Technologies of the Scientific Self: John Tyndall and His Journal

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Abstract: This essay examines the physicist John Tyndall's journal writing in the mid-nineteenth century and focuses on how Tyndall used his journal during a series of transitions that occurred when he was a young man: when he went from being a surveyor to a public school instructor and then from a Ph.D. student and budding experimenter in Germany to Professor of Natural Philosophy at the Royal Institution in London. As well as providing insight into these various transitions, the journal more importantly shows how Tyndall developed a particular ethical conception of self, based on his readings of Carlyle, Emerson, and Fichte, and how that sense of self shaped—and was shaped by—his early experimental practices. Thus, the article is a case study in the development of a particular scientific self that emerged in the mid-nineteenth century, whose novel claim to authority was based on a particular fusion of the ethical and the epistemological.

On 17 October 1850, John Tyndall (ca. 1822–1893) began a new volume of his journal that would record the events of his life from 1850 until 1855. While he initially complained about the quality of the stationery he purchased for the journal, he decided that "if good deeds be written thereupon it will be a compensation." He also reflected on the fact that the previous volume of his journal was begun two years before and noted that he "reaped the profit" from the many "chastenings" it contained. "And now I stand upon the threshold of another book," he wrote.[1] He also stood upon the threshold of a new chapter in his life.

Then in his late twenties, the former surveyor had recently resigned his position as an instructor at Queenwood College in order to engage in doctoral studies at Marburg University in Germany; he would work with the renowned chemist Robert Bunsen and under the supervision of the mathematician Friedrich Stegmann. His success at Marburg would ultimately

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[1] John Tyndall, Journal, 17 Oct. 1850, Papers of John Tyndall, Royal Institution of Great Britain, London (hereafter cited as **Tyndall Papers**), RI MS JT/2/6/1.

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lead Tyndall, the son of an Irish shoemaker, to the center of scientific life in England, as he would eventually, in 1853, be appointed Professor of Natural Philosophy at the Royal Institution of Great Britain (RI). He succeeded Michael Faraday as the RI's Superintendent in 1867 and went on to shape the direction of established scientific fields such as physics and chemistry while discovering theories that formed the basis of new fields such as meteorology and glaciology. Moreover, he became an important public figure who utilized his scientific expertise to intervene in a wide range of social and political contexts—most famously in the 1874 presidential address to the annual meeting of the British Association for the Advancement of Science (BAAS) that came to be known as the "Belfast Address."[2] Writing in his journal in 1850, Tyndall had only a vague sense that these achievements were almost within his grasp.

He noted at the outset that his journal was not meant to be a record of his "extacies nor yet of sufferings"; indeed, he was adamant that "it will not be romantic." He expected, rather, that his journal would "attest [to] the commonplace fact that I have done my work. Sterner feelings or higher hopes I will not express. Let my acts utter them if they be real."[3] Journal entries such as this one indicate how Tyndall believed he ought to use his journal: not as a record of his joy or anguish at the events of his life but, rather, as a space to document whether he fulfilled his duty to himself by completing his "work." As we will see, "work" was laden with meaning in Tyndall's philosophy of self, referring at once to physical or mental labor and also to self-development or, to use a more modern idiom that Tyndall would immediately have grasped, work on the self. Tyndall believed that succeeding in life, whether as a surveyor, an instructor, or, indeed, a man of science, was intimately connected to the creation of a particular moral character—an ethos—that would be able to discern reliable knowledge. He therefore used his journal as a space to help cultivate this ethical persona, which eventually formed the basis for the scientific self that he presented to the world.

Tyndall has recently begun to receive substantial scholarly attention. In 2011, for instance, Ursula DeYoung's monograph-length study of Tyndall was published. It was followed in 2018 by Roland Jackson's well-received biography.[4] There is also currently in progress a massive John Tyndall Correspondence Project, the goal of which is to transcribe and publish Tyndall's more than seven thousand extant letters. This project has also led to an edited collection.[5] Moreover, a series of recent articles have explored Tyndall's transcendental religious beliefs, the relationship between his mountaineering and his glacial science, and his early studies of diamagnetism.[6]

Significantly, much of this recent scholarship utilizes Tyndall's eight-volume journal as a key primary source for gaining further insight into his life. Like many Victorian diarists, he used his

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[2] On Tyndall as a leading scientific naturalist see, most recently, Gowan Dawson and Bernard Lightman, eds., *Victorian Scientific Naturalism: Community, Identity, Continuity* (Chicago: Univ. Chicago Press, 2014). On the Belfast Address see Ruth Barton, "John Tyndall, Pantheist: A Rereading of the Belfast Address," *Osiris*, 1987, N.S., 3:111–134; and Lightman, "Scientists as Materialists in the Periodical Press: Tyndall's Belfast Address," in *Science Serialized: Representation of the Sciences in Nineteenth-Century Periodicals*, ed. Geoffrey Cantor and Sally Shuttleworth (Cambridge, Mass.: MIT Press, 2004), pp. 199–237.

[3] Tyndall, Journal, 17 Oct. 1850, Tyndall Papers, RI MS JT/2/13b/512.

[4] Ursula DeYoung, *A Vision of Modern Science: John Tyndall and the Role of the Scientist in Victorian Culture* (London: Palgrave Macmillan, 2011); and Roland Jackson, *The Ascent of John Tyndall: Victorian Scientist, Mountaineer, and Public Intellectual* (Oxford: Oxford Univ. Press, 2018).

[5] For publishing details about this series see https://www.upress.pitt.edu/series/the-correspondence-of-john-tyndall-2/ (accessed 27 Feb. 2019). The collection is Bernard Lightman and Michael Reidy, eds., *The Age of Scientific Naturalism: Tyndall and His Contemporaries* (Pittsburgh: Univ. Pittsburgh Press, 2014).

[6] Geoffrey Cantor, "John Tyndall's Religion: A Fragment," *Notes and Records of the Royal Society*, 2015, 69:419–436; Michael Reidy, "John Tyndall's Vertical Physics: From Rock Quarries to Icy Peaks," *Physics in Perspective*, 2010, 12:122–145; and Roland Jackson, "John Tyndall and the Early History of Diamagnetism," *Annals of Science*, 2015, 72:435–489.

journal for a variety of purposes, not least of which was to record his daily activities—from the people he met and conversations he had to details about his lecture preparations and scientific experiments. He also often drafted letters in his journal or, relatedly, copied out important letters that he had received or written. That there is a close connection between Tyndall's journal and his letter writing is clear from recent volumes of the Tyndall Correspondence Project, as its editors refer to the journal throughout the annotations in order to add further context and provide likely dates for many of the undated letters. Tyndall's journal is also the only source for many of the letters that appear in the published correspondence. But despite this extensive recent work on Tyndall that has utilized the journal quite effectively as a primary source, the journal itself has yet to be examined as a subject on its own or in connection with his extensive letter writing.[7]

This is somewhat surprising, given the relatively recent turn toward the methods of book history that has occurred in the history of science, a turn that has meant that many historians of science have begun to focus on a variety of different kinds of texts as objects of historical inquiry. Notebooks, travel logs, questionnaires, and even archives have all been explored as playing important roles in shaping and managing knowledge and scientific identities. A representative example of this scholarship is Richard Yeo's study of the role of notebooks and note-taking in early modern English science, a wide-ranging practice that helped natural philosophers control and store information that could then be retrieved when necessary.[8] While the use of diaries and journals has received much less attention in this context, there is something to be said for their relevance in shaping burgeoning scientific identities.[9] Indeed, if the practices of early modern note-taking were central in helping to establish English natural philosophers as *virtuosi*, perhaps the practices of Victorian journaling contributed to the establishment of the modern scientific self.

As this essay will demonstrate, Tyndall's journal gradually developed into a space where his observations of self became entangled with his observations of nature. This accords well with one of the key themes of Lorraine Daston and Peter Galison's groundbreaking *Objectivity* (2007), which argues that since the early modern period the production of scientific knowledge has involved the emergence of what they call "epistemic virtues," a fusion of epistemology and ethics that emphasized that the creation of scientific knowledge also necessitated the creation of a particular kind of person. Whereas in the seventeenth and eighteenth centuries the dominant form of this scientific self was concerned with representing the truth of nature, and therefore sought to cultivate artistic virtues and interpretive judgments in the natural philosopher, in the mid-nineteenth century the chief obstacle to scientific knowledge became the practitioner himself, who therefore sought to overcome his will through a regimen of self-mastery in order to let nature speak for itself. As Daston and Galison point out, this self-mastery involved the embrace of virtues such as patience, industry, sacrifice, self-denial, and, above all, self-restraint, virtues that were to be cultivated by relying on a host of "technologies of the self"; specifically, forms of what Michel Foucault called "self-writing," such as correspondence, notebooks, diaries, and journals, were to be utilized to improve one's character, to transform "truth into ethos." Tyndall used his journal in just this sort of way, initially as part of a practice of self-development and later, more explicitly, as a tool to help him master his body by denying his mental and physical desires in order to clear his mind so that he could make the precise sorts of observations necessary to produce accurate knowledge of the physical world. An analysis of

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[7] That said, Roland Jackson presented material on Tyndall's various notebooks and journals at a "Scientific Diaries Workshop" held at the Royal Society Library, in association with the Constructing Scientific Communities Project, on 27 Jan. 2017.

[8] Richard Yeo, *Notebooks, English Virtuosi, and Early Modern Science* (Chicago: Univ. Chicago Press, 2014). See also Yeo and Ann Blair, eds., "Note-Taking in Early Modern Europe," special issue, *Intellectual History Review*, 2010, 20:301–433; and Lorraine Daston, ed., *Science in the Archives: Pasts, Presents, Futures* (Chicago: Univ. Chicago Press, 2017).

[9] However, see Paul White's *Thomas Huxley: Making the "Man of Science"* (Cambridge: Cambridge Univ. Press, 2002), which utilizes Huxley's letter and journal writing to explore his identity formation.

