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THE POETICS OF MID-VICTORIAN SCIENTIFIC MATERIALISM IN THE WRITINGS OF JOHN TYNDALL, W. K. CLIFFORD AND OTHERS

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Jeffrey Robert Mackowiak
Trinity College, Cambridge
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DEDICATED to my mother, Dr Elaine Mackowiak,
my sister, Dr Lisa Filippone,
and to the memories of my father, Dr Robert Mackowiak,
and grandfather, Stanley DeCusatis.

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ABBREVIATIONS AND TEXTUAL CONVENTIONS

The following abbreviations and short forms are used in footnotes and parenthetical documentation; for full bibliographic details of these and other works see the listing of works cited.

'BA'	'British Association', *The Times*, 20 August 1874.
BA	Tyndall, *Address*, 1874.
BA [2]	Tyndall, *Address*, '7th thousand' ed., 1874.
'DP'	Tyndall, 'Descriptive Poem', 18 July 1856 [final fair copy].
'DP' [1]	Tyndall, 'Descriptive Poem', [1] July 1856 [complete first draft].
FoS	Tyndall, *Fragments of Science*, 3rd [British] ed., 1871.
FoS [5]	Tyndall, *Fragments of Science*, 5th [British] ed., 1876.
FoS [6]	Tyndall, *Fragments of Science*, 6th [British] ed., 2 vols., 1879.
LJCM	Campbell and Garnett, *The Life of James Clerk Maxwell*, 1882.
LWJT	Eve and Creasey, *The Life and Works of John Tyndall*, 1945.
NF	Tyndall, *New Fragments*, 1st [American] ed., 1897.
OF	G. Beer, *Open Fields: Science in Cultural Encounter*, 1996.
SSC	Chisholm, *Such Silver Currents: The Story of William and Lucy Clifford*, 2002.

In the dissertation that follows, substantive insertions and deletions from manuscript sources are indicated, respectively, by angle-brackets and strike-outs; 'BAAS' stands for the British Association for the Advancement of Science; 'RI', for the Royal Institution of Great Britain.

The first British edition is used as the baseline for all discussion of the Belfast Address as it was, in a sense, 'officially sanctioned' – that is to say, a corrected text, rather than transcription or abridgement, specifically prepared by its author for widespread publication.

Documentation follows the *MLA Handbook*, 5th edition.

The Authorised King James Version is the source for quotations from Holy Scripture.

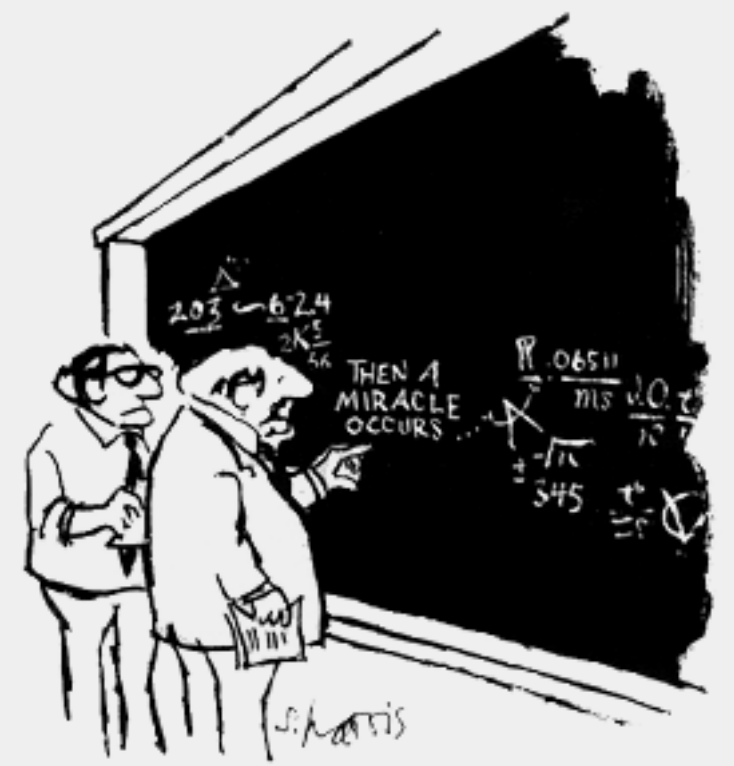
And translations, unless otherwise indicated, are my own.

THE POETICS OF MID-VICTORIAN SCIENTIFIC MATERIALISM IN THE WRITINGS OF JOHN TYNDALL, W. K. CLIFFORD AND OTHERS

My dissertation examines the representations of materialism – a philosophy stereotypically associated with a reductive, anti-theological and mechanistic world-picture – in the published prose and (typically) unpublished poetry of several figures central to scientific discourse in the latter half of the nineteenth century, most notably W. K. Clifford, a mathematician, and John Tyndall, a physicist and media-savvy 'champion of science'. These engagements, and representations, were not merely on the level of 'direct' argumentation, however. A self-consciously allusive, even polyphonous tone was far from uncommon in the many literatures arising from mid-Victorian scientific encounter, and this openness of form permitted both popularisers and critics of materialism to choose the vocabularies in which to relate their observations – the texts with which they would engage – towards specific ends. As I argue, such was a task they performed with great care and an often astonishing felicity: an essay on cosmology, after all, acquires quite a different colouration when interleaved with the cadences of Milton, another again if illustrated with quotations from Whitman or an epigram from 'Tintern Abbey'. My 1st chapter provides a broader context for those that follow, analysing both changing nineteenth-century ideas of materialism and also a range of potential reactions to – and *inter alia* a variety of the contrasting vernaculars used in illustration of – contemporary metaphysical or 'methodological' materialism. My 2nd chapter offers a reading of Tyndall's August 1874 Belfast Address, the *locus classicus* for practically all later elaborations of materialistic belief. My 3rd chapter contrasts the theologically orthodox position of James Clerk Maxwell (buttressed by allusions to the theologically doctrinaire George Herbert) with the radically atheistic and materialistic philosophy of Clifford (underpinned by the similarly atheistic Algernon Charles Swinburne). My 4th and 5th chapters are paired studies in the 'private' nuances of Tyndall's ideology, elaborating on my 2nd chapter's scrutiny of its more public attributes. The former discusses his notions of cosmic connectedness, ironically derived from the non-materialistic works of Carlyle. The latter examines both the exultancy and the despair explicit in Tyndall's poetry and implicit in his prose. As I note in conclusion, such contrary emotions, phrased with striking clarity in Tyndall, are common in mid-Victorian writings concerning materialism, directly or indirectly. They are rooted in the hopes afforded by materialism's explanatory prowess, on the one hand, and the 'atrophy of spirit' born of its austere, even dehumanising, epistemology, on the other; that is to say, in a salutary awareness of both power and pitfalls.

‘Understanding by the theology of the age or country the theory of the universe generally accepted then and there, and by its morality the rules of life then and there commonly regarded as binding, it seems to me extravagant to say that the one does not influence the other’.

- Sir James Stephen, April 1877, *The Nineteenth Century*



Modern cartoon by Sidney Harris suggesting something of the dilemma nineteenth-century scientific materialists faced when trying to account for human sentience.

INTRODUCTION

> Science and philosophy are just now in that irritable state which betrays secret doubt; and an attack on opinions may be more disturbing than one would imagine, because those who are committed to theories feel themselves on very thin ice […].
>
> - Robert A. Watson, *Gospels of Yesterday*, 1888

In his preface to *Contesting Cultural Authority* (1993), Frank Turner traces his abiding fascination with the perplexities of labelling to his days as a postgraduate in the late 1960s, 'suspicious that many of the categories used to understand the Victorians were inadequate and misleading'. Such concerns, he explains, have since led him to a wariness about uncritical acceptance of preordained or pre-existing terminologies, and a concomitant realisation that 'the experience of the Victorians and their intellectual activity can no longer be regarded as unproblematic, inevitable, or quaint' (p. xi).

Even some Victorians had a like sense that categorisation could be, at least potentially, invidious, however. In 'Forgotten Bibles', an article of 1884, Max Müller lamented: 'Nothing is so misleading as names – I mean, even such names as materialism, idealism, realism, and all the rest – which, after all, admit of some kind of definition' (p. 1015). One definition of materialism, for instance, from a *Dictionary of the English Language*, overseen by American lexicographer Joseph Worcester and published in 1859, provided its key term with an apparently resilient explanation; equally, though, it saddled the term's philosophical antithesis with an appellation that, as the century drew nearer its close (and the drawing rooms of genteel New England filled with the sounds of table-rattling and mediumistic divination), might have appeared to warrant either replacing or, at minimum, phenomenological clarification:

> The theory that the material universe is self-existent and self-directed, and that the functions of life, sensation, and thought, arise out of modifications of matter; or the metaphysical theory that is founded on the hypothesis that all existence may be resolved into a modification of matter; – opposed to *spiritualism*, or the doctrine that above the universe there is a spirit sustaining and directing it.

Indeed, among materialism's mid-Victorian advocates and adherents, issues arising out of the

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Epigraph from Watson, *Gospels*, p. v; epigraph page quotation from Stephen, p. 331.

dictionary's suggestively split sense (practical 'theory' describing how things are accomplished in the experiential world; metaphysical 'hypothesis' that such an explanatory presumption encompasses all that there is to know or believe about the experiential world) were destined to remain – and persist to this day as – points of tremendous epistemological stress.

This dissertation is an examination of materialism's literary representations, and philosophical or aesthetic elaborations, in the second half of the nineteenth century, and it offers a reading of some of those discourses in which such epistemological stresses were made most glaringly manifest. It proceeds via analysis in the writings of a number of important scientific (or tangentially scientific) figures of a concept which might seem, upon prejudiced or cursory inspection, to possess the stability of Worcester's second encapsulation but which, upon any closer scrutiny of the particularities of, or problems posed by, individual implementation, reveals an astonishing multifacetedness, far beyond even that suggested by Worcester's first. This study in ideological and terminological jostle is counterparted by, and interlinked with, my investigation into the techniques by which these individuals interacted with England's literary heritage, into their engagement in practices of renegotiation and renewal with prefabricated lexicons and traditions, crafting in the process a variety of rough, though identifiable, personal literary styles. These styles were then 'made available' for other, sometimes non-specialist, usage, for appropriation by politicians and poets, moralists and philosophers.

Stripped of mathematical underpinnings, many of the more general conclusions and implications of the era's physical sciences could be grasped, if not always accepted, by most among the educated. Meanwhile, one cultural transformation in particular expedited enormously the popular diffusion of technical ideas, while concurrently facilitating argument and interdisciplinary exchange: the fact that an ever-increasing 'reading public now had access to a vast array of printed materials' – specialist and generalist, highbrow and lowbrow, periodicals; cheaply priced and heirloom editions of important scientific texts – 'in which conflicting views of science were expounded' (Dawson, Noakes and Topham, p. 17). It was, however, not merely controversialists, nor disgruntled clergymen, nor outraged humanists, who cavilled at, or rejected outright, ideologically troublesome portions of mid-nineteenth-century scientific belief; sometimes even those figures behind its most revolutionary physical syntheses did so as well, seeming startled or unnerved by what their colleagues' (or their own) insights said about the universe surrounding them, often remaining unable, or unwilling, to embrace the seeming ramifications of deciphered equations and conjectured entities. Their anxieties, like their

enthusiasms, sought – and found – expression in books and articles delimiting the meaning and interrogating the effective scope and application of theoretical assertions. Many such works, moreover, provide excellent documentation of their authors' attempts at mediation between an array of competing discourses and antagonistic constituencies, at developing fit, and privately satisfying, vernaculars in which to summarise, debate, popularise and codify both scientific ideas and extra-scientific beliefs.

At the same time, some of these texts tried also to reassure, even fortify, a population increasingly aware that a wide assortment of ongoing investigations into the disposition of the phenomenal world hinted at one (potentially destabilising?) prospect: that physical being, animate or inanimate, in the heavens or on the earth, might be of irrefragable materiality. Such reductive cosmologies had a long history, of course, but somewhere in this period a tipping point was reached, a preliminary consensus established, infusing an old philosophy, that of the ancient Greek and Roman atomists, with a resurgent vitalism. Somewhere materialism, in Worcester's first usage, began to seem – to such prominent individuals as John Tyndall, William Kingdon Clifford, and T. H. Huxley, among others – less an appurtenance to theory, more the basis of sound theory itself (a metamorphosis elaborated upon in my opening chapter). Bertrand Russell, for instance, reminiscing in the early twentieth century about the changes in the intellectual climate of the middle years of the nineteenth, spoke of a 'period often described as "The materialistic '60's"' (Introduction, p. vi), while the Scottish geologist James Croll, in an article of 1872, observed: 'Physical inquiry in every direction is converging towards Molecular Physics, is resolving itself into questions regarding the dynamical action of the ultimate particles of matter' (p. 2). Such an idea of a 'convergent century' is one that both animated nineteenth-century discussions and provided the historian of science Harold Sharlin with the title for his influential 1966 study, subtitled *The Unification of Science in the Nineteenth Century*. This was an explanatory convergence that suggested to many Victorians, somewhat misleadingly, a philosophical one as well, and as scientific authors 'illustrated the uniformity of nature by allusions to the atomic theory', Turner explains, 'their own mode of scientific publicism permitted their readers and listeners to consider them materialists' ('Ancient', p. 332). James Clerk Maxwell, not a 'believer' himself despite analytical inquiries into nominally materialistic topics and themes, quipped, in October 1871, that, '[i]n the present day, men of science are […] supposed to be in league with the material spirit of the age, and to form a kind of advance Radical party among men of learning' ('Introductory', p. 121).

This widespread popular deduction was at once correct and obfuscatory: for it was

with wholesale adoption of Worcester's second usage – materialism as metaphysic, rather than practical programme – that most practicing scientists expressed the clearest quibble, leading to their diversity of opinions about the nature, and significance, of the *matter* with which materialism ostensibly concerned itself, and also about the possible existence, beyond molecular perturbations, of a Higher Power. Such interpretive multiplicity was, however, the inevitable outcome of the range of personalities involved in debate, and of the cultural and professional climate of the time. Indeed, excepting Darwinism, from the early 1860s to the 1890s, there was, within the British scientific community, no more prevalent, or volatile, topic of 'non-technical' discussion and disagreement than materialism's remit. This preoccupation – one at once cantankerous and metaphysically provocative – would, moreover, have reverberations among figures seemingly peripheral to that community, even wholly unrelated or antipathetic to it, provoking strong reactions and engendering passionate dispute, a discourse and process of negotiation and reinterpretation which has left a multitude of literary traces: in published sermons, reviews and quarterlies, philosophical tracts, poems, fictions, extant specimens of correspondence.

One such figure was F. W. H. Myers: though not a scientist himself, he was acquainted with a good number of important scientific personages, a confidant of George Eliot, and an intellectual who also, in any number of ways, served as an embodiment of some of the feuding personal allegiances associated with the middle and later decades of that transitional (if, *pace* Wallace, wonderful) century. His biography reveals an astonishing malleability, and an endearing sincerity. He began, as an undergraduate at Cambridge, as a fervent Hellenist, transitioning, under the influence of friends, into a vigorous, sometimes evangelical, Christian apologist, before succumbing, in the late 1860s, to a sort of existential crisis brought on by his increasing acquaintance with the dictates associated with contemporary scientific naturalism. He finally chrysalized as a spiritualist, that oddly agglomerated intellectual stance compounded equally of (misunderstood) science, (displaced) religiosity, and a pagan exultation in a sense of human spirituality at once unfettered by the doctrines of orthodox theology and suggestive of 'god-like' transcendent potential. In 'Modern Poets and the Meaning of Life' (1893), a product of that final phase, he wrote of two of several conclusions apparently forced upon him by the tenets of late-Victorian science (as he understood it), the physical origin of human 'exceptionality' and the concomitant extinguishing of God, both distressing deductions from the materialist hypothesis, while nonetheless also managing simultaneously to embrace questions – intimately related, he thought – of morality and behaviour:

> We are bound to face the possibility that the human race came into existence from the operation of purely physical causes, and that there may therefore be in all the universe no beings higher than ourselves; not even the remote and indifferent gods of the Lucretian heaven. By many modern minds, in whom the sense of pity for unmerited suffering and the desire for ideal justice have become passionately strong, this conception, which absolutely negatives [sic] the possibility of any pity or justice more efficacious than our own, is felt as an abiding nightmare, which seems from time to time to deepen into a terrible reality. This is the mood of mind illustrated in its extreme form in Tennyson's "Despair".
>
> (p. 97)

'Have I crazed myself over their horrible infidel writings? O yes, / For these are the new dark ages, you see, of the popular press' (p. 1302; ll. 87 - 88), Tennyson's nameless protagonist laments in that poem, composed in 1881. He represents a soul driven to attempted suicide by the workaday contents of widely circulated journals and newspapers, periodicals carrying the writings of much-celebrated and much-feared, putatively anti-religious 'infidels' – England's 'scientific publicists' (Turner's term, and others').

