Hall, famously used by the YMCA to minister to young men of the clerkly class, began to feature speeches about the relations between science and religion. Ciaran Toal, "Preaching at the British Association for the Advancement of Science: Sermons, Secularization and the Rhetoric of Conflict in the 1870s," *British Journal for the History of Science* 45, no.1 (2012): 75-95 likewise reminds us of the mutual influence that BAAS meetings had on the sermons preached in surrounding churches.

with volcanoes and atoms and protoplasm.[142] Not for nothing, after all, did Huxley choose to call his lectures "lay sermons."[143] Huxley's designation reflects the structural and the performative similarities, and also the similar degree of cultural exposure, that the two forms enjoyed: a parity reaffirmed by one *Nature* subscriber's faith in the incipient success of any new series of public lectures, for "surely Huxley or Tyndall would be quite as much sought after as Spurgeon if they came forward to announce a series of lectures."[144] The two forms both, roughly, begin with a parable or premise followed by a lesson in which they aim to gain sympathy, persuade, and engage; their conclusions reaffirm their particular philosophical paradigm, and they tend to end with some kind of moral, or call to action or conduct.[145]

But Huxley's choice of "lay sermon" also reminds us of the potential for emotional guidance and comfort that scientific men increasingly saw in their view of this "new scientific cosmos." They saw the pursuit of science and sympathy not simply as an issue of material gain but, as Roscoe put it in his preface to the second series of Manchester lectures, the foundation "of our

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[142] Huxley's "On the Physical Basis of Life" was originally delivered at a Sunday Evening series in Edinburgh (*Lay Sermons*, x); In "Sunday Lecture Societies," Barton notes that scientific naturalists and Unitarians were brought together in such societies by their mutual support for a secular state, and the removal of state support for a religious vision of how Sunday should be spent (90). For the X-Club's interest in Sunday Lectures, see J. Vernon Jensen, "The X Club: Fraternity of Victorian Scientists," *British Journal for the History of Science* 5 (1970): 70; For more on Sunday Lecture societies, and goals, activities, relationship to religious activity, see John Wigley, *The Rise and Fall of the Victorian Sunday* (Manchester: Manchester University Press, 1980), 102-104, 125-31 and Brian Harrison, "Religion and Recreation in Nineteenth Century Britain," *Past and Present* 38 (1967): 98-125.

[143] Desmond in *Huxley* describes the fervor that greeted Huxley's lay sermon "On the Advisableness of Improving Natural Knowledge," 344-345.

[144] Desmond, *Huxley,* 368; "Science Lectures for the People", *Nature* 4 (June 15, 1871): 120.

[145] Bishop Archibald Campbell Tait's recommendations for his clergy, for example, could easily have been advice given to scientific lecturers. He "[urged] his clergy to take into account the class and educational background of their congregations, to speak to them in a manner they can understand, and to draw examples from the scriptures with which they can most readily identify": Meisel, *Public Culture,* 118. Change "scriptures" to "ordinary life," and these advices recommend themselves seamlessly to a scientific sermon.

social and moral well-being."[146] This last section examines the ways in which the scientific lecture practiced these habits of moral improvement, and looks at some of the moral lessons lecturers issued. Stanley reminds us that scientific naturalism's "uniformity" triumphed because it worked from within a theistic structure, but I'd also like to suggest that the lecture was an instrumental participant in this ideological replacement. The scientific lecture adopted a formal structure that the average Victorian understood to be related to morality and spiritual communion, and an imaginative schema (sympathy) that the average Victorian was accustomed to navigating. In doing so, scientific lecturers helped ease audiences into a sympathy with the idea that a purely naturalistic view of existence could create a "feeling of being at home in the Universe" (Carl Sagan paraphrasing William James) in just as powerful a manner as could a theistic view.[147]

In his lay sermon on "The Advisableness of Improving Natural Knowledge" (1854) Huxley articulates natural knowledge— scientific knowledge— with a sense of morality. "Natural knowledge," he said,

> seeking to satisfy natural wants, has found the ideas which can alone still spiritual cravings. I say that natural knowledge, in desiring to ascertain the laws of comfort, has been driven to discover those of conduct, and to lay the foundations of a new morality.[148]

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[146] Roscoe, preface to *Science Lecture for the People, Second series.*

[147] Carl Sagan, *Pale Blue Dot: A Vision of the Human Future in Space* (New York: Ballantine Books, 1994) paraphrased the sense of religious feeling defined by William James (333), which Ann Druyan links to James' Gifford Lectures on *The Varieties of Religious Experience* (Sagan paid homage to this title when he gave his own Gifford lectures on the varieties of *scientific* experience). Sagan appears to take his religious "definition" from James' *A Pluralistic Universe* (1909) (New York: Longmans, Green, 1920). The quote reads: "[We] are ourselves part of the universe, and share the same one deep concern in its destinies. We crave alike to feel more truly at home with it, and to contribute our mite to its amelioration," (12).

[148] T. H. Huxley, "On the Advisableness of Improving Natural Knowledge (1866)," in *Lay Sermons,* 11. Huxley in fact entered the lecture hall for this oration to the tune of Haydn's *Creation*—fittingly ironic,

Huxley and his cohort believed that the study of science, while approaching the world rationally and naturalistically, could both effect moral habits of mind and yield "a reverential spirituality" in its earnest students because of the mental habits and attitudes it promoted, "mental powers," as Alfred Bennett put it in another lecture conclusion, that marked "the wise and large-minded man."[149] In a lecture "On the Study of Physics" (1854), Tyndall explains that "certain moral qualities come into play" in the process of induction, among them "patient industry, an honest receptivity, and a willingness to abandon all preconceived notions, however cherished."[150] In the "sacrifice of self" required both in the pursuit of truth and the willingness to accept it no matter how it might present itself, the "earnest prosecutor of science…finds in that task the indirect means of the highest moral culture."[151] This was by no means an uncontroversial claim, positioning itself against the frequent argument for the immorality of utilitarian science, and touching, as it did, upon theological concerns.[152] But Charles Kingsley, himself a man of the cloth, glowingly endorsed the moral improvements of science with an account nearly identical to

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but also fittingly suited to the "spiritual craving" that Huxley saw natural knowledge answering. Huxley did not pick the music, but the irony was not lost on the *Standard,* reporting ("The *Standard* on Suppressed Lectures," *English Leader,* March 31 1866*,* 155).

[149] Levine, *Darwin Loves You,* 28; DeYoung, *John Tyndall,* 155; Huxley, Tyndall, and Herbert Spencer were the X-Clubbers at the vanguard of this cause. In his section of "What Knowledge is Most Worth?" where he asserts that science is best "And for Moral Discipline" and "And For Religious Culture," Spencer quotes Tyndall's "definition" that follows, as well as Huxley's belief that science is not irreligious, adding that "Devotion to science is a tacit worship—a tacit recognition of worth in the things studied, and by implication in their cause" (65); Bennett, "How Flowers Are Fertilized," 39.

[150] Tyndall, "On the Study of Physics" (1854) in *Fragments of Science: A series of detached essays* (New York: D. Appleton, 1897), 1:291.

[151] Tyndall, "Study of Physics," 291; George Levine, *Dying To Know: Scientific Epistemology and Narrative in Victorian England* (Chicago: Chicago University Press, 2002) also reminds us that the objectivity theoretically required by pure science mandated a kind of abnegation or "death" of the self, another mental habit consonant with Christian practice.

[152] DeYoung directs in *John Tyndall* us to consider the damning condemnation of science as an immoral practice in Dickens' *Hard Times,* in which Mr. Gradgrind crushes all ethics and imagination out of his students with his utilitarian science (154). John Henry Newman likewise objected to scientific reading rooms for this same reason— he felt that they encouraged learning of a utilitarian, rather than holistic, spiritual, or otherwise substantial nature.

Tyndall's in his own series of object-lesson lectures on "Town Geology" (1873). "[I] tell you," Kingsley says,

> that if you, or I, or any man, want to let our thoughts play freely round questions, and so escape from the tendency to become bigoted and narrow-minded which there is in every human being, then we must acquire something of that inductive habit of mind which the study of Natural Science gives. It is, after all, as Professor Huxley says, only common sense well regulated. But then it is well regulated; and how precious it is, if you can but get it.

In teaching students how to suspend judgment as they compared likeness and difference and questioned and observed cause and effect, the "inductive habit of mind" which belonged to "common sense well-regulated" likewise taught "accuracy, patience, freedom from prejudice, [and] carelessness for all except the truth."[153] These were mental habits, coached by science, which then could be summarily applied to all social and political interactions.[154]

This belief in the moral tutelage of science was reified when the lectures in this chapter rhetorically modeled the "habits" that effect such moral improvement. Lecturers may not have spelled out as they went the mental "ennoblements" that each insistence on beauty, cosmic connection, or experiment could offer their listeners, but through rhetorical actions like the beautification of the common and cosmic metonyms, they tacitly cultivated these mental habits nonetheless. Cobbold's meditation on the fluke, for example, was an exercise in "dispossessing

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[153] Charles Kingsley, preface to *Town Geology* (New York: D. Appleton and Co. 1873), xxxi-xxxii.

[154] Kingsley in *Town Geology* beautifully moralizes the spiritual gifts of science a few pages later: "Do you wish to be great? Then be great with true greatness; which is— knowing the facts of nature, and being able to use them. Do you wish to be strong? Then be strong with true strength; which is, knowing the facts of nature, and being able to use them. Do you wish to be wise? Then be wise with true wisdom; which is, knowing the facts of nature, and being able to use them. Do you wish to be free? Then be free with true freedom; which is again, knowing the facts of nature, and being able to use them" (xxxvii-xxxviii).

[the] mind of all preconceived notions whatsoever."[155] Audiences were quietly prompted to develop "patience" and "freedom from prejudice" as they listened fairly to Cobbold's unconventional testimony of the fluke as "pretty" and "exquisite." In addition to being a case-based sympathetic exercise, imagining what it would be like to think *in that way*, these moments of beautification were also moral exercises in openness. The Cosmos metonyms effected a similar type of moral reform. Like the beautification of the common, they asked audiences to suspend their preconceived ideas about the orientation of the universe, if not their sense of belonging in its continuous and unified creation.[156] Kingsley said that the study of natural science taught "the art of seeing, the art of knowing what you see [and] the art of comparing, of perceiving true likeness and true difference."[157] Cosmos metonyms put objects and systems under the microscope, teaching audiences to see through to the unifying networks of energy within a muffin or a cup of tea, demonstrating experimentally how to know that the goldfish and the piece of wood are connected by the carbon cycle. The imaginative sympathy made possible between the audience and a candle was a result of making visible degrees of likeness and difference. In a way, a sympathetic relationship to the community of matter was made possible by these "mental habits" taught by science.

The continued development of a sympathetic imagination was indeed the moral habit of mind instilled by lecture-going. But the involvement of sympathy in scientific learning also helped lecturers better explain their belief that the study of science "yielded a reverential

[155] Cobbold, "Parasites," 40.
[156] The freedom to explore Nature, like the freedom to attend educational lectures, was of course the privilege of a certain type of normative subject—able-bodied, male-skewed (an issue I note in the introduction to chapter 1).
[157] Kingsley, *Town Geology,*15.

spirituality," by encouragement to openness towards the experiences of others.[158] The virtuous habits of accuracy, patience, open-mindedness, and so on, are fairly logically evidenced by the rhetorical exercises above and in the previous sections of this chapter. But other states and feelings seem to resist rational explication. Witness for example J. Norman Lockyer's conclusion to his lecture on "The Sun" (1871) "Anything which increases our knowledge of that luminary which gives us light…" he says, "which is the origin of all our work, either by the bottled-up energy… as represented by coal, or by the bottled up energy in our veins is a thing entirely to be desired." The benefit of this knowledge is not material, not even strictly moral, but something more. "[It] can do nothing worse than ennoble us," he goes on, "and make us lift our minds from our workaday matters to higher things."[159] Lockyer here links his miniature Cosmos metonym about the material community of the sun's energy to an effect: ennoblement. But unlike "patience," or "accuracy," "ennoblement' and lifting to "higher things" aren't skills— they are more like consecrations. Alfred Bennett likewise connects Cosmos metonyms to a distinctly spiritual kind of feeling in his conclusion to "How Flowers are Fertilized" (1873). Following up his claim that there is no pursuit better adapted "to preserve that even balance of all the mental powers which marks the wise and large-minded man, than to study the ways of Nature," he continues,

> the examination of those laws, which, in their unvarying constancy, and yet their constant variety, raise us so far above the petty details of our daily life, and teach us that we ourselves also are a part of this stupendous whole; that on our own conduct, on our performing those duties in the world for which we are adapted, even if they appear to be

[158] DeYoung, *John Tyndall,* 55.
[159] Lockyer, "The Sun," 345.

as unimportant as those of the insect visiting the flower, depends the fulfilling of our part in preserving the harmony of the universe.

That great and true lover of Nature, the poet Wordsworth, said

To me the meanest flower that blows does bring

Thoughts that do often lie too deep for tears….[160]

Again we see a succinct moral signal: Bennett emphasizes that scientific knowledge produces an awareness of how our conduct effects not just our fellow men, but our fellow-existers. But he also gives the sense of the religious spirituality that scientific knowledge might instill, a spirituality that appears to proceed directly from the community comprehension made visible in the Cosmos metonyms: "that we ourselves are part of a stupendous whole." The marvelous uniformity of the universe is not expressly attributed to a divine source, but it supplies the religious sense of feeling at home in the Universe. His spiritual feeling of belonging is further bolstered by the quotation of Wordsworth, himself emblematic of an irreducible spiritual connection to natural things (a connection visited in-depth in the previous chapter). Bennett takes this Wordsworthian feeling, and gives it a natural rather than supernatural source.

But nowhere is this distinctly spiritual connection and effect more evident than in Roscoe's conclusion to his lecture on "Spectrum Analysis" (1866) where we shall likewise

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[160] Bennett, "How Flowers Are Fertilized," 39. It should be noted that Bennett is probably quoting from memory, as this is a misquotation. The original reads:
""To me the meanest flower that blows can give
Thoughts that do often lie too deep for tears."
William Wordsworth, "Ode: Intimations of Immortality," (1802) in *Wordsworth's Poetry and Prose,* ed. Nicholas Halmi (London: W. W. Norton and Company, Inc., 2014) 439, lines 205-206. In evoking a "stupendous whole," Bennett also quotes Pope's "Essay on Man":
"All are but parts of one stupendous whole
Whose body Nature is, and God the soul,"
which he also replicates in an address before the British Association on "The Theory of Natural Selection from a Mathematical Point of View," in 1870, republished in *Nature* 3 (November 10, 1870): 30-33.

conclude. In it, we see a language similar to Bennett's and to Lockyer's— the idea that scientific knowledge *ennobles* and *elevates*.

> But apart from the *usefulness* of science in the sense which I have here employed— by which I mean its application to raising the material welfare of mankind—there is another and a higher part for science to play, namely, to enlarge the understanding and to purify the hearts of men. To the study of nature men may always look as a source of pure, unalloyed enjoyment, a spring which is never dry, a food which never satiates. What gives zest and spirit to that poor weaver's life, who walks for miles after his hard day's work—as many do—to secure a rare fern, or find a new coal fossil? Does he earn a farthing more? Will his master pay him more wages? Or can he thereby "turn an honest penny" as it is termed? Not he. His aims are loftier and nobler. His prize and payment is a far higher one— that of an enlarged mind and a peaceful heart. His thoughts are raised above the mere struggle for wealth and position. He lives quietly and contentedly, and finds in the pursuit and study of nature that peace and happiness which alone such studies can give.[161]

Roscoe's conclusion that science "purifies the hearts of men," like Bennett's spiritual conclusions, doesn't logically follow from the moral "habits of mind" that the study of nature effects. In the space between "science makes you moral" and "science elevates your soul" there remains an explanatory disjoint. Over a century later, Carl Sagan will find himself battling with the same logical breakdown between his call to fellow-feeling that "we are made of star stuff"— itself a Cosmos metonym— and his experience of scientific insight as "a recognition that he could only compare to falling in love."[162] One assertion does not necessitate the other, which

[161] Roscoe, "Spectrum Analysis," 200.
[162] Ann Druyan, "Introduction" to Carl Sagan, *Cosmos* (1980; New York: Ballantine Books, 2001) xviii.

cannot be satisfactorily evidenced, only gestured towards, by the sympathetic relationships made visible in the lecturer's narration. The act of developing moral "mental habits" through the study of science may be somewhat traceable, but "taking the findings of science to heart" seems to ultimately defy explanation.[163]

That the most religious of all expressions in the secular lecture comes in the very place where lay Victorians, thoroughly acquainted with the proceedings of the sermon, would expect a "moral" imperative can hardly be a coincidence. It is in this parity that the sermon, in its own way, ultimately helped "sympathy for science" along. As we saw with the uniformity of nature, scientific naturalists were rebranding familiar structures in the service of science, and coopting the means of production. Lectures, as educational initiatives, were participating in that ideological re-branding. Ruth Barton has shown how Sunday lecture series helped promote the lecture as an alternative to Sunday sermons, and we've seen in this chapter how the lecture also helped promote an alternative "religiosity" in its rhetorical representation of sympathy towards nature.[164] The beautification of the common and cosmic metonyms provided imaginative baby-steps towards a broader natural sympathy, and scientific lecturers used these kinds of rhetorical gestures to subtly ease their audiences into awareness of the prospect of finding "energy, diversity, beauty, intelligence, and sensibility" in the universe viewed through science "that might provide a world-friendly alternative to otherworldly values."[165] We well know that this was no comfortable suggestion for the Victorians. But when given in a form associated with ministration to the soul, spiritual ennoblement, and purification, it perhaps didn't seem so hostile. Recall Williamson's exhortation to the study of the forces of Nature— "Study them and they will

[163] Druyan, "Introduction," xviii.
[164] Barton, "Sunday Lecture Societies," 190.
[165] Levine, *Darwin Loves You,* xv.

interest you; examine them and they will repay you"— that rings harmonious with Spurgeon's quotation of the Gospel of Matthew at the end of his sermon on "The Great Liberator" (1865): "Seek, and ye shall find; knock, and it shall be opened; ask, and it shall be given unto you."[166] Even if, ultimately, audiences took from this a more traditionally theistic recapitulation, these moments of replacement fought against the myth abroad that science was soulless, and propped open the door for the naturalization of scientific naturalism that would eventually occur.[167]

[166] Williamson, "Paving Stones," 275; Charles Haddon Spurgeon, "The Great Liberator," in *Sermons of Rev. C. H Spurgeon, Eighth Series* (New York: Sheldon, 1865), 205.

[167] Of Huxley's cosmic evolutionary world in 1885 Desmond writes that "what had been damnable for 30 years appeared neutral now" Desmond, *Huxley,* 541, 553.

Chapter 3: "Man's Place in Nature": The physiological sympathies of Thomas Henry Huxley

> *The natural sciences are connected by the same ties that link all the phenomena of nature. The classification of the species, which we ought to consider as the fundamental part of botany…is to the geography of plants, what descriptive mineralogy is to the indication of the rocks which constitute the exterior crust of the globe.*[1]
>
> Alexander von Humboldt, *Personal Narrative* (1814)

Introduction: A liberal education

Thomas Henry Huxley wanted the Victorian public to have an education. In the same year that his pieces of chalk and protoplasm dazzled evening lecture goers, and just a year before his rhapsodic translation of Goethe graced the title pages of *Nature,* he laid out before an audience at the South London Working Men's college exactly what his vision of an education entailed, and into what kind of person one so educated would transform. Huxley's education was not to be gotten from that process that *Nature* so abhorred, "book-knowledge"; was not to be consummated through the text book or lecture hall, however much those two formats served as Huxley's intermediaries. No, a thorough education, in its most fundamental form, came from Nature itself. He opens "A Liberal Education and Where to Find It" (1868) with an explanatory metaphor. If our lives depended upon winning a game of chess, he provokes, should we not learn what we can of the pieces, and have a "keen eye for all the means of giving and getting in and out of check"?

> The chess-board is the world, the pieces are the phenomena of the universe, the rules of the game are what we call the laws of Nature. The player on the other side is hidden from

[1] Alexander von Humboldt, *Personal Narrative* (London: Longman, Hurst, Rees, Orme, and Brown… J. Murray… and H. Colburn, 1814-1829), iv-v.

> us. We know that his play is always fair, just and patient. But also we know, to our cost, that he never overlooks a mistake, or makes the smallest allowance for ignorance. To the man who plays well, the highest stakes are paid, with that sort of overflowing generosity with which the strong shows delight in strength. And one who plays ill is checkmated– without haste, but without remorse.[2]

Huxley's analogy calls attention to the perpetually active and reactive situation of humankind in the context of Nature. Every action will have a consequence, good or bad, and "playing well" in the game of Nature, just as in the game of chess, depends on one's ability to recall the properties of the pieces and anticipate the possible permutations of their movements. "In other words," he continues,

> education is the instruction of the intellect in the laws of Nature, under which name I include not merely things and their forces, but men and their ways; and the fashioning of the affections and of the will into an earnest and loving desire to move in harmony with those laws. For me, education means neither more nor less than this. Anything which professes to call itself education must be tried by this standard, and if it fails to stand the test, I will not call it education, whatever may be the force of authority, or of numbers, upon the other side.[3]

To his audience of educational seekers in South London on this evening, Huxley insinuated that truly liberal education culminated in something more than an intellectual or affective affinity

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[2] T. H. Huxley, "A Liberal Education and Where To Find It," in *Lay Sermons* (New York: D. Appleton and Company, 1870), 31-32; Huxley's rendering of the "calm, strong angel" of Nature who "plays for love" bears resemblance to a characterization in Goethe's aphorisms on Nature, which Huxley translated for *Nature* magazine a year later: "Mankind dwells in her and she in them. With all men she plays a game for love, and rejoices the more they win. With many, her moves are so hidden, that the game is over before they know it. "Nature: Aphorisms by Goethe," *Nature* 1 (November 4, 1869): 9-10. Given Huxley's deep affinity for Goethe this linguistic parity is almost certainly not a coincidence.

[3] Huxley, "Liberal Education," 32.

for science and its objects of study. It made a relationship with the laws of nature essential to humankind's being, and to humankind's survival.[4] Like a supplicant before a god, Huxley renders nothing so desirable, so morally admirable, as the "earnest and loving desire to move in harmony with those laws," and after an extended character sketch of the liberally educated man, he circles back to his operant equation: a liberally educated person "is, as completely as a man can be, in harmony with nature."[5]

That harmony, in Huxley's specific rendering, forms the subject of this final chapter. In introducing "harmony" as another key term into our lexicon of scientific affinity, Huxley conjures a resonance with an ancient mode of physico-magical thinking that parsed the connections and interactive effects individually and separately among bodies, feelings, and things: with sympathy. Huxley's liberally educated person was *in* harmony with Nature in part because they understood the harmonies—that is, to say, the connection and mutual influence—of Nature's laws. But they were also in harmony by the substance of their frame, a body that was also an organ in a conceptual body of Nature. For Huxley, those dual harmonies critically merged in his own pet discipline, physiology, a field in which "sympathy" has a uniquely pertinent relevance to emotional, social, and physical unity. "I think it is one of the grandest features of Biology," Huxley told another audience in St. Martin's Hall years earlier, "that it occupies this central position in human knowledge," encompassing the science "which deals with the relation of living beings to one another— the science which *observes* men." "There is

[4] Will Abberly, "Deceptive Nature and Truthful Sciences in Charles Kingsley's Natural Theology," *Victorian Studies* 58, no.1 (2015): 49, has recently alluded to the parity between Huxley's secular morality and Charles Kingsley's God-oriented natural morality as derived through a natural education. The similarity between the two friends' philosophies, which we've seen elsewhere in chapter 2, is one of many reminders of how the scientific naturalists successfully coopted the theist language of natural morality as well as uniformity.