Tyndall's journal use, therefore, provides a remarkable case study for considering just how the cultivation of an ethical persona came to shape—and be shaped by—developing scientific practices to form a particular scientific identity. It also sheds light on an aspect of mechanical objectivity that was possibly specific to the Victorian context, in which class and related social anxieties informed the desire to transcend the self—as was certainly the case with Tyndall.[10]

In order to flesh out this study in the making of Tyndall's scientific self, this essay will focus on how Tyndall used his journal during a series of transitions that occurred when he was a young man, when he went from being a surveyor to a public school instructor, and then from a Ph.D. student and budding experimenter in Germany to Professor of Natural Philosophy at the RI in London. This period of roughly ten years, from the early 1840s until the early 1850s, was a remarkable decade of steady upward mobility that is well documented in Tyndall's journal. As well as providing insight into these various transitions, the journal more importantly shows how Tyndall's ethical persona was formed out of his early experiences in the self-improvement culture of Northern England and through his careful readings of Thomas Carlyle and, later, the American transcendentalist Ralph Waldo Emerson and the German idealist Johann Gottlieb Fichte. Through his own particular synthesis of these different thinkers, Tyndall articulated in his journal a decidedly masculine persona that was devoted to truth and valorized work, embraced self-development but also self-denial, extolled the virtue of patience and careful analysis, and rejected laziness and egotism. This was an ethos, moreover, that needed to be reproduced in others, a task Tyndall embraced with relish through his teaching at Queenwood College and by mentoring other young men. It was also applied to, and informed by, his experimental practices and thereby played a formative role in shaping his scientific self.

I. THE PURSUIT OF KNOWLEDGE UNDER DIFFICULTIES

Tyndall's earliest extant journal entry was written on 9 February 1841, when he was a civil assistant in the Ordnance Survey Office in Youghal, County Cork, Ireland.[11] He therefore began his journal precisely when the popularity of diary writing had peaked in Britain, after it had grown substantially in the preceding decades. By the 1840s, the diary had become a genre in its own right owing to the publication of diaries by such celebrated literary figures as John Evelyn, Samuel Pepys, Lord Byron, Walter Scott, and David Wilkie. Fictional diaries began to appear with regularity in novels and plays, notably forming the subject matter of Charles Dickens and Mark Lemons's farce *Mr. Nightingale's Diary* (1851), about a man whose diary became such a self-obsession that his actual life became quite secondary to the imaginary world he constructed therein. Diaries, therefore, may have the appearance of being entirely the private thoughts of an internal life. In the Victorian period, however, diary authors were self-consciously participating in a genre that came with its own literary devices, expectations, and circumscribed possibilities.[12]

The literary analysis of diaries has become a staple of Victorian scholarship, particularly for understanding what Regina Gagnier has called the "pragmatics of self-representation"—namely, the function that autobiographical statements played in the concrete circumstances of daily life.[13] A prominent theme in this scholarship is how the diary can be understood as a site of

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[10] Lorraine Daston and Peter Galison, *Objectivity* (New York: Zone, 2007), esp. Ch. 4 ("The Scientific Self"); and Michel Foucault, "Self-Writing," in *The Essential Works of Foucault, 1954–1984*, Vol. 1: *Ethics: Subjectivity and Truth*, ed. Paul Rabinow (New York: New Press, 1997), pp. 207–222, on p. 209. For an analysis of self-abnegation in the Victorian context see George Levine, *Dying to Know: Scientific Epistemology and Narrative in Victorian England* (Chicago: Univ. Chicago Press, 2002).

[11] Tyndall, Journal, 9 Feb. 1841, Tyndall Papers, RI MS JT/2/13a/i. It should be noted that the terms "journal" and "diary" were relatively interchangeable in this period, though Tyndall used "journal" in reference to his own diary.

[12] Kathryn Carter, "The Cultural Work of Diaries in Mid-Victorian Britain," *Victorian Review*, 1997, 23:251–267; and David Amigoni, "Introduction," in *Life Writing and Victorian Culture*, ed. Amigoni (Burlington, Vt.: Ashgate, 2006), pp. 1–19.

[13] Regina Gagnier, *Subjectivities: A History of Self-Representation in Britain, 1832–1920* (Oxford: Oxford Univ. Press, 1991), p. 4.

identity formation at a time of fraught class, race, and gender relations. In the context of the changing cultural landscape of early Victorian Britain, it is clear that many Victorians used their diaries as a way to help navigate those new circumstances, which also often entailed the management of their public identities.[14]

The diary as a tool for "self-fashioning" is a common trope in Victorian scholarship, as certain members of the middle and working classes took advantage of limited but very real possibilities for mobility by constructing new social identities. While Stephen Greenblatt coined the concept to explain the process by which men of noble status in the Renaissance performed their public identities by constructing socially acceptable modes of comportment, Victorianists have typically appropriated the idea to refer to the creation of new or multiple public identities that transcended previous social roles.[15] Historians of science have also found the concept useful, as it has been enlisted to describe, for instance, the way in which Galileo sought to navigate the different social contexts of the Italian court system, how Humphry Davy, in the early nineteenth century, cultivated different scientific identities to suit the changing circumstances of his public life, and how Davy's assistant at the RI, Michael Faraday, fashioned different modes of self-presentation and performance that enabled him to transcend his impoverished background to become the most celebrated science lecturer and natural philosopher in midcentury England. Bernard Lightman has even applied the notion of self-fashioning to Tyndall by claiming that if as a young man he presented himself as a political rebel, he later fashioned a conservative persona that better suited his position at the RI; his identity was later transformed again, this time showcasing the rebellious defender of the autonomy of science against the meddling of the Church, as was made most explicit by his controversial Belfast Address.[16]

If in this regard "self-fashioning" refers to the public-facing and surface identities that were often adopted and then discarded in favor of new ones that better suited changing social and cultural circumstances, I am concerned here with something slightly different: namely, with the construction of a deep sense of self that is formed in dialogue with changing circumstances such as those of occupation. While it is true that Tyndall took on many jobs during his formative years, becoming, respectively, a surveyor, public instructor, translator, lecturer, and professor of natural philosophy, the identity he adopted for each was in the first instance given shape by his own idealized sense of self. Rather than seeking to fashion new identities to suit each of these positions, Tyndall believed himself to be in a constant, progressive process of self-development; each new position was meant to help furnish him with new resources to continue that process. I argue, therefore, that Tyndall's scientific self was ultimately the culmination of a long process of self-cultivation that he began early on, well before he began lecturing at the RI.[17]

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[14] Amigoni, "Introduction" (cit. n. 12), p. 2; and Anne-Marie Millim, *The Victorian Diary: Authorship and Emotional Labour* (Burlington, Vt.: Ashgate, 2013), p. 2. See also Rebecca Steinitz, *Time, Space, and Gender in the Nineteenth-Century British Diary* (New York: Palgrave Macmillan, 2011); Martin Hewitt, "Diary, Autobiography, and the Practice of Life History," in *Life Writing and Victorian Culture*, ed. Amigoni (cit. n. 12), pp. 21–40; and Lawrence Rosenwald, *Emerson and the Art of the Diary* (Oxford: Oxford Univ. Press, 1988).

[15] See, e.g., James Eli Adams, *Dandies and Desert Saints: Styles of Victorian Masculinity* (Ithaca, N.Y.: Cornell Univ. Press, 1995), for the "rhetorical self-fashioning" of models of Victorian masculinity (p. 5).

[16] Bernard Lightman, "Fashioning the Victorian Man of Science: Tyndall's Shifting Strategies," *Journal of Dialectics of Nature*, 2015, 38:25–38. See also Iwan Rhys Morus, *Frankenstein's Children: Electricity, Exhibition, and Experiment in Early-Nineteenth-Century London* (Princeton, N.J.: Princeton Univ. Press, 1998); Jan Golinksi, *The Experimental Self: Humphry Davy and the Making of a Man of Science* (Chicago: Univ. Chicago Press, 2016); Mario Biagioli, *Galileo, Courtier: The Practice of Science in the Culture of Absolutism* (Chicago: Univ. Chicago Press, 1993); and Stephen Greenblatt, *Renaissance Self-Fashioning: More to Shakespeare* (Chicago: Univ. Chicago Press, 1980).

[17] W. H. Bruford, *The German Tradition of Self-Cultivation: "Bildung" from Humboldt to Thomas Mann* (Cambridge: Cambridge Univ. Press, 1975).

Tyndall's early journal use gives us insight into the development of his ethos as a product of his adherence to a lifelong process of self-education. Like many from the newly mobile working and middle classes who kept diaries at the time, Tyndall did so as part of a wider practice of self-improvement, or what he called "self-culture." Much like the diary itself, the notion of self-improvement was a prominent theme in the 1840s and 1850s and was associated with "character" development, a connection that was popularized in the series of "self-help" works written by Samuel Smiles for the benefit of the "self-made" man that explicitly linked moral and intellectual development.[18] The self-examination that was central to many Victorian diaries was therefore undertaken in the hope of improving the writer's moral character. Tyndall's early journal writing reflected this larger context as he sought to better himself, economically, socially, intellectually, and morally.

In the 1840s, therefore, Tyndall benefited from his participation in what Ruth Barton calls the "mechanics' institute culture," a range of formal and informal institutions, as well as individual and social practices, that stressed the self-learning that developed around the mechanics' institutions of Northern England.[19] Indeed, after being transferred to the English Ordnance Survey in Preston in 1842, Tyndall took advantage of its culture of self-education by joining the mechanics' institute there. His journal makes note not only of weekly lectures that he attended on various scientific subjects but also of his burgeoning reading habits. When Tyndall was eventually fired from the survey in 1843 for raising concerns about the pay and work conditions for the Irish assistants, he went to Halifax to work as a railway surveyor for Richard Carter, who encouraged his employees to take advantage of the kind of educational practices that Tyndall was already engaged in, thereby providing an environment that was conducive to Tyndall's self-learning ambitions. As he had done in Preston, Tyndall joined the local mechanics' institute in Halifax in 1845 and continued seeking ways to improve his knowledge and better himself, a message that was itself reinforced by what he was reading.[20] His journal writing, moreover, became an important tool in his self-learning, functioning both as a record of his daily life and as a commonplace book.