Nonetheless, as has become the consensus view among modern scholars, such figures were themselves far from secure in any advocacy of unmitigated or un-prettified materialism, that cosmological and ethical nightmare precipitating the unfortunate soul's disillusionment in Tennyson's lyric. Contemporary scientists, it seems, were prone to identify themselves, though not always explicitly, among Myers's 'many minds' troubled – or left, on some level, unsatisfied – by the mandates of any too uncompromised naturalistic faith. For instance, though Maurice Mandelbaum, in his monumental *History, Man, & Reason* (1971), pigeonholed Tyndall as not only the most intransigent, but practically the lone, materialist in Victorian society ('if materialism is construed […] as a position which is an alternative to idealism and to other forms of metaphysics on one hand and to positivism on the other, then there were relatively few materialists in the nineteenth century […]. [I]n England Tyndall stands out as an almost unique example' [p. 23]), Ruth Barton, writing sixteen years subsequently, casts even such a swingeing classificatory proviso into doubt, redefining Tyndall as nouveau pantheist or closet idealist and suggesting, not without cause, that '[p]erhaps dogmatic materialism, like Social Darwinism, was an ogre created by its opponents' (p. 134).

Similarly, Steven Kim, in *John Tyndall's Transcendental Materialism and the Conflict Between Religion and Science in Victorian England* (1996), follows Barton in diligently resituating Tyndall's 'materialism' amid active Continental traditions of Romanticism and philosophical idealism. So, too, Paul Sawyer's outstanding 'Ruskin and Tyndall: The Poetry of Matter and the Poetry of Spirit', an essay in Paradis and Postlewait's 1981 anthology *Victorian Science and Victorian Values: Literary Perspectives*. In it, Sawyer insists that deep-seated resemblances between two such (famously antagonistic) individuals 'illuminate a crucial intersection in Victorian culture:

the intersection of Romantic tradition with the triumph of scientific naturalism' (p. 217). Likewise, James Bartlett, in a dissertation stressing Tyndall's mountaineering narratives, 'Preaching Science: John Tyndall and the Rhetoric of Victorian Scientific Naturalism' (1996), contends that, within the freedom provided by that generic form, 'Tyndall creates the scientist as both nature conqueror' – literally (through pioneering exploration), figuratively (though the pacification of physical law) – 'and nature lover, as both British imperialist and Wordsworthian poet' (p. 110). Surveying the intellectual landscape more broadly, Bernard Lightman's *The Origins of Agnosticism: Victorian Unbelief and the Limits of Knowledge* (1987) arrives at similar conclusions, insisting that, during the period covered by his argument, '[…] European materialism was limited almost exclusively to Germany […]' (p. 25), while Peter Allan Dale, in *In Pursuit of a Scientific Culture: Science, Art, and Society in the Victorian Age* (1989), reclassifies many superficially materialistic writings of that century's latter half within the anti-essentialist discourse of philosophical positivism.

My own work, though on one level complementary to such studies, diverges from them in its central focus on the languages of representation, not just the substance, or heritage, of ideologies. In particular, I pay attention to the role played in the 1850s and beyond by poetry, by poetic citation, and by the notion of 'poeticised' science, in qualifying or enriching conceptions and descriptions which might otherwise seem uncharitably reductive or brutishly materialistic. Now, this is, in part, an old story: the idea that allusion, literary like philosophical, is infrequently, if indeed ever, either innocent or adequately constrained, that meaning almost invariably overflows metaphor, blurring and distorting surrounding sentences like a drop of water falling unexpectedly on a page of fresh ink. 'The language', Gillian Beer notes in one of her essays, 'Translation or Transformation? The Relations of Literature and Science',

> available alike to nineteenth-century creative writers and scientists had been forged out of past literature, the Bible, philosophy, natural theology, the demotic of the streets or the clubs. Scientists as various as James Clerk Maxwell and Charles Lyell habitually seamed their sentences with literary allusion and incorporated literature into the argumentative structure of their work [...]. (*OF*, p. 174)

But, following on from Beer's insights concerning evolutionary narrative in *Darwin's Plots* (1983), what is particularly striking about many of these grammars of allusion and citation is their surprising reciprocity; that is to say, the manner in which their deployment does not merely serve to adorn 'uncouth' science with some tasteful, literary embellishment, but also, at the same time, to suggest a real complementarity – and to establish a (sometimes halting) dialogue – between two ancient and empowering traditions. Commonly, for instance, poetic

references in nineteenth-century scientific prose serve not so much to constrain as to liberate meaning – to expose both the limitations and the lacunae in certain interpretations (then thought to be in the ascendancy) of contemporary materialistic paradigms even as they argue, more often than not, forcibly in favour of an unyielding form of obdurate materialism – at the level of analysis, if not elucidation. And, at other times, they tend to roll in, almost surreptitiously (allusion's 'benign haunting', in Harold Bloom's evocative phrase [p. 16]), the assumptions of entire regimes of metaphysical speculation, beliefs and conjectures seemingly at odds with, and having no place in any account of, a dawning era of scientific rationalism – and preening cultural predominance in both the academy and Victorian society at large. Occasionally, they are there simply to remind us of the truism that the poet and the scientist are, in their own ways, of an imagination compact. Thus, a poetic (or other) quotation might, in any number of these circumstances, serve as a commonplace (worn-out citation decoupled from original artistic context), a critical aside, an epigram (pithy, fulsome substitute for several lines of prose), a metaphysical rumination: sometimes it might even function as all four of these things concurrently.

Figures like John Tyndall and W. K. Clifford (a mathematician more famous during his lifetime for the atheism he espoused than the algebras he devised) could, therefore, humanise their 'materialistic' writings via deliberate interlinkages with, or allusions to, or invocations of, a linguistic register associated with a poetic or literary tradition that was decidedly non-materialist (Carlyle's *Sartor Resartus*, Wordsworth's 'Tintern Abbey', the King James Bible). They could also relate sideways with up-to-date vocabularies dealing with problems posed by materialism (the poems of Tennyson, for instance), or which suggest a meliorist side to a non-theological cosmos (those, say, of Whitman or Swinburne). As McSweeney and Sabor insist in a recent introduction to Carlyle's most celebrated work: '[…] *Sartor Resartus* is essentially a work of imaginative fiction that demands a more sensitive and complex response than that in which its formal and stylistic husks are stripped away to reveal the doctrinal kernels' (p. viii). Though hardly fictitious, there is certainly an imaginative component to the reality described by nineteenth-century scientific materialism – courtship among molecules, unrest among atoms, a singing ether – and a similar sensitivity to the form, context and style of recorded beliefs reveals a comparable diversity and richness of signification beyond the argumentatively explicit, providing further confirmation that Turner, like Max Müller, was right to be apprehensive about any too rigid taxonomisation of Victorian philosophical attitudes. 'The difference between Darwin and many who call themselves Darwinians, is as great at least as the

difference between the horse and the mule', wrote Müller ('Forgotten', p. 1015); so, too, that between the many materialisms of the nineteenth century, not even favoured with such a progenitor from which their separate discourses could be said to descend.

THE DISCURSIVITY OF MID-VICTORIAN PHYSICAL SCIENCE

In October 1873, less than a year before he was to bestir the Victorian cultural imagination with his stern materialistic pronouncements at Belfast, *The Westminster Review* ran a rather disapproving review of John Tyndall's *Six Lectures on Light*, a publication in one volume of a series of his American addresses. The precise circumstances of that disapproval might seem somewhat perplexing to modern ears, however, especially when considered in light of paradigms inferred from present-day precedent, of those 'manners' now expected of, or popularly associated with, legitimate scientific discourse. Tyndall's factual content, the *Westminster Review*(er) suggested, was adequate enough: not cutting-edge, perhaps, but just the sort of thing – a broad-based survey, replete with suggested experiments and a discussion of historical development – that one might have expected from such an individual: a natural philosopher and eminent public intellectual of multifarious interests and abilities, with no small measure of pedagogic and rhetorical skill.

Dissatisfaction stemmed rather from its form, from the work's comparative plain-spokenness, from the lack within its pages of philosophical or meta-thematic conjectures (unsanctioned by empiricism, beyond the reach of then-present theory). Particularly missed, it seems, were those interpolated extrapolations, so prominent and memorable in a number of Tyndall's previous writings and orations, in terms of scale and reference from the microscopic to the macroscopic and, from thence, to what would have been deemed by many (though not, perhaps, by the scientist himself) the ineluctably metaphysical:

> We expected, indeed, that these lectures would afterwards prove quite an original addition to scientific literature, if not in the promulgation of novel facts, yet in the striking mode of treating old facts, in the manner of illustrating them by experiments, striking or instructive, or both, as each case would require; and, above all, we looked forward to the glowing introductions to each subject, the magnificent thoughts on the road, by which the Professor concatenates apparently wildly distant facts, and fills the minds of his hearers with elevated thoughts often of the highest poetry; and finally, we counted on the magnificent perorations, for which qualities, as well as for the other characteristics we have mentioned, Professor Tyndall's lectures have become justly famous. ('Science' [1873], p. 487)

The reviewer, respectful of the volume's informational content, recoiled nonetheless from the atypicality of presentation, its dull recapitulation of 'mere' truth. He felt plainly the absence of

what might be called the characteristic vernacular of Tyndallic exposition: poetically exuberant, philosophically suggestive, synthesising and readily quotable, a medium, it would seem, for far more than the communication of broad theoretical consensus or simple empirical fact. His frame of reference, in other words, was not that of science writing considered expansively, but rather science writing as perpetrated by Tyndall, with that author's fixations and propensities, even if (as the case here) in puzzling non-attendance, very much at the fore.

Neither rhetorical nor apparent ideological largesse was unusual in the scientific prose of the age, however. On the contrary, from a modern perspective, the discourse's polymorphousness is perhaps as striking as its perceptible oddness; its refusal to be clumped indiscriminately together as remarkable as its jarring remove from what would seem to be more normative 'grammars' of technical communication. 'The humane, intellectual, and moral elements of the writing of the great naturalist-publicists are there in the freshness, clarity, cockiness, and energy of their prose', yet that writing was not unitary, at times evidencing neither 'consistency' nor 'philosophic depths', as George Levine has observed (p. 254). Still, for all that, Darwin's and Huxley's works remain models of eloquent exposition (yet unique in their own ways, despite similarities of mood); Clifford's and Maxwell's, of terse rhetorical grandeur (if likewise differentiable); Tyndall's, of pantheistic effusion atop ever-engaging popularisation. Though (to twenty-first-century ears, at least) some of these heterogeneous modes can sound elliptic – at times, overwritten; at others, under-evidenced – a bewildering copiousness was in fact a more general characteristic of the era's writing; as Alastair Fowler has noted: 'Personal styles abound in nineteenth-century literature: the profusion of letters, journals and memoirs, many of them highly influential, never ceases to astonish' (*History*, p. 239). Scientific authors, then, like all authors, were of their time.

Beyond such tonal factors, the range of venues available for publication, particularly in the periodical press – which was characterised by extraordinary editorial diversity, with thousands of regional and national serials pitched at a wide array of political and religious dispositions, not to mention levels of literacy – allowed the nineteenth century's theoreticians and experimentalists, like its essayists and theologians, ample freedom to establish, as Gowan Dawson has phrased it, 'distinct authorial personas with consistent individual opinions expressed throughout several different articles' (p. 264).

The issues of opinion and persona are pivotal. Greg Myers has elaborated a pair of suggestive terms for the classification of modern biological writing: the 'narrative of nature', unlike the 'narrative of science', focuses more on the phenomena under description than the

mechanisms of discovery and analysis (*Writing*, pp. 144 - 64). It can seem a difficult, if not hopeless, task differentiating any such contrasting modes in Victorian scientific prose, however, where authors, trying to appeal to (and edify) varied readerships characterised by divergent needs and expectations, took 'care to make their work as accessible as possible. Works like Darwin's *Origin of Species* was [sic] not simply a piece of research written by one scientific practitioner for his peers; it was meant to be read by a general educated audience'; simultaneously, many of these authors also incorporated what might be considered a 'narrative of meaning' alongside (or intermingled with) those of 'nature' and 'science', as many, if not most, of their texts sought, beyond instruction, 'to promote a particular interpretation of scientific knowledge', as Frank James has commented ('Books', pp. 271, 270).

Yet not all was surface and ornament, nor opinion and hearsay. Obfuscation was as dreaded a failing as oversimplification; clarity, an absolute virtue; rigour, essential and celebrated. 'Everything should be made as simple as possible, but not simpler', Einstein once insisted – this is true, needless to say, for explanation as much as entheorisation, an imperative guiding orations and equations alike (qtd. in Cohen and Cohen, p. 116). In the nineteenth century, paradoxically, the same urge could lead to difficulty, confusion, even the appearance of muddle. '[T]he selections presented here', A. S. Weber wrote in his introduction to an anthology *Nineteenth Century Science: A Selection of Original Texts* (2000), 'have not lost their value as models of rhetorical persuasion, precise observation, and clear exposition of the perennial problems of natural philosophy' (p. xii). Two years later, Laura Otis was to remark in the preface to a rival volume: 'It is thus no surprise that nineteenth-century scientists found they could be more persuasive by using the story-telling techniques of fiction writers' (p. xxiv). To 'fiction writers' she might profitably have added 'poets, philosophers and preachers', perhaps other cultural groupings. To 'story-telling techniques': 'vocabularies', 'assumptions' and 'strategies of argument'. Any discrepancy between Weber's and Otis's observations is, however, easily accounted for, a topic discussed at length in following chapters, when considering the interrelationships between the 'two worlds' shaping mid-Victorian discourse. First, the cultural milieu which scientists of the age inhabited (one of 'vigorous, non-specialized, polymathic freedom of thinking […]' [Davis, p. 212]). Second, the actual world each was trying to explain. That was a place which Maxwell, in a variant text for one of his poems, was playfully, if aptly, to describe as 'atom-haunted' ('Hermann', p. 651*n*1). His label, meant to characterise a cosmos, could equally be said to designate the Zeitgeist: 'The open challenge [of Darwinism] was grave enough', the author and BBC broadcaster L. L. Whyte once wrote,

'but [materialism's] unconscious shock went deeper' (p. 241).[1] The former brought into disrepute some niceties of parentage. The latter called into question the nature of being itself. It seemed a primal wounding, not glancing blow – a new(ish) philosophy casting all in doubt.[2]

From the point of view of materialism, the second half of the nineteenth century has as its twin spiritual foci the November 1859 publication of *The Origin of Species* and Tyndall's August 1874 delivery of the Belfast Address. The latter proclamation, though hardly of the pyroclastic invective that some critics claimed for it, was nonetheless one of scientific self-sufficiency and supreme self-confidence, unqualified in its announcement of the necessity for a 'materialistic' path for future physical inquiry. Turner has called the stance brazenly advocated within it 'scientific naturalism':[3] 'These ideas were naturalistic because they referred to no causes not present in empirically observed nature and were scientific because they interpreted nature through three major mid-century scientific theories' ('Tyndall', p. 174). These were the atomic theory of matter (a series of principles explaining chemical reactions and the behaviour of gasses); the conservation of energy (that is, the First Law of Thermodynamics, a precept restricting the outcome of any dynamic process); and Darwinian evolution.