[5] Huxley, "Liberal Education," 35.

no side of the human mind," he opined, "which physiological study leaves uncultivated."[6] This statement from "On the Educational Value of the Natural History Sciences" (1854) presages "A Liberal Education's" totalizing educational vision that includes "not merely things and their forces, but men and their ways," and through it we come to the essential focus of Huxley's education. It began with the body, and by the signs, substance, and language of that body, it would encompass all things.

This chapter treats Huxley the educator and the practitioner as a case-study for what a particular manifestation of "sympathy for science" might look and sound like, and how it might individualize itself. The harmonious, if hard-edged, sympathy evoked by "A Liberal Education" illuminates the unified and uniform Nature that the scientific naturalists were re-mastering for Victorian audiences, in which humankind was both a perpetual player and a perpetually affected part. Huxley's rhetorical enactment of a certain impersonalized harmony indebted to a physiological characterization of Nature helps us conceptualize how the liberally educated man could remain in earnest and affected "harmony" with Nature in the face of the doubt, dread, or negative feeling that the vistas of science could offer. As he makes clear as early as "A Liberal Education," Huxley's rendering of humankind's harmony with nature did not exempt mankind from destruction— nor did it cast destruction as antithetical to harmony. Yet his system remained harmonious nonetheless. Physiology, and sympathy, do some work in unpacking this paradox.

In addition to the majesty of his prose, Huxley's identity as a investigator, teacher, and expositor of the "vital" science, biology, locates him in the whirling dense heart of the Victorian system around which all the concerns of this project— man and nature, fact and feeling, morality and materialism, sympathy, science—gravitate. The ubiquity and multifariousness of Huxley's

[6] T. H. Huxley, "On the Educational Value of the Natural History Sciences," in *Lay Sermons,* 88.

work present a unique challenge, for as Cyril Bibby, a biologist himself, once reminded us, Huxley's thinking was never "conveniently compartmentalized to permit easy grouping." "Whatever the ostensible subject," Bibby writes, Huxley "almost always ranged into neighboring fields, using whatever occasion presented itself as a peg on which to hang a complete garment from his educational wardrobe."[7] That same ranginess characterizes Huxley's public corpus more generally. Rather than attempting the impossible task of transcribing a comprehensive Huxleyan philosophy, this chapter strives to offer an interpretive sketch of a key rhetorical leitmotif. In honing in on physiology and the likeness between organic beings on which it depends, this chapter also implicitly abuts that critical Victorian issue which has thus far remained on the margins of this project: evolution. No proper project on Victorian science can neglect the enormous impact that the implications of evolutionary connection and competition exerted on the idea of having "sympathy for science." Likewise, no Victorian voice was more associated, on the ground, in the culture-war trenches, with the sweeping disciplinary implications of the evolutionary question than Huxley's own. Among other things, this chapter sees Huxley's rhetorical approach as a link which draws evolution into the realm of a sympathetic imaginary.

Though I draw from the broad corpus of Huxley's work, his pointedly named volume *Lay Sermons, Addresses, and Reviews* forms the nucleus of this chapter. Published in 1870, this compilation would become an international bestseller. It contains some of Huxley's most iconic and electrifying essays, including "A Liberal Education" and "On the Educational Value" above, and "On The Physical Basis of Life" from the previous chapter. With its "exultant vision of the new scientific cosmos," the *Lay Sermons* optimally render Huxley's voice at the height of

[7] Cyril Bibby, *T. H. Huxley on Education* (Cambridge: Cambridge University Press, 1971), ix.

scientific naturalism.[8] They are also an important rhetorical and philosophical signpost. The *Lay Sermons* contain a significant density of traceable physiological and sympathetic metaphors that capture, I argue here, a critical function of Huxley's explanatory appeal to the public imagination. The theoretical and rhetorical qualities of such lay sermons, their fluency and gravity, are part of what makes Huxley such an excellent study in the art of popular exposition for the mind and the sensibilities. Though his popularizing work was conceptually adjusted for lay consumption, much of this chapter will also draw from scientific memoirs of more limited distribution— in which the same linguistic and ideological patterns can be observed.[9] The *Lay Sermons* and other lay sermons, then, should be taken as the most publicly audible part of a grand ideological symphony, a catchy refrain or sound-bite which, true to John Tyndall's desire, "extended a sympathy for science beyond the limit of the scientific public."[10]

The broader argument of this chapter is comprised, like an anatomical body, of several discrete parts working in conjunction to form a picture of Huxley's signature contribution to sympathy for science. I first turn to Stoic and Neo-Platonic ideas of "sympathy" as a way of imagining an interaction with the physical universe and the matters of science. This lens of physiological sympathy lets me refocus attention on physiology as a critical through-line in Huxley's work, sampling a few case studies. Finally, I consider how approaching humankind's relationship to nature via physiological sympathy, as Huxley did, might help us register the kind

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[8] Adrian Desmond, *Huxley: From Devil's Disciple to Evolution's High Priest* (Reading, Mass: Addison-Wesley, 1997), 368.

[9] As a point of clarification, though Huxley did adopt a rhetorical posture of "science for all" and supported and participated in working-men's institutes (like the Manchester lectures), his vision of science education and his greatest contributions to reform thereof were—like much of the reform work at the time—decidedly middle-class. See Richard A. Jarrell, "Visionary or Bureaucrat? T. H. Huxley, the Science and Art Department, and Science Education for the Working Class," *Annals of Science* 55 (1998): 219-240.

[10] John Tyndall, preface to *Fragments of Science for Unscientific People: A Series of Detached Essays, Lectures, and Reviews* (New York: D. Appleton and Co., 1871).

of "harmonies" he described among the myriad elements and living participants in the physical world, and how its materially-centered connectivity helped bridge, if not explain, the ever-widening gulf between evolution and ethics at the close of the Victorian era.[11]

Sympathy as a physiological principle

> …That there is nothing really aberrant in nature; that the most widely different organisms are connected by a hidden bond…[12]

In an early scientific address "On the Theory of the Vertebrate Skull" (1857), Huxley alludes with "wonderful" satisfaction to the increasing evidence for a force of connection in the realm of nature. His subsequent analysis is based, per his wont, in a discourse on the "community of form" in material gradations of vertebrate comparative anatomy. But his choice of the phrase "hidden bond" evokes a more mysterious force, echoing the language of earlier epochs in which the "hidden affinities" between natural things were ascribed to the protean pull of universal sympathy.[13]

Stemming from the Stoic tradition, *sympatheia* could be called upon to describe the mysterious harmonies of everything from atoms, to planets, to musical instruments, from human

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[11] James Paradis, *T. H. Huxley: Man's Place in Nature* (London: University of Nebraska Press, 1978) has characterized what I am calling Huxley's "harmony" as the "demonstrable, material order of physical nature, and its idealization, the theoretical transcendental order of cosmic eternity" (96).

[12] T. H. Huxley, "On the Theory of the Vertebrate Skull" (1857) in *The Scientific Memoirs of Thomas Henry Huxley* (London: Macmillan and Co., 1898), 1:538.

[13] Christia Mercer, "Seventeenth-Century Universal Sympathy: Stoicism, Platonism, Leibniz, and Conway" in *Sympathy: A History*, ed. Eric Schliesser (New York: Oxford University Press, 2015) enlists the German philosopher Jacob Heinrich Gangloff to illustrate the state of metaphysical and physical debate regarding sympathy in the 17th century, which captures, like Spinoza, the blur between ancient metaphysics and the mechanistic physics of the scientific revolution in its recognition of physical explanations for natural affinities, but incomplete comprehension thereof. Gangloff describes sympathy, then as "a mutual harmony among natural things, arising from a particular hidden affinity on account of which these things, by a friendly affect or secret love, are mutually drawn to each other" (119); Jacob Heinrich Gangloff, *Disputatio physical de sympathia* (Jena: Samuel Adolphus Müller, 1669), A 2r.

bodies to human feelings. Described by Rene Brouwer as the "physical interconnectedness of the world with itself and the entities in it," for Plato and Aristotle the term connoted involuntary co-affection, generally physiological, as when a yawn incites others to yawn, or when a shrill sound affects the root of a human hair; for Epicurus and the Stoics, it implied a mechanistic kind of action, to explain perception and the interaction between the physical body and the metaphysical soul.[14] The concept permuted along these lines to varying degrees through the Renaissance, but what remained consistent— and therefore relevant to the purposes of this discourse— is that *sympatheia,* sympathy, or "sympathies," broadly described the phenomenon of action at a distance.[15] Confederated by a "hidden bond" of sympathy, musical instruments resonated with the stars, people became friends or enemies, animals resembled each other, diseases were cured and exacerbated under the influence of plants or stones, magnets attracted metal. Long before the laws of thermodynamics, the uniformitarianism of the globe and the organic bond of evolution, a "hidden affinity" drew things together.[16]

In its etymological and conceptual heritage as a principle of connection, the idea of "sympathy" is implicit in what James Paradis describes as the "transcendent order Huxley

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[14] Plato addresses the phenomenon of this type of sympathy only in passing in the *Charmides,* where describes Critias falling into a state of being "at a loss" in response to seeing Socrates at a loss, as though that state is of the same involuntary contagion as a yawn; in the *Problems,* generally attributed to Aristotle in antiquity, the chapter on sympathy includes the yawning phenomenon encountered in Plato as well as the urge to pass urine in the vicinity of water, or raising of the body's hairs in response to an unpleasant sound; Epicurus, in contrast, used "sympathy" in a systemic manner. In his *Letter to Herodotus* he uses the term "sympathies" in a sense commensurate with a kind of mechanistic particle physics, and to explain perception as well as interactions between body and soul. See Rene Brouwer, "Stoic Sympathy," in *Sympathy: A History*, 17-19.

[15] Ann E. Moyer, "Sympathy in the Renaissance" in *Sympathy: A History*, 70-101 surveys how the term "sympathy" figured and changed over the course of the Renaissance, mingling with theories of magic and emergent natural and medical philosophy in the work of figures like Ficino, Agrippa, Fracastoro, and Paracelsus; Marsilio Ficino, *Three Books on Life,* ed. and trans. Carol V. Kaske (Binghamton, NY: Center for Medieval and Early Renaissance Studies, 1989).

[16] Mercer, "Universal Sympathy," 121.

theorized as the fundamental property of the universe."[17] For Huxley that order could be discerned by way of an increase of natural knowledge, by which the "spectacle of the ebb and flow of the tide, under London Bridge" could be understood "to be a symbol of the working of forces which extend from planet to planet, and from star to star, throughout the universe."[18] Paradis also makes a connection between Huxley's cosmic vision and the "the divine rational order of Spinoza's nature," though without Spinoza's humanity or monadistic implication.[19] While Spinoza's universe was unified by the existence of God, and Huxley's by the mechanism of physical law, Paradis suggests a resemblance between Huxley's system of connection and the sympathetic order of Spinoza's Neo-Platonism. In his vision of a fundamental unity in nature in which all causal relations are intelligible, Spinoza (like his precursor, Descartes, another object of Huxley's meticulous study) recalled the strong philosophical bonds between the ancient metaphysical *connexio rerum* and the Newtonian universe made intelligible through mechanistic physics.[20]

We can point to a rich heritage of philosophy in which *sympatheia* as a mystical explanatory mode became gradually or replaced by or synthesized with physical theories of matter. Huxley himself writes of the scientific replacement of "notion[s] of creative, or other

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[17] Paradis, *T.H. Huxley,* 96.

[18] T. H. Huxley, *Physiography: An Introduction to the Study of Nature* (London: Macmillan and co., 1883), 377.

[19] Spinoza's doctrine of unity ultimately followed to the conclusion that there was only one thing— God (or some force like him): see Paradis, *Man's Place,* 96.

[20] For a succinct gloss of Spinoza's rehabilitation of the concept of "sympathy," see Karolina Hübner, "Spinoza's Parallelism Doctrine and Metaphysical Sympathy," in *Sympathy: A History*, 147-148; Huxley seemed to retain a prolonged interest in Descartes, perhaps as his role as a physiologist as well as a scientific philosopher, noting with admiration that "there is no doubt that Descartes was the first to propound the fundamental conception of the living body as a physical mechanism," even if he was "misled" in paralleling too closely the clockwork and living machine. (Huxley, "Connection," 362). Among his other references, Huxley included in his *Lay Sermons* a lecture centered exclusively on Descartes, called "On Descartes' "Discourse Touching the Method of Using One's Reason Rightly and of Seeking Scientific Truth," (320-344).

interferences, with the natural order of phenomena."[21] As he pointedly observes in his lay sermon on "The Origin of Species" (1859), "When Astronomy was young 'the morning stars sang together for joy,' and the planets were guided in their courses by celestial hands. Now, the harmony of the stars has resolved itself into gravitation according to the inverse squares of the distances."[22] Even while Huxley's sets out to replace theology and magic with science, he nevertheless demonstrates the staying power of a harmonious or sympathetic rhetoric despite its insufficiency as an explanatory model. He re-invokes "harmony" twice more just a paragraph later as the quality of the order of "the web and woof of matter and force interweaving by slow degrees" that makes up "the picture which science draws of the world."[23] Like a syncretic religion, sympathy's fundamental framework of action and order at a distance could remain serviceable, while the details changed. Huxley's harmonious evocation is just one of the ways that, even emptied of its active force, *sympatheia* or "sympathy" as a doctrine of the "fundamental relatedness of all things" lingered on into the nineteenth century. The concept carried particular weight in yet another Huxley purview, medical discourse, and this physiological iteration of sympathy formed a fertile proving ground for how Huxley modeled his "transcendent order."

Following on the physiological "community of plan discernible in the manifold diversity of organic structure," Huxley rhetorically and literally positions the organic body and its study as a connective tissue that runs through the body of his educational program.[24] In his various

[21] T. H. Huxley, "The Origin of Species" (1860), in *Lay Sermons,* 282. Originally published in the *Westminster Review.*
[22] Huxley, "Origin of Species," 283. His quotation regarding the "morning stars" is a compression of Job 38.7 "When the morning stars sang together, and all the sons of God shouted for joy?" Web. https://www.kingjamesbibleonline.org/Job-38-7/. Accessed September 13, 2018.
[23] Huxley, "Origin of Species," 283.
[24] Huxley, "Vertebrate Skull," 538-539.

attentions and approaches to physiology, he not only conjures a sense of generalized unity in nature, but he reminds us of the long and productive history that the term and concept of "sympathy" has had in medical discourse in describing the action of forces on and within the human body—a harmony of ideologies born out by Huxley's own initiation into science through medical training.[25] In Galen and his medical contemporaries we see the term "sympathy" used to describe the appearance of action across an ailing body, or to indicate that the physiological processes in one part of the body could have effects on another part.[26] Soranus of Ephesus, for example, assumed a "natural sympathy" between the uterus and the breasts as he tried to account for phenomena of influence, like tenderness during menstruation, in modernity intelligible as hormonal and nervous interaction.[27] And as with the physical sciences, even when sympathy is abandoned as a serious explanatory mechanism, the concept will persist in medical parlance to connote the same sense of "being influenced or affected." Sympathy retains its facility in William Carpenter's *Elements of Physiology* (1851) when he notes that "[p]athology has been

[25] Though he had little formal education, Huxley began his medical course at the age of 15, for, as his son Leonard Huxley would write, "medicine was then the only avenue for science," and the field was in his view as two of his sisters had married doctors. Huxley was apprenticed first to a physician in Rotherhithe, then enrolling at the private Sydenham College before splitting his time among Charing Cross Hospital and the dissecting rooms of the Royal College of Surgeons until he was eligible to take the medical exam (Huxley came of age in the era before the reform of medical education which he himself helped to enact, which transformed medicine from a haphazard system of apprenticeship and written exams into a scientific, clinical profession) Desmond, *Huxley,* 18-34.

[26] Brooke Holmes, "Reflection: Galen's Sympathy," in *Sympathy: A History* notes that Galen was often vague about the exact mechanism of sympathy. Rather, he approached by way of example, frequently analogizing the "attraction and expulsion performed by the natural faculties to a range of phenomena observed in inanimate things," phenomena which were all explained in antiquity in terms of sympathy, like the capacity of emetics to attract specific humours, antidotes to draw out venom, and the lodestone to attract iron" (64). This is a bodily-centered permutation of the (what will later be thought of as occult) theory that all substances are attracted or repelled according to degrees of affinity or antipathy to each other.

[27] See Owsei Temkin, *Soranus' Gynecology* (Baltimore: Johns Hopkins University Press, 1956), introduction xxxi-xxxii.

appealed to, as showing a decided connexion between the disease of the Cerebellum and the affection of genital organs…yet it appears…that such a sympathy is comparatively rare."[28]

This medical sympathy came to rest most trenchantly in the sympathetic nervous system, whereby eighteenth-century theorizations of sensibility (sympathy) came to extend through a now-identifiable bodily system (the nerves) into bodily phenomena (the "sympathies").[29] Carpenter writes that

> The peculiar connexion of this system of nerves with the organs of vegetative life, has caused it to receive the designation of the Nervous System of Organic Life; the Cerebro-spinal system being termed the Nervous System of Animal Life. [For this system] [t]he term *Sympathetic* is perhaps the best; although it must not be supposed that this system of nerves is the instrument of by any means *all* the sympathies, which manifest themselves between different organs.[30]

Carpenter's conceptualization of the sympathetic nervous system here is particularly interesting, as it emphasizes a quality of connection between vegetative and animal life which was of especial importance to Huxley.[31] "Vegetative" in this context should be understood to mean not

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[28] William B. Carpenter, *Elements of Physiology, including physiological anatomy* (Philadelphia: Blanchard and Lea, 1851). Carpenter joined the lineup of lecturers for Manchester's third series of science lectures for the people, along with Huxley, Henry Roscoe, and chemist William Odling; L.S. Jacyna, "The Physiology of Mind, the Unity of Nature, and the Moral Order in Victorian Thought," *The British Journal for the History of Science* 14, no. 2 (July, 1981) notes that Carpenters especial attention to the physiology of the nervous system was particularly naturalistic (113).

[29] Jessica Riskin, *Science in the Age of Sensibility: The Sentimental Empiricists of the French Enlightenment* (Chicago: University of Chicago Press, 2002) explores an aspect of this collapse, in which "sentimental" data counted as part of the empirical "sense" date of Enlightenment science.

[30] Carpenter, *Elements of Physiology,* 527-528.

[31] Matthew Stanley, *Huxley's Church and Maxwell's Demon: From Theistic Science to Naturalistic Science* (Chicago: University of Chicago Press, 2014) notes that Carpenter's *Physiology* was one of Huxley's main texts, and that it was from him that he adopted the idea that "the human body was subject to all the same forces and laws as the inorganic World. [And s]econd, that the human mind was subject to all the same forces and laws as the inorganic world" (197). Carpenter's was more than a one-way

merely vegetable, opposite animal, but *vegetative*, opposite consciousness. The sympathetic nervous system acts unconsciously, with or without volition— so too, do the "sympathies" of Huxley's system of nature.[32]

But with the physical nerves offering both conscious and unconscious linkage to the feelings, it is not difficult to see how physiological sympathy neatly lent itself to metaphors for human society, and ultimately to the moral and social sense of the word which came to abound in the nineteenth century.[33] Johannes Müller's *Elements of Physiology* (1843), the textbook that young medical apprentice Huxley devoured and that formed the basis of his physiological education, gives a sense of the flexible nature and application of this vocabulary. [34] In a section

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influence for, as Adrian Desmond notes, Huxley corrected proofs of Carpenter's *Principles of Comparative Physiology,* and they shared a working relationship. "Huxley was Carpenter's sort of expert," he writes, "and Carpenter was Huxley's sort of man." Desmond, *Huxley,* 180; Carpenter's Manchester lecture "On the Unconscious Action of the Brain" (1871) in *Science Lectures for the People, Third Series* (Manchester: J. Heywood, 1871) discusses the automatic actions of the brain and body as conducted through the nervous system, and the general connection thereof (72-100).

[32] Huxley makes a salient point in support of unconscious versus conscious sympathy, albeit of a moral color, in a footnote of the "Prolegomena," (1894) in *Collected Essays* (New York: D. Appleton and Co., 1897) where he states: "Adam Smith makes the pithy observation that the man who sympathises with a woman in childbed, cannot be said to put himself in her place…Perhaps there is more humour than force in the example; and, in spite of this and other observations of the same tenor, I think that the one defect of the remarkable work in which it occurs is that it lays too much stress on conscious substitution, too little on purely reflex sympathy" (9: footnote 15).

[33] Of this link Carpenter writes in *Elements of Physiology* that "there is much reason to believe, however, that [the sympathetic system] constitutes the channel through which the passions and emotions of the mind affect the Organic functions; and this especially through the power of regulating the calibre of the arteries…It is probable that the Sympathetic system not only thus brings the Organic functions into relation with the Animal, but that is also tends to harmonize the former with each other, so as to bring the various acts of secretion, nutrition, &c., into mutual conformity" (529); Carpenter was an influential presence in physiology at the time, and his *Physiology* was especially interested on the moral implications and interactions of the nervous system, according to Gerald L. Geison, *Michael Foster and the Cambridge School of Physiology: The Scientific Enterprise in Late Victorian Society* (Princeton, N.J.: Princeton University Press, 1978), 33.

[34] Desmond, *Huxley,* 14; Müller was among the most notable anatomists and physiologists of the first half of the 19th century, and his textbook on *Physiology* had an international reputation. His experimental researches on the heartbeat during the 1830s linked the contraction of the heart muscles to the influence

tellingly titled "On Sympathies," Müller dissects "sympathy" into multiple strains of "radiation and coincidence of sensations" separate from the "greater part of the sympathetic phenomena formerly attributed to [the] influence" of the sympathetic nervous system.[35] The "sympathies of the different parts of one tissue with each other" are the most common manifestation, as in the "sympathetic enlargement of the lymphatic glands" which is frequent in the case of "inflammatory affections of a neighboring part."[36] The repeated occurrence of the word "affection" in Müller's description, and in Carpenter's above, marks the terminological flow between physiological and sentimental theory, and the currency that such entangled terms held simultaneously in the physiological, emotional, and social realm— all spheres of experience which Huxley's physiological rhetoric labored to weave together into one larger physico-natural body.[37] Even when "sympathy" as a term is not directly employed, the discourse of physiology

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of the sympathetic nervous system. Müller was also a teacher to Huxley's contemporary and fellow physiologist, the physicist Hermann von Helmholtz. Geison, *Michael Foster,* 4, 194-195.