Thus, one of the ways Tyndall used his journal in the mid- to late 1840s was as a record of his reading practices, practices that were encouraged by the mechanics' institutes of which he was a member. He often recorded in his journal that he was reading the *Mechanics' Magazine*; and on one occasion, when he was feeling particularly apathetic because he was between positions, he read the anonymous *The Pursuit of Knowledge under Difficulties*—a book with which he was already familiar—in order to lift his spirits. Published by Charles Knight and the Society for the Diffusion of Useful Knowledge, *The Pursuit of Knowledge under Difficulties* provided an array of biographical sketches of important historical figures who produced new knowledge despite their social hardships. The young Tyndall was enthralled with the sketch of Newton, which stressed that Newton was careful after making his famous discovery of gravity not to publicize it

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[18] Tyndall, Journal, 6 July 1852, Tyndall Papers, RI MS JT/2/13b/575. On self-improvement and the relationship between moral and intellectual development see Anne Secord, "'Be What You Would Seem to Be': Samuel Smiles, Thomas Edward, and the Making of a Working-Class Scientific Hero," *Science in Context*, 2003, *16*:147–173; and Stefan Collini, *Public Moralists: Political Thought and Intellectual Life in Britain, 1850–1930* (Oxford: Oxford Univ. Press, 1991), pp. 100–101.

[19] Ruth Barton, *The X Club: Power and Authority in Victorian Science* (Chicago: Univ. Chicago Press, 2018), p. 59.

[20] For details about this early period in Tyndall's life see Geoffrey Cantor and Gowan Dawson, "Introduction to Volume 1," in *The Correspondence of John Tyndall*, Vol. 1: *1840–3*, ed. Cantor and Dawson (Pittsburgh: Univ. Pittsburgh Press, 2016), pp. xxxix–liii; Melinda Baldwin and Janet Browne, "Introduction to Volume 2," in *The Correspondence of John Tyndall*, Vol. 2: *September 1843–December 1849*, ed. Baldwin and Browne (Pittsburgh: Univ. Pittsburgh Press, 2016), pp. xxxix–liii; and Jackson, *Ascent of John Tyndall* (cit. n. 4), pp. 10–23. For an analysis of this environment of self-learning as it related to Tyndall's colleague and friend Thomas Hirst see James Secord, *Victorian Sensation: The Extraordinary Publication, Reception, and Secret Authorship of "Vestiges of the Natural History of Creation"* (Chicago: Univ. Chicago Press, 2000), Ch. 10.

until he had cleared away all possible objections. This required years of patience, self-sacrifice, and self-denial. It was this profound act of patience, more than the actual discovery, that constituted Newton's true heroism.[21]

Tyndall found this observation so important that he incorporated it into his own self-education practices. A few days after reading *The Pursuit of Knowledge under Difficulties* he spent several hours reading a single, very challenging article in the *Mechanics' Magazine*. He did so because he recognized that in order to understand something difficult, it was important, above all else, to be patient. He became "induced to exercise this virtue," he wrote, because of the humble example provided by Newton.[22] Whether trying to comprehend a magazine article or investigating a law of nature, Tyndall believed that the same patient mode of analysis was necessary—a mode that was also, perhaps most importantly, a *virtue*. As we will see, this virtue of patience and all that it entailed, from perseverance and concentration to self-denial and self-sacrifice, became central to Tyndall's self-education practices and, eventually, to his scientific practices as well, and it was reinforced in his journal as he reminded himself of its centrality to his idealized self.

II. TYNDALL'S MANLY READING HABITS: NOBILITY, SELF-CULTURE, AND PERFECTIBILITY

At this stage in Tyndall's life, however, it was the literary sage Thomas Carlyle who emerged as the most formative influence on his self-cultivation. Tyndall's first exposure to Carlyle occurred in June 1844, when he began reading *Past and Present*. He was utterly transfixed by it. On 23 June he referred to *Past and Present* as a "first rate work written in a very peculiar style." And on 24 June he finished reading the book.[23] Several subsequent entries refer to his second reading of the book and the "ample" extracts he was making.[24] Rather than clutter his journal with these extracts, however, he made his notes on "some old sheets of foolscap" and later tied the sheets together, making a separate notebook. Tyndall kept this notebook with his possessions his entire life and even read out portions of the notes to Carlyle himself after the two became closely acquainted in later years.[25]

What Tyndall appreciated about *Past and Present* was the rejection of aristocratic birthright and its association with inherent nobility in favor of the nobility of work that transcended social circumstances.[26] Carlyle's celebration of work and the kind of virtuous, self-disciplined character that was necessary to engage in that work, whether cotton spinning or shoe making, was effectively a celebration of Tyndall's father, whom Tyndall greatly admired, believing that he had inherited from him a sense of the importance of an "inflexible integrity" that had to be maintained at all cost.[27] Carlyle, therefore, reinforced some of the virtues Tyndall had already embraced, such as patience, honesty, and hard work. More important, he gave Tyndall's

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[21] Tyndall, Journal, 15 Apr. 1844, Tyndall Papers, RI MS JT/2/13a/28; and [George L. Craik], *The Pursuit of Knowledge under Difficulties* (London: Charles Knight, 1830), p. 7. See also Daston and Galison, *Objectivity* (cit. n. 10), p. 229.

[22] Tyndall, Journal, 20 Apr. 1844, Tyndall Papers, RI MS JT/2/13a/29.

[23] Tyndall, Journal, 22 June 1844, 23 and 24 June 1844, Tyndall Papers, RI MS JT/2/13a/43. For Carlyle's influence on Tyndall and other scientific naturalists see Frank Turner, "Victorian Scientific Naturalism and Thomas Carlyle," in *Contesting Cultural Authority: Essays in Victorian Intellectual Life* (Cambridge: Cambridge Univ. Press, 1993), pp. 131–150.

[24] Tyndall, Journal, 25 June 1844, Tyndall Papers, RI MS JT/2/13a/43; 27 June 1844, Tyndall Papers, RI MS JT/2/13a/43–44; 29 June 1844, Tyndall Papers, RI MS JT/2/13a/44; 2 July 1844, Tyndall Papers, RI MS JT/2/13a/45; 12 July 1844, Tyndall Papers, RI MS JT/2/13a/47; and 15 July 1844, Tyndall Papers, RI MS JT/2/13a/47.

[25] John Tyndall, "Personal Recollections of Thomas Carlyle," *Fortnightly Review*, 1890, *47*(277):5–32, on p. 6.

[26] See Tyndall, Journal, 8 July 1844, Tyndall Papers, RI MS JT/2/13a/46, where Tyndall praises "the nobility of soul" possessed by his friend William Wright.

[27] Tyndall, Journal, 6 July 1852, Tyndall Papers, RI MS JT/2/13b/575.

journey of self-improvement a deeply moral language and purpose that was not previously articulated. This is because Carlyle stressed that intellectual labor was a heroic activity that was just as important and manly as physical labor, a view that Tyndall adopted enthusiastically. As he later recollected, he found in Carlyle's *Past and Present* "a morality so righteous, a radicalism so high, reasonable, and humane, as to make it clear to me that without trucking to the ape and tiger of the mob, a man might hold the views of a radical."[28]

Over the next few years, as Tyndall worked in various survey positions, he continued to read Carlyle, notably the edition of *Oliver Cromwell's Letters and Speeches* (1844), which he found overturned a long-received view of Cromwell as a hypocrite. Carlyle showed Cromwell in a more "true speculum," Tyndall wrote, as "a stalwart man in mind and body." A few days later, after writing out a few extracts from Carlyle's observations about Cromwell, Tyndall exclaimed: "By pondering over these pages of Carlyle I may gather a little soul! May the heavenly powers grant it!" The next day, Tyndall turned to Carlyle's *On Heroes, Hero-Worship, and the Heroic in History* (1841), a book on which he wrote extensive notes in his journal. He embraced Carlyle's view about the importance of great men in history, men who were not beholden to received doctrines but, rather, devoted themselves to a set of practical beliefs that were put into practice through hard work, whatever their economic or social backgrounds.[29] As great as these men were, Tyndall could also identify with their beliefs, practices, and overarching struggles.

The same month that Tyndall read *On Heroes*, he also purchased a copy of the sensational and anonymously published *Vestiges of the Natural History of Creation* (1844). He immediately found the work "admirable" and used his journal as a space to make an analytical summary of parts of the book.[30] One might think that Tyndall's seeming embrace of the Vestigarian narrative of humanity's progressive development from a cosmic nebular mist, along with Carlyle's stress on the possibilities of upward mobility through intellectual labor, would have instilled in him sympathy for the political rights of historically oppressed groups. This was not the case. A brief trip to Paris in 1848, during the revolutionary uprising, convinced him that the "rights of man" could not be extended willy-nilly. He was particularly frustrated with the central shocking idea proposed in a book he was reading about the equality of men and women. Tyndall believed that the fallacy of the argument was exposed as soon as one realized that the same logic could then be applied to all creatures, great and small. "Mammalia, Birds, Fishes, Reptiles, down to the lowest Zoophite that waddled in the mud of our unripe world ten thousand years ago [would be] embraced in its comprehensive clasp," Tyndall wrote. He claimed that his own very different view of these matters was based on a historical understanding of the universe, which showed that progress has been possible only because of the "entrenchment of the strong upon the weak, of the enlightened upon the ignorant," and he asserted that these divisions cannot simply be swept away without the collapse of civilization itself. He then applied this perspective to the notion of Irish self-government, which he argued was "a question not of numbers but of ability"—meaning that the Irish were not yet able to govern themselves.[31]

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[28] Tyndall, "Personal Recollections of Thomas Carlyle" (cit. n. 25), p. 6. Carlyle's own attempted reconciliation of intellectual and physical labor, however, was not without tension. See Norma Clarke, "Strenuous Idleness: Thomas Carlyle and the Man of Letters as Hero," in *Manful Assertions: Masculinities in Britain since 1800*, ed. Michael Roper and John Tosh (London: Routledge, 1991), pp. 25–43.

[29] Tyndall, Journal, 31 July 1847, Tyndall Papers, RI MS JT/2/13a/240; 5 Aug. 1847, Tyndall Papers, RI MS JT/2/13a/241; and 6 Aug. 1847, Tyndall Papers, RI MS JT/2/13a/241–243.

[30] Tyndall, Journal, 7 July 1847, Tyndall Papers, RI MS JT/2/13a/228 ("admirable"); and 20 July 1847, Tyndall Papers, RI MS JT/2/13a/231–237 ("Digest" of *Vestiges*).

[31] Tyndall, Journal, 5 July 1848, Tyndall Papers, RI MS JT/2/14/21–22, 24.