1859, moreover, was also an important, if now less remembered, date in the field of spectroscopy. Robert Wilhelm Bunsen's discovery of the identity between 'lines' observed in solar (and extra-solar) absorption spectra and those found in mid-Victorian physical laboratories for 'earth-bound' elements shattered a long-standing cultural myth (the exceptionality of the heavens), even as it rendered yet another phenomenon ineradicably 'material'. Some scientists were astonished as they came to realise that the most distant visible stars could be examined for composition, temperature and structure as readily as if they were ground mineralogical samples stored in Erlenmeyer flasks. Others were unnerved about what such a revelation – another Copernican decentring: just as Darwin was perceived as linking man with the animals 'below' in the biological realm (though he himself shunned such hierarchy), so did Bunsen with the stars above in the astrophysical – said about the nature of the cosmos. If the 1870s, as William McGucken has observed (p. 73), were the heyday for unification of chemical with atomic views of stellar (and other) spectra, Alexandre-Edmond Becquerel, a

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[1] Judeo-Christianity had always featured some form of 'supervised' development myth; Gladstone, for instance, eagerly authored articles claiming evolution and Genesis compatible 'in the broad sense' (Gould, p. 404).

[2] 'But now [in 1882]', as Matthew Arnold warily reported, '[…] [materialistic] conceptions of the universe fatal to the notions held by our forefathers have been forced upon us by physical science' ('Literature', p. 66).

[3] Many of the texts I quote, both Victorian and modern, use the labels 'scientific naturalism' and 'scientific materialism' more or less interchangeably, though strictly speaking, in Turner's scheme, the latter would add to the suppositions of the former the idea, to be addressed in my next chapter, of psychophysical parallelism.

French physicist, spoke for many when he remarked, in 1874: 'To study the physical constitution of the sun and stars, Astronomy employs in general telescopes and the spectroscope; this last instrument shows us that the heavenly bodies are composed of the same elements that are found in the earth; whence it may be concluded that the forces governing matter are of universal existence' (p. 133).

I am not suggesting that there was any total change in this period, nor that its scientific writings differed utterly in either substance or tone from the productions of previous generations and established disciplines – or subsequent generations and emergent disciplines, for that matter.[4] On the contrary, modifications in form or idiom happened along a continuum, even as evolution had its precursors, even as materialism had an ideological genealogy (as was acknowledged by many at the time, conspicuously Tyndall) stretching back into antiquity.

I would nonetheless suggest that during this period, and in these writers, something intriguing, if not unprecedented, was taking place. They charted a strange transition, or change of phase, describing a time in which physical sciences were grappling with universals of a new 'global' sort, a transformation examined in some detail in my first chapter. Some of these revelations seemed so profound and distressing that they could only be mentioned in a kind of awed – or stuttering – fashion. Furthermore, audiences, whether in print or person, were experiencing this 'as it happened', in a sense, like watching live television coverage of a disaster in progress, and the uncertainty and ambivalence of scientists can be clearly gleaned from those texts documenting transmission. '[T]he history of thought', as early twentieth-century physicist Alfred North Whitehead phrased it in his important study *Science and the Modern World* (1927), 'in the eighteenth and nineteenth centuries is governed by the fact that the world had got hold of a general idea' – that physical behaviour, studied empirically, was best explained without reference to the preternatural – 'that it could neither live with nor live without' (p. 64). This observation, characteristically trenchant, is nevertheless insufficiently precise. There were multiple ways of 'liv[ing] with', even as there were any number of methods for 'liv[ing] without', for denial.

Prior to *The Origin*, prior to the formalisation of the Second and First Laws of Thermodynamics (the ordering is deliberate, and follows historical progression), prior to Bunsen's

[4] That is not to say there were *no* quantifiable transformations in, say, language or disciplinarity, however: for example, as David Roos has pointed out: 'By the end of the nineteenth century' – unlike nearer its middle, before specialisation and increased professionalisation had fragmented what is often stereotypically conceived as the unitary character of its intellectual culture – 'the chances of a major scientific achievement being influenced by an article in the *Edinburgh Review*, or any other generalist, nonprofessional journal, were almost nil' (p. 162).

remarkable discoveries in solar spectroscopy, it seemed that one could find room in science for a wide range of ancillary beliefs, suppositions and metaphysical hypotheses. This became far more challenging afterwards. The change in mindset augured by these transfigurations in awareness can hardly be overstated. Before them, materialism could be viewed as an interpretation of theoretical constructs; subsequently, it seemed to men like Tyndall and Clifford a presupposition, something that could not be avoided, only refused. (In an article of 1875, Tyndall scorns one antagonist for failing to accept a *fait accompli*: 'the modern scientific interpretation of Nature […]' ['Materialism', p. 587].) Though *The Constitution of Man* (1828) – a phrenological study by Combe, a work tending towards materialism – had at its publication invited a flurry of denunciations, by the late 1830s 'reflective treatises by Herschel, Lyell, Nicholl, and others had shown how natural laws might be discussed without outraging public sensibilities. Outside the shadowy world of freethought, the slightest opportunities for accusations of materialism had to be blocked […]' (Secord, p. 75).

Tyndall and Clifford, by contrast, writing little more than a generation later, actively courted such a judgement. To them, materialism was no longer a prejudice or corollary, a 'taste', it had begun to seem the irresistible condition for advance, the only legitimate way forwards, as necessary for a profitable science – and an expansionist Empire – as belief in a round earth.

To assert that the art of Shakespeare was potential in the sun (as the former did), or that the universe would inevitably be rendered unfit for life: not just human life, but life of any sort (as the latter, among others, did), is to argue for a qualitatively different role for scientific explanation, far more radical than the recalibrations of belief advocated by, say, Lyell or Chambers. These are speculations about process, about teleology, about first origins and final endpoints, seeming neither to require, nor admit, 'the extraneous'. Few scientists were undisturbed by this – not even figures who would actually seem to be arguing in favour – and, from within their texts, literary remnants of various and irresolvable discontents can be readily exhumed. It is this that unites such a polymorphous discourse, such a diversity of styles and assumptions among mid-Victorian writings in the physical sciences, making them, despite divergences, seem like species of one genus: all had to deal with a likely positioning of materialistic philosophy, no longer alongside, but behind – or beneath – unprecedented revelations.

Though some 'non-specialists' found this possibility a wonder, others were unnerved: to F. W. H. Myers it served to suggest a sort of panoptic diminishment, that 'the Cosmos has no true place for man […]'. For, he elaborated, such 'inhumane' belief seemed not only to

reveal, but to revel in, the 'underlying aspect of Nature which, once seized, is no less than appalling; when the familiar garden seems alien and terrible as a gulf in the Milky Way; and, nakedly confronted with the everlasting universe, man that must die feels more than the bitterness of death' ('Modern', p. 103).

Myers, if uniquely eloquent in expressing it, was not alone in this inference. Many audiences were equally discomforted, finding themselves frightened and adrift. Not accidentally does Tyndall's reviewer long for guidance as much as edification; not for nothing does he mourn the lack of oratorical uplift, 'the magnificent thoughts on the road', a figure stressing the scientist's role as guide, or fellow traveller. Whether a Virgil among the shades (a parallel suggested by T. S. Eliot for Tennyson and his *In Memoriam* [p. 246]) or a Moses in Judea (one implicit in some of W. K. Clifford's comments on the interrelationships between scientists, scientism and progress), traversing a hell or wandering in search of some – hitherto unfathomable – promised land, was for many in those audiences worryingly unclear.

And yet on the answer to that question so much depended.

'Methodological' Materialism as Spiritual Refuge

Turner's important study, *Between Science and Religion: The Reaction to Scientific Naturalism in Late Victorian England* (1974), provides sympathetic analysis of the careers and beliefs of gentlemen like Myers, Alfred Russel Wallace, and Herbert Spencer, among others, all of whom 'generally accepted the concepts and theories of science. At one time or another each had contributed to the naturalistic synthesis or had been trained in scientific procedures and philosophy or had been profoundly affected by its ideas' (p. 2); yet, ultimately, each had also 'embraced the belief that [...] they could not meaningfully guide their lives with reference solely to the visible world' (p. 4). In so doing, they were able to back away from what they perceived as the nineteenth century's deadening, intermittently nihilistic, materialism.

Tyndall, too, had a route of egress, one likewise achieved via faith in an invisible world. But it was a world of intrinsically natural, not supernatural, specification, an unseen reality of molecules and atoms and all their marvelous and varied interactions, not spiritualism, nor other modish elaboration of antiquated belief. Moreover, as Barton has noted, he, 'like Huxley, Hermann von Helmholtz, and [Frederick] Lange, advocated materialism as a methodology, a program, or a method of scientific research, but not as a general philosophy' (p. 134). Turner had some years before reached an identical conclusion: 'Often within the

same lecture or essay the scientific publicists dealt with a matter in two ways – in terms of scientific theory and as a philosophical stance' – the very tension so conspicuous in Joseph Worcester's *Dictionary*'s 1859 definition for the concept. 'In the latter regard, they usually backed away from materialism. Huxley always said that if forced to answer the unanswerable question, he would chose idealism over materialism'. Tyndall, indeed, despite lecturing 'for several years on a materialistic theory of psychology […]' ('Carlyle', p. 340), represented perhaps the apotheosis of this class, the individual in whose writings such a bifurcation of approach was most unmistakably – and expressively – instantiated.

He wrote, to give one example of this, of a transcendental tingle apprehended in the audience of nature in a letter of 17 April 1862 to Juliet Pollock, wife of William Pollock:[5]

> The part of human nature which came into play under such circumstances is that which puzzles me most. That solemn unison which the soul experiences with nature, and which is a thing essentially different from the intellectual appreciation of her operations. But I will not carry you into a cloudland where I have often wandered myself without finding rest for the sole of my foot; and where probably man's spirit may wander till the end of time without being sensibly more instructed. (p. 1985)

Of course, reluctance to burden his correspondent with such speculations does not imply that Tyndall did not juggle them himself, and his frequent wanderings left textual traces throughout his career: in his atmospheric perorations, in the poetry he composed ('I do not know that he has ever written poetry', wrote W. T. Jeans in 1887, 'but he is certainly a poet in the fire of his imagination and in his love for all the forms of natural beauty' [p. 73]), in the splitting he continually emphasised between the pragmatic need to approach science materialistically, but never to think that such rational inquiry could – or should – unreservedly gratify private desire. This bifurcation was never more accentuated than in his Belfast Address. My second chapter is an analysis of that address, along with another, 'Crystals and Molecular Force', delivered in Manchester around six weeks later, though clearly aligned with the earlier oration in topic as well as tone; in both, as we shall see, the adamancy of Tyndall's insistence on the prerogative of materialism in discussions and explanations of the physical world's witnessed behaviour contrasts somewhat awkwardly with his avowal of a nebulous inspecificity regarding the intrinsic significance of that physical world, or the manner in which its phenomena were to be spiritually understood and appreciated.

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[5] He, Queen's Remembrancer, noted barrister, translator of *La Divina Comédia*, 'a man of liberal culture and rare social charm'; she, a *bonne-vivant* and intellectual, favoured, like her husband, with 'numerous […] friendships in the world of letters, science, and art' (Rigg). It was Mrs Pollock who brokered the preliminary meeting between Tyndall and Tennyson, for instance (*LWJT*, p. 75).

My third chapter is a study in contrasts and similarities between two nineteenth-century analytical luminaries, whose most celebrated writings stressed a tough-minded or algebraic description of nature over the kind of enraptured depiction favoured by Tyndall, though that was a rhetorical mode never fully abandoned: the first, W. K. Clifford; the second, another Cantabrigian, James Clerk Maxwell, a scientific visionary whose theories concerning electromagnetism and statistical mechanics were to leave the landscape forever altered, heralding the arrival of a revolutionary new paradigm, a 'change in the conception of Reality […]', according to Einstein, that was 'the most profound and the most fruitful that physics has experienced since the time of Newton' (p. 71). At this chapter's heart is a discussion of two contrasting apprehensions of the fundamental nature of material substance, as embodied in two divergent conceptualisations of (to mid-Victorian minds) its most elementary constituents: atoms and molecules; related to this are the two men's speculations on the destiny of human consciousness after death. F. W. H. Myers, in his posthumously published textbook, *Human Personality and Its Survival of Bodily Death* (1903), had his own views on this subject (unambiguous in such a choice of title), arising from his 'third way' spiritualistic convictions. Clifford and Maxwell, by contrast, exemplified the two other primary possibilities. The former, like many Victorian positivists, advanced a belief in death's physical dominion but metaphoric impotence if life has been lived well and nobly, dedicated to the betterment of both self and species. The latter, among peers almost uniquely secure in his Christian adherence, was – and this perhaps due to the orthodoxy of that faithfulness – far more muted publicly on the subject of the afterlife than either Clifford or Myers, but trumpeted, when the opinions of colleagues seemed unworthy of the 'science' on which they were allegedly based, his disagreement with a comparable vehemence.

My final two chapters are paired examinations of Tyndall's 'cloudland' wanderings, discussions of their impingements on those narratives and texts which, on first appraisal, might seem more involved in the first part of his essential dualism: 'the intellectual appreciation of her [nature's] operations'. The fourth is a study of how Tyndall's materialism was underpinned, challenged and revitalised via the writings of Thomas Carlyle. Particular focus is placed on the manner in which, through those writings, Tyndall was able to struggle with the conception of being put forth in Carlyle's prophetic texts, where, contra utilitarian and eighteenth-century mechanistic philosophies, readers are impelled towards 'a more unworldly conception of human life', as the Irish social historian W. H. Lecky explained things, in 1891 (p. 528). Tyndall's phrase in the letter – the one discussing '[t]hat solemn unison which the

soul experiences with nature', seemingly almost a verbatim recapitulation of Wordsworthian sentiment – suggests the subject of my fifth, in which I discuss how Romanticism (particularly English Romanticism), broadly construed, provided a specific framework in which Tyndall could articulate his own vision of Carlyle's 'natural supernaturalism'. This, however, was an endeavour seemingly founded on irresolvable paradox: if, following Lecky, Carlyle's task was the estrangement of humanity from the corrosively material, the lauding of otherness, the scientist's own was precisely contrary, in that Tyndall sought to demonstrate humankind's intimate 'worldliness', the utter interlinkage of *Homo sapiens* with the measurable and mundane, while concurrently distancing such beliefs from what he referred to, and derided, as the 'practical materialism' of both contemporary thinkers (like Harriet Martineau and Thomas Young), and those Enlightenment mechanists whose pronouncements earlier in the century had so affrighted a young Carlyle.

These were nuances frequently irrelevant to adversaries, however: the unnamed author of one extended critique spoke for many in claiming that, while '[i]t may appear the difference is great between Miss Martineau's and Professor Tyndall's views on the question of Materialism […]', and 'though as regards actual substance or matter, this is in some degree true; yet when the main and most important principles are concerned, the same line of thought is plainly manifested […]' (*Materialistic*, p. 1). Tyndall, like other publicists, recognised this propensity, and expended considerable energy – often for nought – in contesting such unflattering, if schematically accurate, interpretations of his belief.

These chapters are therefore studies in 'redacted materialism'. My first, by contrast, provides more abstract analysis, overviewing the historical context of materialism, the 'literary' status of popularising language, the possibility of a 'poeticised' science, while sketching also some nineteenth-century readings and reinterpretations of the unadorned hypothesis. All of these discussions, moreover, are set against more general theological issues presented by the ongoing conflict between science and religion. While Turner is certainly correct in interpreting this as, on one level, a contest for authority between rival professional clans ('Conflict', p. 360), it must never be overlooked that there were real feelings at stake, too; as the Rev. John Quarry explained in a sermon published within two weeks of Belfast: 'The supposition that lifeless matter is the origin of all being, and contains in itself the source of all life and thought, cannot fail to give a rude shock to our better feelings, and to deaden all the higher aspirations of the human mind' (p. 3). His were worries, as we shall see, not entirely foreign to a number of mid-Victorian 'scientific materialism's' most ardent and prolific propagandists as well.