[35] Johannes Müller, *Elements of physiology* (Philadelphia: John Bell, 1843), 573.

[36] Müller, *Elements of Physiology,* 573. This shows little variation in kind from Diderot and D'Alembert's Enlightenment definition of the term, as "the communication that the parts of the body have with each other, and which holds them in a mutual dependence," and which "transports to one part the pains and maladies which afflict the other." ("Il s'agit ici de cette communication qu'ont les parties du corps les unes avec les autres, qui les tient dans une dépendance, une position, une souffrance mutuelle, συνπάθεια, & qui transporte à l'une des douleurs, les maladies qui affligent l'autre.") Ryan Patrick Hanley, "The Eighteenth-Century Context of Sympathy From Spinoza To Kant," in *Sympathy: A History*, ed. Eric Schliesser (New York: Oxford University Press, 2015), 186-187; "sympathie, (physiolog.) *Encyclopédie, ou dictionnaire raisonné des sciences, des arts et des métiers, etc.,* eds. Denis Diderot and Jean le Rond d'Alembert. University of Chicago: ARTFL Encyclopédie Project (Autumn 2017 Edition), Robert Morrissey and Glenn Roe (eds), http://encyclopedie.uchicago.edu/. Accessed October 17, 2018.

[37] This terminological flow extended, for a time, into the realm of reading practices and novel theory. For more on the physiological theory of novel reading, see Nicholas Dames, *The Physiology of the Novel: Reading, Neural Science, and the Formation of Victorian Fiction* (New York: Oxford University Press, 2007); Jacyna notes in "The Physiology of Mind," that this "physiological psychology" was part of a larger movement in Britain towards a naturalistic understanding of man (110). The declaration of unity between mental and neural events marked in work like Müller's in Germany and Claude Bernard's in France would form the basis of experimental investigation into mental phenomena, including psychiatric work of the late 19th century (109).

in the nineteenth century was intimately predicated upon sympathy-adjacent ideas of interconnection, organization, and harmony, especially as related to living matter. The opening pages of an early edition of Huxley's textbook on *The Elements of Physiology and Hygiene* lean heavily on the idea that "the parts of Nature are intimately connected in one great whole," of which physiology is branch that inquires into the "uses, operations, and mutual influence of [living] parts."[38] John Call Dalton, an American contemporary of Huxley's, likewise writes in his 1875 physiology textbook that physiology "embraces all the active phenomena presented by living beings." "Living bodies," he writes,

> are distinguished…by the fact that they are *organized*; that is, they are composed of a number of different parts, or organs, connected with each other and mutually dependent….Thus all the different functions are in a state of mutual dependence, and the life of the whole body is a result of the simultaneous and harmonious action of its different parts.[39]

This is all to say that Huxley's dependence on physiological language and physiological structures reflected a larger scientific and social impulse to conceptualize bodies human, animals, and social in terms of a living and mutually entangled system.[40] Huxley brings physiological

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[38] This American edition was a cooperation between Huxley and Youmans, which featured the text of Huxley's *Lessons in Elementary Physiology* appended by Youman's section on hygiene. Later editions exclude the note on the larger interconnections of nature, though we know they of course feature ubiquitously outside of Huxley's textbooks, which tended towards sparer prose and avoided the metaphysics into which Carpenter often drifted. See T. H. Huxley and William Jay Youmans, *The Elements of Physiology and Hygiene: A Textbook for Educational Institutions* (New York: D. Appleton, 1868), 16-17.

[39] John Call Dalton, *A Treatise on Human Physiology, designed for the use of students and practitioners of medicine,* (Philadelphia: Henry C. Lea, 1875), 25.

[40] Huxley's actual textbook on *Lessons in Elementary Physiology* (11th ed. London: Macmillan, 1878) contains no theoretical, but only anatomical explication of the sympathetic nervous system. This is interesting, but not surprising, for Huxley's targeted pedagogical work is extremely direct and is

language and the ideological tendencies in Victorian physiology, relatively unpopular in the public imagination, into general discourse with his thunderous evolutionary voice. His ganglionic system not only unites humankind with the apes, and the animate with the inanimate, but comprises the whole universe, and all of time.[41]

A "unity of organization": the physiology of a corpus

In his presidential address to the Geological Society in 1869, Huxley creates a kind of scientific golem, vitalizing the non-living earth through a series of vivid analogies:

> The internal heat of the earth, the elevation and depression of its crust, its belching forth of vapors, ashes, and lava are its activities in as strict a sense as are warmth and the movements and products of respiration the activities of an animal. The phenomena of the seasons, of the trade winds, of the Gulf-stream are as much the results of reaction between these inner activities and outward forces, as are the budding of the leaves in spring and their falling in autumn the effects of the interaction between the organization of a plant and the solar light and heat. And as the study of the activities of the living being is called its physiology, so are these phenomena the subject-matter of an analogous telluric physiology, to which we sometimes give the name of meteorology, sometimes that of physical geography, sometimes that of geology. Again, the earth has a place in space and in time, and relations to other bodies in both these respects, which constitute its

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distinguished most by its clearness, rather than its rhetorical art. See section "The Nervous System and Innervation," 248-271.

[41] Gerald L. Geison's work on Huxley's friend and sometime-protégé *Michael Foster* notes that British physiology was somewhat of a backwater for much of the second-half of the nineteenth century (thanks to institutional constraints) and not a science which typically captured the popular imagination (13-47). Likewise, we can see in evidences like the *Lay Sermons* or Huxley's lectures in the Manchester Series of Science Lecture for the People that the meat of these lectures did not comprise intricacies of his dedicated daily work in the stuff of anatomy —though the implications and conclusions of that work, as this chapter argues, it made its way into his electrifying writing in important ways.

distribution. This subject is usually left to the astronomer; but a knowledge of its broad outlines seems to me to be an essential constituent of the stock of geological ideas.[42]

The planet Huxley describes takes the aspect of a vast animal, a body which respires through tectonic movement and in whose physical cycles are legible the same forces that govern the vital body. As is the living body, so is the earth. The relations of the earth to other celestial bodies, and the relations of the geological forces of the earth, are bound together in a dramatic cosmic analogy made intelligible by a single science: physiology.

For Huxley's study of the earth, the investigative blueprint is the organism. His address proceeds to draw biology and geology into even closer analogy, in terms which privilege the plan of living structures. "What is termed stratigraphical geology is neither more nor less than the anatomy of the earth," and "geological speculation…may be physiological speculation so far as it relates to undetermined problems relative to the activities of the earth."[43] After a dismissal of the arbitrary assumptions inherent alike to catastrophism and uniformitarianism, Huxley recalls the ultimate commingling of biology and geology: evolutionary theory, which

> applies the same method to the living and non-living world; and embraces in one stupendous analogy, the growth of a solar system from molecular chaos, the shaping of the earth from the nebulous cub-hood of its youth, through innumerable changes and immeasurable ages, to its present form; and the development of a living being from the shapeless mass of protoplasm we term a germ.[44]

Though this was an address originally given to his scientific colleagues, we can read the force of its theoretical importance in the fact that Huxley selected it for reproduction in his *Lay*

[42] T. H. Huxley, "Geological Reform" (1869) in *Lay Sermons,* 237-238.
[43] Huxley, "Geological Reform," 238.
[44] Huxley, "Geological Reform," 243.

Sermons. Its original context affirms the seriousness of his demonstration. But its selection and reproduction along with a host of other manifesto-esque public pieces tells us something of the way Huxley strove to frame natural science for the public mind. We might take this "stupendous analogy," which recalls the "community of matter" of the previous chapter and which, once again, actualizes the "non-living world," as a stupendous analogy for Huxley's public project more generally. Huxley's fundamental grounding in physiology as an analogic referent opens a window on his naturalistic iteration of the uniformity of nature in terms of that multifarious, generative term "sympathy" that physiology evokes. Attention to unity and uniformity in Huxley's philosophy is in itself nothing new. We saw in an earlier chapter how this thesis crystallized in the aptly-named "On the Physical Basis of Life" (1868), Huxley's rhapsody on protoplasm. There, we had a preview of how one might use the shared component of the physiological body to facilitate a sense of unity or community within and between a lecture audience and physical nature. But Huxley's protoplasmic vision was in fact even more intricate than it seemed in that transformative lecture that rendered "all living powers…cognate" by their shared materials.[45] This section explores how physiology and physiological analogy were more than just opportune metaphors, but the basis of a comprehensive philosophy of unity in engaging and being engaged with nature.

An early and enduring interest in physiology places Huxley within a broader Victorian discourse on the human organism, and on a number of questions regarding the nexus of psychology and physiology and the material origins of mind which preoccupied many of his colleagues and fellow naturalists.[46] This section leaves those questions aside in the spirit of

[45] T. H. Huxley, "On the Physical Basis of Life" (1868) in *Lay Sermons,* 129.

[46] Huxley's long-time friends and associates Herbert Spencer, George Henry Lewes, and Leslie Stephen were prominent interlocutors on this subject, and Nicholas Dames locates Lewes, who with his partner George Eliot were long close intimates of Huxley's, as a prime example of an intellectual formation of the

Huxley's agnosticism towards such irresolvable metaphysics, to focus instead on how he uses the language of physiology— or rather, a collapsed version of physiology that also contains morphology—as specifically a rhetorical tool.[47] Refining the long-held premise that the "young Turks" of science like Huxley sought to create a view of culture from an evolutionary point of view, I attend to the specific ways in which physiology and the metaphors it provided operate as the primary term of that paradigm, implying or logically preceding a unifying evolutionary vista even where direct discussion of evolution is not present.[48] In Huxley's broad and deep public discourse, and with particular weight in the *Lay Sermons,* physiology and physiological analogy

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mid-Victorian era which comprised influential critics whose criticism (both amateur scientific and literary) was informed by the most advanced psychological researches of the day (physiology) and which sought a material or organic basis of mind (8-9). Huxley was certainly aware of the discussions about the physiological origins of consciousness, particularly in his later career, and was no stranger to metaphysical debate). Such papers don't form the bulk of his "popular" corpus and certainly not his lecturing or educational material— fitting, considering that metaphysics, however skilled Huxley was at them, ran antithetical to his fundamental philosophy of advocating learning from observation and of teaching, as much as possible, grounded in directly or indirectly observable phenomena. I address Huxley's accepting agnosticism on metaphysical subjects in the conclusion of this chapter. For the place of physiology in 19th century British psychology, see Edwin Boring, *A History of Experimental Psychology* (New York: Appleton-Century-Crofts, 1957).

[47] Huxley explains in his lay sermon on "The Origin of Species" that "that part of biological science which deals with form and structure is called Morphology— that which concerns itself with function, Physiology…" (258); While Huxley doesn't use the word "physiology" to connote pure morphological issues, we see in this chapter that he frequently employs "physiology" as a shorthand for all morphological and anatomical meditations. This inclination likely reflects the broader state of English physiology for most of Huxley's education and a great deal of his public activity. In comparison to France and Germany, whose physiological researches followed an experimental model and treated it as an abstract science, English physiology was characterized (or burdened by) an anatomical bias until well into the 1870s (see Geison, *Michael Foster,* 26-27.) Regardless, the distinction is largely immaterial to this study, as Huxley's meditations on form and function are conceptually related and support the same goal.

[48] Huxley's championing of an evolutionary paradigm is so much of a historical truism that one hardly requires an authoritative source on the matter. For sources besides Adrian Desmond's thoroughly comprehensive biography, see Paul White, *Thomas Huxley: Making the Man of Science* (Cambridge: Cambridge University Press, 2003); Bernard Lightman, "Introduction" *Victorian Science in Context* (Chicago: University of Chicago Press, 1997), 3; Cyril Bibby, *T. H Huxley: Scientist, Humanist, and Educator* (London: Watts, 1959); Leonard Huxley, *Life and Letters of Thomas Henry Huxley,* 3 vols. (New York: D. Appleton and Co., 1900).

suffuse an impersonal cosmic uniformity with a Neo-platonic aura of sympathetic implication, a constant reminder of his Victorian readership's constant, and rigidly non-negotiable, entanglement with the universe.[49]

If Matthew Arnold found Charles Darwin to be a "born naturalist," Thomas Henry Huxley was a born physiologist. "The only part of my professional course which really and deeply interested me," Huxley wrote in reflection on the medical training of his early years, "was physiology, which is the mechanical engineering of living things."[50] While natural science was to be his "proper business," he sympathized with the engineer as much as with naturalists like his friend Darwin, for "what [he] cared for was the architectural and engineering part of the business, the working out of the wonderful unity of plan in the thousands and thousands of diverse living constructions, and the modifications of similar apparatuses to serve diverse ends." Physiology served his ends of uncovering and communicating that "wonderful unity of plan" nicely. As a young ship's surgeon on the HMS *Rattlesnake* off the coast of Australia, Huxley spent his most enthusiastic hours (save those in which he courted his eventual wife, Henrietta Heathorn) leaned over a microscope in his cramped cabin, parsing the physiological entanglements of the *Medusae* jellyfish; as a lecturer and educator in the heart of South Kensington he led students on a "weekly haul through the animal and plant kingdoms, starting with mould and ending with monkey brains," uncovering, deconstructing, and reconstructing the

[49] The utility of physiology as an organizing rhetorical principle, for Huxley, runs usefully adjacent to a trend in Victorian novel theory to import physiological concepts into novel reading for conceptualizing the novel "form" whose structure was temporal and whose process evoked bodily response: Dames, *Physiology of the Novel,* 11.

[50] T. H. Huxley, "Autobiography" (undated, probably 1890-1894) in *Collected Essays* (New York: D. Appleton and Co., 1894), 1:7; Medicine was the only avenue of science open to a young Huxley of modest means. Both of his sisters' husbands were physicians, and his brother Jim also followed a medical course: Desmond, *Huxley,* 9.

organic form in pursuit of unities.[51] Scientific prophets like Faraday might have had shining candles and glorious fire balloons; Tyndall his sympathetic singing flames; Ball and Proctor their shining stars and glorious sustaining suns; but Huxley had bodies, and these had a certain easy practical utility in connecting to the public imagination. If the ultimate education, in Huxley's view, was an experiential model, the body was the ultimate classroom: a portable, personalized laboratory that was always on hand, for

> The subject of study is always at hand, in one's self. The principal constituents of the skeleton, and the changes of form of contracting muscles may be felt through one's own skin…. while the wonderful phenomena of sensation afford an endless field for curious and interesting self-study. The prick of a needle will yield, in a drop of one's own blood, material for microscopic observation of phenomena which lie at the foundation of all biological conceptions.[52]

Huxley makes the simplest of connective moves here with an appeal to the audience's material presence, for as a targeted subject of study the human body naturally provided the most easily imaginable of entry-points into scientific inquiry. As an object the body was, of course, ready-made for sympathetic engagement along the lines Adam Smith and David Hume had laid down a century before. But for Huxley the direct capitalization upon the human form and its ready intimacy was only the most superficial (though effective) move in a far more complicated

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[51] Huxley's first publication in the Royal Society's *Transactions* was a piece "On the Anatomy and the Affinities of the Family Medusae" (1849) a piece composed during his tenure on the *Rattlesnake,* where he spent long hours in a cramped ship's cabin collecting and dissecting jellyfish. This early morphological project marked a pattern of lifelong attention to structure and affinity in his scientific and in his publicizing work; Desmond, *Huxley,* 453. The Royal School of Mines is now subsidiary to Imperial College in South Kensington, where the Huxley archive is housed: Desmond, *Huxley,* 418.

[52] T. H. Huxley, "On Elementary Instruction in Physiology" (1877) in *Collected Essays* (New York: D. Appleton and Co., 1897), 3:297-298. Huxley's privileging of the body has an appropriate double-relevance considering his empirical commitment to observable physical phenomena—*physis* being the Greek word for "body."

network by which to engineer affinity. This network depended on physiology, not simply for the familiarity of the felt "skeleton," "contracting muscles," and pulse of the blood, or for the practical utility of medical knowledge.[53] Rather, it essentialized physiology for the literal and conceptual structures and interconnections that the language of physiology summoned to the mind. Just as "one's self" became depersonalized into a proving ground for "biological conceptions," no organism under Huxley's examination was ever *just* an organism for very long. As we saw in "On the Physical Basis of Life," this physiologically modeled system, the vital body, whether human or otherwise, was always a miniaturized network of affinity. In "The Connection of the Biological Sciences with Medicine" (1881) Huxley would urge readers and students to consider the

> conception of the life of one of the higher animals as the summation of the lives of a cell aggregate, brought into harmonious action by a co-ordinative machinery formed by some of these cells[54]

Huxley stressed that this idea of harmonious action "constitutes a permanent acquisition of physiological science," which was to say a fixed truth, a primitive term essential to the intelligibility of life. "The Physical Basis of Life" took the harmonious action of vital bodies as its direct subject, but even the most straightforward of Huxley's anatomical lectures rarely aimed at the mere description of anatomy.[55] Rather, as we saw with "Elementary Physiology" above,

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[53] Medical knowledge and, by extension, medical education were nevertheless a perennial subject of discourse for Huxley which formed another vital anchor point between abstract physiological knowledge and the social body. See various commentaries including "On Medical Education" (1870) *Critiques and Addresses* (London: Macmillan, 1882); "The State and the Medical Profession," *Nineteenth Century* 15 (1884) 228-38; a letter on medical education to *Nature* 42 (August 7, 1890): 352-353.

[54] T. H. Huxley, "The Connection of the Biological Sciences with Medicine" (1881) in *Collected Essays*, 3:370.

[55] His textbooks, however, did. Used for a different purpose, Huxley's textbooks are spare efficient prose, free from editorializing.

such lectures proceeded from anatomy as a foothold of familiarity, an object lesson from which to contemplate the grand abstraction of a thoroughly interconnected Nature. Huxley would verbally dissect the layers of a horse, or a crayfish, peeling away their geographical provenance and etymological origins layer by layer before starting systematically into each body system, only to emerge with armfuls of raw materials—legs, eyes, carapaces, and cartilage—from which to build a wonderful organic totality.[56] Lectures at the Hunterian Museum on the elements of comparative anatomy give a sense of typical subject and typical refrain. Having used his dissective approach to dismiss the notion of animal life's discrete, independent appearance, Huxley rejoins that

> no such mutual independence of animal forms exists in nature. On the contrary, the different members of the animal kingdom, from the highest to the lowest, are marvelously interconnected. Every animal has a something in common with all its fellows: much, with many of them; more, with a few; and, usually, so much with several that it differs but little from them.[57]

Huxley calls attention to the continuity of analogous and homologous structures, presenting the still-sensational idea of evolutionary unity in the animal kingdom as a matter of fact, each injection of "interconnected," "common," and "fellows" reinforcing the "mutual

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[56] Huxley does this in "A Lobster, or on the Study of Zoology" (1861) in *Lay Sermons,* 94-119 and in his Royal Institution lecture "On the Pedigree of the Horse" [summary] *Proceedings of the Royal Institution of London* 6 (1870): 129.

[57] The independent existence of all forms of animal life, rather than an evolutionary or mutative lineage, was a principle held most notably by Cuvier, who in his fossil researches maintained that he saw no evidence that any animal form had or was capable of transforming into another: see Georges, Barón Cuvier and Robert Jameson. *Essay On the Theory of the Earth*. 3th ed., with additions. ed. Printed for William Blackwood [etc.], 1817. See also Martin J. Rudwick, *Georges Cuvier, fossil bones, and geological catastrophes: new translations & interpretations of the primary texts* (Chicago: University of Chicago Press, 1998); T. H. Huxley, "On the Classification of Animals, Lecture I," in *Lectures on the Elements of Comparative Anatomy* (London: John Churchill and sons, 1864), 3.

connection." In addition to its ideological example, this passage is also an excellent instance of an indirect brand of persuasion from a writer capable of scorching polemic. While Huxley was famous for his ruthless direct argumentation, his publicizing and pedagogical efforts mark a great talent for what oratory training calls "suggestion," to such an extent that his work continued to be held up as a pedagogical example of suggestive acumen throughout the 20th century.[58] "[Suggestion,]" explains Donald Cross Bryant, "is the process in which a stimulus or idea works in the *margin* of attention and perception and provokes a response— the acceptance of an idea or action."[59] In this passage, Huxley makes no explicit argument to compel his listeners to believe or to feel. But he renders the interconnection at hand "marvelous," his lone subjective adjective telegraphing sincerity and a personal conviction in *his* response to organic contemplation. In so doing, he suggests that to take such a position is to bear witness to marvels— and that the system of understanding by which one might arrive at such a feeling is marvelous as well.[60]

Many of Huxley's other educational lectures center similarly on physiological subjects, as a way of meditating upon a broader "unity of plan" in nature—a plan which, unlike natural theology's irrational teleology, was not "merely a fancy" but the "expression of deep-seated

[58] Donald Cross Bryant, *Fundamentals of public speaking (*New York: Appleton-Century, 1947), 465. Unsurprisingly, Huxley was also held up as an example of "clarity" in argumentation; Huxley's contemporaries in the 19th century likewise recognized the suggestive power of his renderings, and the way he rhetorically brought the "dry matter" of science alive for the imagination. Arabella Buckley, "The Fairy Land of Science, Lecture I: How to Enter It; How to Use it; And How to Enjoy it," in *The fairy-land of science* (London: Edward Stanford, 1880) refers to his Manchester Lecture "On Coral and Coral Reefs," the suggestive power of which turned calciferous coral polyps into a castle fit for her "fairy-land of science" (21-23).

[59] Bryant, *Public Speaking,* 465.

[60] Bryant notes in *Public Speaking* that suggestion also can rely on the authority or trustworthiness of the speaker, a continuation of the authoritative argument *ad verecundiam* we saw in chapter 2 (467); Of the effect of Huxley's oratory, at least partially influenced by this rhetorical brand of suggestion, his former student T. Jeffrey Parker wrote in "Professor Huxley: From the Point of View of a Disciple" *Natural Science: A Monthly Review of Scientific Progress* 8 (1896): "As one listened to him one felt that comparative anatomy was indeed worthy of the devotion of a life, and that to solve a morphological problem was as fine a thing as to win a battle" (162).

natural facts."[61] We see him repeatedly recur to the organism and the gradient structural unities of its diverse manifestations in many of his most famous orations: "On the Physical Basis of Life," "A Lobster, or The Study of Zoology," and the energizing, inflammatory "Man's Place in Nature."[62] Such orations, as it happens, share a structural anatomy as well as an thematic one, for the procession from the particularity of the organism to the generality of the organic world to a finish in an artful cosmic éclat is a hallmark of Huxley's prose.[63] In fact, and as its title may suggest, "On the Physical Basis of Life" is perhaps the best and clearest example of Huxley's vision of physiological unity in a single piece, miniaturizing a physiological philosophy to the same degree that "A Liberal Education" can be said to miniaturize a natural educational one. The lecture blossoms from the "infinitesimal ovoid particle" to connect "the great Finner whale, hugest of beasts that live, or have lived, disporting…with easy roll, among the waves" or to scale "the Indian fig, which…endures while nations and empires come and go around its vast circumference," cresting up the "catholicity of assimilation" in the bodies of organic world that

[61] For how Huxley and the other scientific naturalists deconstructed the logic of a "unity" based on the preferential caprice of a deity, see Stanley in *Huxley's Church*, especially chapter 7, "How the Naturalists "Won"."