This was also, of course, Carlyle's view, which was itself based on an explicit rejection of the burgeoning notion that education could help minimize the distinctions between classes, genders, and races. For Carlyle and for Tyndall, only certain individuals were capable of engaging in the kind of self-education necessary to make a claim for political rights, and thus such rights should be limited to a select group of able white men. The forces of nature and of history meant that Tyndall's own journey of self-improvement was therefore not available to most others—notably nonwhite men and all women. Thus in 1853, when Tyndall noted in his journal that he had read "Carlyle's discourse of the Nigger Question," he defended the unabashed racist views contained therein, claiming that "of course [the book] is all right. This is because it expresses the facts of nature." Those "facts" would later lead Tyndall to support the South in the American Civil War, even though his much-beloved cousin was fighting for the North. He also endorsed the violent actions of Governor Eyre in Jamaica. Many of his liberal friends found these positions difficult to comprehend.[32] They were, however, entirely consistent with the Carlylean moral code that he articulated in his journal in the mid- to late 1840s.

In 1848 Tyndall began reading the American poet and essayist Ralph Waldo Emerson, having attended a lecture Emerson gave in Halifax at the end of December the previous year. Throughout 1848 and afterward his journal often referred to his readings of Emerson, whose poetic musings on character, work, and independence meshed well with his own developing moral philosophy.[33] He wrote to his friend Thomas Hirst that he believed Emerson to be "one of the noblest souls that ever was struck in clay" and that "he teaches one to be so independent that you almost feel disposed to quarrel with himself just to shew how little you cared about even him." Tyndall was perhaps referring to Emerson's essay on "self-reliance," which stressed the need for the individual to find truth within himself and not from wider social recognition. This was a key aspect of the American transcendental movement of which Emerson was a part, best expressed by the concept of "self-culture" that Tyndall also embraced, a concept that was most explicitly articulated at the time by the Unitarian minister William Channing. "Grandeur of character," Channing argued in his 1838 Frankland Lectures in Boston on the topic of self-culture, "lies wholly in force of soul, that is, in the force of thought, moral principle, and love; and this may be found in the humblest condition of life."[34] Tyndall thoroughly agreed.

Emerson also stressed the importance of "character," which was to be cultivated in individuals by denying the flesh all its worldly desires. This is a form of manliness complementary to Carlyle's, though not to be confused with the celebration of sport and fitness as promoted by "muscular Christianity."[35] Emerson's manliness was marked by extreme self-discipline that was expressed by self-denial and self-control and symbolized by the image of Christ on the cross. The only way to cultivate a decidedly moral and thus Christian character, in Emerson's view,

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[32] Tyndall, Journal, 10 July 1853, Tyndall Papers, RI MS JT/2/13b/610. On Tyndall's positions and his friends' perplexity see Jackson, *Ascent of John Tyndall* (cit. n. 4), pp. 199–202.

[33] Tyndall, Journal, 28 June 1848, Tyndall Papers, RI MS JT/2/13b/347; 10 Dec. 1848, Tyndall Papers, RI MS JT/2/13b/405; 20 Jan. 1849, Tyndall Papers, RI MS JT/2/13b/415; and Jackson, *Ascent of John Tyndall*, p. 35. See also Raychel A. Haugrud, "Tyndall's Interest in Emerson," *American Literature*, 1970, *41*:507–517.

[34] John Tyndall to Thomas Hirst, 1 Feb. 1848, in *Correspondence of John Tyndall*, Vol. 2, ed. Baldwin and Browne (cit. n. 20), p. 261 (letter 0342); and William E. Channing, *Self-Culture* (London: John Mardon, 1839), p. 4.

[35] On forms of manliness in the Victorian period see J. A. Morgan and James Walvin, eds., *Manliness and Morality: Middle-Class Masculinity in Britain and America, 1800–1940* (Manchester: Manchester Univ. Press, 1987); Collini, *Public Moralists* (cit. n. 18), Ch. 5; Donald E. Hall, ed., *Muscular Christianity: Embodying the Victorian Age* (Cambridge: Cambridge Univ. Press, 1994); and John Tosh, *A Man's Place: Masculinity and the Middle-Class Home in Victorian England* (New Haven, Conn.: Yale Univ. Press, 1999). For the centrality of notions of masculinity to Victorian science more generally see Heather Ellis, *Masculinity and Science in Britain, 1831–1918* (London: Palgrave Macmillan, 2017), esp. Ch. 5, which discusses Carlyle and the scientific naturalists.

was to bring the body and mind into harmony through a rigorous program of self-denial that would make the mind independent of the body's desires.[36] The themes of self-discipline and self-denial were central to Carlyle's promotion of the manliness of intellectual labor as well and would be explicitly embraced in the ascetic practices Tyndall cultivated with the purpose of bringing his bodily desires under the control of his mind in order, ultimately, to produce knowledge of the natural world.[37]

Before Tyndall began his regimen of self-discipline, which started in earnest when he began his Ph.D. studies in Marburg (see Sect. IV), he more explicitly connected the themes of self-development, work, and morality in his own personal religion. His Ulster Protestantism, which was so central to his early life, began to fade into the background. Tyndall noted this fact on 12 July 1848, Orangemen's Day, a day that Tyndall had failed to acknowledge as such in his journal going back several years. "The old vapid 12th has come back to me again," Tyndall wrote. "Whoever would read my journal for the last 3 or four years would begin to imagine that I was a confirmed apostate from my old opinions."[38] He was, instead, embracing a form of transcendentalism that came out of his synthesis of Carlyle and Emerson.

In the late 1840s Tyndall added a third figure to Emerson and Carlyle, completing a triumvirate of key influences that informed his developing moral philosophy and self-cultivation more generally. This was the German idealist Johann Gottlieb Fichte. After he decided to move to Germany Tyndall picked up a copy of Fichte's *Vocation of the Scholar* (1847), the English translation of a series of lectures Fichte gave in Jena in 1794. He selected a quotation from the book to begin the fourth volume of his journal: "'Perfection,' says Fichte, 'is the ultimate object of man, eternal *perfecting* is his vocation'"—a sentence that resonated with his desire for self-improvement. Reading Fichte, however, made Tyndall realize that this continued self-improvement was possible only through an exercise of the "will," a key theme of Fichte's work that was derived from Immanuel Kant's conception of the moral self as "tightly organized around the will, posited as free and autonomous"; this notion was also central, according to Daston and Galison, to the development of mechanical objectivity. As Tyndall explained, "I have to *will* it and it is done. My culture is in my own hands, I feel that I have the power, and if I exercise it not the sin is mine." He recognized that what Fichte advocated was a profound responsibility that he fully embraced and that only a "rude animalism" could thwart him in fulfilling his duty. Much work, however, remained unfinished if Tyndall was to continue "his earnest effort struggling onward and upward." In order to fulfill his duty, therefore, he wrote that the "Tyndall of tomorrow must learn to take care of himself."[39]

By bringing together the philosophies of Carlyle, Emerson, and Fichte, Tyndall produced his own particular moral code that stressed a manly devotion to truth and work, to self-culture and eternal perfecting, to overcoming the forces of evil within that would seek to undermine such a noble pursuit. He was, moreover, highly self-conscious about the development of this

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[36] Sarah L. Roberson, "'Degenerate Effeminacy' and the Making of Masculine Spirituality in the Sermons of Ralph Waldo Emerson," in *Muscular Christianity*, ed. Hall, pp. 150–166. See also David Robinson, *Apostle of Culture: Emerson as Preacher and Lecturer* (Philadelphia: Univ. Pennsylvania Press, 1982); and John T. Lysaker, *Emerson and Self-Culture* (Bloomington: Indiana Univ. Press, 2008).

[37] There is little written about Tyndall's own ascetic practices, but see Michael S. Reidy, "Mountaineering, Masculinity, and the Male Body in Mid-Victorian Britain," *Osiris*, 2015, N.S., 30:158–181, esp. pp. 170–171, for how they related to his later mountaineering.

[38] Tyndall, Journal, 12 July 1848, Tyndall Papers, RI MS JT/2/13b/358. On Tyndall's changing religious views see Cantor, "John Tyndall's Religion" (cit. n. 6).

[39] Tyndall, Journal, 20 June 1848, Tyndall Papers, RI MS JT/2/14/1 (the italicized words are underlined in the journal); Johann Gottlieb Fichte, *The Vocation of the Scholar*, trans. William Smith (London: John Chapman, 1847), p. 24; and Daston and Galison, *Objectivity* (cit. n. 10), p. 210.

moral code, which he embraced as his life's goal and would ultimately apply to his scientific researches. As he later told a group of University College, London, students in 1868, Carlyle, Emerson, and Fichte "told me what I ought to do in a way that caused me to do it, and all my consequent intellectual action is to be traced to this purely moral source." He believed, more importantly, that "these three unscientific men made me a practical scientific worker."[40] This is an important observation that will be explored more fully below, as it is central to the main claim of this essay concerning the fusing of Tyndall's moral code with his scientific self. However, it is important to note that before Carlyle, Emerson, and Fichte made Tyndall a scientific worker, they helped him become an instructor and mentor.

III. "FOR THEIR SAKES I PURIFY MYSELF"

In August 1847 Tyndall accepted a teaching position at the newly established Queenwood College, an experimental school for boys that focused on practical learning and included programs in farming, railway surveying, and—most novel for a public school at the time—science. The headmaster was George Edmondson, a Quaker, who envisioned that the school would teach valuable skills in mathematics, chemistry, and engineering while also imbuing a strong moral foundation for boys as they entered manhood. Queenwood College was therefore part of a trend in Britain, as other public schools were being reformed along similar lines with the purposes of building both knowledge and character in their student bodies. Tyndall was drawn to the idea of Queenwood and accepted the position, he later said, because of "the opportunities of improvement which it promised." He took advantage of those opportunities, sitting in on Edward Frankland's chemistry class, a course that he soon after began teaching himself, complementing other courses he taught on surveying and mathematics.[41]

Tyndall also, however, became enthralled with imparting his knowledge to the boys—not just what he knew about mathematics or surveying but also guidance as to how they should conduct and educate themselves. He therefore embraced the wider Queenwood goal of developing well-rounded men, and his reading of Carlyle initially shaped the chief message he sought to impart. His position at Queenwood started in 1847, just a month after he finished reading *On Heroes* and *Oliver Cromwell's Letters and Speeches*. Biographical lectures, therefore, became central to Tyndall's pedagogy. For example, he recorded in his journal the concluding remarks he made in a lecture on the celebrated Scottish inventor and mechanical engineer James Watt. The purpose of the lecture was not simply to inform the students about Watt's many discoveries; rather, Tyndall sought to focus on how Watt's scientific work was an extension of his character, of his inner self. "He applied *himself* to the naked facts of the case," argued Tyndall; "his own genius was the spirit which moved upon the surface of these facts and molded them into beauty; and herein, if you read his biography aright, you may gather strength from his example." It was important to gather strength from Watt's example, argued Tyndall, because one's own memories and experiences were not enough to satisfy the "demands of the human soul." Learning from the examples offered by great men such as Watt, therefore, was necessary in order to achieve manhood, to throw away the "child's rattle" and seek "a higher occupation."[42]

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[40] John Tyndall, *Fragments of Science for Unscientific People* (London: Longmans, Green, 1871), pp. 102–103.