CHAPTER 1

THE PRESENTATIONS (AND REPRESENTATIONS) OF SCIENTIFIC NATURALISM IN MID-VICTORIAN LITERARY CULTURE

> I have shown that all the realms of the universe
> Are mortal, and that the substance of the heavens
> Had birth; and I have explained most of those things
> That in the heavens occur and must occur.
> Please listen now to what remains to tell.
> - Lucretius, *On the Nature of the Universe*

The nineteenth century saw the rise of a sense, and a definition, of 'literature' as applying to, and demarcating, a body of writings as distinct owing to origin or nominal subject. Perhaps fittingly, it is two science writers who are in the *OED* credited with innovation (or, at minimum, priority of citation), thus becoming, from a lexicographical point of view, the figures associated with these broadenings out of denotated meaning: Humphry Davy in the first instance (1815: literature as 'the body of writings produced in a particular country or period' [def. 3a]), and, splendidly, John Tyndall – whose own productions teeter so precariously between those three styles of 'narration' discussed in my introduction – for the second (1860: literature as '[t]he body of books and writings that treat of a particular subject' [def. 3b]). Brande and Cox's definition of literature in the 1865 edition of their *Dictionary of Science, Literature, & Art* managed to capture something of that term in the very throes of semantic mitosis:

> The word denotes, generally, the entire results of knowledge and fancy preserved in writing; but, in the narrower use to which ordinary custom restricts it, we draw a distinction between literature and positive science, thus exempting from the province of the former one extensive branch of our studies. And, in a still more restricted sense, the word *literature* is sometimes used as synonymous with *polite* literature, or the French *belle-lettres*. (p. 381)

The Victorian *fin de siècle*, despite the persistence in some quarters of such reservations and provisos, saw classificatory amnesty made complete – in 1895 we encounter for the first time application of the signifier 'literature' to '[p]rinted matter of any kind' (*OED*, def. 3c) – with the admittance of all comers, if only informally, to that hitherto exclusionary realm. Yet the

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Epigraph from Lucretius, p. 180; 6.42 - 46.

other meanings were never far behind, and a whiff of elitism continued to linger about both the word and the concept. '[A] general term which, in default of precise definition, may stand for the best expression of the best thought reduced to writing' – so the entry for 'literature' in the 1911 *Encyclopædia Britannica* begins (F.-K., p. 783). This is a designation at once open-ended ('best thought' allows much manoeuvre) and limiting (the banal, witless or poorly phrased need not, it seems, apply, as the mere status of 'information written down' becomes a necessary, though hardly sufficient, criterion for class membership). A recent academic definition keeps such qualifications intact, Robert Scholes saying of literary criticism (and thus the object of its inquiry): 'It is an art, not a science, […] which means we learn it by studying the texts in which the arts of language are most powerfully on display. We call these texts "literature" […]' (p. C1).

Over the past thirty-odd years, scholars have come to grant 'literary' status to some, even most, of the linguistic artefacts of nineteenth-century scientific culture, if perhaps warily. William Bartlett, for instance, described his dissertation on Tyndall as 'a contribution to the recent (and rapidly growing) field of science studies' because of 'its emphasis on the rhetorical analysis of texts that are often placed on the margins of a canon of Victorian literature' (p. 4). Conversely, critics like Gillian Beer, George Levine, Sally Shuttleworth and Jonathan Smith have illuminated the fashion in which works central to that canon were influenced by those 'technical' discourses purportedly nearer its outskirts. What did the scientific writers of that century say about the 'status' of their own writings, however? How did *they* view them? in relation to the literary tradition? in relation to the philosophical? What did such authors, not ourselves, mean by a 'poetic' sensibility or 'universal' applicability? And what did they accentuate as most novel about the *kinds* of discoveries they were seeking to elucidate?

These issues are paramount in any examination of the coupling of scientific naturalism with its literary representations. This chapter is thus in large part a study of definitions, of changing nineteenth-century ideas of materialism, 'poetic' science, 'teleological' or 'global' natural philosophy. It also provides, in its concluding section, analysis – oriented around a reading of a twentieth-century poem outlining a trio of possible responses to materialism – of a series of *re*-definitions, a survey of mid- to late-Victorian attempts to humanise that belief-system by remaking it into something less ethically dismaying or spiritually austere. These queries frame my terms of debate, providing a broader context for those specific responses to materialism discussed later in this dissertation. To start with, the idea of the 'poetical-ness' of science was one that exercised a variety of thinkers, particularly scientific popularisers. I will

examine two texts which directly addressed themselves to this question. An anthology by the astronomer Richard Proctor argued forcibly in favour of parity between scientific investigation and a rousing 'poetic sense'. The contrary case, that for disproportion, was made in 'Prose and Verse', a poem of 1857 by fellow astronomer John Herschel, a piece which also suggests something of the 'new course' for – and, implicitly, the emergent sense of import associated with – scientific theorising in the second half of the nineteenth century, a recalibration of belief for which I argue in this chapter's middle section.

On the Likeness and Unlikeness of Science and Poetry

In 1881, Richard Proctor published an anthology suggestively entitled *The Poetry of Astronomy*. That's one designation which would seem to lay bare authorial intention. Yet just as important is Proctor's subtitle, which clarifies the nature of this proposed 'poetic' exploration, a task he conceived not so much aesthetically, or linguistically, as ideologically: *A Series of Familiar Essays on the Heavenly Bodies, Regarded Less in Their Strictly Scientific Aspect Than as Suggesting Thoughts Respecting Infinities of Time and Space, of Variety, of Vitality, and of Development*. This is astronomy, then, as (in part) Romantic spectacle, productive of deep thoughts, a correlative to wonder. This is astronomy as aid to reflection, a belittling splendour willingly sought; astronomy as teaching tool abetting personal reflection and the necessary reconceptualisation of the role and relation of self to universe (or, in terminology less solipsistic, species to same). F. Scott Fitzgerald was to write in the 1920s of the panorama of Long Island Sound that greeted European pioneers, of the 'fresh, green breast of the new world', describing it as inadvertent encounter, unplanned revelation: it suggested the bewilderment of early modern man 'compelled into an æsthetic contemplation he neither understood nor desired, face to face for the last time in history with something commensurate to his capacity for wonder' (p. 189). On earth, perhaps, was this, if debatably, the case, though other vistas remained, other New Worlds presenting like possibilities of discovery, self- and otherwise. Views directed outwards towards space or backwards in time (geological, evolutionary), examinations oriented inwards towards the submolecular, or downwards towards the psyche (psychological meditations on the effluvium of consciousness itself), these were similarly to transfix the Victorian observer, perhaps an individual sufficiently secure in material terms or adequately ensconced in worldview that he or she deliberately courted destabilisation and conceptual rebooting, craving the narcotic rush of novel perspective. Proctor celebrated this dual movement.

Figure 1 - 'The Transit of Venus, – December 9, 1874', *Punch's Almanack for 1875*.

He defended a conception of science allowing its impact on our 'poetic' sense, even as our 'poetic' sense told us better where to look, why to look, and, indeed, what to bother looking for:

> Many think that science cannot truly be called science if clothed in poetic garb, and, on the other hand, others seem to fear that a glory must depart from the face of nature if science scrutinise her mysteries too closely. I believe both these fears to be unfounded – that science need not be less exact though poetry underlie its teachings; while, beautiful and glorious though the ordinary aspect of nature may be, a deeper poetry, a more solemn significance, a greater beauty, and a nobler glory can be recognised in the aspect of nature when science lifts the veil which hides it from the unaided vision.
>
> (p. v)

Proctor's slightly confused, and confusedly sexed, scheme of anthropomorphisation is telling, indicating something of the complexity of his metaphor. Nature is feminised, something to be uncovered, or stripped bare, blushing if necessary. Yet a 'poetic' sense is likewise figured as a sort of 'garb', a concealing garment draped atop nature, like a throw shrouding a classical sculpture. Such dressing, then, is done not so much to preserve modesty as to facilitate admittance to, and passage through, polite society. It is science (and scientists), in other words, that unclothe nature, before sending nature out of the house wearing something more suitable. And it is science (and scientists) that can be trusted to behold, unblanchingly if with some delight, things in their unadorned state; it (and its practitioners) that can persist comparatively unfazed by prospects, precipitously discovered, of 'unearthly' beauty. (9 December 1874 witnessed a transit of the planet Venus, an event epitomised in a *Punch* cartoon as a procession of beauties, a Venus each, from across the globe, from all historical epochs. They move in orderly fashion, as if themselves governed by 'beautiful' inexorable law, passing above the leering lenses of enraptured scientists – though an obvious pun, this joke, like Proctor's explanation, suggests something of the gendered nature of Victorian scientific conceits [fig. 1].) Beyond the figurative, Proctor's language evokes other associations as well: 'lifts the veil', for instance, looks backwards towards *In Memoriam* and 'The Lifted Veil' (1859), George Eliot's famed short story, towards canonical variations on that fragment fixed in discourse.

The Poetry of Astronomy, however, though citing passages from several ancient and Renaissance poets (particularly revealing is one mid-chapter excursus integrating discussion of *The Iliad*, the recent naming of the two moons of Mars, Phobos and Deimos, and astronomically based speculation on the date of the Trojan War [pp. 305 - 08]), makes scarce *direct* mention of mid-Victorian verse reflecting scientific engagement: that of Tennyson, that of Myers, that of Swinburne or Browning. It focuses still less on potentially poetic ('poetic' here meaning 'conventionally literary', a 'surface' phenomenon: 'poetic' as stereotypically conceived) aspects

of, or flourishes within, the technical and popular writings of mid-nineteenth-century scientists and science writers themselves. The distinction, to him, seems a prepositional one, a valuation of the poetry *in* science above the poetry *of* science.

Proctor, in effect, fixated on 'first-order' experience, the shiver of poetic feeling precipitated by direct (or nearly direct, as it is mediated via the astronomer's own aesthetic proclivities) contact with nature. But sometimes a 'second-order' production can replicate something of that immediacy, sometimes poetry can communicate the hackneyed 'wonder of science' – unimpeded by equations or Latin nomenclature – with the force, if not always the knowledge-content, of science as purportedly 'felt' by the initiated. There are, of course, certain topics more obviously prone to such literary appropriation-hence-appreciation. As Maurice Riordan and Jon Turney observe in their introduction to *A Quark for Mister Mark* (2000), an anthology (prejudiced towards the twentieth century) collecting verses and verse-fragments influenced by the methods, results and opinions of science:

> We did find, though, that poets' curiosity has its blind spots. Or perhaps only certain kinds of news from science can get through clearly. The scale and age of the universe impress plenty of poets, and one could make a sizable, but repetitive, collection just featuring awe-struck or morose meditations on star-gazing. The struggle to understand evolution is another, nineteenth-century, theme which continues to thrive, perhaps because it builds on a traditional poetic concern with natural history.
>
> (p. xiii)

This was the case, not infrequently, in Victorian intellectual life as well. Then, as now, certain frontiers – in scale (the very large, the very small) as much as subject – perennially intrigue, appearing more seductive to the curious. Not coincidentally do the themes which Riordan and Turney identify find semi-mythic origin in the period covered by this study. The giddy wheel of cosmic perspective (brought to popular awareness by mid-Victorian explorations and quantifications of the vastness of the heavens and related speculations regarding the plurality of worlds); the plummet of recognition felt in acknowledgement of simian ancestry, of deep geological time: these were, and remain, invitations to thought and self-questioning, like the tableaux of the Stations of the Cross. Yet, as often as not, they are productive of sometimes contrary emotions, feelings of terror and unease alongside awed humility or wonder.

Proctor's definition of poetry as applied to science, then, has little to do with manner of expression, still less with caesuras and end-rhyme. It is more an index of common humanity, of shared affections, a register harkening back to Burkean concepts of the sublime (as Burke wrote: 'Infinity has a tendency to fill the mind with that sort of delightful horror, which is the most genuine effect and truest test of the sublime' [p. 101]); accordingly, the 'poetry' he

identifies in astronomy venerates the intangible, the power of glorious spectacle, even as it recalls more current notions of Romantic beauty, that recognition of – and those meditations upon – the overlooked or picturesque. Like Proctor, many Victorian scientific publicists were capable of discerning within, and publicly investing, the routine – even the prosaic or 'household' – with a semblance of inspirational grandeur: Huxley lectured on a piece of chalk; Tyndall, on the colour of the sky; Faraday, on the chemical history of a candle, to name only three of the most renowned of many such discourses.[1]

In these talks, each scientist sought, after a fashion, to poeticise the commonplace, yoking rational comprehension with imagination and fancy, and joining to *that* an unmistakable sense of immanent or transcendent meaning, like Keats with his urn, or Wordsworth, his daffodils. Such works upon publication, like Proctor's own text, typically attained at least the minimum standards set forth in a definition of literature given, nearly contemporaneously, by Craik in his pioneering *A Compendious History of English Literature, and of the English Language, from the Norman Conquest* (1864). This was a work which, by its very nature, busied itself distinguishing between 'what was in' and 'what was out', delimiting categories:

> As for literature, it is not the synonyme [sic] even of written language. It is not coextensive with that, or limited to that. For want of a better term, we call artistic composition in words, or thought artistically so expressed, literature; but, on the one hand, there is abundance of writing, and of printing too, which is not literature in this proper sense, and, on the other, it is not a necessity of artistic composition that it should be in a written form. (1: 22)

Huxley, for instance, in an unpublished manuscript (available electronically), once opined:

> But there is a portion of scientific work which seems to me to have an indisputable claim to the title of literature – I mean the work of the popular expositor – of the man who being a well qualified interpreter of nature translates that interpretation out of the hieratic language of the experts into the demotic vulgar tongue of all the world.
>
> I call this literature – for it seems to me to be the essence of literature – that it embodies great emotions and great thoughts in such form that they touch the hearts and reach the apprehensions not merely of the select few but of all mankind. ('Literary')

The latter paragraph effectively restates definitions of poetry given earlier in the century, particularly in the specific issues raised: that of 'translation' from a lofty to a 'demotic tongue'; the Romantic conceit revivified to extend to science, conveying, like verse, 'great thoughts' and 'great emotions'. ('Hieratic' is even a Shelleyan word, bringing to mind his noble defence of poetry's art and function.)

Huxley here made claims for the literary worth of science writing (though mainly that

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[1] Huxley, 'Chalk'; *FoS*, pp. 245 - 87; Faraday, *Chemical*.

of the 'popular expositor'); Proctor, in *The Poetry of Astronomy*, for the subject's spiritual profundity, or 'poetry-like' appeal. Not all scientists, of course, were interested in these issues. Nor, among those that were, was confidence absolute in comparable equivalencies. For instance, the following, written in 1857, seems a manifesto impelling the era's science *away* from dry or workmanlike inquiry, *towards* poetry, a request that science commence itself to addressing the grandest sorts of philosophical conundrums. This is not to suggest that there isn't a feeling of palpable affection for the subject intermixed with an overtone of broader humanistic dissatisfaction pervading 'Prose and Verse', a poem by Sir John Herschel, professional astronomer, enthusiastic amateur musician, son of Sir William Herschel (himself an astronomer of renown). In it, science and poetry are addressed, not so much as wife and lover, but rather as two muses, or infidelities: one, science, now regarded affectionately though with perhaps diminishing ardour (he writes to her in apology: 'And if from thy clear path my foot have strayed, / Truant awhile, – 'twas but to turn / With warm and cheerful haste; while thou didst not upbraid, / Nor change thy guise, nor veil thy beauteous form […]' [p. 538]); the other, poetic art, praised passionately, if chastely, exuberantly, if clandestinely, like a teenager's crush. Thus Herschel's poem reads as a double ode, to cloying and coy mistresses, respectively. Science feels to him clear-headed, but a bit dull, enlightening but distant, a presence at once unapproachable and drearily unreproachable.