[62] In *Lay Sermons* alone, the following center significantly or entirely around physiology and organic structure: "On the Advisableness of Improving Natural Knowledge" (1866), "On the Educational Value of the Natural History Sciences" (1854), "On the Study of Zoology" (1861), "On the Physical Basis of Life" (1868), "Geological Contemporaneity and Persistent Types of Life" (1862), and "Spontaneous Generation" (1870); Charles S. Blinderman, "T. H. Huxley's Theory of Aesthetics: Unity in Diversity," The *Journal of Aesthetics and Art Criticism* 21, no. 1 (1962) argues that it is in his essay on the lobster that Huxley "penned his most thorough exposition of his theory of aesthetics" (52-53).

[63] James Paradis notes in *T. H. Huxley* that the degree of metaphysical abstraction in Huxley's legible explorations often failed to be fully comprehended, writing of "On the Physical Basis of Life" that "what many failed to understand was that Huxley's exploration of the hidden organization of living protoplasm was moving into a highly abstract realm of thought. Huxley was in search of the principle that would connect the animal with the inanimate," (90). This was no small thing. My contention is that sympathy, as a term which moves between the physical and metaphysical, is a useful concept for envisioning Huxley's complicated totality; For more general analysis of the hallmarks of Huxley's rhetoric, see Walter E. Houghton's seminal "The Rhetoric of T. H. Huxley," *University of Toronto Quarterly* 18, no. 2 (January 1949): 159-175 and Ed Block Jr.'s "T. H. Huxley's Rhetoric and the Popularization of Scientific Ideas: 1854-1874," *Victorian Studies* 29, no. 3 (1986): 363-386.

doubly confirms their harmonies, before settling at last to meditate upon the metaphysical pale at which matter meets the mind.[64] Huxley himself summarizes "On a Piece of Chalk" (1868) in what could well be his discursive slogan: "A small beginning has led us to a great ending."[65]

Separately and together, orations like "Physical Basis" spin these vivid, imagistic webs of connection, which run from the "germ" or the egg through morphological variations which harmonize the skeleton in fishes, in lobsters, in horses, in apes and in humans.[66] "These are wonderful truths," he writes of the common development of the leg and jaw of the lobster,

> the more so because the zoologist finds them to be of universal application. The investigation of a polyp, of a snail, of a fish, or a horse, or of a man, would have led us, though by a less easy path, perhaps, to the exact same point. Unity of plan everywhere lies hidden under the mask of diversity of structure—the complex is everywhere evolved out of the simple.[67]

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[64] Huxley, "Physical Basis," 121. This kind of blossoming crescendo and its focus on the transmutation of living matter is of a piece with the ascent of scale seen in what was by the mid-century the popular genre of the "evolutionary epic," what Bernard Lightman describes in *Victorian Popularizers* as the "monad-to-human style cosmic evolutionary narrative" (221) though Huxley's engagement with the form, like Spencer's and Darwin's, tended to be more technically accurate and less narratively anthropomorphic than many popularizer versions. See Ian Hasketh, "The Evolutionary Epic," *Victorian Review* 41, no. 2 (2015): 36.

[65] T. H. Huxley, "On a Piece of Chalk" (1868) in *Lay Sermons,* 201. "A Piece of Chalk" serves as perhaps the other exemplar of Huxley's object lesson-centered style. A review of "Huxley's Lay Sermons" in *Nature* 3 (November 10, 1870) remarked that "those who do know it, for the most part recognize it as a model both in matter and in manner of what a single lecture ought to be; those who do not had better read it at once, for till they have done so they will have but an imperfect idea of such a model" (22-23).

[66] Huxley, "The Rede Lecture," (1883), "Lectures on the Elements of Physiology XII" (1864) and "On the Study of Biology" (1876); Huxley was also an excellent draughtsman, and in "Professor Huxley" Parker writes that often he would sketch creatures on the blackboard and, "to show the relations of two animal types, he would, by a few rapid strokes and smudges, evolves the one into the other before our eyes," (162).

[67] Huxley, "Study of Zoology," 206. We hear an echo of Goethe in the "unity in diversity" of this passage.

In Huxley's view, physiology was not only the science which revealed that all bodies were linked, but the science through which all scientific disciplines were unified. The sentiment that physiology "lies at the foundation of all biological conceptions" is echoed in the preface of Huxley's highly popular and widely used textbook, *A Course of Practical Instruction on Elementary Biology*. "Very soon after I began to teach Natural History, or what we now call biology," he writes,

> I arrived at the conviction that the study of living bodies is really one discipline, which is divided into Zoology and Botany simply as a matter of convenience….Moreover, it was obvious that the road to a sound and thorough knowledge of Zoology and Botany lay through Morphology and Physiology.[68]

Morphology and physiology were not only the watershed of the life sciences, but the best passage to the inorganic sciences, for as Huxley reminded eager lecture-goers, "the Matter constituting the living world is identical with that which forms the inorganic world."[69] He brought the physiological good word made visible in the laboratory and through the microscope to bear on the entire frame of science. The body's component part, the cell, which in its protoplasmic aggregate makes up all the bones, all the tissues, of the "co-ordinative machinery" of organic life, "is composed of the chemical elements carbon, hydrogen, oxygen, and nitrogen"[70] sharing the same the component parts of the physical sciences of chemistry, geology, astronomy, beholden in their turn to the great laws of physics.[71] He will even use a quite telling

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[68] T. H. Huxley, *A Course of Practical Instruction on Elementary Biology* (London: Macmillan and Co., 1877), v.

[69] T. H. Huxley, "Six Lectures to Working Men On Our Knowledge of the Causes of the Phenomena of Organic Nature" (1863) in *Collected Essays*, 2:316.

[70] Huxley, "Phenomena of Organic Nature," 309.

[71] In "On the Physical Basis of Life" Huxley will reaffirm the chemical integrity of the physiological being. As living forms are cognate on the level of the protoplasm, "[the] researches of the chemistry have

analogy in a discourse on the study of the human nerves, correlating the forces which function alike within organic and inorganic matter. "We have reason to believe," he writes, "in the existence of a nervous force, which is as much the property of nerve as magnetism is of certain ores of iron."[72] This aside is at once an ode to physiology and a subtle nod to the sympathetic theory which preceded his age, in which the magnet and the lodestone were a common example of sympathetic action.[73]

But physiology's kingdom did not end in unifying the realm of the physical sciences. "[Y]ou should not be surprised," Huxley wrote jovially in a lecture "On the Study of Biology" (1876), "if it occasionally happens that you see a biologist apparently trespassing in the region of philosophy or politics; or meddling with human education; because, after all, that is a part of his kingdom which he has only voluntarily forsaken."[74] Because the subject of physiology, the organism, included humans and the social animals, the field's inquiries, laws, and implications by right extended into *all* the provinces of human life. In order to move seamlessly from the abstractions of astronomy and physics and chemistry to the "region of philosophy or politics" or, what he would call in "Science and Culture" (1880) the "phenomena of society," the scientific seeker must pass through the sympathetic sinews of the human frame.[75] Thus "connected by innumerable ties with abstract science," Huxley writes in another lay sermon, "Physiology is yet

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revealed no less striking uniformity in living matter" (142) reiterating the shared "carbon, hydrogen, oxygen, and nitrogen" that comprise the basic elements of protoplasm" (151).

[72] T. H. Huxley, "On the Present State of Knowledge as to the Structure and Functions of Nerve" (1854) in *Scientific Memoirs,* 1:315-320.

[73] See Holmes, "Reflection: Galen's Sympathy," 64. On the magnet and its attractions in antiquity see Richard Wallace, "Amaze Your Friends!: Lucretius on Magnets," *Greece and Rome* 42, no. 2 (Oct 1996):178-187.

[74] T. H. Huxley, "On the Study of Biology" (1876) in *Collected Essays,* 3:271.

[75] T. H. Huxley, "Science and Culture" (1880) in *Collected Essays,* 3:158.

in the most intimate relation with humanity."[76] Medicine, of course, provided another obvious physiologically inflected channel through to social concerns, particularly those of public health. What else but the lack of it caused mothers "to persist in exposing the largest possible amount of surface of their children to the cold, by the absurd style of dress they adopt, and then marvel at the peculiar dispensation of Providence, which removes their infants by bronchitis and gastric fever?"[77] But Huxley's harmonic concern transcended the practical use of physiology ("the *practical value* of Physiological knowledge!") into a unified philosophy that ran from the abstract to the social. Witness his famous counterpoint to Matthew Arnold, where Huxley claims that the social body is beholden to and an extension of the same physical laws which govern the physiological bodies that comprise it. "Social phenomena," he writes, "are as much the expression of natural laws as any others…[and] no social arrangements can be permanent unless they harmonize with the requirements of social statics and dynamics."[78] Coming full circle, theoretical sympathy collapses into social sympathy, but always moving across the anatomical medium.[79]

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[76] Huxley, "Educational Value," 88.

[77] Huxley, "Educational Value," 89. The improvement of public health as a practical value of physiological knowledge is a subject that regularly takes up in his various physiological and medical addresses, with particular reference to the improvements wrought by germ theory— among the *Lay Sermons* alone we see this example in "Educational Value," "On the Advisableness of Improving Natural Knowledge," and "Spontaneous Generation" (1870) where he refers to the "strong evidence that some diseases of an extremely malignant and fatal character….[are] the work of minute organisms" and the "striking facts adduced by Professor Lister in his various well-known publications on the antiseptic method of treatment," asking: "How can we over-estimate the value of that knowledge of the nature of epidemic and epizoonotic diseases, and consequently the means of checking or eradicating them, the dawn of which has assuredly commenced?" (376-377).

[78] Huxley, "Science and Culture," 158.

[79] That Huxley claims the social and cultural realm for physiology on the grounds that it is literally made up of bodies also recalls the metaphor of the social realm "as" a body, which summons its own affective entanglements. Mary Poovey, *Making a Social Body: British Cultural Formation 1830-1864* (Chicago: University of Chicago Press, 1995) for example, observes that the conception of society *as* a body in the mid-Victorian era authorized those who were not associated with either the Church or professional

Anatomizing the sentence: Physiology as a body of rhetoric

While separately Huxley's physiological interest, and his insistence on a naturalistic uniformity in the universe, particularly among organic life, have been well-studied, the deployment of that interest as a rhetorical strategy— a trope for familiarization and engagement of the popular sympathies, and a facilitator of conceptual unity with a distinctly sympathetic implication— has escaped sustained examination.[80] We've seen how physiology offers a conceptual organization to Huxley's writing in structuring relationships to and within scientific knowledge. The paradigm provides a basket of convenient reference material, as when he requires a particular example to crystallize a claim about his culture's critical need for science. In his early lay sermon "On the Advisableness of Improving Natural Knowledge" (1866) an address broadly advocating the practical and philosophical advantages of an education grounded in natural science, Huxley's first recourse for an illustrative example is to physiology: an introductory anecdote about the 1660s plague which, through the physiological meditations of the newly-formed Royal Society, "is kept from our city…[by] the improvement of our natural knowledge."[81] Elsewhere for examples of the systems of knowledge that have "embraced such infinite varieties of being, [and] have laid open such new worlds in time and space," Huxley

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medicine to feel greater involvement in caring for that body (15-16). This dynamic certainly circulates in Huxley's theorization.

[80] Again, this is only a specific subset of Huxley rhetoric that I find to be under-examined— Huxley as a rhetorician has been a study since before his death.

[81] As a former medical man and a frequent speaker on the subject of medical education, Huxley of course never failed to stress the most immediate practical implications of a physiology education: improved health and medical care. Huxley's medical commitment and involvement is the subject of a different kind of study. I have passed over examination of it here because, for one, the material that treats it is extensive, but more importantly, Huxley was ideologically opposed to "mere" practical incentivizing of natural knowledge, and his publicizing work labors hard to stress the grander metaphysical and sympathetic potential of natural knowledge (physiology included).

turns first not to natural history, but to the "Physick" and "Anatomy" of Vesalius and Harvey, natural knowledges grown out of the system which we carry with us and which connects us to each other.[82]

Even Huxley's lifelong loyalty to Goethe seemed to draw from the poet's power as, among other things, a physiological referent. Across the years and across the disciplines, Huxley calls upon Goethe's influence to signal something fundamental about the spirit in which he held the pursuits of science, as he does in "Science and Church Policy" (1864) when the poet's words come to the defense of "the uniformly beneficent and ennobling working of scientific thought" against detractors unsure of its [propriety] or in fear of "diabolic agency." "The philosophy of the present day," he writes,

> is neither scoffing, nor presumptuous, nor destructive. Since the world began, there never has been so deep a reverence for truth, so keen a sense of the fallibility and limitation of the intellect of man, so earnest a desire to build up some theory of this wonderful universe that cannot be shaken by the questioning of a child, so profound a yearning
>
> "Im Gutes, Ganzen, Wahren, resolut zu leben,"
>
> as among the scientific workers of this age and generation.[83]

First building his own tower of wondrous praise for the intentions of scientific men— reverent, humble, earnest— Huxley summons Goethe for an exalted flourish. Prosaic scientific workers are transformed into ecstatic Romantic supplicants desiring in the "good, whole, and true, to resolutely live." Through the resonance of Goethe's prophetic voice, the labor of science

[82] T. H. Huxley, "On the Advisableness of Improving Natural Knowledge," 5. Huxley is also quick to call other physiologists to the forefront as exemplars of experimental science— Harvey frequently, but also, in "Educational Value," the more nearly contemporary Charles Bell and Claude Bernard (81).
[83] T. H. Huxley, "Science and 'Church Policy'." *The Reader* 4 (December 31, 1864): 821.

is colorized as both a type of intellectual heroism, and an aesthetic, spiritual vocation.[84] We saw Huxley make a similar move in an earlier chapter. But where in *Nature* Goethe enchanted simply by the fact of his Romantic presence in a professedly empirical periodical, in Huxley's personal corpus the poet's force was shaped by Huxley's regard for him as a physiological inquirer. Goethe clearly mattered to Huxley as an early, if imperfect, morphologist and orderer of Nature. "Goethe," Huxley would write in one of his "Lectures on Elementary Physiology" (1864), "had been led to drink deeply of the spirit of morphology."[85] He pointedly enumerated the German poet and his "fervid creative genius" among more conventional early investigators of anatomical science.[86] In an 1894 gloss of the history of the anatomical sciences, Huxley devoted as much time to Goethe as to Cuvier or Buffon, defending the poet's "artistic way of looking at things" as an approach to morphological science that "might tend to revivify the somewhat mummified body of technical zoology and botany." But it was Goethe's philosophy, equitably applied to poetry or to science, which for all his actual scientific failings clearly made him most mighty for Huxley.[87] "[I]n the last two decades of the eighteenth century," Huxley continues,

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[84] Interestingly, Huxley misquotes the original German of 'Generalbeichte,' which reads "Schoenen" instead of "Wahren." Stefano Evangelista, "'Life in the Whole': Goethe and English Aestheticism," *Publications of the English Goethe Society* 82, no. 3 (2013) notes that Walter Pater will make this same misquotation, which appears to originate in Carlyle. He writes: "It is probably because of this epigrammatic usage in a widely reprinted and widely read essay that Carlyle's substitution of truth for beauty— a veritable Freudian slip revealing the extent of Carlyle's ambivalence towards this notion— came to be frequently repeated later in the century" (188). In this situation, the misquotation doesn't undermine Huxley's point, and in a certain way, is a germane reflection of the particular collapse of "Truth" and "Beauty" that we see in the affective scientific discourses pursued in this project.

[85] Huxley, "Vertebrate Skull," 279-280.

[86] Huxley, "Vertebrate Skull," 280.

[87] In a lay sermon on "Spontaneous Generation" (1870) in *Lay Sermons* first delivered to the BAAS and reproduced in *Nature,* Huxley tellingly relates Goethe to Lucretius, another sympathetic unifier of Nature, when he writes, "Lucretius, who had drunk deeper of the scientific spirit than any poet of ancient or modern times except Goethe, intends to speak as a philosopher, rather than a poet, when he writes that 'with good reason the earth has gotten the name of mother, since all things are produced out of the earth.

> Goethe arrived, by a generally just, though by no means critical, process of induction, at the leading theses of what were subsequently known as *Naturphilosophie* in Germany, and as *Philosophie anatomique* in France; in other words, that he was the first person to enunciate and conceive as parts of a systematic whole, whatever principles of value are to be met with in the works of Oken, Geoffroy, and Lamarck.[88]

The perfume of Goethe's supernaturalizing Romanticism might infuse Huxley's agnostic rationality with diffuse affect, as it did in inaugurating *Nature* magazine. But it equally drew its power from Goethe's *Naturphilosophie* and the principle of unity in diversity which, scattered across the Huxley corpus in space and time, recapitulated a Goethian conviction that all fragments of nature and natural knowledge were "parts of a systematic whole." As such, Huxley's deployment of Goethe on virtually any scientific occasion evoked an echo of a physiologically inflected natural unity. Huxley's nuanced debt to Goethe is a subject worthy of its own investigation. For the purposes of this chapter, however, Huxley's general theoretical and linguistic affinity for the German poet stands as one of a constellation of influences which mark a correlation of physiology, unity, and sympathy across Huxley's "bodies" of writing both popular and scientific.

Huxley's reliance on Goethe worked physiology at a metaphysical remove, but the science he shared with Goethe also provided a foundation of more primitive terms in Huxley's discourses. Physiological or anatomical language frequently formed the basis of subtle analogic relationships, ones that often have little inherently to do with the subject of physiology or the work of physiologists, but are called into its orbit through the deployment of a certain lexicon.

And the living creatures, even now, spring out of the earth, taking form by the rains and the heat of the sun.'" (346).

[88] T. H. Huxley, "Owen's Position in the History of Anatomical Science," *Scientific Memoirs,* 4:658-659. Originally published in Rev. Richard Owen's *The Life of Richard Owen* (London 1894).

We've seen already in Huxley's address on "Geological Reform" how physiological example or reference might inflect even discourse that does not purport to tackle anatomy directly. Two more of Huxley's "lay sermons" fortify this pattern, showing how small linguistic choices tacitly centralize physiology while, more importantly, using that science to support a more flexible sense of emotional and physical sympathy among systems and living things.

This priming occurs at the level of the seemingly simplest of choices in Huxley's lay sermon on "Scientific Education: Notes on an After-Dinner Speech" (1869).[89] Addressing a favorite topic, "the introduction of scientific training into the general education of the country," Huxley commends those "great Universities" which are now beginning to honor cultivators of the physical sciences and to put the "facts and principles of physical science before the undergraduate mind." With ample descriptive referents at his disposal, Huxley tellingly selects a descriptor most sympathetic to his content:

> And I say it with gratitude and great respect for those eminent persons, that the headmasters of our public schools, Eton, Harrow, Winchester, have addressed themselves to the problem of introducing instruction in physical science among the studies of those great educational bodies, with much honesty of purpose and enlightenment of understanding[90]

Later on in the speech he twice uses the same anatomical referent, "bodies," as he interrogates the clergy's general antagonism to the teaching of science:

> I ask, Why do not the clergy as a body acquire, as a part of their preliminary education, some such tincture of physical science as will put them in a position to understand the

[89] First delivered as an address before the Liverpool Philomathic Society in April 1869, and subsequently republished in *Macmillan's Magazine*, and later in *Lay Sermons.*
[90] Huxley, "Scientific Education," 55.

> difficulties in the way of accepting their theories, which are forced upon the mind of every thoughtful and intelligent man, who has taken the trouble to instruct himself in the elements of natural knowledge?[91]

Taken alone, this rhetorical choice might have little weight. Huxley also describes organized bodies (if I may use the word to leverage my point) as "institutions," "professions," "organizations" and so on— though organizations, too, resonates anatomically. Yet these potentially inconsequential "bodies" are mobilized into significance when they accompany a more generally physiological bent, in the same way that the celestial "bodies" in the "Geological Address" become anatomized through their physiological proximity. In the passage above, "tincture" takes on a physiological cadence, its proximity to "physical science" activating the word's definition as a pharmacological solution.[92] Likewise in the broader piece, Huxley's chief example of the necessity of a scientific education is enacted through a running commentary not on physical science, per se, but on the medicine that was his special attention as student and examiner. He concerns himself with the skills of that "practitioner [who] is able to make out what is wrong in our bodily frames," and the serious deficit of practical scientific education the medical student faced in his current preparation for his chosen profession. This educational failing (all too apparent in the years before medical educational reform) happens to support a

[91] Huxley, "Scientific Education," 60.

[92] The Oxford English Dictionary offers among its definitions of "tincture" the following selections: "tincture n. **†4.** *fig.* An imparted quality likened to a colour or dye; a specious or 'colourable' appearance; a quality or character with which anything is imbued, esp. a derived quality; a tinge. *Obsolete*.;5**b.** A slight infusion (*of* some element or quality; a tinge, a shade, a flavour, a trace; a smattering (*of* knowledge, etc.).;7†**a.** In early chemistry, and in derived uses: The (supposed) essential principle of any substance obtained in solution. Also, the extraction of this essential principle. *Obsolete*.;7**b.** *Mod. Pharmacy*. A solution, usually in a menstruum of alcohol, of some principle used in medicine, chiefly vegetable, as tincture of opium (laudanum), but sometimes animal, as tincture of cantharides, or mineral, as tincture of ferric chloride." All three seem to be at play here. The term also of course has an alchemical resonance, which bears an interesting if arbitrary connection to my earlier discussion of sympathetic magics. "tincture," Oxford English Dictionary Online. Accessed September 28, 2018.

handy rhetorical point. Nothing so conveniently proves Huxley's argument as the image of the man of science most recognizable to the lay person, the physician, being "devoid of all apprehension of scientific conceptions" and having "no notion of what it is to come into contact with nature."[93] But in preferring the medical student as one of many types of persons who have failed to "learn how to learn" for lack of science, Huxley implicitly centers his oration on the matter or idea of "bodies" as much as he does on the matter of educational reform. Across a sustained discussion in which terms like "anatomy," "physiology," "medicine," "obstetrics," "disease," and "surgeon" circulate, Huxley's repeated reference to institutions sympathetic and oppositional as "bodies" brings the formal and topical elements of his speech into a closer order of alignment, tacitly associating seemingly opposed forces— science and the clergy— on a minute linguistic level that recapitulates the content of his argument.

In fact, his second use of the referent "bodies" in discussing the clergy doubles down on the term's anatomical resonance, as he deploys it in the context of rhetorically anatomizing the very clerical body he has just constructed:

> In fact the clergy are at present divisible into three sections: an immense body who are ignorant and speak out; a small proportion who know and are silent; and a minute minority who know and speak according to their knowledge.[94]

Huxley thus dissects the body (and bodies) that presume to resist physical science, laying scientific claim to both the physical and metaphorical aspects of a social "body." The irony here of using the language and processional mode on a "body" that rejects such a mode of knowledge,

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[93] Before the widespread medical reforms in the United Kingdom and in the United States in the 1870s and again in the 1890s, medical students were not required to have any training in the basic sciences in order to enter a course of medical study, and the basic experimental sciences— biology, chemistry, physics, and so on— were not part of the short course of formal medical training. See Ken Ludmerer, *Learning to Heal: The Development of American Medical Education* (New York: Basic Books, 1985).