[41] Tyndall, Journal, 6 July 1852, Tyndall Papers, RI MS JT/2/13b/575. On the school see D. Thompson, "Queenwood College, Hampshire," *Ann. Sci.*, 1955, *11*:246–254, esp. p. 249 (on Tyndall's courses). On the rise of public schools and shifting conceptions of manliness see Tosh, *Man's Place* (cit. n. 35), pp. 116–118.

[42] Tyndall, Journal, 22 Feb. 1848, Tyndall Papers, RI MS JT/2/14/72–73.

This message of Carlylean manliness was a theme that Tyndall continued to dwell on in his time at Queenwood. He returned to it most forcefully in his last address to the students, just before he was to make the life-altering move to Germany in 1848. In this lecture, which Tyndall duly recorded in his journal, he argued that "the most important step in human education" was the recognition that "our ideal is not necessarily connected with persons, that it is a self-existent quality, and in its purity lives apart from men." Tyndall instructed that the boys ought to "shake away the sensuous portion of our nature and to live a life of thought." And the best way to do that was to study the natural world in a way that Tyndall defined as "manly," through "a steady adherence to truth, virtue and duty, no matter how jolly companions may banter or sneer." He also stressed, with Fichte's "absolute vocation of man" in mind, that what he recommended to the students he would likewise "endeavor to enact myself," practicing what he preached while seeking to better himself in Germany.[43]

Tyndall therefore took Fichte's notion of setting an example for others to follow in order to elevate humanity itself quite seriously, and this extended beyond his lectures at Queenwood to his own fraternal relationships. At the same time that he was teaching Queenwood boys the importance of truth, virtue, and duty, he developed an intense friendship with Thomas Hirst, a relationship that was central to the formulation of his scientific self. The two originally met in 1845 when they were working as railway surveyors in Halifax. Tyndall, who was ten years Hirst's senior, took it upon himself to educate Hirst about the finer points of modern manliness. Hirst proved quite receptive to Tyndall's teacherly behavior and accepted Tyndall as his mentor.

That mentorship involved, primarily, Tyndall teaching Hirst the value of the moral code he had developed from his readings of Carlyle, Emerson, and Fichte. Their correspondence speaks to their bonding over Carlyle, in particular, and Tyndall often copied passages from Hirst's letters that gave evidence of Hirst's educational progress into his journal. On 5 February 1849: "You will not consider it vanity or self-praise when I tell you that Carlyle's Hero Worship has done me a power of good. I feel a different being to what I was. I have got a glimpse of that religion that exists apart from logic, that can receive no assistance from logic: in fact that mysterious 'heart business' you tried to drive into me." Tyndall was delighted that Hirst had proved so receptive to Carlyle, as Hirst recognized the central importance Tyndall had been ascribing to works such as *On Heroes*. After he copied this section of Hirst's letter into his journal, Tyndall wrote that he was so overcome with happiness at Hirst's progress that he was without a dialect to describe how he felt and therefore had to borrow "a phrase from the theologian and muttered God be praised!"[44]

Tyndall also used his journal as a teaching tool for Hirst, as he often let the younger man read the entries or sometimes copied passages from his journal into their correspondence in order to provide Hirst with personal examples of how to act with integrity. In a journal entry dated 30 November 1849, for example, Tyndall wrote about the difficulty he had staying focused on the particular task that he had set for himself. He was by this time at Marburg, working on his dissertation, and was stuck on a difficulty. However, he wrote that he knew that if he was able to overcome his desire to quit he would eventually grasp his subject. Sure enough, after working at his problem "like the persevering mouse," his difficulties eventually fell away, and now, as he wrote in his journal, he was able to feel the sense of satisfaction that "always accompanies a successful discharge of duty." There was an important lesson to be learned

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[43] Tyndall, Journal, 25 Sept. 1848, Tyndall Papers, RI MS JT/2/13b/382–386, on 382, 385, 386; and Fichte, *Vocation of the Scholar*, trans. Smith (cit. n. 39), pp. 24–25.

[44] Tyndall, Journal, 5 Feb. 1849, Tyndall Papers, RI MS JT/2/13b/417–418.

here, Tyndall recognized, and he wrote: "Let me here set my seal to the word PATIENCE, nothing is done without it, looking patiently into the darkest subject a thousand hidden beauties reveal themselves."[45] This recognition on Tyndall's part was not just Carlylean; it also harkened back to the main lesson he took from reading *The Pursuit of Knowledge under Difficulties* concerning Newton's patience in establishing his law of gravity, a lesson that he was now applying to his own Ph.D. studies.

Tyndall recognized, however, that this important observation should be imparted to Hirst as well, writing "I must tell this to Tom." Two days later Tyndall wrote to Hirst, making reference to this passage in his journal in order to educate the younger man about the benefit of sticking with a particular problem and not despairing by turning inward. He also referred to "the blessed truth in the following words of Carlyle," a quotation from *Past and Present*: "even in the meanest sorts of labour," Tyndall wrote, "the whole soul of man is composed into a kind of real harmony the instant he sets himself to work!" This was a familiar routine in Tyndall's education of Hirst: a discussion of Carlyle (or sometimes Emerson or Fichte or all three) was then followed by an example from his own life, and inevitably the spiritual dimension of hard work would be accentuated. "I dwell upon this subject Tom," Tyndall wrote, concluding his discussion of patience, "because I believe nothing is more calculated to combat your present despondency than this very thing employment."[46] But it is important to stress that this particular lesson began as a journal entry that reflected on an episode in Tyndall's own life that led him to realize that it would have value for Hirst as well.

For Hirst and the Queenwood boys, Tyndall believed that he needed not just to impart knowledge but that he must also be an example for them to follow. It was not enough to lecture them on manliness and the nobility of work, on the importance of patience and integrity. He also had to embody those traits himself. Thus there was a performative aspect to his masculine persona, one that he embraced by mobilizing a biblical passage in its favor, writing that "for their sakes I purify myself," a passage from John 17:19.[47] Even though Tyndall had largely abandoned the religious faith of his youth, his use of a biblical passage in this context is indicative of the devotion he felt with regard to his practices of self-development. That devotion became even more prominent after Tyndall went to Marburg University in 1848 and began an intensive period of study that challenged him to pay closer attention to the relationship between his character-building and knowledge-making practices.

IV. "MORTIFY THE DEEDS OF THE BODY": MARBURG, MORALITY, AND MAGNETISM

It is tempting to imagine that Tyndall decided to study mathematics and chemistry in Germany with the goal of gaining a scientific position, as this is ultimately what transpired. The fact of the matter, however, is that Tyndall did not himself imagine such a possibility until much later (see Sect. V). As he made clear in his journal, he was going to Marburg to continue his self-development, which was now filtered through the lens of Fichte's notion of vocational perfectibility. He and his colleague Frankland both realized that their educational aspirations could not be achieved at Queenwood—or elsewhere in Britain, for that matter. Moreover, Germany did not have the same religious and social constraints on higher education as did Britain, and

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[45] Tyndall, Journal, 30 Nov. 1849, Tyndall Papers, RI MS JT/2/13b/469.

[46] *Ibid.*; and Tyndall to Hirst, 2 Dec. 1849, in *Correspondence of John Tyndall*, Vol. 2, ed. Baldwin and Browne (cit. n. 20), pp. 359–371, on pp. 362–363 (letter 0390). The Carlyle quotation is from Thomas Carlyle, *Past and Present* (London: Chapman & Hall, 1843), Ch. 11.

[47] Tyndall, Journal, 30 Nov. 1849, Tyndall Papers, RI MS JT/2/13b/469.

pursuing a Ph.D. in Marburg in particular did not require a previous degree. Frankland's friend Heinrich Debus was working toward a Ph.D. in chemistry at Marburg at the time and encouraged Frankland and Tyndall to join him; they decided to do so in the spring of 1848, arriving in Marburg in the fall of that same year.[48]

Just a month before he left for Germany, Tyndall decided to "plant a landmark" in his journal on his birthday, 2 August 1848. In one year's time he would look back and determine "whether I have been a laggard or not." It was necessary, he wrote, to weigh the strengths and weaknesses of his own heart. He was determined to break down the vices and enhance the virtues, and he accepted that there was "much work to be done." He stressed, however, that he believed that there was a spirit that he could harness when he was strong in both mind and body. He hoped that in twelve months it would be possible "to see whether by self denial, rigid temperance, and truth I cannot make the spirit mine."[49]

The next year would indeed prove to be an incredible challenge. Tyndall typically documented his daily routine, which involved waking up early, taking German lessons, and then spending the rest of the day and into the evening attending lectures and seminars on chemistry, physics, mathematics, and philosophy. When he was not attending lectures and seminars he was in the laboratory conducting experiments with Professors Christian Gerling and Robert Bunsen. A rather typical entry reads: "Wednesday 8 November Up at 5½—at German. With Professor Gerling from 8 to 9. In the laboratory afterwards. A violent head ache all the forenoon. Heard professor Bunsen lecture from 9 to 10 [in the morning]. At mathematics till 10 o'clock [in the evening]. Had Professor [Theodore] Waitz to tea, a long discussion on innate ideas." Many daily entries during this year simply recorded when he woke up, how long he worked, and when he went to bed. On 10 November, for instance, he wrote: "Up at 5. The usual routine: 17 hours out of bed, 14 of which were hours of labour."[50]

Understandably, this routine was difficult to maintain. Tyndall began having terrible headaches that were due, he believed, to the inability of his mind to keep up with his intense program of study. He also complained of generally feeling weak and without energy. He determined, therefore, to take better care of himself. This involved carefully monitoring his sleep. He often wrote about wanting desperately to sleep later, but doing so meant that he became tired and weak and lost precious time that was allocated for his work. When he slept as late as 7:00 one morning, and then 6:45 a few mornings later, he determined to use his journal to "chronicle such delinquencies against myself." He hoped that the sight of such entries would "shame me into better behaviour." Invariably they did. He also determined to deny all his pleasures of the flesh, which involved curtailing his eating and drinking. For instance, he often wanted sausages and coffee for breakfast but chose to have bread and water instead. He worried constantly about what he was putting into his body and the effect it might have on his ability to keep up with his studies. "If ye through the spirit mortify the deeds of the body," Tyndall wrote in his journal, "ye shall live," a passage from Romans 8:13.[51] He also wrote about unnamed desires that he sought to avoid indulging, and he found it necessary to chastise himself whenever he gave in to them. "My strength is momentary," Tyndall wrote on 14 April, "my weakness permanent. Others think me good. I am vicious." He therefore determined to continue fasting as a "practical way of strangling a devil."