Poetry to him seems, by contrast, a 'breathy' seductress holding him wholly in thrall, a feminine principle similarly unattainable, yet for whom his desire is never slaked; she is epitomised as a dark lady leading him away from science's day-lit paths, into the night, towards private pleasures, 'cell[s]' and 'haunted grove[s]'. His second stanza enacts this turning away from public obeisance, beginning in a tone of (faint) praise for science, segueing into an encomium for his other joy:

> High truths, and prospect clear, and ample store
> Of lofty thoughts are thine! Yet love I well
> That loftier far, but more mysterious lore,
> More dark of import, and yet not less real,
> Which poetry reveals; what time with spell
> High-wrought, the Muse, soft-plumed, and whisperingly
> Nightly descends, and beckoning leads to cell
> Or haunted grove; where all inspiringly
> She breathes her dirge of woe, or swells my heart with glee. (p. 538)

This seems a bit unfair, as astronomy was often perceived in a similar light, felt as a subject conveying grand or mystifying emotions, at times 'whisperingly'. The aspirations underlying,

and communicated by, the essays in *The Poetry of Astronomy*; the scope and vision endemic to Tennyson's late verse; the solemn sense of personal transcendence, of 'loftier far, but more mysterious lore', implicit in those hyperbolic blazons to celestial beauty spouted by Swithun St Cleeve in Hardy's *Two on a Tower* (1882): these were all markers of a contrary estimation. Perhaps Herschel – raised in Observatory House in Slough, in the shadow of its forty-foot reflector – had just grown too inured to astronomy's charms (his phrasing would certainly seem to indicate just that) from long acquaintance.

However, for such a soul – apotheosis of Walt Whitman's 'learn'd astronomer': domesticating the heavens, divesting the darkness of its wonder – in poetry, not parallax, might be found escape and cosmic perspective. The third stanza of the poem makes explicit this aesthetic transference, telling how verse-forms create within Herschel an alternative space, how they manage to occasion analogous 'cosmological' or ego-rattling shocks. In it, he describes the capacity of poetry to construct for him a linguistic continuum truly self-contained yet possessed of kindred witchery, and, in so doing, to facilitate a kind of psychological moment commensurate with that afforded to others by confrontation with belittling astrophysical spectacle, by jarring encounter – zippy teleportation from Surrey to Sagittarius, or from Herefordshire to eternity – with what must have seemed to almost everyone else the incomprehensibly vast and timelessly existent:

> Oh! rosy fetters of sweet-linked Rhyme,
> Which charm while ye detain, and hold me drowned
> In rich o'er-powering rapture! Space and Time
> Forgot, I linger in the mazy round
> Of loveliest combination. […] (p. 538)

There is one sense, though, in which Herschel's criticisms might be justified. The title of the piece – and as G. K. Chesterton once noted with characteristic sagacity: 'titles are sometimes neglected even when books are studied' (p. 1042) – is at once surprising and easy to overlook. It is not, as might be expected, 'Science and Verse', but rather 'Prose and Verse'. Nonetheless, the work begins with a dedication ('To thee, fair science, long and early loved'), and ends with a vision of reconciliation between two rival temptresses.

Could, however, this invocation of 'prose' say something about the *variety* of science being critiqued? If not for Herschel, then for others who might have felt some sympathy with such a stance, with its inchoate 'anti'-reductionism, its aura of vague aesthetic and moral dissatisfaction? Does he, in other words, indict or censure *prosy*-science because *prosaic*-

science? In the July 1859 *Westminster Review*, Herbert Spencer, towards the conclusion of an essay offering spirited defence of the nation's need for a universalised scientific curriculum, formalised a revealing distinction. He in so doing made explicit what many among his peers had for long years presumed. Speaking with fervour of the superior wisdom and discernment of 'the sincere man of science', he immediately qualified that term with a parenthetical: '(and by this title we do not mean the mere calculator of distances, or analyser of compounds, or labeller of species; but him who through lower truths seeks higher, and eventually the highest) […]' ('What', p. 39). Mere classificatory knowledge, in other words, the stereotypical, drudging labour of vicar naturalists and amateur geologists, the unexamined production by scientific professionals of cross-checked tabulations of latent heat, or taxonomies and chemical charts, does not qualify. Nor, indeed, does abstract analysis, airy mathematical fantasias at an unimaginable remove from lived reality.

A different sort of endeavour is here affirmed, an endeavour more akin to that poetic affliction lamented by Herschel. *This* variety of science, it seems, *could* whisper. It could breathe a 'dirge of woe', or utter such words as would 'swell the heart with glee'. Though whether the former or the latter – that is, whether mournful dirge or gleeful proclamation – would more often than not be determined, not by some quality inherent in theories or facts themselves, but rather by who was listening and what he or she expected to hear, by senses (and sensibilities) conditioned by temperament or through theological predisposition.

Coleridge, writing in 1822, gave aphoristic expression to one enduring antagonism, perceived or actual: 'Poetry is not the proper antithesis to prose, but to science […]. The proper and immediate object of science is the acquirement, or communication, of truth; the proper and immediate object of poetry is the communication of immediate pleasure' ('Definition', p. 7). (This judgment was at the time considered to be so authoritative that it was often cited in lieu of – or given as supplement to – both definition and argument in a surprising number of mid-Victorian reference texts: for instance, the definition of poetry in Latham's *Dictionary* [1866].) A half-century later, Henry Drummond, in his polemical study *Natural Law in the Spiritual World* (1883), offered an appraisal diametrically opposed: 'True poetry is only science in another form', he wrote (p. 274). These are extreme positions, of course, and heavily qualified. Drummond was a noted Christian evangelist, a 'hybridised' explorer-scientist of some distinction (he authored works on anthropology as well as on the flora and fauna of tropical Africa), not to mention a lifelong campaigner for a rapprochement between science and religion. For him, therefore, '[t]rue poetry' was, unsurprisingly, the source text of

Revealed Faith, the Christian Bible, above all else. Equally, Coleridge's position, perhaps semi-flippant at bottom, appears similarly suspect. It hardly seems a quibble to inquire: cannot poetry serve as a conduit for truth (of *some* sort)? Or, conversely, cannot science be the source of 'immediate pleasure'? Now it would be disingenuous to argue that the period between Coleridge's assessment and Drummond's own witnessed a wholesale conversion, from everyone siding with the former to everyone assenting to the latter. Most people in 1822 or 1883 – that is, at either endpoint – if they had opinions on the subject at all, probably held opinions that were admixture. It would likewise be absurd to insist that a change in the *character* of science was the sole reason for its increased 'poetic' acceptability over the years.[2] The rise of technology, science's sibling – the telegraph, the railroad, later the telephone – abetted the process, as did the increase in cultural audiences for science (itself the consequence of the rise of Mechanic's Institutes, among other ever-ongoing processes of social and educational transformation).

I would nonetheless suggest that more people agreed with Coleridge earlier in the century; more with Drummond towards its close. In addition, as I will argue (and Drummond himself made this connection, as did most of the major figures addressed in this dissertation, if sometimes more hesitantly), a transformation in the aspirations of science, a shift in the quality of the claims it made, over the period separating the two had an inevitably profound effect on popular perception. Herschel's poem, composed in 1857, provides documentation of that transformation's early stages, and also its general tendency. What, however, was the nature of this change? What was it about this 'new science', beyond Darwinism, that could prove so enthralling to some, but menacing, even existentially paralysing, to others? And what exactly did the 'sincere man of science', in his questing after those higher – and highest – truths ostentatiously valorised by Spencer, discover (and, as crucially, communicate) about the nature of the physical world? And, not always implicitly – and at times with grim or foreboding insistence – about the metaphysical one as well?

TELEOLOGICAL CLAIMS IN NINETEENTH-CENTURY NATURAL PHILOSOPHY

In his 1986 study *James Clerk Maxwell and the Electromagnetic Field*, John Hendry concocts, in part, a narrative of synthesis, an heroic tale of stubborn contraries reunited through the agency of a

[2] The term 'science' itself shifted and narrowed its sense over this period, Coleridge's usage encompassing 'all systematic knowledge', not merely results of laboratory empiricism (Engell, p. 69).

'great man'. He identifies two trains of thought – the mechanistic and the dynamistic – in the epistemology of early nineteenth-century physics. These he characterises, on one level, as effective binaries, antithetical tendencies, if not diametrically opposed then, prior to the diplomatic labours of Maxwell and various 'Maxwellian' successors, only imperfectly or inadvertently reconciled. On another, he suggests that each of these concepts presupposes the other, requires the other; that each was less the embodiment of a clear-cut cultural or intellectual movement, a reaction to specific and local circumstance, and more the manifestation of inherent psychological and philosophical bias, predispositions culturally influenced and affirmed, certainly, but really transcending any individual moment or context. A few historians of science have since faulted Hendry for having taken what they believe an inappropriately reductive approach, despite the nuances implicit in such an interpretive bifurcation; they have found fault, or improper oversimplification, in his orienting of discussion between two such idealised contraries, whether conceived as unities or mixture. Yet as Robert Purrington has written: 'If we resist the temptation to label each individual a dynamist or a mechanist but recognize those terms as two poles on a continuum and acknowledge that there are other dimensions to this graphical representation of philosophical inclination, then more good than harm may result from it' (p. 20).

The same can, of course, be said usefully not just of nineteenth-century scientists but a range of nineteenth-century scientific theories as well. Of these, perhaps the most foundational, wide-ranging and (in time) revolutionary was the so-called 'analytical theory of heat'. It was derived from Joseph Fourier's totemic *Théorie analytique de la chaleur*, first published in 1822, finally making its way into full English translation in 1878. In the meantime, however, it was to exert a profound influence on a generation of natural philosophers, in Britain and elsewhere. William Thomson, the man later to be known as Lord Kelvin, and in whose honour the modern metric unit of absolute temperature is named, was one; James Clerk Maxwell, another. The former, indeed, according to Purrington, built 'his entire career […] upon Fourier's work and its implications' (p. 85). It is often taken to be a paradigmatic example of a dynamical theory, unwilling to be too specific about the basic nature of the concepts involved, content with numerical description, with establishment of algebraic relations capturing known behaviour. In this, it was uniquely successful: Maxwell praised the text as 'one of the very few scientific works which can never be rendered antiquated by the progress of science' ('Extract'). This was in large part owing to its reticence about ultimate natures, true causes. Its author made such a focus clear from the onset: in a philosophically oriented 'Preliminary Discourse',

he began with clear assertion of a dynamicist's – or, if more loosely, a positivist's – apparently unanswerable scepticism: 'PRIMARY causes are unknown to us; but are subject to simple and constant laws, which may be discovered by observation, the study of them being the object of natural philosophy'.[3] He then elaborated on this, going on to make plain his deep-seated aversion to unjustifiable inference or ontological speculation, his desire to craft a theory mathematically accurate, one in accord with known facts, adequately epitomising and systematising those facts, but never attempting, in effect, to derive phenomena from 'the bottom up', nor speculating on (potentially fallacious) intrinsic realities: 'The object of our work is to set forth the mathematical laws which this element [heat] obeys' (p. 1) – 'element' here means 'aspect of experience', not 'real thing', not heat as chemical or material substance, but rather as it is known via thermometry, through the tabulated register of instrument-readings and sense-impressions.

Such philosophical caginess was understandable, perhaps even prudent. The nature of heat was, after all, one of the most radically (and frequently) redefined concepts in the whole of physical science, one destined forever to remain to some minds a bit mysterious or misunderstood. Michael Guillen, in a modern popularising work, has charted no fewer than five competing theories of heat – starting with that of the ancient world; progressing via the caloric theory (dominant in the latter eighteenth century, pioneered by Joseph Black); ending with the molecular, with heat (in the famous phrase) as a 'mode of motion', a theory which was in the ascendant by the middle of the nineteenth – each new conception seeming less like a refinement of the previous than a wholesale re-imagining (pp. 182 - 99). Yet few doubted heat's ubiquity, nor its significance. Fourier himself likened it to the force of gravitation, omnipresent and inescapable. He wrote: 'Heat, like gravity, penetrates every substance of the universe, its rays' – like those enmeshing vectors interlinking body with body implicit throughout classical mechanics – 'occupy all parts of space' (p. 1). But with a difference: Newton's gravity is time-independent, eternal, unsullied, the planets processing unimpeded through an ethereal emptiness. Newton's Law, as paradigmatically understood, describes a clockwork cosmos, a perfect, perpetual engine.

That abstraction tackled by Fourier, by contrast, imposes a definite arrow to time, a clear – and inarguable – directionality. It tells tales not of effective stasis, nor celestial perfection, but rather decay, irreparable rupture, the corruption of the world, the bleeding of heat.

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[3] Auguste Comte, for instance, found much to admire in the arguments of Joseph Fourier (Hendry, p. 37*n*91).

The world, it insists, of the past differed from that of today; the world of today will differ from that of tomorrow, perhaps unrecognisably. As noted by Stephen Brush in his important study *The Kind of Motion We Call Heat* (1976), many nineteenth-century debates on the irreversibility of physical transformation turned on recognition of theoretic incompatibility, pointing 'out that in Newton's second law, $F = ma$, the substitution of $-t$ for t leaves the right-hand side invariant, whereas this is certainly not the case with Fourier's heat conduction equation […]' (p. 556).

In Fourier's model, in other words, could be discerned the spectre of entropy (a notion formally quantified nearly three decades later by Clausius and others). Its rules describing the flow and ablation of sensible heat in solid objects function only in a 'forward' direction unequivocally; to try to use them to extrapolate indefinitely *backward*, an application so congenial to Newton's time-symmetric law, produces in the case of heat-exchange gibberish, not discrete solution nor plainly intelligible response. The oracle, it seems, works one way only. Tellingly, Clifford wrote of this analytical asymmetry in a fashion bringing to mind, among other things, story and storytelling: 'suppose you try to go backwards, in time […]', soon enough, Fourier's equation, which previously had seemed so straightforward in its prophesising, '[begins] to talk nonsense', as he commented in his article 'The First and Last Catastrophe' (pp. 478 - 79).

Maxwell, in his textbook *Theory of Heat* (1871), likewise made explicit this failing – or maybe collapse – of theory, pointing to it as yet another harbinger of entropic decay, yet another signpost differentiating future from past, a glimpse in algebra of thermodynamic convulsion:

> The negative value of t [for time], for which the series becomes divergent, indicates a certain date in past time such that the present state of things cannot be deduced from any distribution of temperature occurring previously to that date […].
>
> This is only one of the cases in which a consideration of the dissipation of energy leads to the determination of a superior limit to the antiquity of the observed order of things. (pp. 244 - 45)

So, here we encounter a key implication derived from thermodynamic theory: the failure of prediction, nineteenth-century science's discovery, or unearthing, of a limit to prognostication. Many Victorian physicists, grasping only too well the likely cosmological implication of such domestic behaviour – 'Your coffee grows cold on the kitchen table, / Therefore the universe is dying', in the words of twentieth-century poet Neil Rollinson – came also to believe that the universe had a long-term teleology, that it was progressing (or, less prejudicially, implacably transforming) from its unknowable beginnings towards termination in 'heat death', the thermodynamic equilibration of all physical things. Convinced of the predictive power of entropy,

a few of the more outspoken among them started publicly to contend that the universe of distant futurity – uncountable eons hence, to be sure – would be a corpse sans potential, becoming a place finally (though fatally) at rest: physically static, biologically sterile, chemically inert.