[94] Huxley, "Scientific Education," 61.

alerts us to another critical dynamic in Huxleyan physiological sympathy: systems can be mutually entangled, and mutually affecting, apart from necessary desire or consent— a critical distinction, we shall see, for ideas of "sympathy" in a Darwinian cosmos.

Physiological analogy shows yet again an early lay sermon already quoted in this chapter, Huxley's "On the Educational Value of the Natural History Sciences" (1854).[95] Though Huxley will note in a prefatory remark to Tyndall that the lecture-cum-essay contains "a view of the nature of the differences between living and not-living bodies out of which I have long since outgrown," the essay itself remains an excellent study in how physiology forms the analogic basis of so many of Huxley's explanatory metaphors.[96] Per Huxley's prefatory note, the essay largely concerns itself with the differences between living and non-living bodies, but also acknowledges the *lack* of differences in the ways both bodies are studied. Part of his aim is to bring biology, or physiology, in line with the rest of the more orderly sciences, despite the obvious difference in its living subject matter. To illustrate this parity of "method," despite the difference in disciplinary "habits," Huxley recurs again to the body, the disciplinary and practical interpreter of all things.[97] "[D]ifferent habits and various special tendencies of two sciences do not imply different methods," he writes:

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[95] This address was originally delivered in St. Martin's Hall— see the table of contents in *Lay Sermons, ix.*

[96] Huxley, "A Prefatory Letter" to *Lay Sermons,* vi.

[97] The body was, of course, the most relatable point of reference for his audience, but it is important to note that the centrality of the physiological body recapitulated, for Huxley, his claim that physiology was the central and most intimate of the sciences. It was not an indication of a theologically inflected sense that the human actually was, literally, the "measure of all things." In exalting the wonderful intricacy of the human form, and praising the marvelous powers of the human mind, Huxley is keen to remind his audience of the simultaneous singularity and insignificance of the human animal— and indeed, of all things. In "On the Relation of Man to the Lower Animals," *Man's Place in Nature* (New York: The Modern Library, 2001) he writes: "It is as if nature herself had foreseen the arrogance of man, and with Roman severity had provided that his intellect, by its very triumphs, should call into prominence the slaves, admonishing the conqueror that he is but dust," (101). See also the opening of the "Prolegomena,"

> The mountaineer and the man of the plains have very different habits of progression, and each would be at a loss in the other's place; but the method of progression, by putting one leg before the other, is the same in each case. Every step of each is a combination of a lift and a push; but the mountaineer lifts more and the lowlander pushes more. And I think the case of two sciences resembles this.[98]

Playing on the etymology of "method" here as a pathway or mode of proceeding, Huxley uses the mechanics of the body (while also happening to evoke a very popular Victorian pastime) as a sympathetic touchstone through which his lay-audience might work from the familiar to the abstract.[99] As before, the analogy begins from the known in the body. Biology is to mathematics as lowland walking is to mountaineering. It is immaterial which science goes with which mechanical action— Huxley's comparison invites his listeners and readers equipped with bodies to think proprioceptively and imagine their own steps— steep steps or steady ones, lifting one's legs and pushing off of the ground. The effect is a kind of double-utility, as Huxley's analogy is imagined in the body at the same time as it is accepted into the mind, the physical method recognizing the abstract. The methodological difference between the sciences is in degree, rather than kind.

"Educational Value" performs another critical linguistic collapse between physiology and sympathy, this time in a more Enlightenment style as the essay moves from connecting the

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where he compares the reign of man to the evolutionary life of the gentian, chiding: "Compared with the long past of the humble plant, all the history of civilized men is but an episode," (2).

[98] Huxley, "Educational Value," 87.

[99] "method n." "classical Latin *methodus* mode of proceeding" Oxford English Dictionary Online. Accessed Sept 28. 2018. Huxley's play on "method" here turns a literal "mode of proceeding" to use in explaining the metaphorical "mode of proceeding." Michael Reidy, Bernard Lightman, and Ruth Barton all note the connection between naturalism and mountaineering during this period. See Reidy's, "Evolutionary Naturalism on High: The Victorians Sequester the Alps," in Dawson and Lightman, *Victorian Scientific Naturalism,* 55-78.

sciences by bodily analogy to an equally palpable order of connection between "sensitive bodies." This move evokes the eighteenth-century merger of physiology (specifically the nervous system), sensibility, and moral sentiment. The study of "natural history" of which physiology was a part connoted the systematic observational knowledge of natural objects, plants, and animals, but particularly—and particularly for Huxley—animals. Such knowledge often came across as clinical or abstractly encyclopedic, as Huxley acknowledges when he later quips that he "[does] not suppose that the dead soul of Peter Bell…would have been a bit roused from its apathy, by the information that the primrose is a Dicotyledonous Exogen, with a monopetalous corolla and central placentation."[100] But beneath the surface of the anatomical knowledge that helped the natural historian to identify the Wordsworthian "primrose by the river's brim," or to taxonomically distinguish the horse from the zebra from the ass, pulsed a connection that transcended pure intellect or pure utility as it worked through to a complex affective combination of ends. To the "use" of natural history— as he ventriloquizes a would-be detractor, "use of knowing all about these miserable animals"—Huxley recruits physiological connection to somehow transform sympathy, feeling it or understanding it, into a desirable practical aim.

> I take it that all will admit that there is a definite Government of this universe— that its pleasures and pains are not scattered at random, but are distributed in accordance with orderly and fixed laws, and that it is only in accordance with all we know of the rest of the world, that there should be an agreement between one portion of the sensitive creation and another in these matters.

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[100] Huxley, "Educational Value," 91. Huxley here refers to Wordsworth's eponymous poem "Peter Bell,"
"A primrose by the river's brim
A yellow primrose was to him
And nothing more." See William Wordsworth, *Peter Bell: A Tale in Verse* (London: Longman, Hurst, Reed, Orme, and Brown, 1819), 19.

Surely then it interests us to know the lot of other animal creatures.

The providential language here evinces a characteristic Huxleyan move that adopts theological or Biblical language as a performative rhetorical posture, of particular utility in the context of a "lay sermon."[101] This passage shows Huxley interconnecting living beings on the basis of an anatomical likeness, a nervous system, which also becomes mutual responsiveness. The parts of "the sensitive creation" agree morphologically, but also physiologically, sensitively, sympathetically. Just as with Huxley's clergy-body analogy, the bodily comparison in "Educational Value" structurally recapitulates the broader ideological implication of his argument, bringing bodies and sciences together rhetorically on the level of the letter and the sentence as Huxley relates them together conceptually on the level of the essay. But while the former analogy kept feeling in the abstract, this one shows that the "secret and wonderful harmony which pervades [all living things]," while always an intricate, unconscious chain of cause and effect, has the potential to act on and through the more conscious feelings. Science thus becomes a function of sympathy.

It is no coincidence that "Educational Value" reaches its affective crescendo precisely when Huxley begins to bring under direct discussion the "ties that bind." The evocation of physiological recognition across the "sensitive creation" leads in the very next paragraph to that "secret and wonderful harmony," and then to the influence of the natural history sciences on our "finer feelings" as the "greatest of all sources of that pleasure which is derivable from beauty."

[101] Huxley was famous for turning Biblical language on its head— even in his early works, Huxley enacted a self-conscious imitation of the language of natural theology to express secular mechanisms. His facility with religious and theological rhetoric is another excellent example of how practitioners used all of the powers at their disposal to make science sympathetic to the Victorian ear and mind. Like the lecture which mimicked the sermon, the faux-theology that naturalism could perform made for a subtler, more seamless transition as ideologies were substituted while language remained the same. See especially Stanley's chapters on "Religious Lives" and "How the Naturalists 'Won'" in *Huxley's Church.*

To pass through the gates of physiology is to enter into a kingdom of rich art and beauty: "Surely our innocent pleasures are not so abundant in this life that we can afford to despise this or any other source of them." And yet his poetical flourish ends with as much abruptness as its amplification was slow. "But I shall be trespassing unwarrantably on your kindness," Huxley inserts, "if I do not proceed at once to my last point— the time at which Physiological Science should first form a part of the Curriculum of Education."[102] This short, isolated sentence that follows his long monologue acts not so much as a course-correction as a securing knot: the affective and practical matters of physiology are intimately entangled, as his coda will confirm.

In closing, Huxley leaves no doubt of his personal conviction that physiology is a kind of epistemological summa theologica, as he arrives back at the consummate, unified physiological cosmos which links the abstract to the somatic and the social body as well:

> Leave out the Physiological sciences from your curriculum, and you launch the student into the world, undisciplined in that science whose subject-matter would best develop his powers of observation; ignorant of facts of the deepest importance for his own and others' welfare; blind to the richest sources of beauty in God's creation; and unprovided with that belief in a living law, and an order manifesting itself in and through endless change and variety, which might serve to check and moderate that phase of despair through which, if he take an earnest interest in social problems, he will assuredly sooner or later pass.[103]

This culmination showcases the subtle and persistent degrees of collapse by which the sympathies of the body merge into the "sympathy" of the feelings. The "living law" of material bodies governs the physical action of the body, which in its thinking mind has the ability to both

[102] Huxley, "Educational Value," 92.
[103] Huxley, "Educational Value," 93.

perceive and respond to "the richest sources of beauty in God's creation" and yet is physically, also a source of that beauty; the study of the physiological body slips into the apprehension of and fellow-feeling for the social body. The referential instability of "sympathy," then, helps us clarify the uniformity of the natural law, laid out in "A Liberal Education," which unifies "things and their forces [with] men and their ways." Not only are the living and non-living like each other, and not only do living things share in a common physiological identity, but through the sympathetic nexus in which body and mind interpenetrate, inert or extinct or non-living matter can induce thought or feeling, which can in turn effect action on the material and social world.[104] The pathways of influence are endless, "a practically infinite chain of natural causes and effects."[105] Casting the unity facilitated by Huxley's physiology as "sympathy" thus allows us a closer approximation of where "sympathy *for* science" meets "sympathy *with* science." It recognizes that the scientific seeker's thrill (a nervous or moral reflex), and the source of that thrill (harmony or unity) —the development of continents, and the development of animals; the "hidden bond [that] connect[s] the flower which a girl wears in her hair and the blood which courses through her youthful veins"—are part of the same realm of inquiry, and converge one way or another in the human body.[106]

[104] This syncs with Hume's emphasis on the awareness of cause and effect as the primary criterion for sympathy. See Rob Boddice, *The Science of Sympathy: Morality, Evolution, and Victorian Civilization* (Urbana, University of Illinois Press, 2016), 43.

[105] Huxley, "The Progress of Science," 98.

[106] James Rodgers, "Sensibility, Sympathy, Benevolence: Physiology and Moral Philosophy in *Tristram Shandy*," in *Language of Nature: Critical Essays on Science and Literature,* ed. L. J. Jordanova, and Raymond Williams (New Brunswick: Rutgers University Press, 1986) summarizes the collapse between physiology and sensibility succinctly: as a natural progression from the Cartesian and Lockean systems of mind and body and the origins of thought and sensation, "the nervous system provided the place where mind and body interacted and sensations became ideas," (119); Huxley, "Physical Basis," 122.

Faith in doubt: Physiological sympathy in a Darwinian cosmos

> With relation to this universe, man is, in extent, little more than a mathematical point; in duration but a fleeting shadow; he is a mere reed shaken in the winds of force.[107]
>
> T. H Huxley, "Lectures on Evolution"

If much of the mid-Victorian project of cultivating "sympathy for science" was successful, it was because practitioners knew that, with whatever earnestness they held their personal convictions, and whatever spiritual, intellectual, and moral benefits they felt the pursuit of science bestowed, they had also succeeded in making science appeal to a public that was sensitive to beauty and morality and that craved entertainment.[108] No publicist would have been unaware of the pull of the market, particularly the dazzling spectacle that competed with information for the attention of the popular imagination.[109] The popular rhetoric of practitioner-publicists carefully trod the line between truth and wonder, projecting the positive attractions of "the extent and interest of the universe."[110] This dissertation has thus far attended to such projects which, in their quest to cultivate scientific affinity, often glossed over the perplexities or

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[107] T. H. Huxley, "Lectures on Evolution: On the Three Hypotheses Respecting the History of Nature" (1877) in *Collected Essays,* 4:46.

[108] See, among other sources: Aileen Fyfe and Bernard Lightman, *Science in the Marketplace: Nineteenth Century Sites and Experiences* (Chicago: University of Chicago Press, 2007); Bernard Lightman, *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago: University of Chicago Press, 2009); James Secord, *Visions of Science: Books and Readers at the Dawn of the Victorian Age* (Oxford: Oxford University Press, 2014); Joe Kember, John Plunkett and Jill A. Sullivan (eds.) *Popular Exhibitions, Science, and Showmanship 1840-1910* (London: Pickering and Chatto, 2012).

[109] Aileen Fyfe notes the similarity between our modern perspective and the perspective of the scientific naturalist, both of which might consider the skill of the showman distinct from proper scientific expertise as "merely" the expertise of the performer, *Science in the Marketplace,* 13. Regardless, the undeniable positive attractions of scientific spectacle, visual museums, animatronic dinosaurs, and so on, would have enacted no small pressure on more technical scientific productions to play up the beauties of science, while downplaying the troubling complications (much in the same way that simple scientific explanations by their nature downplay the complexity or chaotic quality of the actual subject).

[110] Robert S. Ball, "Stars," *Starland: Being Talks With Young People About the Wonders of the Heavens* (London: Cassell and Co., 1889), 82.

theoretical problems that plagued their chosen topic, yet also sometimes seemed to work double-time to diffuse scientific doubt. Huxley was not alone in confronting the less attractive implications of his "new Nature," but the obstinacy with which he refused to turn away from articulating them is remarkable.

That the Darwinian hypothesis could be breathtaking in its implication of the physiological unity in diversity of all bodies is demonstrated by the popularity of Huxley's work on the platform, in the classroom and in print.[111] One of Huxley's first periodical responses to Darwin's theory, published just a month after the *Origin* hit the shelves in late 1859, expresses the elevating arc of that anatomical intimacy:

> And when we know that living things are formed of the same elements as the inorganic world, that they act and react upon it, bound by a thousand ties of natural piety, is it probable, nay is it possible, that they, and they alone, should have no order in their seeming disorder, no unity in their seeming multiplicity, should suffer no explanation by the discovery of some central and sublime law of mutual connection?[112]

In this powerful query we sense the sympathetic force of a unified nature that "acts and reacts" upon itself, and the inevitable end to which all living things— humans not the least— are bound. But this bondage is not forced by cold shackles, but rather fortified by a softer power: "piety," a small word that here performs an enormous affective labor. In his pious characterization of nature's evolutionary connectivity, Huxley gestures to the final lines of Wordsworth's "My heart leaps up" (1807), the famous lyric which speaks, in miniature, that wistful reflection on the

[111] Desmond notes in *Huxley* for example, that Huxley's Edinburgh lectures in 1875 brought in 600 students on the first day alone (459).
[112] T. H. Huxley, "The Darwinian Hypothesis," in *The Times* (December 26, 1859); later published in *Collected Essays* (1897).

natural intimacy of the Romantic child elaborated in the "Ode: Intimations of Immortality."[113] Huxley's Wordsworthian gesture performs a sanctification similar to what his Goethe aphorisms and the Wordsworthian epigraph did for *Nature* magazine. In recalling the chain of connective longing triggered by the "leap" in the heart at the "rainbow in the sky," Huxley cues an instant Romantic attachment, projecting that same quality of affective engagement into a new horizon of mutual connection. Even for readers who missed the allusion, the theological connotations of "piety" worked a similar note of connection. Resonant with the Christian virtues of faithfulness, devotion, willing loyalty, respect, and reverence, Huxley's evocation of a word resonant for Victorians clinging to the divine transformed a material system into a congregation—united by all the willing faith and mutual love of Christian devotion. In implying a community trammeled atomically, cellularly, by an aggregate anatomy and a joyful heart, in both senses Huxley conjures a feeling commensurate with a sympathetic kind of secular worship.[114]

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[113] The full lyric reads:
"MY heart leaps up when I behold
A rainbow in the sky:
So it was when my life began,
So it is now I am a man,
So be it when I shall grow old
OR let me die!
The child is father of the man:
And I could wish my days to be
Bound each to each by natural piety."
William Wordsworth, "My heart leaps up," in *Wordsworth's Poetry and Prose.* Ed Nicholas Halmi (New York: W. W. Norton and Co., 2014). Halmi notes that in 1815 Wordsworth replaced the epigraph of the "Ode," which read "Paulo majora canamus," with the final three lines of "My heart leaps up" (434). The context makes it impossible to tell whether Huxley was quoting from the lyric or from the epigraph—but for the purposes of his rhetorical argument, it hardly matters. For the significance of this substitution see Peter Manning, "Wordsworth's Intimations Ode and its Epigraphs," *Journal of English and German Philology* 82 (1982): 526-540.

[114] In a private letter to Charles Kingsley after the death of his first child, Noel, Huxley would draw an even deeper connection between scientific inquiry and Christian submission that captures a similar, if more grave, sense of sublime surrender: ""Science seems to me to teach in the highest and strongest manner the great truth which is embodied in the Christian conception of entire surrender to the will of

But not all visions could be so beautified. The Darwinian specter of Nature red in tooth and claw dogged the life sciences insistently. Huxley did not hide this existential gloom from his readership. "[M]etaphysical speculation," he wrote, "follows as closely upon physical theory as black care upon the horseman."[115] Here, through Horace's edict, Huxley acknowledges the hard fact—cushioned as it often was by beautified candles, rock candy, poetic ornaments—that whosoever adopts the mantle of scientific knowledge inherits a great burden along with great gifts.[116] It was a truth that his own work encouraged, as the "physical basis of life" created alarm by knocking life out of its rarified, exceptionalist tier within material existence. "One need but mention such fundamental, and indeed indispensable, conceptions of the natural philosopher as those of atoms and force," he continues, "to call to mind the metaphysical background of physics and chemistry; while in the biological sciences, the case is still worse."[117] Huxley respectfully nods to the unavoidable, metaphysical questioning— indeed, the potential existential crises—that could accompany the view of ordered, connected, purposeless Nature that he so persuasively advocated. Huxley's field-specific questions, "Are genera and species realities or abstractions?"

God. Sit down before fact as a little child, be prepared to give up every preconceived notion, follow humbly wherever and to whatever abysses nature leads, or you shall learn nothing. I have only begun to learn content and peace of mind since I have resolved at all risks to do this," September 30 1860, HP: 19.169-76, quoted in J. Vernon Jensen, *Thomas Henry Huxley: Communicating for Science* (Newark: University of Delaware Press, 1991), 132.

[115] T. H. Huxley, "On the Sensation and the unity of structure of the sensiferous organs" (1879) in, *Scientific Memoirs,* 4:358.

[116] "Post equitem sedet atra cura." Stephen Harrison, "Horace and the Construction of the Victorian Gentleman," *Helios* 34, no.2 (2007): 208-209, 213 notes the wide circulation of Horace among the Victorians and particularly among the male aristocratic elite, but also observes that many characters in Victorian literature pursuing self-improvement take Horace up as a way to success. He cites, among others, Thackeray's Clive Newcome in *The Newcomes* (1855), and Mrs. O' Bleary in Dickens' *Sketches by Boz* (1836-7), as well as the Horatian formal elements in Tennyson's *In Memoriam A. H. H.* (1850). The *Odes,* from which this quotation hails, was the most widely read. In any case, Huxley's quotation of Horace, like his quotations of Goethe, indicates another layer of shared meaning with his audience across which his arguments could move.

[117] Huxley, "Sensiferous Organs," 358.

and "Is there such a thing as Vital Force?" invariably build to a chorus of Victorian voices that in the last several decades of the era cried out in doubtful lamentation: Tennyson's moan against Creation's final law; Matthew Arnold's "eternal note of sadness" at Dover Beach; Thomas Hardy's fear that man is "framed…in jest, and left…now to hazardry."[118] While a casual lecture goer or reader might escape enchanted, the properly initiated would find questions beneath questions. What is humankind in relation to deep time? How are we special if we are an organism like any other? Is there a meaning to human life? To be brought into scientific knowledge was a humbling, often terrifying process[119] "I bid you beware," Huxley cautioned his protoplasmic audience, "that in accepting these conclusion, you are placing your feet on the first rung of a ladder which, in most people's estimation, is the reverse of Jacob's, and leads to the antipodes of heaven."[120]

The mode of relationship that Huxley engineered seems tailor-made for the doubt-filled Darwinian world that he helped to create. His physiological imagination of one's place in the unity of Nature redirected the idea of sympathy back into the body— not divorced from the feelings, but not dependently determined by them either. It allowed for a pause in which fear and disgust were not proof of estrangement, but opportunities for intellectual growth and meditation.[121] Establishing this kind of sympathy *with* science, where the intellectual

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[118] Alfred Tennyson, *In Memoriam A. H. H.*, *The Poetical Works of Alfred Tennyson* (New York: Harper Brothers, 1871), 144 stanza LV; Matthew Arnold, "Dover Beach" (1867), *Poems by Matthew Arnold* (London: Macmillan and Co., 1877), 2:65-66; Thomas Hardy, "Nature's Questioning" (1898), *Collected Poems of Thomas Hardy, with a portrait* (London: Macmillan and Co., 1920), 58-59.

[119] This terrifying humility recalls the obliteration of the self, or self-abnegation that George Levine, *Dying to Know: Scientific Epistemology and Narrative in Victorian England* (Chicago: University of Chicago Press, 2002) identifies in John Tyndall's *Fragments of Science* — and, for that matter in Huxley's agnostic posture—as the epistemological paradigm critical to scientific investigation (4).

[120] Huxley, "Physical Basis," 153-154.

[121] Paradis writes in *T. H. Huxley* that "the shock of recognition as one journeyed into the origins and affinities of man could be due only to a face-to-face confrontation with the self; the "blurred copies," as

understanding of sympathy superseded but did not eclipse bodily or affective sympathy, was crucially important to the success of his vision, for the "harmonious" mechanisms of a fully evolutionary cosmos not only offered terrifying prospects, but often ran counter to the diktat of moral sympathy. This ideological clash would become particularly apparent in the work of Victorian social speculators and early eugenicists, where the mechanism of natural selection was often tortuously twisted to rationalize and sanction suppression and marginalization as a moral imperative.[122] It was likewise evident to the physiological researchers of the late nineteenth century, when their increasingly widespread forays into animal vivisection and, in some cases, human experimentation (vaccine administration, for example) created the need for certain mental acrobatics to make physical pain commensurate with moral ethics.[123] By placing the terms of

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Huxley observed, while capable of arousing disgust, were as likely to awaken a "sudden and profound mistrust" of one's own human prejudices regarding his uniqueness and remoteness from animal nature. In short, Huxley considered the problem of man's place in nature as a problem of identity" (124).