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[48] For Tyndall's decision to leave Queenwood for Marburg see Baldwin and Browne, "Introduction to Volume 2" (cit. n. 20), pp. xxii–xxiii; and Jackson, *Ascent of John Tyndall* (cit. n. 4), p. 41.

[49] Tyndall, Journal, 2 Aug. 1848, Tyndall Papers, RI MS JT/2/13b/372.

[50] Tyndall, Journal, 8 Nov. 1848, 10 Nov. 1848, Tyndall Papers, RI MS JT/2/13b/398.

[51] Tyndall, Journal, 20 Feb. 1849, 22 Feb. 1849, Tyndall Papers, RI MS JT/2/13b/419.

The following day, things seemed better: "Clearer and clearer, brighter and brighter, happier and happier."[52]

It is clear that, after being in Marburg for eight months, Tyndall knew what he needed to do to succeed there. He needed to limit his bodily pleasures and follow a strict routine of getting up early, eating small meals at certain times, and retiring to bed at a reasonable time in the evening. Most important, he needed to document his daily routine and experiences in his journal—and do so at a specific time. He sought to maintain this practice as a "law of duty," he wrote, not unlike the way a mathematician constructs a "formula in mechanics." Tyndall, moreover, reflected on his time at Marburg on his birthday, 2 August 1849, when he was reminded of the resolution he made on that day the year before. In glancing back over the pages he had filled in his journal since that time, he recognized that "amid manifold shortcomings I have at least worked hard and made good progress. If no stronger than this day twelve-month, I am no weaker. I hold at least my own, and cross the threshold of another year undaunted, determined to do my duty; still willing to work as hard as ever."[53] Indeed, by the end of 1849 and the beginning of 1850, Tyndall's patience and persistence seemed finally to be bearing fruit. Despite his periodic failings, his chosen regimen worked, and he had, in fact, made the spirit of knowledge his own.

Tyndall became most aware of his progress at Marburg when he realized that he had quietly begun to surpass many of his colleagues, even those whom he had assumed were brilliant upon his arrival. He wrote in particular about the American William Faber, "a young man of high parts," who he initially believed was an "admirable mathematician." His view of Faber soon changed. Faber, he wrote, had clearly not "derived a shillings worth of benefit" from his time at Marburg, whereas Tyndall had grown immensely, both morally and intellectually. He noted that Faber was "totally devoid of energy," a sure sign of an unmanly character, and was "viciously rooted in frivolity," such that were he to succumb to his basest instincts he would do nothing other than eat, smoke, and sleep. His "most vicious trait" was what Tyndall referred to as "his wish to appear," by which he meant that Faber believed himself to be a "man of genius" who did not actually need to engage in the difficult work necessary to succeed. Faber was ultimately unwilling to put in the kind of work on the self that Tyndall had embraced, which meant that his success would be quite limited.[54]

Tyndall, moreover, came to recognize that there was an intimate connection between the kind of character he cultivated and the kind of work he was able to complete in the laboratory. After finishing his mathematics dissertation, Tyndall was drawn to the laboratory, in particular to the problem of magnetism and diamagnetism, a problem that required patience and persistence on the part of the experimenter but also precision and sensitivity on the part of the experimental apparatus. In November and December of 1849 and throughout much of 1850, Tyndall worked fairly consistently at what he called "magnetical researches," which he initially found quite "puzzling." His focus was on the weak force known as diamagnetism that had recently been considered by Michael Faraday and Julius Plücker. Faraday had already established that "all bodies were affected by either a magnetic or diamagnetic force," meaning that certain substances would be attracted to the poles of a magnet whereas others would be repelled. In considering these two forces, Plücker experimented on the optic axes of crystals

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[52] Tyndall, Journal, 14 Apr. 1849, Tyndall Papers, RI MS JT/2/13b/424; 20 Apr. 1849, Tyndall Papers, RI MS JT/2/13b/425; and 21 Apr. 1849, Tyndall Papers, RI MS JT/2/13b/425.

[53] Tyndall, Journal, n.d. [likely 4 Nov. 1849], Tyndall Papers, RI MS JT/2/13b/466; and 2 Aug. 1849, Tyndall Papers, RI MS JT/2/13b/443.

[54] Tyndall, Journal, 30 Nov. 1849, Tyndall Papers, RI MS JT/2/13b/469–470. It should be noted that Tyndall sought to mentor Faber, in order to help reform his character. Faber initially proved receptive to Tyndall's efforts and made some progress but then rather suddenly moved back to America. See Tyndall, Journal, 18 Dec. 1849, Tyndall Papers, RI MS JT/2/13b/471.

and determined that he had discovered an entirely new force that was neither magnetic nor diamagnetic. He called this the "optic axis" force.[55] Collaborating at the time with Hermann Knoblauch, Tyndall sought to reproduce Plücker's experiments with crystals but was unable to confirm his conclusions. He initially assumed that Plücker's argument about the operation of the optic axes must be right. However, after conducting repeated experiments of his own he realized that Plücker had sought to assert his law far too hastily. In other words, Plücker was not patient enough to secure the evidence necessary to establish his law. By experimenting on crystals that were cut into various sizes and shapes Tyndall was able, as he wrote, "to reduce the complexity of the influences" and thus came to realize that the crystals did not respond to Plücker's optic axis but, rather, to a diamagnetic force that was also modified by the chemical composition of the crystals themselves. Diamagnetism was real. This discovery led to a further intense period of experimental research on diamagnetism that formed the basis of a lengthy memoir in the *Philosophical Magazine* as well as Tyndall's first presentation at the BAAS, which met in Edinburgh in August 1850.[56]

It is clear that Tyndall believed that his experimental successes were due to those virtues that he had embraced as a young man—patience, endurance, and hard work—but also to the self-discipline and self-mastery that found their chief expression in the ascetic practices he developed while studying for his Ph.D. His time in Germany was particularly conducive to his developing regime of self-mastery and experimentation, a regime that was perfected after Hirst arrived at Marburg to pursue his own Ph.D., which allowed Tyndall the opportunity to extend his stay there by a further six months. During this period, the two men experimented together on a daily basis and reinforced one another's burgeoning epistemic virtues. Tyndall wrote in his journal that they happily worked right through Christmas and celebrated Christmas Day by enjoying "no wine, no punch, but a basin of soup and a slice of sausage." He was convinced that they were the better for it and that their daily experiments with the laboratory magnet would eventually bear fruit. By March 1851 the friends had been working together closely for several months; and Tyndall reported that he could not have been happier, working next to his "other self." He noted that this expression was entirely appropriate: "He thinks my thoughts and shares my creed, and knows almost as much about me as I do myself."[57]

For Tyndall, it was important to be working closely with someone who thought as he thought and worked as he worked. It was also important that they were sharing their discoveries, not just about magnetism and diamagnetism, but about what this careful and precise scientific research said about themselves. This is particularly apparent in a telling dialogue about morality, science, and methodology that Tyndall recorded in his journal. "The romance of human life Tom, as Emerson says, lies under the details of daily action," Tyndall wrote. He said that the importance of daily action was no better illustrated than by the work he had achieved in the laboratory, work that gave insight not just into the laws of nature but also into his own self. "I have learned more from 6 months work before a magnet," Tyndall wrote, "watching during the time the alternations of my own mind—its joy and disappointment[,] its courage and its fear—than I could have learned in all my life from books." Hirst apparently responded that "it is by such practical experiments alone that we learn to know ourselves and to be content with the dispensations of nature."[58] For

[55] Ruth Barton, Jeremiah Rankin, and Michael S. Reidy, "Introduction to Volume 3," in *The Correspondence of John Tyndall*, Vol. 3: *January 1850–December 1852*, ed. Barton, Rankin, and Reidy (Pittsburgh: Univ. Pittsburgh Press, 2017), pp. xiii–xxxiii, on p. xviii.

[56] Tyndall, Journal, 18 Dec. 1849, Tyndall Papers RI MS JT/2/13b/471; J. Tyndall and H. Knoblauch, "On the Deportment of Crystalline Bodies between the Poles of a Magnet," *Philosophical Magazine*, 1850, 36:178–183; and Jackson, "John Tyndall and the Early History of Diamagnetism" (cit. n. 6), p. 11.

[57] Tyndall, Journal, 31 Dec. 1850, Tyndall Papers, RI MS JT/2/13b/515; and 2 Mar. 1851, Tyndall Papers, RI MS JT/2/13b/523.

[58] Tyndall, Journal, 9 Apr. 1851, Tyndall Papers, RI MS JT/2/13b/532.

Tyndall and Hirst there was no separation between knowing the self and knowing nature. They were fusing ethos into epistemology, as Daston and Galison would put it, as their scientific practices became entangled with, and gave further shape to, their moral codes, such that carefully experimenting on a magnet not only uncovered some of the secrets of nature but some of the secrets of their inner selves as well.