Such a process might begin with local morbidity. 'Prophets', Greg Myers observes snappily in an outstanding article, 'through the ages [had] predicted the end of the earth', but it was to be Thomson who, in the 1850s, was to become the first among them to offer mathematically precise formulae for dispassionate computation of 'its final temperature' ('Nineteenth', p. 46). Ultimately, however, entropy – 'heat death' – would insure a more comprehensive extinction.[4] As put in *Geschichte des Materialismus* (History of Materialism; 1865), a work of philosophical genealogy – by Frederick Lange, the prolific neo-Kantian – which was to prove revelatory in certain mid-Victorian quarters: 'Finally, there seems to result also, as a simple consequence of the mechanical theory of heat, the destruction of all life in the whole universe' (3: 11). Lange's seems a phrase at once coolly understated and curiously disbelieving, the deadpan utterance of a gentleman absolutely certain that he was fated to perish from unstanchable blood-loss subsequent to the most trifling of cuts. Nor was he alone among Victorians in knowing how the bouncing would stop, the unchanging fate of the dropped and unmolested ball of children at play. Thomas Pynchon suggested this analogy in *The Crying of Lot 49*, a twentieth-century novel itself entropy-obsessed (and, as Gillian Beer has explained, the text responsible for introducing her, along with so many 'others of her literary generation […]', to the ideas and particulars of nineteenth-century thermodynamic dispute [*OF*, p. 29]); of a deceased ex-lover Oedipa Maas, Pynchon's harried protagonist, at one point reminisces: '"Keep it bouncing," he'd told her once, "that's all the secret, keep it bouncing." He must have known, writing the will, facing the spectre, how the bouncing would stop' (p. 68).

The Second Law of Thermodynamics, that edict stipulating a global entropy increase over any given time, foredooming Oedipa's bouncing ball, was, famously, derived from (at minimum) three directions, finding theoretical justification within the bounds of putatively contrary tendencies in thought. Firstly, it can be inferred from measured inefficiencies in industrial machinery, becoming a guiding principle of engineering. This was hinted at in Sadi

[4] Perhaps the most famous declaration of this belief was made by the Prussian Rudolf Clausius; its phrasing, moreover, in a translation from the German well known to British and American physical science, was far from euphemistic: 'supposing this condition' – that is, the final maximisation of cosmological entropy – 'to be at last completely attained, no further change could evermore take place, and the universe would be in a state of unchanging death' (p. 419).

Carnot's slim volume of 1824 – unnoticed for decades – *Réflexions sur la puissance motrice du feu* (Reflections on the Motive Power of Fire). Secondly, it can be viewed as a consequence of the equations of Fourier, elegant dynamical descriptions capturing and quantifying the amount and direction of heat transference from hot to cold regions. (An approach that, in early days, led to confusion; as the Hungarian physicist C. Szily observed, in 1872, one rationale for the slow professional acceptance of the Second Law lay in the fact that it 'did not find in [post-Newtonian analytic] mechanics any correlative principle so generally known as the [F]irst [Law] did […]' [p. 339].)

Thirdly, it can be derived from theories proposing a specific character to the 'element' (heat) being shuffled about (this was established by Ludwig Boltzmann in 1877), from an actual material philosophy predicated on the definition of heat as 'mode of motion', one presupposing jiggling atoms and vibrating molecules as unobservable, though basic, entities. These, then, would be neither proxies for reality, nor models of reality, but the *really there* stuff constituting reality. In other words, as with a variety of physical precepts of the mid-nineteenth century, in retrospect the 'entropy law' would seem irredeemably materialistic, but many philosophers and scientists at the time could conceive otherwise, insisting that as an in part dynamical rule (or, perhaps, merely pragmatic statement of Victorian technological limitation), it could be surreptitiously reintegrated into a less reductive – and pessimistic? – world-picture.

For the publicists, however, for men like Huxley, Tyndall and Clifford, the laws of thermodynamics were essential parts of an explanatory synthesis. The conservation of energy, the First Law, in particular, which Tyndall referred to as one of science's 'great generalizations', 'has been called the most important discovery of the nineteenth century', as Sharlin has noted (p. 37); it underpinned countless declarations by the century's 'materialistic' propagandists in favour of the nebular hypothesis, against the interposition of the miraculous in terrestrial affairs, against the ideas of spontaneous generation or vitalism in biology, as it bound 'nature fast in fate […] to an extent not hitherto recognized, exacting from every antecedent its equivalent consequent, from every consequent its equivalent antecedent', thereby rendering universal history, like sentience and organic growth, material phenomena, as Tyndall explained at Belfast (*BA*, p. 45).

Huxley wrote similarly of energy conservation in 'The Progress of Science' (1887), reflecting on the theoretical accomplishments of five glorious decades with self-evident pride (though never quite the awe-struck dizziness of a Tyndall or Clifford):

> I have said that our epoch can produce achievements in physical science of greater moment than any other has to show, advisedly; and I think that there are three great products of our time which justify the assertion. One of these is that doctrine concerning the constitution of matter which, for want of a better name, I will call "molecular;" the second is the doctrine of the conservation of energy; the third is the doctrine of evolution. Each of these was foreshadowed, more or less distinctly, in former periods of the history of science; and, so far is either from being the outcome of purely inductive reasoning, that it would be hard to overrate the influence of metaphysical, and even of theological, considerations upon the development of all three. The peculiar merit of our epoch is that it has shown how these hypotheses connect a vast number of seemingly independent partial generalisations; that it has given them that precision of expression which is necessary for their exact verification; and that it has practically proved their value as guides to the discovery of new truth. All three doctrines are intimately connected, and each is applicable to the whole physical cosmos. (p. 66)

These three represent the very pillars of scientific naturalism as outlined by Turner, the 'doctrinal' trinity of that intellectual denomination. Yet, as mentioned in my introduction, few (including Huxley himself) subscribed to outright *philosophical* materialism without some dilutions or reservations, for all the evidence – that motion from 'foreshadowed' belief to likely hypothesis – suggesting veracity, much of which had been unavailable prior to mid-century. In that, however, such figures were merely continuing a practice of reflexive denial which had for centuries characterised the genealogy of materialism, a stance many deem coeval with that of 'philosophy' as an identifiable discipline in the West. Bertrand Russell, in an introduction to Lange (itself, fittingly, penned even as quantum mechanics and special relativity posited their own novel twentieth-century challenges to materialistic allegiance), once remarked that '[m]aterialism as a theory of the universe has had a curious history. Arising almost at the beginning of Greek philosophy, it has persisted down to our own time, in spite of the fact that very few eminent philosophers have advocated it'.

Likewise, many scientists – even those active during periods when materialism as a policy or presupposition might have appeared virtually 'synonymous with the scientific outlook' (p. v) – have been similarly dismissive (or half-hearted). Perhaps mid-Victorian materialism's most fraught contention, however, one prone to rattling even the most fixed of adherences, was that of psychophysical parallelism, the connecting of mind with matter. Lange, always wary of mental reductionism, ridiculed eighteenth-century expostulations – he spoke of a time when 'the childishly naïve conception could still be put forward with the pretension of a scientific hypothesis, that every idea has its particular fibre in the brain, and that the vibration of these fibres constitutes consciousness' (2: 11) – but then hinted that even its more subtle or sophisticated nineteenth-century variants might be of equal indefensibility. Similarly, Herbert Spencer, so bullish about evolutionary insight, nevertheless classified among the Unknowable knowledge of the sort increasingly claimed by fellow publicists, asserting that, in matters of

physiological psychology, as elsewhere, 'the Materialist and Spiritualist controversy is a mere war of words; the disputants being equally absurd – each believing he understands that which it is impossible […] to understand' ('Progress', p. 485). Spencer's comments are from an article of 1857, two years pre-*Origin*; Lange's, from a text of six years post-.

Both men were often accused of, or slandered for, 'materialistic' leanings – and justifiably, too. But in neither case – as with so many such sympathisers, throughout the centuries – was conviction absolute.

VICTORIAN 'MATERIALISM(S)': QUESTIONS OF CLADISTICS AND NOMENCLATURE

Croll, writing in 1872, had identified as a primary goal of the scientific theorist: 'We try to induce a unity amongst the multifarious facts of the senses by bringing as many of them under a certain conception as will be rationally connected by it' (p. 1). Such a statement, while epistemologically accurate, should not, however, be misconstrued as equivalent to signifying that all nineteenth-century scientific unifications took place within a robustly materialistic paradigm. Some principles of heat exchange, as discussed, could be accepted without commitment to ontological hypotheses, as could many aspects of contemporary chemical theory (Purrington, p. 132). Interpretive double-ness could even be suggested by the period's nomenclature: the nineteenth century's paradigmatic theory of heat, for example, was often labelled the 'dynamical theory' as it had vanquished the idea of a caloric fluid: 'Till the latter part of the last century', Hamblin Smith summarised in a popular undergraduate textbook, 'heat was generally regarded as a material substance, an invisible weightless fluid […]'. Now, however, '[i]t has been conclusively proved that heat is not matter, but that the application of heat to a body causes a vibration to the minute particles composing that body; that this vibration increases in intensity as the body receives more heat; and that what in our sensation is *heat* is in the body nothing but *motion*' (p. 1).

As a descriptive term, then, 'materialism' might seem inadequate, even useless, encompassing more than two millennia of philosophical speculation, only a fraction of which can be made conveniently to seem, or interpreted as, 'genuinely' or rigorously 'materialistic' – by our own contemporary standards, at least. By the appearance of the 1911 *Encyclopædia Britannica* the seeming unity of subject implicit in its 1860 definition ('MATERIALISM is the name given to that speculative theory which resolves all existence into a modification of matter') had been superseded by an awareness of diversity, a recognition of the different ends and origins of

materialistic philosophising. Totalising '*cosmological materialism*', it is argued, had as its impetus the aesthetic desire for a pleasing, all-encompassing system; '*medical materialism*', by contrast, found pragmatic, 'local' and limited justification in an awareness that certain forms of treatment and disease prevention had better outcomes than certain others forms of treatment and disease prevention. '[*A*]*nti-religious materialism*' was entrenched in a reactionary resistance to received dogma and existential belief, a stance having far less to do with physics than social politics; '*naïve materialism*', on the other hand, is somewhat condescendingly attributed not to any coherent intellectual commitment, but rather a sort of unexamined credulity, and the author of the article found it both in, say, ancient Greek animistic hylozoism and such pre-Socratics as Thales (who famously believed that in the different manifestations of water could be discovered all the forms and variety of the experiential world), and also in the considerably more contemporary writings of T. H. Huxley and the German embryologist Ernst Haeckel (both of whom should have known better, as argued implicitly by this scheme of classification and critique). Above all these in the hierarchy, indicating, perhaps, where our encyclopaedist's sympathies lie (it is, we are told, materialism's 'highest form'), is the methodology of '*scientific materialism*', that 'doctrine so commonly adopted by the physicist, zoologist and biologist'.

Such a *fin de siècle* fracturing in terms of ideology and implementation should hardly surprise, however – nor was it solely the consequence of Victorian scientific and philosophical dispute. Materialism's genesis as articulated system, a fact acknowledged since mid-century by commentators, could be traced amid the conjectures of Leucippus, Democritus, Epicurus; indeed, the Roman atomist Lucretius, essentially overlooked for more than a millennium, was in the 1870s 'thrust […] into the mainstream of contemporary polemics over science, religion, and philosophy […]' by Tyndall's Address at Belfast. Though some found ancient conceptions of 'falling atoms' – of collocations of matter wrought by oddly domestic forces (love, hate, and so forth) – quaint, others recognised in them legitimate precursors to certain aspects of scientific naturalism's rapacious worldview. Lucretius, more than the rest, came to seem prophetic, having argued 'that nothing can come from nothing, that the universe is orderly, and that atoms alone are the constituent elements of nature' (Turner, 'Ancient', p. 336).

Philosophical materialism, after centuries in desuetude, had first made an impression in Britain, becoming a serious – and, more often than not, antagonistic – alternative to conventional systems of metaphysical belief, in near lockstep with the inception and progress of the Enlightenment, with the publications of Newton on gravitation and Laplace and Lagrange

on mechanics and de la Mettrie on physiological function. The arrival of the nineteenth century, however, saw empiricism catch up with conjecture: atoms, formerly mental abstractions, became (to some) actual, weighable entities; physiological correlations between thought and electric currents became manifest, if scarcely uncontroversial.[5] Materialism, put another way, by mid-century came at last to seem something potentially falsifiable, a scientific belief in the Popperian sense. (Either the world had, or had not, the properties of 'atoms'; either 'energy' was, or was not, the sole currency of its phenomenal interchange.) At the same time, it became cognizant of its own past. Practitioners and advocates laboured to find proof, and found solace in the continuity of belief. Much of this activity took place on the Continent, Ludwig Büchner's *Kraft und Stoff* (Force and Matter; 1855) becoming, like Lange's *Geschichte*, a reference document on the functioning and significance of materialism even as Laplace's *Mécanique Céleste* (Celestial Mechanics; 1799 - 1825) began to seem one of the proudest monuments to its thorough implementation.

A complex of factors – the length and richness of its history, the polyglot nature of dissemination – contributed enormously to the profusion of 'materialisms' in mid- to late-Victorian intellectual life, causing the term itself to become semantically pliant, a linguistic marker having endless gradations of meaning and, in many instances, tremendous cultural and individual specificity. Roger Smith has argued this point as well, noting that, throughout the latter decades of the nineteenth century (and in a formidable range of discursive contexts), the noun 'materialism', like the noun 'materialist', seemed a designation – and a disparagement – at once 'notably common and notably undefined' (p. 85).

This is not, however, to insist that such terminologies and labellings are wholly pointless or misleading. Rather, they have modal functions, significations that are malleable, though not indefinitely so. Take 'modernity': as an abstract concept or ontological mode it has a certain understood genealogy, consensually accepted, a conventional tang of significance in talks about architecture, a different one in talks about social welfare or literature or art history. So, too, with classicism, rationalism, Romanticism – and scientific materialism or naturalism. Contemporary 'evolution', for instance, is multifaceted, accommodating not only the strict neo-Darwinian synthesis as found in the works of Richard Dawkins, but also the 'methodological evolution' of Steven J. Gould, even (some would argue) the decidedly more benign '[t]heistic evolution […] borne most forcefully in moderate to liberal Protestantism and

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[5] This paragraph draws heavily on George Stack's entry on 'materialism' in the *Routledge Encyclopedia of Philosophy*.

in mainstream Catholic thought' (Witham, p. 47). Diachronic mutability further enriches such synchronic pluralism: the term 'scientist' meant one thing in 1850, something again in 1950, nothing at all in 1800. Burdens of meaning change with context, with locale, within social groups. In the nineteenth century, publicists like Tyndall and Clifford used a range of classificatory or philosophical terms generically (not unfailingly, but often enough), as did critics and commentators. To reduce Wordsworth to sentiments expressed (or understood to have been expressed) in 'Tintern Abbey', or Pope to those adduced from *An Essay on Man*, is grossly unfair; it also seems not altogether removed from how many at the time – particularly those outwith the literary tradition – genuinely perceived things. To reduce Darwin(ism) to 'survival of the fittest' is equally unjust, yet was itself a commonplace. Victorians returned to the same texts, cited the same lines, distilled the same 'essences' of meaning and implication, from both literary works and scientific theorems.

Generalisation, like periodisation, is therefore, I believe, nearly unavoidable, though hardly excuse for critical sloppiness. Such a point follows on from Purrington's observations concerning Hendry's perhaps too schematised deployment of ideological categories like 'mechanist' and 'dynamist' in his study of Maxwell's electromagnetism. Many thinkers of the nineteenth century likewise broke the world – and history – into pieces, writing as if the severance between rationalism and Romanticism was as absolute as a line of longitude (once defined, then accepted). To give one example: William James, in an essay of posthumous appreciation, said of Myers's work (his output consisted primarily of studies of border states of consciousness, mesmeric and schizoid trances, liminal personality profiles) that it was rather as if Myers had gothicised the rationalistic garden of thought, adding picturesque architectural follies and patches of untended growth ('Nature', James concluded, 'is everywhere gothic, not classic. She forms a real jungle […]' ['Frederic', p. 22]), in the process making an interdisciplinary analogy that calls to mind also the changes in the background of Stoppard's *Arcadia*. Scientists themselves, particularly those under the sway of positive doctrine, were often wholly conscious of the sunderings implied, or invidiously imposed, by such deep-seated tendencies towards intellectual compartmentalisation. Comte identified three stages in moral evolution, charting – or projecting – in society a path from the theistic to the metaphysical to the positivistic; these were progressive and clearly differentiable, like the evolving forms of a butterfly. 1859 was, for many Victorian thinkers even uninfluenced by positivism, the occasion of a like disjuncture, rendering an irretrievable 'before', an uncertain 'after'. Frequently, there was a trajectory foreseen – or hoped for. Was this, however, one for the better?