[122] The most famous, or rather infamous, example of this mutation arises in Francis Galton, *Hereditary Genius: An Inquiry into Its Laws and Consequences* (London: Macmillan, 1869), but permutations of evolution as "progress" of a particularly Western, British elite definition are also detectable in the work of Herbert Spencer, as early as "Progress: Its Law and Cause" (1857) where Spencer coins the phrase "survival of the fittest" and "The Social Organism" both in *Essays: Scientific, Political, and Speculative* (New York: D. Appleton and Co., 1910), 1:8-62; 1:265-307. The work of the early Victorian ethnologists, the founders of modern anthropology—Edward Burnett Tylor, most prominently—also prominently reflected an implicit bias towards Western culture which placed Europeans at the top of a moral and cultural hierarchy. See *Primitive Culture: Researches Into The Development of Mythology, Philosophy, Religion, Language, Art and Culture* (1871), (Boston: Estes and Lauriat, 1874).

[123] Huxley himself, though no prominent crusader for vivisection, would himself comment on the contradictory lines drawn around what was, and what was not, "sympathetic" behaviour towards animals. On his lecture "On Elementary Instruction in Physiology" (1877) he writes of legislation regarding cruelty to animals: "So it comes about, that, in this present year of grace 1877, two persons may be charged with cruelty to animals. One has impaled a frog, and suffered the creature to writhe about in that condition for hours; the other has pained the animal no more than one of us would be pained by tying strings round his fingers, and keeping him in the position of a hydropathic patient. The first offender says "I did it because I find fishing very amusing," and the magistrate bids him depart in peace; nay, probably wishes him good sport. The second pleads, "I wanted to impress a scientific truth, with a distinctness attainable in no other way, on the minds of my scholars," and the magistrate fines him five pounds….I cannot but think that this is an anomalous and not wholly creditable state of things." (301-302). For a

entanglement beyond the reach of moral consent, Huxley largely avoided this conflict. Doing so allowed the negative feelings of fear, doubt, disgust, and even denial, to play freely in the scientific understanding of the cosmos, without disrupting the unity of nature or removing the seeker from it.

Consider Huxley's illustration of the distinction between human mores and Nature's amorality in an address on "The Struggle for Existence in Human Society" (1888). In it we find a harsher echo of the justice of Nature first laid out in "A Liberal Education." While in this essay, as in his late "Evolution and Ethics" (1893) and subsequent "Prolegomena" (1894), Huxley is keen to stress the ultimate impossibility of achieving the ideal "moral" society without to some degree mitigating the influence of Nature, his fundamental vision of a mechanistic nature remains intact. He begins by confronting the paradox of his godless Nature.

> The vast and varied procession of events, which we call Nature affords a sublime spectacle and an inexhaustible wealth of attractive problems to the speculative observer. If we confine our attention to that aspect which engages the attention of the intellect, nature appears a beautiful and harmonious whole, the incarnation of a faultless logical process, from certain premises in the past to an inevitable conclusion in the future. But if it be regarded from a less elevated, though more human, point of view; if our moral sympathies are allowed to influence our judgment, and we permit ourselves to criticise our great mother as we criticise one another; then our verdict, at least so far as sentient nature is concerned, can hardly be so favourable.[124]

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more in-depth look at the logical acrobatics necessary to legitimize the "morality" of vivisection, see Boddice, *Science of Sympathy,* 72-100 and Stewart Richards, "Drawing the Life-Blood of Physiology: Vivisection and the Physiologist's Dilemma, 1870-1900," *Annals of Science* 43 (1981): 27-56.

[124] T. H. Huxley, "The Struggle for Existence in Human Society," *The Nineteenth Century* 23 (1888): 195.

As in "A Liberal Education," Huxley here parses the difference between natural "harmony" and human justice. This passage highlights the theoretical tensions at play in the earlier discourse, where Nature's characterization as a "calm strong angel…just, fair, and patient" seems at odds with the difference between its "overflowing generosity" to the skillful player and its forceful "checkmate" of the "one who plays ill…—without haste, but without remorse."[125] In both cases he gives his readers the sense that "justice" is a relative concept, one which cannot be securely applied to the world outside of our "artificial" ethics. A more concrete example refines this distinction:

> Viewed under the dry light of science, deer and wolf are alike admirable; and, if both were non-sentient automata, there would be nothing to qualify our admiration of the action of the one on the other. But the fact that the deer suffers, while the wolf inflicts suffering, engages our moral sympathies. We should call men like the deer innocent and good, men such as the wolf malignant and bad; we should call those who defended the deer and aided him to escape brave and compassionate, and those who helped the wolf in his bloody work base and cruel. Surely, if we transfer these judgments to nature outside the world of man at all, we must do so impartially. In that case, the goodness of the right hand which helps the deer, and the wickedness of the left hand which eggs on the wolf, will neutralize one another: and the course of nature will appear to be neither moral nor immoral, but non-moral.[126]

[125] Huxley, "Liberal Education," 32.

[126] Desmond notes that Huxley, from his time in Rotherhithe, had "seen society at the sharp end," and couldn't quite accept the utilitarian shadow of Darwin's Nature. "Even as he championed evolution," Desmond writes of Huxley, "he softened selection," Desmond, *Huxley,* 271. In his "Huxley File" James Paradis notes that Huxley was not initially a supporter of the theory of evolution, but though he eventually embraced it, he never became a 100% defender of natural selection as evolution's ultimate mechanism. We can see this ambivalence reflected in Huxley's discourses, physiological and otherwise,

Taking the view of moral sympathy, we lose focus on the "beautiful and harmonious whole," and are compelled to resist the system of nature. We are compelled to hate the predatory and sympathize with the prey (or, perhaps, if we are Nietzscheans, vice versa), and to morally qualify those creatures in keeping with these acts of identification. In employing the moral qualifiers, "innocent," "good," "malignant," "bad," Huxley (perhaps inadvertently) calls attention to how moral sympathy can be a divisive heuristic in the scientific contemplation of the system of Nature. If we cannot but carry moral sympathy into our impressions of the natural world, better to do so by conceptualizing "good" and "bad" acts as a system of checks and balances which "will neutralize one another."

But even this formulation, of moral and immoral acts neatly balancing out to non-morality is an inaccurate representation. "*If*" he says, "we transfer these judgments to nature outside the world of man *at all,* we *must* do so impartially." Huxley's contingents and imperatives make it clear that a system of human moral sympathy will always misapprehend the mechanism of Nature, discounting its balance in the name of justice. After raising and putting to rest the views of the pure moralist, the theologian, and the evolutionist, Huxley settles into a characteristic agnosticism. Acknowledging that we may be able to apprehend Nature only in relation to a human system, he offer the closest approximation to truth:

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where he implies a shared physiological origin of vital life, and its susceptibility to act and be acted upon, but rarely (save perhaps in "Evolution and Ethics") articulates a selective principle. For an example of how Huxley validates evolution via morphology and physiology, not natural selection, see T. H. Huxley, "On Species and Races, and Their Origin," *Proceedings of the Royal Institution of Great Britain,* 1860; We can see Huxley's partiality to a cosmically symmetrical view of Natural order as late as 1887, where in an address on "The Connection Between Science and Art and Literature," reproduced in *Nature* magazine, Huxley offered some suggestive remarks: "I imagine," he said, "that it is the business of the artist and of the man of letters to reproduce and fix forms of imagination to which the mind will afterwards recur with pleasure; so, based upon the same great principle by the same instinct, if I may so call it, it is the business of the man of science to symbolize, and fix, and represent to our mind in some easily recallable shape, the order, and the symmetry, and the beauty that prevail throughout Nature." Huxley, "Struggle," 197.

> If we desire to represent the course of nature in terms of human thought, and assume that it was intended to be that which it is, we must say that its governing principle is intellectual and not moral; that it is a materialized logical process, accompanied by pleasures and pains, the incidence of which, in the majority of cases, has not the slightest reference to moral desert.[127]

In the words of Thomas Hardy, "'tis not in [Nature] to feel with, or against'— it is, at best, indifferent (though, as Hardy suggests in "Hap," we might take a cruel "Powerfuller" better than an indifferent one.)[128] Huxley's use of the word "materialized" brings us back to the tangibility of his natural sympathy, in which "pleasures and pains" and all other manner of feelings are a visceral but not a vital term of the connective process. Just as a sciatic pain is a reminder of sympathetic nerves that run between the spine and the leg, pain is as much an indication of material involvement as pleasure.

Huxley's conception of Nature as a system apart from human ethics reaches a crescendo in one of his last lay sermons. "Evolution and Ethics" (1893), as Huxley's contemporary, philosopher Andrew Seth, put it had "the air of being something of a palinode" in Huxley's corpus. In a seeming departure from the old "conspiracy" to unite all questions under what James Paradis calls "the monistic terms of scientific naturalism," Huxley argued in "Evolution and Ethics" that the human ethical system was not only irrelevant to, but was by necessity in constant active *resistance* to, the order of the cosmos.[129] The lecture follows Huxleyan structure, beginning with the image of a beanstalk, an organic structure whose immanent energy, growth,

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[127] Huxley, "Struggle," 202.
[128] Thomas Hardy, "Hap," in *Collected Poems, 7.*
[129] James Paradis, "Evolution and Ethics" In Its Victorian Context," *Evolution and Ethics: T. H. Huxley's Evolution and Ethics With New Essays on Its Victorian Sociobiological Context,* eds. James Paradis and George C. Williams (Princeton, New Jersey: Princeton University Press, 1989).

maintenance, withering, and ultimate recombination with the basic material elements typified existence as a state of impermanence: that "all the choir of heaven and furniture of the earth" are transitory forms of parcels of cosmic substance wending along the road of evolution."[130] This beanstalk, which his listeners climbed like Jack of lore, provided an aerial view of a harsher dimension of the cosmic process. Nature here seems not simply amoral, but cruel: "the cosmic process is evolution: that it is full of wonder, full of beauty, and at the same time full of pain."[131] The remainder of "Evolution and Ethics" is devoted to an anthropological examination that parses some of the same distinctions Huxley made in "The Struggle for Existence" above, exploring in a cross-cultural sweep the seeming incommensurability between the moral indifference of "the struggle for existence" and the ethical ideals of the "just and the good" in moral persons. Far from following the mandate of nature that the "struggle for existence" licensed in every other corner of creation, Huxley argues that the social progress of civilized society "means a checking of the cosmic process at every step and the substitution of it for another, which may be called the ethical process." "The practice of what is ethically best," Huxley continues,

> involves a course of conduct which in all respects is opposed to that which leads to success in the cosmic struggle for existence. In place of ruthless self-assertion it demands self-restraint; in place of thrusting aside, or treading down, all competitors, it requires that the individual shall not merely respect, but shall help his fellows.[132]

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[130] T. H. Huxley, "Evolution and Ethics," (1894) *Collected Essays,* 9:50.

[131] Huxley, "Evolution and Ethics," 53. The arbitrary (or, rather, uncompassionate but regular) distribution of pleasures and pains throughout the universe in "Evolution and Ethics" belies a kind of "Scientific Calvinism" that Adrian Desmond identifies as a modification of the *Divine Government* of Southwood Smith's that Huxley read as a boy— another of many instances of a theological worldview transposed onto secular purposes. Desmond, *Huxley,* 200.

[132] Huxley, "Evolution and Ethics," 81.

Huxley's injunction that care for one's "fellows" was an ethical imperative refuted the rational order of Nature conceived by men like Leslie Stephen, who held the utilitarian line that human ethics evolved harmoniously from natural laws.[133] Stephen maintained that reason, on which sympathy was based, was preceded and shaped by instinct, and that the social utility of virtue was identical with its evolutionary utility.[134] Stephen's view put human ethics in line as part of a logical evolutionary continuum, harmonizing Herbert Spencer's principle of the "survival of the fittest" with the conditions of ethical and social life (licensing a eugenic view of culture in the process).[135] In refusing to take natural selection as an ethical guide, Huxley's anti-

[133] Caroline Sumpter, "Suffering and Sympathy: *Jude the Obscure,* Evolution, and Ethics," *Victorian Studies* 53, no. 4 (2011) locates Hardy's *Jude the Obscure* as an illuminating case-study in the divergences among Stephen's, Spencer's and Huxley's views of nature, justice, and ethics (668-670).

[134] Paradis, "Evolution and Ethics," 43; See Leslie Stephen, "Ethics and the Struggle for Existence," *Contemporary Review (*1893). This rationalization of the evolutionary to the social proved foundational to the development of in cultural anthropology in the 19th century. In ideologically structuring the history of man along the Darwinian— but really, Spencerian— lines of the "survival of the fittest," early theorists like Edward Tylor schematized human societies in terms of a seamless evolutionary continuum—"social evolution"— in which Western culture formed the pinnacle of progress. Though Huxley was clearly influenced by the ethnological categories of "savage" and "civilized" culture, both "Evolution and Ethics" and the "Prolegomena" fervently reject the "survival of the fittest" on the collective or individual level as ethical grounds for the operation of a society.

[135] Stephen's response to *"*Evolution and Ethics," though it disapproves of the methods used by the Spanish and the English in extirpating the natives of the Americans, nevertheless sanctions the competitive hegemony of "civilized" man on the uncivilized, for the "[struggle for existence] underlies morality." "Is it desirable that it should be otherwise? Should we wish, for example, that America could still be a hunting-ground for savages? Is it better that a country should contain a million red men or twenty millions of civilized whites?" Stephen's argument is often contradictory, but it hinges on the indispensability of the struggle for existence that drives even moral action, where even in a perfect future "there would still be the same necessity for preserving the fittest and suppressing, as gently as might be, those who were unfit," (165-166, 170); James Paradis details "Evolution and Ethics"' place in the context of the late 19th century's burgeoning eugenics movement, in which many thinkers (and later scientists and physicians) began to apply the "survival of the fittest" mandate to the task of imaginatively (and later, literally) developing the "best stock" of humanity, noting that especially Huxley's "Prolegomena" broadly criticized this growing eugenics movement. Paradis, "Evolution and Ethics," 47. See also Martin Fichman, "Biology and Politics: Defining the Boundaries," *Victorian Science in Context* ed. Bernard Lightman (Chicago: University of Chicago Press, 1997), 103.

eugenic thesis of resistance subverted this particular view of evolutionary harmony.[136] It introduced a developmental gap between the cosmic and human processes with no rational explanation. To those accustomed to a Huxley stumping for evolution, his conviction that "cosmic nature is no school of virtue, but the headquarters of the enemy of ethical nature" seemed, to former associates and Victorian social speculators like Stephen, Spencer, Karl Pearson, and Petr Kropotkin, to sever humankind from the natural body in which the naturalists had worked for over thirty years to place them.[137]

Huxley clearly didn't see it that way. Moreover, the ideological flexibility of his contradictory-yet-complementary system in "Evolution and Ethics" reconfirms the utility of a de-personalized (or at least de-moralized) way of understanding sympathetic entanglement. Though he was content to speculate that the sympathetic impulse had an adaptive origin, the agnostic Huxley was untroubled by the un-soundable logical gulf between the ape and "savage man" who obeyed the state of nature, and the civilized human whose moral code overrode it. "Evolution and Ethics" wasn't interested in uncovering the evolution *of* ethics, or of any other intangible human sense. As Huxley said, "cosmic evolution may teach us how the good and the evil tendencies of man may have come about, but in itself, it is incompetent to furnish any better reason why what we call good is preferable to what we call evil than we had before."[138] He was, after all, a physiologist. His concern was not with projecting the metaphysics of what might have been, but with describing the mechanism of what was there. And by whatever mechanism, it was

[136] Paradis notes that Huxley's view of ethical versus cosmic nature in "Evolution and Ethics" took direct aim at a number of principles long identified with Herbert Spencer, including the law of progress, the perfectibility of man, laissez-faire social policy, radical individualism, and utilitarian ethics. Paradis, "Evolution and Ethics" 45-46. For the sources of some of the ideas which "Evolution and Ethics" reacted against, see Spencer, "Progress: Its Law and Cause" (1857) and "The Social Organism" (1860).
[137] Huxley, "Evolution and Ethics," 75; Paradis, "Evolution and Ethics," 43.
[138] Huxley, "Evolution and Ethics," 80.

plain to Huxley that humankind *had* an ethical sense, and that "all the understanding in the world will neither increase nor diminish the force of the intuition that this is beautiful and that is ugly."[139] In this late lecture, Huxley's concern was not rational or utilitarian, but humanistic and sympathetic: to question "to what extent modern progress in natural knowledge, and…the doctrine of evolution, is competent to help us in the great work of helping one another." More especially, he impressed on his audience that, however much their arts and morals now "repudiate[d] the gladiatorial theory of existence," it was an undeniable truth that "men in society are undoubtedly subject to the cosmic process" and as much a part of nature as he had always said they had been.[140]

Huxley's agnostic abstention from theodicy in "Evolution and Ethics" may have caused distress, but it hardly suffered from the philosophical inconsistency of which it was accused. In terms of the basic conception of a unified if paradoxical system of Nature, Huxley's schema in "Evolution and Ethics" exhibited essentially the same manner of sympathetic modality as his work always had. As an affected and affecting organization, Huxley's physiologically sympathetic Nature had never hinged upon the logical cohesion of the elements of the cosmos; it had only ever required that they were constituents of the same universe, physically and materially inter-involved.[141] As he writes in a footnote to "Evolution and Ethics,"

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[139] Huxley, "Evolution and Ethics," 80.

[140] Huxley, "Evolution and Ethics," 81.

[141] Huxley was keen to acknowledge the explanatory limits of physical science while acknowledging the legitimacy of many inexplicable but clearly real phenomena, most of which (in keeping with the trend of late century science) pertained to psychological and perceptual phenomena. "Nobody," he writes in " Science and Morals" (1886) I imagine, will credit me with a desire to limit the empire of physical science, but I really feel bound to confess that a great many very familiar and, at the same time, extremely important phenomena lie quite beyond its legitimate limits. I can not conceive, for example, how the phenomena of consciousness, as such and apart from the physical process by which they are called into existence, are to be brought within the bounds of physical science." T. H. Huxley, "Science and Morals" *Fortnightly Review* 40 (1886): 167.

> Of course, strictly speaking, social life, and the ethical process in virtue of which it advances towards perfection, are part and parcel of the general process of evolution, just as the gregarious habit of innumerable plants and animals, which has been of immense advantage to them, is so….Among birds and mammals, societies are formed, of which the bond in many cases seems to be purely psychological; that is to say, it appears to depend upon the liking of individuals for one another's company. The tendency of individuals to over self-assertion is kept down by fighting. Even in these rudimentary forms of society, love and fear come into play, and enforce a greater or less renunciation of self-will, just as the "governor" in a steam-engine is part of the mechanism of the engine.

In spite of the anthropomorphic pitfalls of his explanation, what Huxley here elucidates are fundamental cooperating and opposing forces which inhere to animate life and which increase by degrees of complexity across organized bodies to culminate in the ultimate sympathetic interdependence of ethical humanity. (In extending what might be termed sociological or even socially-sympathetic impulses to animal aggregates as well as human, Huxley also reminds us of his openness to a biological rationale for sympathy— but again, a natural history of the ethical impulse was not his aim.) He delineates the complicated balance of social action, which resists one innate "nature" even as it harmonizes with another. Proto-sociobiology aside, Huxley's purpose in this footnote was to fortify a paradox which he saw as still "part and parcel" of the cosmic process. The survival of ethical humanity, however it came to be ethical, depended upon "checking the cosmic process at every step." But, as Huxley wrote in a letter to Andrew Seth, he saw no inherent fracture in this opposition: "I really have been unable to understand what my

critics have been dreaming of when they raise the objection that the ethical process being part of the cosmic process cannot be opposed to it."[142]

In their sympathy with Nature, Huxley's human had always been in a harmonious opposition to it. His earlier work may have borne Romantically-inflected flourishes that cushioned this blow, like his claim in "Liberal Education" that a liberally educated person and Nature "will get on together rarely; she as his ever beneficent mother; he as her mouthpiece, her conscious self, her minister and interpreter."[143] But in its operation, his cosmos had always been both just and unfeeling. We see, in the passages below, a marked linguistic parallel. Huxley frames Nature's mode of instruction in "A Liberal Education" as materially just—that is to say, regular— but morally insensible:

> But, like all compulsory legislation, that of Nature is harsh and wasteful in its operation. Ignorance is visited as sharply as wilful disobedience–incapacity meets with the same punishment as crime. Nature's discipline is not even a word and a blow and the blow first; but the blow without the word. It is left to you to find out why your ears are boxed.[144]

In "Evolution and Ethics," Huxley likewise emphasizes the morally arbitrary quality of Nature's operations, remarking

> that, in the realm of nature, ignorance is punished just as severely as wilful wrong; and that thousands upon thousands of innocent beings suffer for the crime, or the unintentional trespass, of one.[145]

In both passages, Huxley insists on a mechanism of Nature that is uniformly indifferent and uniformly disinterested. In both he offers the same solution, though in "Liberal Education" that

[142] Huxley, *Life and Letters,* 2:380.
[143] Huxley, "Liberal Education," 86.
[144] Huxley, "Liberal Education," 34.
[145] Huxley, "Evolution and Ethics," 58.

solution is swathed in all of the optimism of the high-Victorian era rather than the malaise of a century on the edge of its grave. Humankind's reality is that they are locked in an eternal chess-match against their opponent, and their survival is prolonged only by knowing "the rules of this mighty game" and by playing with enough acumen to scratch out a life. "Evolution and Ethics" champions but a larger iteration of this individual game, in which society's survival depends on knowing the laws of Nature, "full of wonder, full of beauty, and at the same time, full of pain," and turning them, at every step, to lessening the pain of the state of Nature.

And in both passages, that opposition to the state of Nature, whether by moral restraint or mechanical art, is inescapably still inside of Nature. "In every family, in every polity that has been established," he continues in "Evolution and Ethics," "the cosmic process has been retrained and otherwise modified by law and custom; in surrounding nature, it has been similarly influenced by the art of the shepherd, the agriculturist, the artisan."[146] Here Huxley's argument shows its anthropological bent, framing human material culture as both making and responding to the environment. His shepherd, his agriculturist, and his artisan have indeed restrained the cosmic process through their art, but only as that art was based upon a working knowledge of the course of the cosmic process. In "learning the rules of this mighty game," the agriculturist's crop flourishes, and the physician combats the deadly pathogen. This reactive, antagonistic, but physiologically sympathetic relationship between the "State of Art" and the "State of Nature" was spelled out in Huxley's philosophy from the very beginning in "A Liberal Education":

> The object of what we commonly call education–that education in which man intervenes and which I shall distinguish as artificial education–to make good these defects in Nature's methods; to prepare the child to receive Nature's education neither incapably nor ignorantly, nor with wilful disobedience; and to understand the preliminary symptoms of

[146] Huxley, "Evolution and Ethics," 84.

> her pleasure, without waiting for the box on the ear. In short, all artificial education ought to be an anticipation of natural education. And a liberal education is an artificial education which has not only prepared a man to escape the great evils of disobedience to natural laws, but has trained him to appreciate and to seize upon the rewards, which Nature scatters with as free a hand as her penalties.