What Tyndall also came to recognize is that just as his research on diamagnetism required carefully constructed experimental apparatuses, his body had to be treated like an apparatus as well, so that he would have the patience and persistence necessary to observe the workings of nature when the time came. Unfortunately for Tyndall, the experimental conditions in Germany were much more ideal for maintaining what he called his "bodily apparatus" than were those that awaited him back in England, a situation that was made more problematic, as we will see, by Tyndall's humble social status.[59]

V. THE "TEMPTATIONS" OF SCIENCE: "CULPABLE LASSITUDE AND DISORDER OF THOUGHT"

Tyndall's return to England in 1851 was therefore initially somewhat bittersweet. While he was now a man of some scientific standing and was explicitly committed to pursuing a scientific vocation, that standing was more tenuous in England than it was in Germany, where his social origins had been much less of an issue. He now had to make his way in a scientific culture largely shaped by patronage networks and social hierarchies, and he worried that he would be tempted to loosen his commitment to the very moral values that were so central to his emerging scientific self in order to pursue his vocation. He therefore reminded himself that "scientific success" was of value only if it "can be converted into nutriment for my proper manhood." Indeed, even at this stage, when he was applying for scientific positions in Toronto and Sydney and amassing testimonials from some of the key scientific figures in Britain and Germany, he was adamant that he needed to keep his own moral development at the forefront of his mind while avoiding taking "an egotistic turn," which he deemed "despicable."[60]

When a scientific position did not initially materialize, however, Tyndall had to return to Queenwood College, a return that he soon recognized was likely to hinder his further moral and scientific development. Tyndall was afforded the use of the lab at Queenwood, which meant that he could continue his experimental research on his own time, but he soon found that his "spiritual energies" were low. As early as November 1851, for instance, they were so low that he "got frightened by their decadence." He was therefore forced to resort to "self-denial as a discipline," meaning that he systematically cut back on his meals and other unnamed "sensualities," continuing the ascetic practices that he began at Marburg. As a result, he felt his spiritual energies returning. This would, however, be a recurring problem, because Queenwood offered a serious challenge to Tyndall's program of self-development. The problem was that the Quaker-run school encouraged what Tyndall called a "respectable sensuality," a "life of organized comfort," that was in opposition to his regime of self-mastery. He worried about indulging in that respectable sensuality and then failing to break free of it afterward. A full year after this entry, he was still struggling against all "these comforts and indulgences which I consider my bane." He wrote that during the preceding week he had "made the acquaintance of the devil," presumably meaning that he had given in to those very same comforts and indulgences. "I have suffered lassitude to take hold of me," Tyndall complained, and "have indulged my stomach too much, and felt thoughts and tendencies rising within me which expanded a little would furnish the elements of a sufficiently ugly

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[59] Tyndall, Journal, 6 July 1853, RI MS JT/2/13b/608 ("bodily apparatus").
[60] Tyndall, Journal, 22 June 1851, Tyndall Papers, RI MS JT/2/13b/547.

devil." He hated himself for these lapses and needed to find the strength to combat these forces of evil.[61]

This was important, Tyndall reminded himself, because he believed that his intellectual development was dependent on finding a precise balance between his mind and his body. "I find that bodily discipline is essential to mental development," Tyndall wrote on 13 December 1852. Finding resonance with his developing physical researches, Tyndall argued that the

> body and the mind are like t[w]o forces to be equilibrated. As the instrument of the latter, the former must be taken care of; but in my case the comforts and indulgences of the body are so many deductions from the force and clearness of the mind. In fact the very act of physical discipline affords a purchase for the soul. It feels a kind of triumph when it can stand erect upon an act of self-denial as basis.[62]

Tyndall believed that he had to take care of his bodily apparatus in order to free his mind to grasp the very careful observations that were necessary for the subtle branch of knowledge that he pursued.

Tyndall came closest to articulating fully the relationship between his ascetic and knowledge-making practices when writing about his research on thermal heat in 1852. He tellingly described a sudden breakthrough he accomplished, after a long period of frustration, by relying on an analogy with photography. Tyndall argued that he was able to grasp the nature of thermal heat only once his "intellect became cleared, and sensitive like a daguerreotype plate to the ray of light which then entered." In much the same way that the daguerreotype image becomes visible only when exposed to light, Tyndall wrote, the scientific mind must be cultivated to see the natural phenomenon when it has been made visible by the experimental apparatus. "The light of truth appears to surround us," Tyndall wrote, "and mental exercise, instead of finding it, merely clears away the rubbish and the rust which obstruct its passage. As regards the direct reception of truth we appear to be more passive than active, and often at an hour which we know not—and mental exercise may be suspended—it dawns upon us." This active passivity, or what Daston and Galison refer to as the "will to willessness," was central to mechanical objectivity—namely, the belief that the proper acquisition of scientific knowledge effectively "involved a battle of the will against itself."[63] For Tyndall, freeing his mind from the control of his will could be achieved only by denying his body its "comforts and indulgences." Unfortunately, Queenwood was simply not conducive to his necessary regimen of self-denial given that everyone at the school, according to Tyndall, "live[s] for their bodies alone, men[,] women and children."[64] Tyndall desperately wanted to implement the developmental routine that had worked so well for him in Marburg, but the conditions at Queenwood made that impossibly difficult.

This was made particularly evident to Tyndall whenever he sat down to write in his journal, a practice that became more labored throughout 1852. While in Marburg he wrote in his journal almost daily, and certainly several times a week. By March 1852, however, he wrote that "I ought to weep over my sins of omission." This was because a full five weeks separated this entry from the previous one, and more than a month separated that entry from the one before. He

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[61] Tyndall, Journal, 21 Nov. 1851, Tyndall Papers, RI MS JT/2/13b/551–552; 13 Dec. 1852, Tyndall Papers, RI MS JT/2/13b/592; and 12 Dec. 1852, Tyndall Papers, RI MS JT/2/13b/591.
[62] Tyndall, Journal, 13 Dec. 1852, Tyndall Papers, RI MS JT/2/13b/592.
[63] Tyndall, Journal, 11 Jan. 1852, Tyndall Papers, RI MS JT/2/13b/557; and Daston and Galison, *Objectivity* (cit. n. 10), p. 210.
[64] Tyndall, Journal, 13 Dec. 1852, Tyndall Papers, RI MS JT/2/13b/592.

was, understandably, irritated with himself because of the rather large gaps that now appeared in what was otherwise a fairly substantial record of his life, but he also believed that the gaps were signs of larger, and deeper, problems, notably "culpable lassitude and disorder of thought." He wrote that his journal entries were not just one part of his larger duty of self-development but, rather, were central for making self-development possible in the first place. Without his journal, he would not be able to document his routine and track his development and know how far he had come or fallen behind. "When I consider that my sole business in this world is to work in it," Tyndall wrote, "and the longer I live the clearer does this creed arise before me; and when I think how imperfectly I discharge my solemn task there is plenty of room for self-upbraiding and repentance." Making note of this in his journal, however, was "unmanly" if he did not also follow through by changing his behavior.[65] He eventually decided to alter his journal writing practices by writing a single weekly entry, a plan that he was unable to maintain after the first week. This was a sign of just how weak he had become.[66] Life at Queenwood had reduced his strength, and everything suffered because of it—mind, body, and self.

Tyndall became rejuvenated in the summer of 1852, however, in large part because his prospects for a scientific position improved dramatically. He was officially elected a Fellow of the Royal Society (FRS) on 3 June 1852, which was a symbolic recognition of his growing scientific achievements as it meant that he was now included in a relatively small group of elite and powerful British scientific practitioners. While Tyndall was glad that he could now say that he was "met . . . by men of the widest scientific fame in England," he stressed that he was not "over elated by the honour." It was now his duty to make himself worthy of the honor and labor for the benefit of science itself. Indeed, as he explained in a letter (coped in his journal) to Colonel Edward Sabine, who had nominated Tyndall as FRS, he had nothing but his own "naked character" to recommend him, and he would therefore continue to rely on his character and nothing else in pursuing his duty to science in the future.[67]

This was a message that Tyndall sought to remind himself of as his successes began to mount. For instance, soon after his election to the Royal Society he was invited to be the secretary of the Physical Section for the BAAS meeting in September 1852. As the BAAS was meeting in Belfast, this represented something of a homecoming for Tyndall. He wrote in his journal that he had not been on Irish soil for roughly five years and that during that time he had "found my vocation in the world." His experience was proof that there were opportunities available for those with the courage and ability to take advantage of them. He therefore felt a great satisfaction in returning. As usual with Tyndall, though, a caveat followed his self-praise. He stressed that his satisfaction was not derived from the fact that he could now claim some standing in the world. It was, rather, evidence that he had now so clearly channeled "the spirit of labour" through himself that its results could no longer be denied or doubted.[68]

In his description of the meeting itself, however, Tyndall unveiled a side of himself that suggested that he did in fact harbor some conceit about his newly found standing, conceit that was perhaps derived from his own insecurity about his social status. He was, for instance, irritated that the famous natural philosopher Sir David Brewster at first seemed to ignore him. The next day, however, Brewster sought Tyndall out, shook him by the hand, and apologized for not responding to a letter that Tyndall had sent him earlier. A few days later, in recalling the episode in his journal, Tyndall wrote that Brewster's "melting . . . pleased me for the moment, but

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[65] Tyndall, Journal, 14 Mar. 1852, Tyndall Papers, RI MS JT/2/13b/559.

[66] Tyndall, Journal, 4 Apr. 1852, Tyndall Papers, RI MS JT/2/13b/562; and 26 July 1852, Tyndall Papers, RI MS JT/2/13b/580.

[67] Tyndall, Journal, 2 June 1852, Tyndall Papers, RI MS JT/2/13b/569 (not "over elated"); and 6 July 1852, Tyndall Papers, RI MS JT/2/13b/575 (copy of letter to Sabine).

[68] Tyndall, Journal, 29 Aug. 1852, Tyndall Papers, RI MS JT/2/13b/581.

it pleases me no longer, it is common place; for I feel something within me which completely dissipates such differences as exist between him and me." He then decided that his next goal would be to abolish all that distinguished "Sir David" and himself, presumably in scientific achievements but also in public recognition of those achievements. In Ruth Barton's reading of this episode, Tyndall's comments are evidence that he wanted desperately to reject class distinctions but often "caught himself giving in to them."[69]

Tyndall was also made to realize that he was perhaps beginning to put his scientific success ahead of his personal development. This was Hirst's assessment after reading Tyndall's description of his encounter with Brewster. Hirst believed that it was indicative of a larger trend he had witnessed in Tyndall's character lately—and was a sign that science had demanded too much from him. He reminded Tyndall that science "has allurements and temptations [that are] all the more dangerous because [they are] not recognized as such by the more intelligent part of the world. Its demands are great, tending to swamp the man in the philosopher." Was it possible that Tyndall was not keeping a careful enough watch on this issue? Hirst moreover worried that perhaps Tyndall had made too many "sacrifices to science during the last few years" and that though he had attained "brilliant and durable results," such results also came with a certain amount of danger—namely, the danger represented by egotism.[70]

Tyndall accepted this criticism with a great deal of humility. Hirst was right, after all. Tyndall copied the "admonitory letter" in his journal so that he would not forget it. He later reflected that Hirst's letter had been of "service" to him; "it has called out 'Patience!' to my scientific haste, and induced me to withdraw for a time to a higher and holier contemplation."[71] Hirst's rare admonishment led Tyndall to remind himself of a central moral precept he had adopted almost a decade before: the importance of patience, and of self-denial and self-sacrifice, in the advancement of knowledge.