Alternatively, one could conceptualise terms like 'Romanticism' and 'rationalism' not as incompatible allegiances but rather as an axis (or axes) in (or atop) a coordinate system, just as one can rethink evolution, or scientific materialism, not as the product of one moment, but as a historical tendency, a conceptual space, not geometric point. Doing so might suggest intriguing interconnections. Hendry himself links the dynamicist tendency in natural philosophy with the Romanticism of Wordsworth and Constable (p. 4), even as Gillian Beer suggests a punning, if suggestive, interplay between theories of deconstruction in the human sciences and that of plate tectonics ('with its emphasis on un-grounding' [*OF*, p. 194]) in the geological ones.

Such junctures constantly vitalise nineteenth-century scientific writing, especially that of the publicists, figures poised 'between the secular implications of scientific naturalism and the theological underpinnings of the culture. In a culture hostile to materialism', as Barbara Gates comments in an essay on the pedagogic role of scientific popularisation, 'they helped initiate the acceptance of science by reconfiguring its message' (p. 182). The remainder of this chapter provides an outline of several of the reconfigurations proffered, siting them within the context of three primal reactions (acceptance, rejection, compromise) to those various – and, to some, profoundly 'antagonising' – orthodoxies of mid- to late-Victorian naturalistic belief.

THE VARIETIES OF MATERIAL EXPERIENCE; OR, THIRTEEN WAYS OF LOOKING AT A BLACKBOARD

In an essay entitled 'Cosmic Emotion', W. K. Clifford observed that knowledge, here referring specifically to scientific knowledge, knowledge about the world 'as it is',

> must have been in men's possession for a long time before it has acquired the certainty, the precision, the familiarity, the wide diffusion and comprehension which make it fit to rouse feelings strong enough and general enough for true poetic expression. For the true poetry is that which expresses *our* feelings, and not *my* feelings only – that which appeals to the universal in the heart of each one of us. So it has come about that the world of the poet, the world in its emotional aspect, always lags a little behind the world of science […]. (p. 412)

If this, then, be the case then that is perhaps one among several reasons why a poem like 'Meaning', written late in the twentieth century by the octogenarian Polish Nobel laureate Czeslaw Milosz, feels nonetheless startlingly 'late Victorian', calling to mind, thematically, among other pieces, Thomas Hardy's 'New Year's Eve' (1906). Its imagery likewise suggests that poet's 'The Darkling Thrush' (1900), where, over a desolate, meaningless, 'material' landscape, an 'aged thrush, frail, gaunt and small / In blast be-ruffled plume, / Had chosen to

fling his soul / Upon the growing gloom'. In fact, a number of figures addressed in this dissertation found such an emblem – bird on branch, flittering from Matthew 10: 29, but also *Hamlet* (V.ii.219 - 20) – of a heartrending poignancy, if never (quite) Hardy's desolation. It seemed so iconic at once of mortality and aspiration. '[W]e will second every word', Frederic Harrison said pointedly of positivists in 1877, 'of those who cry out that civilisation is in danger if the workings of the human spirit are to become questions of physiology, and if death is the end of a man, as it is the end of a sparrow', his dread of materialism shading into reflex antagonism ('Soul', p. 630). A phrase equally epigrammatic, of comparable cinematography, yet markedly different in both implications and mood, was scribbled a decade or so later by Richard Jefferies, the nature writer and social activist. Eschewing both the melancholy and vituperation of Hardy, and Harrison's negative polemic, it sublimates instead into something near transcendence, a private reverie likewise occasioned by a series of musings on the existential ramifications of materialistic psychology: 'Bird on tree – expressing an idea I do not understand. They are beyond' ('Notebook', p. 166).

Nonetheless, for all the indisputable diversity in their rhetorics, metaphysically minded thinkers of the nineteenth century, like their twentieth- and twenty-first-century counterparts, in confronting the implications of a potentially 'meaningless' universe, ultimately had to align themselves with one of three interpretive frameworks. Each is adumbrated with admirable acuity and forthrightness in a stanza from Milosz's postmodern codification:

MEANING

– When I die, I will see the lining of the world.
The other side, beyond bird, mountain, sunset.
The true meaning, ready to be decoded.
What never added up will add up,
What was incomprehensible will be comprehended.

– And if there is no lining to the world?
If a thrush on a branch is not a sign,
But just a thrush on the branch? If night and day
Make no sense following each other?
And on this earth there is nothing except this earth?

– Even if that is so, there will remain
A word wakened by lips that perish,
A tireless messenger who runs and runs
Through interstellar fields, through the revolving galaxies,
And calls out, screams, protests.

Either an order beyond the visible, inaccessible to experiment, or nothing 'on this earth […]

except this earth'. Either a bright and numinous realm 'beyond bird, mountain, sunset' in which a deductive explanation is ready to hand for that which we must presently take on faith (a world in which, in short, 'What was never added up will add up'), or – to the detriment of religion and metaphysics – one in which the arbitrary is doomed to remain ever as such, even after death, in which 'a thrush on a branch is not a sign, / But just a thrush on the branch'.

Such a poem, like many of the disturbances occasioning it, would have made perfect sense to any of mid-Victorian England's scientific publicists. Even Milosz's language seems backward-looking and curiously nineteenth-century (his conceit of the universe as book-keeper's ledger, for instance, or natural philosophy as a generalised form of accountancy), as are his examples meant to show the unsettling and irreducible contingency of most observed natural phenomena. Questioning the causal necessity of sunrise and sunset was, indeed, not merely a Victorian commonplace, but a Humean – if not Biblical – one. The second option sketched by Milosz's 'Meaning', of course, encapsulates the perspective of materialism (the perspective, as Jefferies put it in a manuscript of the mid-1880s, that '[t]here neither is, nor has been, nor will be any chair, or table, or picture, or quern in the cosmos', that interpolated suggestions of design in nature are chimerical [*Old*, p. 51]); the first, that of most traditional approaches to metaphysics, whether neo-Platonic, theistic or otherwise. Needless to say, viewpoints of this latter sort perforce require an essential splitting of focus, an ontological doubling, one nicely captured in a remark by T. H. Huxley: adherents to such forms of belief, he explains, insist that 'beyond the *natura naturata*, mirrored or made by the natural operations of the human mind, there is a *natura naturans*, sufficient knowledge of which is attainable only through the channel of revelation' ('Modern', p. 537).

For this reason, a suggestive and readily transportable phrase (excerpted from the celebrated fifty-sixth canto of *In Memoriam*) like Tennyson's gnomic '[b]ehind the veil, behind the veil', the gist of which seems to argue in favour of just this sort of cosmological dualism, came to have an almost iconic importance to those who sought solace in the idea of a *natura naturans*, and it was repeated and re-echoed in their writings time and time again – and, as ever, in a striking variety of (frequently clashing) philosophical and scientific contexts.[6] For many

[6] Deprived of God, deprived of faith (Tennyson's enigmatic 'O for thy voice to soothe and bless!', of course, refers as much to his dead friend Hallam as it does to the Word of God as 'spoken' in Holy Scripture), the poet wonders despairingly: 'O life as futile, then, as frail! / O for thy voice to soothe and bless! / What hope of answer, or redress? / Behind the veil, behind the veil' (p. 912; LVI.25 - 28). Whether such a declamatory closing couplet suggests that a spiritual accommodation has been reached or merely the persistence in Tennyson's conflicted heart of some species of hope (or lingering faithfulness) remains at this juncture tantalisingly unresolved.

opponents of materialism it served in effect as a rallying cry. It appears, for instance, as a motto near the conclusion of Balfour Stewart and P. G. Tait's *The Unseen Universe; or, Physical Speculations on a Future State* (1875; p. 155), where its presence would seem to suggest that 'the veil is the material world, and behind it we find angels in the form of energy' (G. Myers, 'Nineteenth', p. 55). Other Victorian malcontents found for it different interpretations and wildly divergent significations. Some merely used it as an ideal way of silencing or foreshortening debate and analysis, a rhetorical gambit to which (they thought) there could be neither answer nor apt rebuke. As Harrison, perhaps the foremost positivist in England at the time, observed in his article 'The Soul and Future Life', many such individuals 'assume the question [of materialism's insufficiency] closed, when they have murmured triumphantly, "Behind the veil, behind the veil"' (p. 623).

Clifford, among others, took note of this, writing: 'To some minds there is hope and renewing of youth in the sense that the last word is not yet spoken, that greater mysteries yet lie behind the veil' ('Cosmic', p. 412). Nonetheless, the number and specification of potential denizens in such blessedly (or, in the arguments of Stewart and Tait, 'scientifically') revealed or unveiled 'other worlds', such *natura naturans*, as Clifford rightly points out – the varieties and specifics of these much sought-after special revelations – cannot be limited to those mentioned in Christian Scripture. Accommodation, he explains (in a fine *reductio ad absurdum* of dualist logic), need not only be found for the Holy Trinity, nor even, perhaps, the 'ethereal angels' described in *The Unseen Universe*, but also the 'goddess Kali, with her obscene rites and human sacrifices, or for any intermediate between these. Here is the clay; make your images to your heart's desire' ('Unseen', p. 792).

Yet materialism by itself represents an arduous path to follow. Belief in some further, more perfect ordering to things, as suggested by 'Meaning', provides inbuilt justification for the endless tribulations of quotidian experience. Indeed, Milosz's first stanza hints at just the kind of soothingly satisfying frisson of coherence and tidy completeness – one enabled in large part by thoroughgoing acceptance of a Janus-faced metaphysic – with which death will then imbue a life lived and lost on earth. The second, that stanza setting forth unornamented materialism, requires additional resolution, however; it is phrased as a series of conditionals, anxious enquiries about the state of things, each apparently more apprehensive than the last. Reductive philosophy presents not an answer, it seems, but rather a series of disquieting secondary questions. The third, hence, manages to evince a grimace of stoicism or defiance in the face of such truths, harsh realities about our cosmos revealed or implicated by the tenets of

modern (or nineteenth-century) science.

'Even if that is so', even if, as his argument goes, there is no world beyond this world, 'there will remain / A word wakened by lips that perish'. That word, of course, is, in a sense, the poem itself, a plea which 'calls out, screams, protests', carrying the staccato syntax of its concluding lines (whose halting rhythms seem jarringly removed from the bardic confidence of Milosz's opening) forward to future generations via the printed page, or disseminating outward at the speed of light, through the ether, across the void. Again, such sentiments find countless analogues amid the ideological tumult of the latter nineteenth century. (Quite literally, too: Stewart and Tait, in *The Unseen Universe*, as discussed in more detail in my third chapter, used conservation principles suggested by thermodynamics to argue that the human soul after death would be preserved eternally within a sort of 'second ether', like a standing wave bounding and rebounding forever between distant stars.) In other words, remarkably few – then, as now – could accept the facts of an unmitigated materialism, one bereft of supplement or balm to assuage us in our grief, though yet we realise, howsoever reluctantly, that customary Western perspectives on nature, 'taken as the production of the Creator's will, can never be made to harmonize with the blind force of cellular tissues sprouting by accident into all the phenomena of life' (*Darwinian*, p. 5). (So one Cantabrigian observed with sober clear-headedness in an anonymous study of 1867.) There were also, of course, temporal and earthly consequences to such naturalistic belief, not just eternal and heavenly ones. These, too, have long been acknowledged – and lamented.

W. H. Mallock, the mid-Victorian satirist and cultural critic, published an essay, 'Is Life Worth Living?', late in the 1870s, in *The Nineteenth Century*. He prefaced it with an observation bridging the recondite and the day-to-day, in the process irrevocably associating sociological, even moral, inquiry with the sort commonly deemed scientific and, as such, 'dispassionate':

> My aim is a far humbler one. It is simply to awake others, and enable them to pass judgment for themselves. It is my aim to make them see what in these days we are really debating […] and to show them that it is not only first causes, and natural selection, and the condition of the universe millions of years ago [presently under discussion]; but the tone and character of our human existence now – our hopes, our fears, our affections, even our amusements […]. (2: 252 - 53)

Yet such revelations were hardly so singular as Mallock pretends, particularly among the intelligentsia, though they also had a currency amid any number of constituencies far distant from that serial's well-educated (and -heeled) readership.

Many were moved to response and action, fearful of the projected spiritual and cul-

tural impact which material science's dismissal of those great truths – about human exceptionality, or centrality to Creation – would have upon the contemporary psyche, repelled by that adrift-at-sea emptiness associated with suspicion that their lives were suddenly less 'meaningful' or profound than they had previously been. As Dale has explained: 'By the late 1870s there began to emerge a distinctly negative reading of the meaning of science for the future of man. […] Advances in biology, genetics, heat theory, and astronomy all worked relentlessly towards the dehumanization of the world picture' (pp. 221 - 22). Though, as Dale contends, spiritual pessimism among practicing scientists was never the majority view, revolutionary scientific developments still managed to convey to many non-professional audiences in Victorian Britain a range of discomforting or troublesome possibilities. *Punch*, in a poem of 12 December 1874, 'The Fine Old Atom-Molecule' – featuring such kowtowing couplets as 'Then bow down, Mind, to Matter; from brain-fibre, Will, withdraw; / Fall Man's heart to cell Ascidian, sink Man's hand to Monkey's paw' – gave six stanzas of despondent interpretation, all the while effectively dismissing any induced gloominess though the easiness and whimsy of its touch.

Few were quite as adept as Mr Punch at maintaining such a demeanour of unflappable geniality. In a well-remembered account of George Eliot, Frederic Myers recalled her once declaiming the interpersonal obligations of humankind, the need for each member of society to strive for the betterment of others; they had been on a walk one rainy evening through the Fellows' Garden of Trinity College, Cambridge (J. Beer, p. 134). 'Never, perhaps', he wrote in 1883 of these pronouncements, 'have sterner accents affirmed the sovereignty of impersonal and unrecompensing Law' ('Eliot', p. 269).

Grimmer still, however, were those disembodied injunctions – heard as an 'inward Voice' – made by *science*, edicts, as he wrote in 'An Autobiographical Fragment', which had led him in the late 1860s to 'an agnosticism or virtual materialism which was sometimes a dull pain borne with joyless doggedness, sometimes […] a horror of reality that made the world spin before one's eyes' (pp. 12 - 13). Though written after the passing of that malaise, his poem of 1877, 'A Cosmic History', encodes perhaps the most 'dehumanising' version of the contemporary naturalistic hypothesis, unspooling a tale of nebular condensation and arbitrary vertebrate evolution, culminating in the loveless equilibration of thermodynamic 'heat death':

> Come then, poor worm at war with Fate, –
> (What inward Voice spake so stern and low?)
> Come, paltry Life importunate,

Enough of truth thou too shalt know;
Since man's self-stirred out-reaching thought
Hath seen in visions sights of awe;
Hath from a darker Sinai brought
Damnations of a vaster Law.

From dust, they told thee, man was born? –
The Cosmos' self from dust began, […]

[……]
No Mind creating watched alone,
Nor bade the emergent minds begin;
To weltering waters, senseless stone,
The seeds of Life had entered in.

[……]
Then all in silence; all in one
The exhausted orbs have crashed and sped;
Cold to the core is every sun,
And every heart that loved is dead. (pp. 187 - 88)

This is darkly Miltonic, in a way. A new Exodus, in which the oppressed are liberated at the cost of hope. A new Genesis, in which the Saturnalian disordering of things, of primordial chaos – 'The womb of Nature, and perhaps her grave, / Of neither sea, nor shore, nor air, nor fire, / But all these in their pregnant causes mixed / Confusedly […]' (Milton, p. 163; 2.911 - 14) – is shown in the universal scheme to have had effective hegemony all along, despite our momentary respite on a sunlit world, in a civil society.