A liberal education, which we can theoretically extend to the formation of the moral and social laws of civilization, is necessarily both artificial and natural; both mitigating, but predicated upon, the knowledge of nature and its effects. The wolf and the deer are not "good" and "evil," and the system of nature attributes no moral desert to their struggle; but however it came about, the ethical human creates artificial conditions to exclude that struggle— but they can only do so by knowledge of the struggle, by an understanding of their sympathy with the natural system, and an awareness of the constant potential for the "cosmic process [to resume] its sway."[147] Strictly speaking, it hardly matters what fallacies his contemporaries saw in his cosmic process—paradoxes included, as long as his universe remained affected and affecting "through infinite diversities of life and thought," Huxley considered it whole.[148] As in so many other things, he seems to take the spirit of his direction from Goethe: "We obey her laws even when we rebel against them; we work with her even when we desire to work against her."[149]

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[147] Huxley, "Prolegomena," 45.

[148] Huxley, "Evolution and Ethics," 50. Jay Clayton likewise recognizes Huxley's conviction of humankind's transcendence over the state of Nature *only* because of its inextricable tie to that state. What makes human intelligence not just competent to, "but worthy of, influencing its environment is a recognition that humans will forever remain part of that environment," an existential unity which, in Clayton's attention to Wells' *Dr. Moreau* and Huxley's "Evolution and Ethics" in relation to modern bioethical debates, has a particularly pointed type of physiological relevance. Jay Clayton, "Victorian Chimeras, or, What Literature Can Contribute to Genetics Policy Today," *New Literary History* 38, no. 3 (2007): 569-591, 584.

[149] "Nature: Aphorisms by Goethe," *Nature* 1 (November 4, 1869): 10.

Like Thomas Hardy's phantom chorus in *The Dynasts*, Huxley renders the cosmos in multiple voice. Like the Spirit of the Years, Huxley's empiricism intoned a zen-like observance of the "ever unconscious…automatic sense,/Unweeting why or whence" of the universal whole, while like the Spirit and Chorus of the Pities his ethical humanism resonated in sympathy with the sufferings of life, in search of a "kindlier build" of law.[150] Hardy followed Huxley in his struggle to parse the dynamic correlation of sympathetic humanity with the "Vast Imbecility" of the universe.[151] Likewise the poet's view of human sympathies as rogue, illogical, but natural forces both mutant from and yet part of the totality of existence called the Immanent Will reaffirms the affective logic of the paradoxical body of Huxley's Nature, in which man's feelings ethical and otherwise could be a real and natural, if inexplicable, mover and phenomenon in the cosmos.[152] For as his "Evolution and Ethics" made agnostic space for man's irrepressible human instincts, Huxley's rhetoric too made space for the finer feelings in the harmonious struggle of the cosmos. Man, the organism, may have been a physiological machine bound "by a thousand ties of natural piety" or by some material doom to the organization of existence. But he was more

[150] Hardy, *The Dynasts,* 2,4.

[151] Sumpter, "Suffering and Sympathy," 668-669, 672-673. Hardy, "Nature's Questioning" (1898), 59.

[152] I can make no argument of influence here, but the Spirit of the Years' presentation of the "anatomy" of the Immanent Will, exhibits a productive parity with my conception of Huxley's universe as a physicalized body, down to the "strange waves" that the Spirit of the Pities sights in the organism of existence, "Which complicate with some, and balance all." According to the "stage directions," at Years' effort, "a new and penetrating light descends on the spectacle, enduing men and things with a seeming transparency, and exhibiting as one organism the anatomy of life and movement in all humanity and vitalized matter included in the display." Years goes on to anatomize the earth as a body of "Prime Volitions," a mélange of matter and will in which "fibrils, veins
Will-tissues, nerves, and pulses of the Cause,
That heave throughout the Earth's compositure.
Their sum is like the lobule of a Brain
Evolving always that it wots not of;
A Brain whose whole connotes the Everywhere." Hardy, *The Dynasts,* 10.

than a mere instrument, however inextricably trammeled he was to the consequences of his material reality.

In this most seemingly fatalistic of dynamics Huxley, like Hardy, whose conception of the Immanent Will later acknowledges the energetic power of human feelings and aesthetic vulnerability upon the total system, will insist on a transformative force that interpenetrates both the stuff of matter and the stuff of human feelings.[153] In the lecture halls of South Kensington Huxley was known to treat dead specimens in a "peculiarly loving manner," sometimes "throwing his arm over the shoulder of the skeleton beside him and take its hand, as if its silent companionship were an inspiration."[154] We might read this gesture as a literal embrace of the Horatian edict that Huxley wrote above the portal of life—*Debemur morti nos nostraque.*[155] In this macabre reminder of the harmony by which all life was, is, or will be cognate, Huxley projects the ambiguity of affect that he rhetorically repeats elsewhere, in the spiritual and intellectual lights he ignited amid the evolutionary darkness.[156] In distilling "our reverence and our wonder" from humankind's connection with the apes and Mont Blanc's origin in sea mud; in palpating a spiritual resonance in the "dim religious gloom" of the orangutan's primeval jungle; and in adorning with the mantle of a heroic Romantic struggle the "marvelous destruction of life" in Darwinian natural selection through Goethe's words—"*Eine Bresche ist jeder Tag"—*[157]

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[153] On the power of human feeling, and of poetry, to effect the system wrought by the Will, see Herbert Tucker, *Epic: Britain's Heroic Muse, 1700-1910* (Oxford: Oxford University Press, 2008), 600-601.
[154] Parker 162.
[155] "We are destined to death, we and ours."
[156] Horace, *Odes and Art of Poetry* (St. Louis: Blackwell Wieland Company, 1938), line 61. This stanza of *Ars Poetica* captures the impermanence of poetry and nature alike, a fitting reference in Huxley, "Physical Basis," 131.
[157] Carlyle translates this line, and the quatrain it heads off, thusly:
"A rampart-breach is every Day,
Which many mortals are storming:
Fall in the gap who may,

Huxley articulates the paradoxical, irrepressible pull that Nature, whether calm or exterminating angel, still had on the human feelings—and, just as importantly, the pull that the human feelings could perhaps enact upon Nature.[158]

There may have been no outside to this Immanent Will; no escape from or total mitigation of the cosmic process. Yet there was still something humankind could do about it, and their ability drew its power from their knowledge of their physiological sympathy with the system that seemed everywhere to oppose them. As he had so often done elsewhere with Goethe to express the "fusible" wonder behind the material world, Huxley recurs to poetry in the final lines of "Evolution and Ethics." He concludes a vision of fateful cosmic struggle with a resolute evocation of Tennyson, summoning verse to give voice to the force—perhaps to act as a force itself— of valor, courage, and beauty that persisted amid a harder truth: acceptance of and resignation to the world that late Victorians lived in and to which they were irrevocably bound.[159] In "noble words" that Seth said voiced "impressive insistence on the imperishable worth of human effort inspired by duty," Huxley urged a courageous embrace of the futility of "harmonizing human ideals with the course of the universe" even as the human *body's* harmony with that universe remained inescapable. Huxley's allusiveness to Victorian poetry was a reflection of his time, both by the nature of reality and by the emergent intellectual grasp of that reality; a retrospective vista in a retrospective age. Aged, infirm, and reeling from the loss of a

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Of the slain no heap is forming."
"Eine Bresche ist jeder Tag.
Die viele Menschen erstürmen;
Wer da auch fallen mag,
Die Todten sich niemals thürmen." Thomas Carlyle, "Goethe's Works," *Foreign Quarterly Review* 10 (1832): 37.

[158] Huxley, "Relation of Man," 113; Huxley, "Science and Morals," 167-168; Huxley, "Mr. Darwin's Origin of Species," 147.

[159] Appropriately it was Tennyson, as remarked to John Tyndall, who Huxley held was the first poet since Lucretius who has understood the drift of science" Huxley, *Life and Letters,* 2:338.

brilliant but tortured daughter, Huxley no longer spoke in the tones of unquenchable Romantic youth; like a black-eyed Ulysses, charmed with the same gift of persuasion, he called upon his age to forebear—to use and "follow knowledge like a sinking star." "We are grown men," he says, "and must play the man

> "strong in will
> To strive, to seek, to find, and not to yield,"[160]
> cherishing the good that falls in our way, and bearing the evil, in and around us, with stout hearts set on diminishing it. So far, we all may strive in one faith towards one hope:
> "It may be that the gulfs will wash us down,
> It may be we shall touch the Happy Isles,
> ... but something ere the end,
> Some work of noble note may yet be done."[161]

Huxley's conclusion, between affect and effort, transforms an education into a valiant struggle, wherein we each and all labor doughtily with weapons ivory, steel or ink, forged through our scientific sympathy with the cosmos. There is no telos, no discernible goal. Huxley's vision of the future remains contingent, uncertain; its goal, continued action. Huxley died aged seventy, just a year following his "Prolegomena." To the last, what he urged was an agnostic embrace of the physiologist, perennially focused on the unceasing process of the great cosmological body of which we are a part—a surrender to existence itself. Andrew Seth poignantly summarized: "We

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[160] Alfred Tennyson, "Ulysses," *The Poetical Works of Alfred Tennyson* (New York: Harper Brothers, 1871), 57-58.

[161] Huxley, "Evolution and Ethics," 86. To these two quotes Huxley appends the footnote: A great proportion of poetry is addressed by the young to the young; only the great masters of the art are capable of divining, or think it worth while to enter into, the feelings of retrospective age. The two great poets whom we have so lately lost, Tennyson and Browning, have done this, each in his own inimitable way; the one in the *Ulysses,* from which I have borrowed; the other in that wonderful fragment 'Childe Roland to the dark Tower came.'

must conclude that the end which we recognize as alone worthy of any attainment is also the end of existence as such— the open secret of the universe."

Coda: The Universe or Nothing

> *If we are to survive, our loyalties must broaden further, to include the whole human community, the entire planet Earth…. [The] choice, as H. G. Wells once said in a different context, is clearly the universe or nothing.*[1]
>
> Carl Sagan, *Cosmos* (1980)

Historians and critics have staked out a number of plots in the field of Victorian science which, after thorough survey, we trust to be solid ground. The first that relates to this project is, of course, that far from being "two cultures," science and literature in the nineteenth century had always been deeply interdependent.[2] Another is that Romanticism in particular left its signature upon scientific practice and expression—and vice versa.[3] Still others: that as the century wore on, "professional" scientific discourse tried to distance itself from "amateur" conversation by eschewing the more elaborate narrative devices common to the natural theology of the eighteenth and early nineteenth centuries; but also, that the dividing line between "popular" and "professional" discourse was a permeable rather than rigid barrier, sometimes highly so.[4] And

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[1] Carl Sagan, *Cosmos* (1980) (New York: Ballantine Books Trade Paperbacks, 2013).

[2] The field of Darwin scholarship initiated by George Levine, *Darwin and the Novelists: Patterns of Science in Victorian Fiction* (Cambridge, Massachusetts: Harvard University Press, 1988) and Gillian Beer See Gillian Beer, *Darwin's Plots: Evolutionary Narrative in Darwin, George Eliot, and Nineteenth Century Fiction* (New York: Cambridge University Press, 1983) and *Open Fields: Science in Cultural Encounter* (Oxford: Clarendon Press, 1996) which has continued over thirty years to grow and nuance, is but one of many testaments to the scholarly commitment to deconstructing the "two cultures" myth. See introduction to this project.

[3] Among texts that thoroughly explore aspects of this trend: Richard Holmes, *The Age of Wonder: How the Romantic Generation Discovered the Beauty and Terror of Science (*London: HarperPress, 2008), Richard Sha, *Imagination and Science in Romanticism* (Baltimore: Johns Hopkins University Press, 2018), *Romantic Science: The Literary Forms of Natural History* ed. Noah Heringman (Albany, State University of New York Press, 2003) and Noah Heringman, *Romantic Rocks, Aesthetic Geology* (Ithaca: Cornell University Press, 2004).

[4] Compare, for example, William Paley's *Natural History* and Gilbert White's *The Natural History of Selbourne* to John Tyndall's comparatively more prosaic *Six Lectures on Light*; work on the popular/professional boundary included but not limited to: Aileen Fyfe and Bernard Lightman, *Science in*

perhaps most immediate to the formal and rhetorical concerns of the preceding pages: that scientific naturalism—the material view of Nature that the texts in this project largely champion—paradoxically depended upon shared rhetorical premises *with* the natural theology, Romanticism, and metaphysics that it conceptually opposed.[5]

I have overturned none of these. I have, in fact, depended on such established critical truths as guidelines for the interpretive overlay I have crafted in "Sympathy for Science." That their projects were not just products of an affectless pursuit of truth, but enchantments woven to enlighten and impassion, Victorian practitioners—to say nothing of the Romantic poets—knew very well. "Poetry," Wordsworth wrote in his "Preface" to *Lyrical Ballads,* "is the breath and finer spirit of all knowledge; it is the impassioned expression which is the countenance of all Science"; Huxley fished for scientific souls with his prose-poetry like a latter-day prophet.[6] But what I hope I have done here is added additional depth to our current ways of thinking about how the naturalist paradox was managed linguistically, by locating "sympathy"—a term with immense Victorian purchase but as of yet little scientific application—as a rhetorical anchor with which to link, if not entirely unify, the projects of learning, teaching, and feeling in which practitioners and the public engaged as a community. In composing this project at a mid-way point between the methodologies of literature and the textual ground of the history of science, I have taken an admittedly unconventional approach to scientific non-fiction prose. Yet in doing

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the Marketplace: Nineteenth Century Sites and Experiences (Chicago: University of Chicago Press, 2007), Bernard Lightman, *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago: University of Chicago Press, 2009) and James Secord, *Visions of Science: Books and Readers at the Dawn of the Victorian Age* (Oxford: Oxford University Press, 2014).

[5] See Gowan Dawson and Bernard Lightman's editor's introduction to *Victorian Scientific Naturalism: Community, Identity, Continuity* (Chicago: University of Chicago Press, 2014), and all subsequent articles in that volume, including George Levine's nicely summary "Paradox: The Art of Scientific Naturalism." See introduction of this project for more thorough critical discussion of these trends.

[6] William Wordsworth, "Preface" to *Lyrical Ballads*, *Wordsworth's Poetry and Prose*, ed. Nicholas Halmi (New York: W. W. Norton and Co., 2014) 88.

so, "Sympathy for Science" nuances the way we think about Victorian public science writing, and how amid its (mostly) pedagogical intent and persuasive aims, scientific writing also behaved as literature in the public sphere—active, interpretable, and alive with connective resonance.[7]

Nature magazine, for example, may have been a targeted professional project, circumscribed by the demands of the market and the obligations of its editors. But as I show in Chapter 1, reading the work (again mostly) archive-blind allows us to absorb connections that the journal tacitly, formally intimated between affect and objectivity and between poetry and professionalism that resonated with the broader philosophical growing pains of how to connect with an expanding, fracturing universe. Meeting the Manchester and Royal Institution lectures at the level of their conceit, rather than tracking the process of their conception, encourages us to revalue the latent creative relation-building powers of documented language in a genre which privileged performance. My exploration of Huxley in Chapter 3 likewise bypasses the intricacies and contradictions of the well-lived life that has made Huxley biography a titanic challenge. By tracking theoretical grooves that run through the rhetoric of a published corpus, I expose a system of sympathetic bodily responsiveness that, like the sympathetic nervous system itself, has the power to behave unconsciously, in seamless interconnection with and without contradiction to the actions of its conscious operator. If anything, "Sympathy for Science" shows that a rhetorical rather than purely historical reading can enrich and confirm the truths we already broadly understand of this field, and perhaps reacquaint us with some of the enchantments from which, as critics, we have drifted.

[7] I like to think of this as akin to adopting to the "actual behaviour" principle in cultural anthropology, wherein observers attend to the discrepancy between what people say they do or believe in their lives (what practitioners say their writing is doing) versus what they actually do (what their writing, as an interpretable source, ends up saying.)

I have been tacitly navigating throughout this project a paradox of my own: I imply a uniqueness to the Victorian approach of scientific rhetoric, but I also locate a timelessness in the potential connective experience of natural knowledge from which that rhetoric gained its power. Both, as is the manner of paradoxes, are true. Victorian "sympathy for science" circulated at a remarkable historical moment full of new literacies, new inventions, and new awareness of natural "causes now in operation." The ethos of sympathetic rhetorics reflects that spirit of novelty. As we've seen, the practitioner-publicizers in this project spoke, managed, and crafted enchanted natural relations on the wave of a phenomenon the most immediate goal of which was *interest*: each small promotion of comprehension and zeal was a pedagogical, sometimes even evangelical, victory.[8] T. H. Huxley's characterization at the beginning of "Evolution and Ethics" (1894) tracks with mid-century science's general optimism about itself, his metaphorical Jack drunk on the view from the top of the scientific beanstalk, on the progressive potential at the height of the British empire:

> We have climbed our bean-stalk and have reached a wonderland in which the common and familiar become things new and strange. In the exploration of the cosmic process thus typified, the highest intelligence of man finds inexhaustible employment; giants are subdued to our service; and the spiritual affections of the contemplative philosopher are engaged by beauties worthy of eternal constancy.[9]

Huxley here captures a parting whiff of confidence, channeling the Romantic rhetoric that transfigured scientific men into lords of nature: masters of creation bound in eternal worship.[10]

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[8] This is, of course, an over-generalization—as well we know, evolution caused quite the scandal.

[9] T. H. Huxley, "Evolution and Ethics" (1894), *Collected Essays* (New York: D. Appleton and Co., 1897), 9:50.

[10] Huxley's phrasing here calls me to mind of two Romantic works of poetry and prose which, in their connection, reiterate one of the "truths" at the beginning of this coda. One is from Sir Humphry Davy's "A Discourse Introductory to a Course of Lectures on Chemistry, Delivered in the Theatre of the Royal

Huxley's essay of course goes on to skewer such a view of the cosmos, but before he reminds his readers that nature is "full of beauty, and at the same time full of pain," his passage usefully recalls for us the prevailing spirit of the age, before metaphysics and consequences, like Horace's dark care, closed in on scientific riders.

As the same time, I want to suggest that structures of sympathy and sympathetic rhetorics undoubtedly continue to be a generative paradigm for writing and thinking about humankind's place in Nature, if not in quite the same way. As the world in which such rhetorics operates alters, grows, and reorients, "sympathy" as a force for thinking through scientific engagement likewise changes, and gains the potential for a different type of power even as it intones the song of its past. How might sympathetic rhetoric operate as a pedagogical tool, or a confessional mode, in an age of scientific orthodoxy? The roughly thirty years that this project spans witnessed the beginning of that shift: *Nature* moved from generalist to specialist periodical; the Manchester lectures boomed, and then waned, because of increasing accessibility elsewhere; evolution shifted from heresy to doctrine. Sympathy has always been a social and moral force, but how might the capital and priorities of "sympathy for science" reorient in an age circumscribed on every side by that methodology? In which, in the pursuit of checking the

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Institution, on 21 January 1802," *The Collected Works of Humphry Davy,* ed. John Davy (London: Smith, Elder and Co., 1839), when he writes, "Science has…bestowed upon [man] powers which may be almost called creative; which have enabled him to modify and change the beings surrounding him, and by his experiments to interrogate nature with power, not simply as a scholar, passive and seeking only to understand her operations, but rather as a master, active with his own instruments" (2:319). The second is from Monsieur Waldman from Mary Shelley's *Frankenstein: The 1818 Text* (New York: Penguin, 2018), who entrances Victor with his vision of that scientists "penetrate into the recesses of nature…They ascend into the heavens; they have discovered how the blood circulates, and the nature of the air we breathe. They have acquired new and almost unlimited powers; they can command the thunders of heaven, mimic the earthquake, even mock the invisible world with its own shadows" (35-36).

cosmic process, "social progress," as Huxley coined it, has eventuated a threat of its own making?[11]

The reader wondering how "sympathy for science" might resonate with the discourses of the contemporary moment will not, I hope, have been disappointed in the foregoing discussions. That same reader will have no doubt considered that auxiliary to this project's focus on physical Nature as a sympathetic unity lies, of course, nature as an actual vulnerable environment in a rapidly industrializing world. T. H. Huxley, as James Paradis reminds us, may have had little conception of "ecology" or "environment" in the contemporary sense.[12] Nevertheless, in pitting ethical and cosmic nature against each other, and in recognizing that humankind's survival hinged upon "modifying the conditions of existence," Huxley's "Evolution and Ethics" (1894) incubates some of the germs of what will become our 21st century crisis of place: where environmental and civic ethics are all the more intertwined, and where modifications of the conditions of existence worked all too well.[13]

After casting a last glance at the Victorians, I take this final moment to reflect on the ecological relevance of imagined sympathy in the work of a practitioner-popularizer living on the other side of the tipping point: Carl Sagan. Sagan's earnest and unabashedly feelingful embrace of scientific inquiry first prompted me to push further into the heritage of affect in empirical discourse during the century before his— what it meant, where it came from, and what it was supposed to do. Just as Huxley parsed a collapse between physiological and emotional sympathy, Sagan prompts us to consider how "affect," far from an idealist's fancy, might

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[11] T. H. Huxley, "Evolution and Ethics," 81.

[12] James Paradis, "Evolution and Ethics: Its Victorian Context," *Evolution and Ethics: T. H. Huxley's Evolution and Ethics With New Essays on Its Victorian Sociobiological Context,* eds. James Paradis and George C. Williams (Princeton, New Jersey: Princeton University Press, 1989). 55.

[13] T. H Huxley, "Evolution and Ethics," 85.

navigate the complicated affinities between natural and geopolitical action. This project began with the cosmos, so it seems only fitting that there, too, it should end.

The April 28, 1870 issue of *Nature* magazine exhibits a distinct if biased awareness that the entangled system of Nature was neither immune to human action nor spared by economic or political interests. An article on "Legislation and Nature" by E. Goadby considers its subject as "of course, only a minor branch of the larger question of man's influence upon all external life and forms," and traces the resonances of legislative actions like tree-cutting, firearm taxation, game laws, and the decorative hat industry through to their visible consequences on the biological and geological realms. In absorbing the collapse between human and natural interests—he foresees, for example, that the Suez Canal will have an "appreciable effect…in modifying the coast lines of the Mediterranean [and] creating any interchange of marine species"— Goadby clearly apprehends a complex, Cosmos-metonym-like sympathy between the life of humans and the life of the earth. Yet his mode exhibition is distinctly economic rather than affective in nature. No birds sing in Trinidad, where the "small birds" are culled for the fashionable hats of London socialites, and the "hordes of mole-crickets" multiply as a consequence. "Unless something is done to save the birds," Goadby quotes of Charles Kingsley, authority on the scene, "the canes and other crops will surely suffer in their turn."[14] Kingsley suggests a heavy export tax on bird-skins. The decimation of the once-thick pine forest from Danzig to Pillau has eroded the soil, endangered channels and injured fisheries, such that "the State [Germany] would now willingly expend millions to restore the forests again."[15]

[14] E. Goadby, "Legislation and Nature," *Nature* 1 (April 28, 1870): 649. Kingsley writing from this reach of empire also reminds us of the imperial reach of science that has remained on the margins of this dissertation.

[15] Goadby, "Legislation and Nature," 648.