Just a few months after this late October entry, Tyndall's scientific future became more stable, as offers of professorships at the London Institution, the RI, and the Government School of Mines materialized. He eventually accepted the position of Professor of Natural Philosophy at the RI, in large measure because of the presence of Faraday, whom Tyndall began to revere as the ideal scientific worker for his ability to remain humble despite his scientific standing.[72] Tyndall, however, continued to express anxiety about his newfound scientific status and constantly sought to impress upon others that he cared little about it except that it afforded him the ability to carry out his scientific research. He made sure to express this point in his letter of acceptance, recorded in his journal, by stressing that he had made his way in the world entirely on his own merits and that he would accept such scientific positions only so long as he could practice his science in his own moralistic manner. As he wrote in his journal, he had now "entered into the sheepfold by honest means, and in it as an honest man I shall remain, if at all."[73]

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[69] Tyndall, Journal, 3 Sept. 1852, Tyndall Papers, RI MS JT/2/13b/583; 7 Sept. 1852, Tyndall Papers, RI MS JT/2/13b/584; and Barton, X *Club* (cit. n. 19), p. 137.

[70] Hirst to Tyndall, 5 Oct. 1852, in *Correspondence of John Tyndall*, Vol. 3, ed. Barton *et al.* (cit. n. 55), p. 500 (letter 0667).

[71] Tyndall, Journal, 16 Oct. 1852, Tyndall Papers, RI MS JT/2/13b/586–587; and 24 Oct. 1852, Tyndall Papers, RI MS JT/2/13b/588.

[72] Regarding the job offers see Ian Hesketh and Efram Sera-Shriar, "Introduction to Volume 4," in *The Correspondence of John Tyndall*, Vol. 4: *January 1853–December 1854*, ed. Hesketh and Sera-Shriar (Pittsburgh: Univ. Pittsburgh Press, 2018), pp. xii–xxv, esp. pp. xiv–xvi. On Tyndall's reverence for Faraday see Geoffrey Cantor, "The Scientist as Hero: Public Images of Michael Faraday," in *Telling Lives in Science: Essays on Scientific Biography*, ed. Michael Shortland and Richard Yeo (Cambridge: Cambridge Univ. Press, 1996), pp. 171–194, esp. pp. 173–177; and John Tyndall, *Faraday as a Discoverer* (London: Longmans, Green, 1868).

[73] Tyndall, Journal, 26 June 1853, Tyndall Papers, RI MS JT/2/13b/606–607 (letter of acceptance); and 26 June 1853, Tyndall Papers, RI MS JT/2/13b/607 ("entered the sheepfold by honest means").

Tyndall was able to perform his epistemic virtues for the scientific community most spectacularly when he was awarded the Royal Society's Royal Medal in 1853—an honor he duly rejected upon being informed that some members of the Royal Society questioned whether he was truly deserving. Despite the fact that the dissenting voices eventually backed down, Tyndall reconfirmed his refusal to accept the award. His letters rejecting the medal were then read before the Royal Society, announcing that Tyndall cared nothing for such worldly recognition when "coloured by a doubt." This was perceived by London's scientific community as a profound act of self-denial. Tyndall clearly relished recording in his journal the notes he received from those who praised his actions, most notably part of a letter from Hirst. "Tom says with reference to my late behaviour: 'To see you praised and successful is of course pleasant to me, but it is when you meet such cases as these that I am most proud of you.'"[74] Hirst's earlier concerns that Tyndall had succumbed to the temptations of science were apparently unfounded. Tyndall's handling of the Royal Medal episode showed that he was able to perform his scientific self with the same devotion to moral integrity that he had sought to develop and perform over the last decade. This was the deeply moral man of science, imbued with nothing but naked character, that Tyndall sought to present to the public, a scientific self that could explore such fundamental natural processes as magnetism, heat, motion, and force because of its transcendence of the worldly desire for recognition as well as the sinful pleasures of the flesh.

CONCLUSION: TYNDALL'S TECHNOLOGIES OF THE SCIENTIFIC SELF IN CONTEXT

This examination of Tyndall's journal, from the early 1840s until the early 1850s, illustrates his journey of self-development, from his synthesis of "self-help" literature, German idealism, and transcendentalism into a Carlylean, masculine persona to his application of that persona to a careful examination of physical phenomena. He believed that through his regimen of self-denial and hard work he was able to train his bodily apparatus to transcend its desires, to overcome his will, and to access a spirit of knowledge that was possible only for a small minority of able-minded men. In this regard, Tyndall was an exemplar of a scientific persona that emerged in the mid-nineteenth century, one whose novel epistemic views were entangled with a particular moral ethos that emphasized self-mastery in order to produce reliable knowledge of the natural world.

What makes Tyndall emblematic of this particular fusion of ethos into epistemology is that he was quite self-conscious that this was, in fact, just what he was doing. While he often stressed in his later writings the centrality of Carlyle, Emerson, and Fichte for his developing scientific self, he also publicly articulated his epistemic virtues just one year after his appointment at the RI, when he participated in the institution's themed lecture series on education; other participants included such scientific luminaries as Michael Faraday and William Whewell. Tyndall spoke on "the importance of the study of physics as a branch of education," effectively giving a summation of his views concerning the relationship between character formation, scientific knowledge, and his chosen area of expertise. Physics was an important branch of education, Tyndall argued, because when done properly it contributed to both intellectual and moral progress, or what Tyndall referred to as "intellectual culture." This, he stressed, was because physics required the cultivation of the mind, not unlike the intense physical training required for the cultivation of the body. Physics also entailed the cultivation of certain moral qualities that would enable the scientific practi-

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[74] Tyndall, Journal, 16 Nov. 1853, Tyndall Papers, RI MS JT/2/13b/637; and 18 Nov. 1853, Tyndall Papers, RI MS JT/2/13b/638–639 (letters rejecting the medal). For the quotation from Hirst's letter see Tyndall, Journal, 29 Nov. 1853, Tyndall Papers, RI MS JT/2/13b/641. For a thorough analysis of the intricate details of this episode see Roland Jackson, "John Tyndall and the Royal Medal That Was Never Struck," *Notes Rec. Roy. Soc.*, 2014, 68:151–164.

tioner to "surrender himself" to nature, to renounce his own personal desires and goals for the benefit of science itself. "Thus the earnest prosecutor of science," Tyndall argued,

> who does not work with the idea of producing a sensation in the world . . . finds in that task an indirect means of the highest moral culture. And although the virtue of the act depends upon its privacy, this sacrifice of self, this upright determination to accept the truth, no matter how it may present itself—even at the hands of a scientific foe, if necessary—carries with it its own reward. When prejudice is put under foot and the stains of personal bias have been washed away—when a man consents to lay aside his vanity and to become Nature's organ—his elevation is the instant consequence of his humility.

The task of the physicist, or the man of science, for Tyndall, was one of self-sacrifice in order to "become Nature's organ," a task that was inherently virtuous, developed as it was from the moral code Tyndall had cultivated throughout the previous decade. Tyndall even suggested that the study of physics could indirectly shape the morality of the lower orders by training them to act against their temptations. Continuing a theme that he would return to on occasion throughout his life, he then stressed that his own personal development was evidence of the deep connection between morality and science.[75]

The claim here, however, is that Tyndall's journal became an important technology that gave him a space to cultivate a particular kind of self and thereby integrate his moral philosophy with his developing scientific practices. Tyndall's journal practices aided him in his readings of key philosophers such as Carlyle, Emerson, and Fichte, helping him to articulate and construct his own particular masculine, moral philosophy and then apply that moral philosophy to his teaching and mentoring practices, as well as his own self-education and doctoral studies in Germany. His journal became a tool for following a regime of self-denial with the purpose of balancing his mind and body, which then was central, so Tyndall believed, to his own ability to grasp the subtle nuances of nature's magnetic forces. Moreover, in tracking his self-development his journal helped him to recognize when he was living up to his moral code and, sometimes, when he was not. As we have seen, there was no more profound symbol of any moral failing in Tyndall's life than gaps in his journal entries, gaps that for Tyndall were indications that he was failing in his larger duty to himself.

While Tyndall's particular moral philosophy, with its synthesis of Carlyle, Emerson, and Fichte, was no doubt unique to him, the fusion of his moral character and his science was not. Of course, that fusion shares some key similarities with what Daston and Galison identify as the mid-nineteenth-century's dominant ethical-epistemic project of mechanical objectivity, which ushered in a new kind of scientific practitioner devoted to self-renunciation and self-denial. But the case of Tyndall also suggests that there may be a class dimension to this identity, one that certainly obtained in Tyndall's circle of scientific colleagues and friends. We need look no further than Tyndall's fellow X Club members, such as Hirst, Frankland, and T. H. Huxley, who were also keen to decouple scientific expertise from the privilege afforded by upper-class backgrounds by stressing the character of the scientific practitioner as opposed to the inherent noble status afforded by birth. As is so clearly documented in Barton's recent study, they were all keen self-learners who had to make their way in the world largely on their own and managed to enter the scientific community through a delicate combination of tenuous patronage networks and their own abilities.[76] That they all kept journals to aid their endeavors is no doubt significant.

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[75] John Tyndall, "On the Importance of the Study of Physics as a Branch of Education," in *Lectures on Education* (London: Parker, 1854), pp. 171–211, on pp. 190–191; for the evidence from his personal experience see pp. 199–206.
[76] Barton, *X Club* (cit. n. 19), Ch. 1.

As scholars of Victorian literature have long known, there is much to learn by examining the diaries of the period, not just for what they tell us about their authors' inner thoughts and desires, or the events that they may describe, but also for the insights they provide into the public identities and actions that resulted from the personas that are often so carefully crafted within them. Thus there is much to gain by thinking more broadly about the journal writing habits and methods of scientific practitioners, in the nineteenth century and beyond.