The system of nature, like *Nature* magazine itself, may have been spilling its boundaries, but Goadby's article illustrates a nation-bounded limitation to tracing lines of natural sympathy. Ricocheting between a planetary deep-historical and a national perspective across Europe and the Empire, Goadby's environmental awareness continually returns to the state of the soil as a literal and, quite clearly, metonymic national concern.[16] We can hear a rally of English patriotism in his final plea to "protect our woods, and with them our birds and crops" placed in contrast to Spain's diminished national and naval power due to their "prejudice against trees":

> Watch a bare and wooded hill on a cloudy day, or a well-wooded farm in a dry summer, and you will see a difference which need not be described. Disafforesting threatens to become as common in the nineteenth as enclosuring was in the sixteenth century. Are we wise to hasten it?[17]

*Nature'*s article sounds the tenor of environmental reform of the mid-Victorian era: a largely conservative ethic of preservation poised between a germinating consciousness of natural "others" on one hand, and an idea of environment as part of national and cultural identity on the other.[18] Goadby addresses issues which formed loci for early environmental efforts, whose aims

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[16] In his editor's introduction to *Victorian Visions of Global Order: Empire and International Relations in Nineteenth Century Political Thought* (New York: Cambridge University Press, 1997) Duncan Bell notes that the twenty years following the Great Exhibition of 1851 were ones of a balance of optimism and anxiety about Britain's place in the world, the Exhibition itself encapsulating Britain's cosmopolitan dream and desire for national prestige, with which science was deeply intertwined (6-7).

[17] The mention of "enclosuring" calls to mind the specter of Goody Blake and Harry Gill from *Lyrical Ballads*, another instance in which nature, legislation, and moral justice converge, and in which Harry Gill, enforcer of legislative boundaries around the commons, becomes accursed: "…live as long as he may,/He will never be warm again," William Wordsworth, "Goody Blake and Harry Gill" (1798) in *Wordsworth's Poetry and Prose,* ed. Nicholas Halmi (New York: W. W. Norton and Co., 2014), lines 119-120.

[18] John Ranlett, ""Checking Nature's Desecration": Late-Victorian Environmental Organization," *Victorian Studies* 26, no. 2 (1983) notes that Victorian environmental organization, like much Victorian reform, tended to a conservative type of progressivism. Most individuals, he states, "[thought] the

were not entirely self-interested: discouraging the sartorial use of birds was an matter of kindness as well as economics; the blighting of landscapes an issue of nostalgia, of public ownership, and of the respect of beauty as much as of agriculture.[19] But the picture he draws, with its national concerns, also captures the contradictory quality of Victorian "cosmopolitanism" which simultaneously valorized capitalist enterprises of empire and while retaining echoes of Kantian sense of peace and universal brotherhood— of which we might consider the expanding boundaries of nature a part.[20] Goadby's article is peppered with such cosmopolitan tensions, aware of the system of nature that crosses borders, but still measuring by tentative metric of states: Germany, Spain, Ireland, far Trinidad, and blessed England. Care for nature becomes mixed up in care for nation. Nevertheless *Nature,* a boundary-crossing project, acknowledges the truth around which an Anthropocene consciousness will grow: "Neither directly nor indirectly, in fact, can we touch nature by our laws, without beginning a new chain of causes, the end of which we cannot foresee."[21]

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changes they advocate would make life a bit nicer, but [were] fundamentally comfortable with society as it exists and see no reason to make too much noise about their campaign for improvement" (202).

[19] Ranlett in "Checking Nature's Desecration" cites the Selbourne League and the Plumage League, which formed in 1885— the Selbourne league embraced the preservation the preservation of a variety of pleasing natural features (in the spirit of Gilbert White), while the Plumage League focused "against the fashion of turning our dresses, bonnets, and hats into cages, traps, and barn door," and pledged to observe in their dress the "laws of kindness" (206, quoting from *Selbourne Magazine* in 1888).

[20] Tanya Agathocleous, *Urban Realism and the Cosmopolitan Imagination in the Nineteenth Century: Visible City, Invisible World* (New York: Cambridge University Press, 2011), 2-3. Agathocleous reminds us that "cosmopolitanism," the term Victorians would have most likely used for transnational dynamics, is always an internal dialectic between the symptoms of cosmopolitanism and their critique— hence the possibility of so many cosmopolitanisms. She also notes how, despite seeming opposed, "nationalism" and "cosmopolitanism" were frequently seen as symbiotic in Enlightenment and Victorian writings— as they do in *Nature* (4-5); Lauren Goodlad also outlines the capitalist, colonialist bent of Victorian cosmopolitanism in *The Victorian Geopolitical Aesthetic: Realism, Sovereignty, and Transnational Experience* (New York: Oxford University Press, 2015), 23-25.

[21] Goadby, "Legislation and Nature," 648.

The recent Anthropocene focus of eco-criticism, with its fundamental preoccupation with how forms of causality move across time, space, organism and society on a planetary level, has done much to energize a scholarly urgency about our entanglement with the universe, and the dire consequences of ignoring that entanglement.[22] The twenty-first century world is an ecosystem entire; a "web of life" beyond Humboldtian dreams in which legislation and nature are all the more intertwined. With each passing year we learn of—or develop— more ways that our societies, our individual choices, and our bodies are locked in an infinitely complicated sympathy with one another, with the planet we inhabit, and with the organisms that inhabit us. And with each passing year we are made more aware that disregarding that sympathy is a threat to all life. Anthropocene studies urge us to consider how we might bring literary methodology to bear on conceptualizing ecological problems of an unprecedented scale: extinctions, oceanic dead zones, pollution, climate change, all black variations on our membership in the "community of matter" caught between and caused by national interests that differ only in magnitude from those under *Nature's* Victorian scrutiny.

In their introduction to *Anthropocene Reading: Literary History in Geologic Times* (2017), Tobias Menely and Jesse Oak Taylor write that the issues of the Anthropocene "productively unsettle conventional disciplinary modes of inquiry," and it's adjacent to this interdisciplinary Anthropocene conversation that I think Victorian "sympathy for science" can do generative work.[23] The nineteenth-century discourses in this project which privileged imaginative unity were already actively working out communicative scaffolding by which to register, in Menely

[22] "Anthropocene" designates a new geological era, discrete from the Holocene, in which human activity leaves its mark in the stratigraphic record. Various historical epochs' effects on the environment have been proposed as the line of demarcation. See Colin N. Waters et al. "The Anthropocene is Functionally and Stratigraphically Distinct from the Holocene," *Science* 351.6269 (2016): aad26221-10.
[23] Tobias Menely and Jesse Oak Taylor, editor's introduction to *Anthropocene Reading: Literary History in Geologic Times* (University Park: The Pennsylvania University Press, 2017), 4.

and Taylor's words, "modes of affect and experience related to thermodynamic, geological, and atmospheric processes," even when their concerns were circumscribed by national or class boundaries.[24] If "sympathy for science" was not actually extricable from material and national concerns, it did—and does—suggest the possibility of modes of attachment on a much more primitive level of identification.[25] And moving forward, thinking through "sympathetic" structures adds to our interdisciplinary rhetorical toolkit as we negotiate our simultaneously enormous and infinitesimal power in the face of the Cosmos.

Sagan certainly had a sense of anthropogenic power, and he would have agreed with Dipesh Chakrabarty that "the wall between human and natural history has been breached" in the course of the contemporary era.[26] The famed astronomer, exobiologist and publicizer was an interlocutor in the Anthropocene discussion at a time when the geological epoch was still an informal shorthand among scientists. While he was more of a humanist critic than a true eco-critic, frequently using human life as a metonymic shorthand for life on earth, Sagan's vocal advocacy of a cosmic sympathy seems to me to mark an important modern outgrowth of nineteenth-century discourse, seeking as it did to expand the boundaries of affective engagement while confronting the permeable boundaries of nation and nature.[27] A practitioner uncompromisingly committed to making the insights of science "understanded of the people,"

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[24] Menely and Taylor, "Introduction," 12.

[25] This idea supports Regenia Gagnier, *Individualism, Decadence, and Globalization: On the Relationship of Part to Whole, 1859-1920* (New York: Palgrave Macmillan, 2010) in her proposition to re-think the boundaries of the "individual" at all. Reflecting on Victorian conceptions of interdependence, Gagnier considers modern systems biology and the ever-increasingly revealed complexity of minuscule cooperative natural systems, and suggests that these biological or natural scales might offer a certain transcendence over the national and social systems that constrain ideas of individual and community (9-20).

[26] Dipesh Chakrabarty, "The Climate of History: Four Theses," *Critical Inquiry* 35, no. 2 (2009): 221.

[27] We might contrast Sagan with publicizing contemporaries like Stephen Jay Gould, Richard Dawkins, and especially E. O. Wilson, who as biologists recurred to animals living and extinct as object lessons on confronting albeit similar scientific issues.

Sagan married his accuracy and rigor to a "large-hearted love of science."[28] He literally brought the "truths of science home to the people" on a scale unimaginable to Victorian lecturers: in 1980 his *Cosmos: A Personal Journey* ushered the universe right into people's living rooms. Sagan's television series with its deeply humanist streak would eventually reach half a billion viewers across a planetary community.[29]

Sagan may have spoken through the mechanisms of the future, but he accessed the same rhetorical pathos we've seen over the course of this project shot through with counter-cultural idealism.[30] In reaching across space, time, and human history, Sagan visually and textually constructs a *literal* cosmopolitanism. If Kant envisioned a true cosmic-polis as a perpetual peace among "men as Citizens of the world," Sagan ups the ante.[31] His "citizenship of the cosmos" is fomented by the unified and unifying wonder of our material destiny, and the sublime surrender to our smallness.[32]

> The Cosmos was discovered only yesterday. For a million years it was clear to everyone that there were not other places than the Earth. Then in the last tenth of a percent of the

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[28] For the difficulties still posed by being a practitioner and publicizer in the 20th century see the conclusion to Chapter 1.

[29] Keay Davidson, *Carl Sagan: A Life* (New York: Wiley, 1999), 318; William Poundstone, *Carl Sagan: A Life in the Cosmos* (New York: Henry Holt and Co., 199) records that the book version of *Cosmos* stayed on the bestseller list for seventy weeks and sold more copies than any English-language science book ever published (261-262).

[30] Sagan's prose regularly appeared in the countercultural press in the late 1960s and early 1970s, including *The Whole Earth Catalog* and its affiliated magazine, *The CoEvolution Review,* as well as *Rolling Stone*. See Poundstone, *Sagan,* 175.

[31] Immanuel Kant, "Perpetual Peace: A Philosophical Essay" (1795) in *Kant's Principles of Politics, including his Essay on Perpetual Peace,* ed. and trans. W. Hastie (Edinburgh: T. and T. Clark, 1891), 112; Kwame Anthony Appiah, *Cosmopolitanism: Ethics in a World of Strangers* (New York: W. W. Norton and Co., 2006) notes, like Sagan, that "cosmopolitan" in its original Cynic iteration *did* connote "citizen of the cosmos," rejecting the traditional view that individuals must belong to a community within communities (xiv). Appiah suggests a way of reading "cosmopolitanism" as a reminder that human communities, as in national communities, "we need to develop habits of coexistence" (xix).

[32] Sagan, *Cosmos,* 354.

> lifetime of our species, in the instant between Aristarchus and ourselves, we reluctantly noticed that we were not the center and purpose of the Universe, but rather lived on a tiny and fragile world lost in immensity and eternity, drifting in a great cosmic ocean dotted here and there with a hundred billion galaxies and a billion trillion stars. We have bravely tested the waters and have found the ocean to our liking, resonant with our nature. Something in us recognizes the Cosmos as home. We are made of stellar ash. Our origin and evolution have been tied to distant cosmic events. The exploration of the Cosmos is a voyage of self-discovery"[33]

From the outset, the scale of the Cosmos obliterates the nations, coalescing the entire history of the earth into a single, lovely island bounded—like so many nations—by an immense "ocean." Sagan's characteristically soaring vision of existence and his measured simple phrases capture something of his own phenomenological experience of scientific knowledge: a calm bordering secular religion that his wife and partner Ann Druyan described as "informed worship."[34] But in that "informed worship" (which calls to mind Huxley's "intellectual sublimity") Sagan also tonally models the spirit of his solution to the anthropogenic problems addressed in this final chapter of *Cosmos*, "Who Speaks for Earth?" Sagan was deeply troubled by the immoderate striving of the nuclear age and the international tensions effected thereby. In both an earlier chapter in *Cosmos* and in his *Pale Blue Dot: A Vision of the Human Future in Space* (1980), he meditates upon three looming environmental catastrophes—"ozone layer depletion, greenhouse warming, and nuclear winter"— and their promise to damage the planet.[35] After his sublime glance in the passage above he devotes the central bulk of this chapter to the

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[33] Sagan, *Cosmos,* 337.
[34] Ann Druyan, introduction to *The Varieties of Scientific Experience,* xiii
[35] Carl Sagan, *Pale Blue Dot: A Vision of the Human Future in Space* (New York: Ballantine Books, 1994), 176.

"ghastly mutual embrace" of the Cold War and the fear of a martial hubris that would make all national struggles insignificant by destroying the planet altogether. If confronted by an alien race, he asks, "What account would we give for our stewardship of the planet Earth? We have heard the rationales offered by nuclear superpowers. We know who speaks for the nations. But who speaks for the human species? Who speaks for Earth?"[36]

A staunch combatant of "Science so-called," Sagan tirelessly defended the power of scientific knowledge to practically and holistically improve human life. He evoked ancient Alexandria as a cautionary fable of an early but imperfectly harmonious *polis*, where a great civilization crumbled because "science never captured the imagination of the multitude," and knowledge was available only to the few, not the many.[37] His *The Demon-Haunted World: Science as a Candle In the Dark* (1996) opens with a historical sweep of scientific medicine, and the transformations of the conditions of human life under the influence of anatomy, pharmacology, and microbiology. "Diseases that once tragically carried of countless infants and children," he writes, "have been progressively mitigated and cured by science."[38] Medicine and agriculture have saved more lives than those lost in all the wars in history; transportation, communication, and entertainment connect a once-fragmented social world.[39] But in an enhanced spirit of his Victorian predecessors, Sagan's feelingful reminder that "we are made of stellar ash" indicates a far different quality of self-interest in the pursuit of science. In a gesture which evokes the community of matter of the Cosmos metaphors, Sagan implies that the universe "resona[tes] with our nature" because of some originary likeness: a shared materiality, a

[36] Sagan, *Cosmos,* 347.
[37] Sagan, *Cosmos,* 355.
[38] Carl Sagan, *The Demon-Haunted World: Science as a Candle in the Dark* (New York: Ballantine Books, 1996), 9.
[39] Sagan, *Demon-Haunted World,* 11.

mutual "origin and evolution," and a recognition that however small, we are an affecting and affected part of this system. His engagement sprang from a primal knowledge that "this is from where we came."[40]

Recurring to a cosmic perspective, Sagan channeled the peril of nuclear annihilation into an opening-up, rather than closing-off, in the face a terrifying political threat. He transformed a geopolitical tension into an object lesson in unity on the level of the organism, by which anthropogenic threats to the planet might seep beneath instinctive survival to provoke "a new consciousness…which recognizes that we are one species."[41] Like Huxley's, Sagan's pragmatism refused reduction to material utility, however high the stakes ("the *practical value* of Physiological knowledge!" we hear a spectral Huxley scoff). Sagan's injunction that we "think on longer time scales" seems to presage Chakrabarty's third thesis, where "the consequences of [these threats] only make sense" if our view is broadened beyond the cultural or political to include the deep scale of the earth and to "think of humans as a form of life…part of the history of life on this planet."[42] For Sagan, sympathy with a scientific paradigm became thus inseparable from human sympathy. The concept of the affections and bonds we share with others

[40] Sagan, *Cosmos,* 2.

[41] That "recognition he could only compare to falling in love" described in the introduction to this project. See Sagan, *Cosmos*, 351. This too channels a Kantian idealism, which likewise influenced the more altruistic strain of Victorian cosmopolitanism. In "Perpetual Peace" Kant envisioned a peace through a similar nation-diminishment. In this condition, "all men are entitled to present themselves thus to society in virtue of their Right to the common possession of the surface of the earth, to no part of which anyone had originally more right than another" (102).

[42] Sagan, *Cosmos,* 107; Chakrabarty's synopsis of the third general thesis in response to the Anthropocene crisis of climate change in "The Climate of History" is that "the Geological Hypothesis Regarding The Anthropocene Requires Us To Put Global Histories Of Capital in Conversation with the Species History of Humans" (212.)

must extend, with all of our power, not just to our own fleeting species, but to the whole "voice of life on [this] one small world."[43]

Much like Rachel Carson at the end of *Silent Spring,* Sagan too envisioned another road.[44] His scientific vision of the future ultimately sprang from a trust in the finer qualities of the human character: "compassion for others, love for our children and our children's children, a desire to learn from history," and most of all "a great soaring passionate intelligence" which he believed capable of embracing the universe with a simultaneous interest and surrender.[45] In Sagan's view, a love of science, a sympathy with— or, in a Huxleyan idiom, a recognition of our physiological sympathy with— the Cosmos we affect and inhabit would prove the most fundamental step in combating the scientific problems caused by a lack of species-level, planet-level, Cosmos-level thinking. But far from pushing humans into a position of cosmic dread, Sagan's exposition of humankind's place on "a tiny and fragile world lost in immensity and eternity" embraces the unscalable, honoring the universe which defies our comprehension.[46] He eschewed national sovereignty in favor of a Whole Earth universalism, receding from the "Blue Marble" to an even more diminutive locus of compassion: a pale blue dot glinting dimly in the

[43] Sagan, *Cosmos,* 40. While not the Gaia hypothesis per se, Sagan's temporal coincidence both with the counter-culture movement and his proximity to the originators of the hypothesis— he was married to Lynn Margulis who co-authored the theory with James Lovelock— undoubtedly played a role in his Whole Earth style thinking.

[44] Rachel Carson's final chapter in *Silent Spring* (1962) (New York: Houghton Mifflin Harcourt, 2002) called "The Other Road" discusses the budding alternatives the chemical pesticides and urges scientific creativity towards an environmental end (277-297).

[45] Sagan, *Cosmos,* 337.

[46] Matt Hooley, "Reading Vulnerably: Indigineity and the Scale of Harm" in Menely and Taylor, *Anthropocene Reading,* 184-202 discusses the idea of "unscalable" environmental vulnerability, in which he argues that the problems [of the Anthropocene] boast a temporal and spatial vastness irreducible to the subject level. Hooley's view seems to require an embrace and acceptance of a lack of subjectivity, where Sagan's recognizes the immateriality of subjectivity but simultaneously urges action, which implies the power of a subject.

lens of a space craft beyond Neptune.[47] This "mote of dust suspended in a sunbeam" incites fellow-feeling commensurate with its vulnerability:

> It has been said that astronomy is a humbling and character-building experience. There is perhaps no better demonstration of the folly of human conceits than this distance image of our tiny world. To me, it underscores our responsibility to deal more kindly with one another, and to preserve and cherish the pale blue dot, the only home we've ever known.[48]

Elsewhere, Sagan will describe this affective alchemy in simpler terms. "When we recognize our place in an immensity of light-years and in the passage of ages," he writes, "when we grasp the intricacy, beauty, and subtlety of life, then that soaring feeling, that sense of elation and humility combined, is surely spiritual."[49] Sagan combines an existential urgency to the eternal scientific refrain that seeking nature can only add to, not diminish, wonder. Feeling the material entanglement of atoms and stars, "quasars and quarks," snowflakes and black holes is an *existential* responsibility, a bulwark against environmental destruction and the "endless cruelties" of human war.[50] In a cosmic age, the "soaring feeling" that springs from our sympathy with the

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[47] A scientific universalism for which, in an era where such an idea too closely approximated the national commitments of the Soviet Union, Sagan was angrily criticized by political conservatives gaining prominence in the Reagan era. See Davidson, *Sagan*, 337-338; The now-iconic "Blue Marble" photograph of the Earth from orbit was taken by the *Apollo 17* in 1972; the now-iconic "Pale Blue Dot," by the *Voyager 1* spacecraft, at Sagan's behest, in 1989. Sagan makes a comparison between the two images of Earth in *Pale Blue Dot,* 3.

[48] Sagan, *Pale Blue Dot,* 7. The moments preceding this passage plainly position Sagan's cosmic perspective against the martial squabbles on the national scale of the planet: "Think of the rivers of blood spilled by all those generals and emperors so that, in glory and triumph, they could become the momentary masters of a fraction of a dot. Think of the endless cruelties visited by the inhabitants of one corner of this pixel on the scarcely distinguishable inhabitants of some other corner, how frequent their misunderstandings, how eager they are to kill one another, how fervent their hatreds" (6-7).

[49] Carl Sagan, *The Varieties of Scientific Experience,* ed. Ann Druyan (New York: Penguin Books, 2006), 31.

[50] Sagan, *Pale Blue Dot,* 6.

universe might prove the deepest font of a global ethics. For Sagan, sympathy for science could quite literally save our lives, and our souls along with them.

Carson and Sagan both wrote of humankind's implicit "obligation to endure" in consideration of the so far singular nature of the planet we inhabit. "The obligation to endure," Carson wrote of the pernicious influence of chemical pollution, "gives us the right to know."[51] We have, as Sagan reminds us, nowhere else to go. We can sympathize or we can perish: the choice is between "the universe [I.e. existence] or nothing." But to the last, Sagan frames this obligation as an act not simply of self-preservation, but of fellow-feeling: "Our loyalties are to the species and to the planet. *We* speak for Earth."[52] While as scientists Carson and Sagan both rely on the power of evidence to warn of perils of scientific hubris, as humanists the most moving of their rhetorics rely on the power of affection: for "the curving wing of a bird in flight" and the "brilliant coats" of young fish, for the insects in the soil and the "intricately sculptured" *Globigerina* in the sea, and for the quasars and remote suns expelling the shimmering precipitate that in some far-distant future may form a living thing.[53] Our appreciation and recognition of an obligation to "our fellow existers" forms the basis of all future action; our survival on this planet and in the cosmos depends not upon power, but upon love. As the concluding passage of *Cosmos* suggests, the saving grace of scientific knowledge hinges upon the wonder, humility, and

[51] Carson, *Silent Spring,* 6, 13. Carson's chapter is called "The Obligation to Endure," and she notes that she is quoting the French biologist Jean Rostand.
[52] Sagan, *Cosmos,* 365.
[53] Carson, *Silent Spring,* 127, 130, and *The Sea Around Us* (New York: Oxford University Press, 1950), 80. Carson's lovely chapter on "The Long Snowfall" (75-82) calls the Victorian reader to mind of Huxley's homage to the tiny *Globigerina* a century beforehand in "On a Piece of Chalk"; Sagan, *Cosmos,* 7.

sympathy with which it expands our imaginations. "Our obligation to survive," Sagan closes, "is owed not just to ourselves but also to that Cosmos, ancient and vast, from which we spring."[54]

[54] Sagan, *Cosmos,* 365. Carson before him would have a similar take, as Linda Lear records in her "Introduction" to *Silent Spring* (1962) (New York: Houghton Mifflin Harcourt, 2002):
"It seems reasonable to believe," she wrote, "that the more clearly we can focus our attention on the wonders and realities of the universe about us, the less taste we shall have for the destruction of our race. Wonder and humility are wholesome emotions, and they do to exist side by side with a lust for destruction" (xix).

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