'Chaos, Cosmos! Cosmos, Chaos! who can tell how all will end?', the venerable Poet Laureate had asked in 1886, the balance between opposites so delicately poised ('Locksley', p. 1363). Myers, however, had by then known his generation's answer to Tennyson's riddle – and with dreadful certainty – for decades. Those Ten Commandments of Mosaic Law are accordingly supplanted, if not reduced to triviality or a sort of self-deluding archaism, in Myers's 'A Cosmic History' by the revelations of a 'vaster Law': a material rule encompassing energy conservation, entropic decay; a principle suggesting the futility of life, the absurdity of sentience. Tennyson, too, struggled in 'Vastness' (1885) with a comparable sense of kaleidoscopic disorientation, of a race – a species – 'Swallowed in Vastness, lost in Silence, drown'd / in the deeps of a meaningless Past […]' (p. 1348), before ending that poem in a brief coda suggestive of existential accord. 'A Cosmic History', by contrast, allows no harmonious resolution. Its implications seemed especially resonant in an age like that of the Victorians, one in which science seemed to proclaim (to audiences of theists, agnostics, positivists, atheists of varying stripes), that the sum of *all* society's, of all science's, painstakingly acquired knowl-

edge about the cosmos and its generalised laws, when looked at on any grand enough scale, amounted, in effect, to little more than an epitaph, or, at least, the initial drafting of one – a prescription of death, if not final notification.

'[A]ll we know', Clifford explains with brave and stark simplicity towards the end of 'The First and Last Catastrophe', 'is that the sun is going out' (p. 483). And with it, 'not only the earth itself, and all the beautiful face of nature we see, but also the living things upon it, and all the consciousness of men, and the ideas of society, which have grown up upon the surface, must come to an end' (p. 484). Two decades later, H. G. Wells, formerly a pupil of Huxley's at Kensington's Normal School of Science, was to recapitulate these very cadences in the famous concluding chapters of *The Time Machine* (1895), his most influential single work (perhaps inadvertently confirming in the process Clifford's observations about the time-lag between the scientific expression of an idea and its literary elucidation). The Time Traveller, going millennia beyond the etiolated earth of 802,701 with its population of effete Eloi and savage Morlocks, comes at last to a world in ruins, its dying sun hanging vast and incarnadine in a cheerless sky: 'It would', he tells us, 'be hard to convey the stillness of it [that world]. All the sounds of man, the bleating of sheep, the cries of birds, the hum of insects, the stir that makes the background of our lives – all that was over' (p. 65).

Wells here, however, was merely giving fictive form to a haunting prophecy of universal thermodynamic doom known by then to most among the literate (if not always accepted, either blithely or unconditionally), a fate decrypted initially from fussy equations describing the internal working of heat-engines, from Fourier's dynamic models, from the mechanistic understanding of heat as 'mode of motion', then extrapolated to govern a cosmos, before ultimately being given popular expression in the writings of Clifford, Proctor, William Thomson and others. Indeed, the modern physicist Paul Davies, in a popular guide to scientific apocalypse, *The Last Three Minutes: Conjectures about the Ultimate Fate of the Universe* (1994), has described the nineteenth century's discovery of the truth that the universe as a whole was condemned, like a clock running down, to an inevitable (and ignoble) 'heat death' as 'probably the most depressing prediction in the history of science', one which was to have 'a profoundly depressing effect on generations of scientists and philosophers' (pp. 9, 12); and it was an all but irrefutable one, too, 'an inexorable consequence of the laws of thermodynamics […]' (p. 12) – the precise laws that allowed steam engines to chug and milling machines to press, that enabled Britannia to rule the waves along with much of the wider world: militarily, politically, economically.

Gillian Beer summarised the effect that this funereal state of affairs was to have on the Victorian mindset – abetted, of course, by Darwin's, Huxley's (and, almost subliminally, Tennyson's) speculations on species extinction – in her '"The Death of the Sun": Victorian Solar Physics and Solar Myth': 'The expanding of individual death into the idea of the death of a whole species […] as well as the idea of the ebbing of the sun's energy, make for an undertow of sadness in Victorian thought' (*OF*, p. 213).

'God is light', Milton had declared in *Paradise Lost* (p. 167; 3.3). For many intellectuals, however, by the latter years of the nineteenth century that god-function had been usurped by the sun, both literally ('The sun is the great sustainer of our life', as the Irishman W. Goff remarked in an 1891 scientific paper [p. 195]), and, for a smaller group, metaphorically as well ('The sun is our lord and god, sublime, serene', in the opening words of one late Swinburne lyric ['Lake', p. 1122]). At the same time, the era's science recognised that the sun, like the earth itself, was mortal, having birth, facing death. There is, for instance, a certain alarmist tone pervading Thomson's pronouncements on the implications for human life of the twin laws of thermodynamic theory: 'Within a finite period of time past, the earth must have been, and within a finite period of time to come the earth must again be, unfit for the habitation of man as at present constituted […]' (p. 514). This seemed deeply unsatisfying to many of the period's atheistic and agnostic commentators. Even a few Christians were unnerved: Edmund Beckett gave his opinion of materialistic presumptions of solar obsolescence in *Astronomy Without Mathematics*, first published 1865, a volume of both overarching, if prominently acknowledged, theistic suppositions and (more often than not) unimpeachable astrophysical scholarship (the high-minded Society for Promoting Christian Knowledge was its English sponsor); such beliefs, he explained, 'must be perfectly satisfactory and convincing to those who will believe anything except a Creator' (p. 118).

But in that 'anything believed' there was enormous diversity. The sun's senescence was only one among several problematic issues raised by naturalistic belief. Psychophysical parallelism and the apparent banishment of the supernatural or divine from both natural phenomena and mental life seemed likewise to diminish, or render pointless, humanity's existence. Each of the figures addressed in this dissertation had his own scheme of rejoinder to these challenges, however. Each had, as it were, an idiosyncratic vocabulary, in Milosz's vernacular, for 'call[ing] out, scream[ing], protest[ing]' – for responding to (or raging against) the cruelty perceived or assumed to lurk within a cosmos rendered ominously inhospitable to both humanity itself and humanity's freight of moral and theological concerns. A few even

questioned the entire validity of such interpretive assumptions: 'When we hear it said […]', Ernst Haeckel countered in *The Evolution of Man: A Popular Exposition of the Principal Points of Human Ontogeny and Phylogeny* (1874), that materialism would 'cause a retrogression in the intellectual and moral development of man […], I cannot withhold my conviction, that the very opposite will be the true, that by it the progressive development of the human spirit will be advanced in an unusual degree' (2: 458). His unyielding defence of pure rationalism, not unlike Clifford's (discussed in my third chapter), directly contradicts Mallock's contention in 'Is Life Worth Living?'. Meanwhile, a further grouping – among those I have mentioned thus far: Jefferies and Myers, Tyndall after a fashion – looked to science to *redefine* the religious sense, moving it beyond strict naturalism, beyond pedantic piety, hoping to navigate Odysseus-like those tempestuous ideological seas lurking between nineteenth-century science and nineteenth-century religion.

And thus, while Clifford may have felt that poetry was an expression of the universal – he was, after all, reasonably emphatic in his insistence that 'true poetry is that which expresses *our* feelings, and not *my* feelings only' ('Cosmic', p. 412) – clearly it was the issues he and colleagues were addressing, not the conflicted solutions proffered, that were truly communal. Their predicament was self-evident. Rev. Robert Watson, author of scholarly glosses for the Books of Ruth, Numbers, Job and Judges, phrased things succinctly in *Gospels of Yesterday* (1888), saying of the intellectual scramble by his generation's agnostics and materialists:

> Attempt after attempt has been made of late to extract from the ordinary course of things a rule for the guidance of mankind, a religion not altogether wanting in fervour, and having at least an air of wisdom and impressiveness. It is plain that the world cannot go on without something of the sort, for, however much we have outstripped our forefathers in mechanism and sanitation, we remain much like them in our need of comfort, stimulus, and hope. (p. 181)

Many nineteenth-century scientific publicists partook of these attempts, notably Tyndall.

The author of *Extra Physics, and the Mystery of Creation* (1878), a book-length critique of materialist and reductionist physical paradigms, reiterated one popular perception of that scientist in his own analysis, the governing metaphor evangelical:

> more than any of his contemporaries, [Tyndall] stands for Physical Truth. Other men may be greater in their special departments, but as the High Priest of Physical Truth, interpreting, as with a wave of light, its deepest dynamics, and dispensing with radiant beneficence its subtlest gifts, – as the inspired Seer of Molecular Activities, summoned by an expectant universe to strike, with the tuning-fork of science, the keynote of all practical wisdom, and proclaim with authority the possibilities and limits of the human intellect, he stands alone. (p. 13)

Nonetheless, even Tyndall, as we shall see, science's celebrated 'High Priest', was in various

and subtle ways a malcontent, hesitant to accept the burden of his own radical conclusions, unsure about the nature of the world he wished to 'materialistically' encapsulate.

Thus, while theoretical entities (vortex atoms, gear-like current flows) bounding about, unseen though not unremarked upon, in the laboratories and lecture theatres of the nineteenth century rarely survived to trouble the researchers of the next, Milosz's 'Meaning' – a modern restatement of one contemporary puzzle (its like universality confirmed by the encompassing reach of its title) – serves as a strangely affecting reminder that some Victorian concerns linger in the air of the physical laboratory even to this day, long after many other items of 'scientific' import, for all intents and purposes, have been utterly forsaken.[7]

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[7] Or, perhaps more properly, they linger in the study of the kind of ersatz 'natural philosopher' (or interested amateur) still busy pondering such problems, for what *practicing*, results-oriented empiricist has the time to spare!

CHAPTER 2

TYNDALL'S CREPUSCULAR MATERIALISM: ORATIONS AT BELFAST, 19 AUGUST, AND MANCHESTER, 28 OCTOBER 1874

> It is probably part of the great change in the manners of this country that such an Address as that of the President of the British Association will now give but little offence, and encounter little contradiction, even in most religious circles.
>
> - 'Professor Tyndall's Address', *The Times*, 24 August 1874

At the time of its publication, the notice appended to the 13 August 1874 edition of *Nature*, an announcement of a much anticipated annual scientific conference, must have seemed unremarkable enough: 'As usual this season […] congresses are coming thick upon us. The British Association commences its sittings next Wednesday at Belfast, when Prof. Tyndall will give his presidential address' ('Notes', p. 293).

That Address, however – like the fracas that greeted its delivery – was to prove anything but unremarkable. Lange, in the second volume of a revised edition of his *Geschichte des Materialismus*, said of its religious and scientific significance:

> Tyndall's address is, as it were, the official announcement of a new era for England, which plays so important a part in the History of Materialism. The old hollow truce between natural science and theology, which Huxley, and recently Darwin, had seriously shaken, is now broken, and men of science demand their right to follow out in all directions, undisturbed by any subsisting traditions, the consequences of their theory of the world. (3: 363)

Such a message was as unpopular as it was uncompromising. Even Tyndall's close friends, in its wake, 'thought he had gone too far in straying into the murky swamps of metaphysics in defence of scientific materialism. For weeks he was denounced […] and pamphlets attacking the "Belfast Address" continued to appear for years afterward' (Burchfield, p. 7). Indeed, as Frank Turner notes, this exhortation of little more than an hour and three-quarters in length (according to a contemporary account of it in *The Times* ['BA', p. 5]), 'succeeded in sparking perhaps the most intensive debate of the Victorian conflict of science and religion. It aroused far more controversy than the Huxley-Wilberforce encounter […]' – perhaps surprising given the amount that *that* dispute has figured in popular imagination of the cultural foment of the

time – as the Belfast Address 'more clearly illustrated the social and intellectual issues at stake' ('Tyndall', p. 170). Subsequent to it, the scientist found himself assailed for, quite literally, a multitude of sins. Lightman, in 'Scientists as Materialists in the Periodical Press', a study of the Address's aftermath as reflected in contemporary journalism, observes that Tyndall was accused of plagiarism (in *Blackwood's Edinburgh Magazine*), paganism (in the *Edinburgh Review*, *Irish Review*, *Dublin Review*, and elsewhere), atheism (in *Fraser's Magazine*); he was likewise slated for his overriding dependence on Darwinism (in the *Month and Catholic Review*), his slippery use of rhetoric (in *The Contemporary Review*), and, more or less universally, inexcusable lapses in logic and general professional, not to forget philosophical, presumptuousness. He was frequently tarred as well with the charge of being an unrepentant or unscrupulous materialist, an accusation which, in the 1870s, 'was a serious one. It grouped Tyndall together with lower-class atheists, casting aspersions on his status as a member of the intellectual elite'. Lightman even goes so far as to suggest that Belfast signalled a *volte-face* in the intelligentsia's entire disposition towards the man; before it, he explains, '[…] Tyndall was usually cast in a positive light in the periodical press, albeit with some reservations, and he was not labeled as a materialist. But after the Belfast Address he was portrayed as an aggressive, dishonest, devious and distinctly un-British materialist' (p. 202).

This chapter is an examination of the rhetoric, and philosophy, of that Address. Engaging also with a number of issues relating to the oration's instant notoriety (for good or ill) in mid-Victorian society, it provides analysis of a few of those themes elaborated within it destined to cause such a shifting in the popular perception of both the scientist and the nature of the 'materialism' he so earnestly advanced. Its first section incorporates, alongside commentary on the Belfast Address itself, a reading of 'Crystals and Molecular Force', an address given in Manchester two months after the 1874 Inaugural, one which both responded to some of the criticisms levied at its more famous predecessor while effectively reiterating the same overall argument, in miniature but with equal forcefulness. The steadfastness of such conviction, despite all controversy, as evidenced in this follow-up lecture is mirrored, as we shall see, in the obstinacy Tyndall demonstrated in revision of the text of the Belfast Address proper – particularly one divisive assertion on the 'promise' and 'potency' of matter – through a range of editions over the several years following its delivery. Later sections focus on the seeming 'asymmetry' of Tyndall's Belfast worldview (a bias in exposition central to my final two chapters), and the nature of scientific analogy in the structure of his argument, before an epilogue discussing the cultural fate of both Tyndall and his 'truce-breaking' pronouncement.

The major scientific publicists and agnostics, Lightman argues, 'never formed an organized school or net, but they regarded each other as friends and shared a common circle of acquaintances, quoted one another with approval in their writings, and lent support, both moral and financial, in times of need' (*Origins*, p. 93). For that group, the Belfast Address served as the *locus classicus* for discussions and reassessments of the centrality of materialism to physical investigation, as it provided the clearest, most thorough and memorable, exposition of a naturalistic ideology. Maxwell summarised its central message – and that of mid-Victorian materialism as a whole – in a single couplet, where it is phrased as a modernisation of Democritean atomism: 'From nothing comes nothing, they told us, nothing happens by chance, but by fate; / There is nothing but atoms and void, all else is mere whims out of date!' ('British', p. 639).

Subsequent chapters will observe how Maxwell (and several others) reacted against the metaphysical contentions of such belief, how Clifford reaffirmed them with marked zeal, and how Tyndall (so often thought of as materialism's 'high priest') attempted to mitigate any potentially 'debasing' or 'demoralising' aspects of that mid-Victorian interpretive methodology through deliberate invocation of literary or 'non-materialistic' language.

'Atom, the Architect'

'Crystals and Molecular Force' commenced, so far as one can judge from a 'corrected edition' of the lecture's text, with something of a parable. Several years before, Tyndall explains, he had been asked by the headmaster of a local school to address a group of students; he had agreed on the condition that he be permitted to instruct a class of 'the youngest boys', a group, on the whole, unfettered by notions of how the world was to be divvied up and parcelled, who would never refuse to see beauty inhering in the humblest of substances. These children, Tyndall remarks, 'had no notion that the thing they had been crunching and sucking all their lives [crystallised sugar-candy] embraced so many hidden points of beauty […]. [A]nd when they found that in certain directions it could be split into thin laminæ with shining surfaces of cleavage, their joy was at its height'. It seems in matters of learning, as in matters of devotion, children – particularly young children – are by far the most amenable to proceeding solely on 'faith': these 'young philosophers', the scientist tells us, spent the whole hour 'listen[ing] to me with the most eager interest' (p. 69).

Tyndall followed such a personable introduction with a fine specimen of mythologised

historiography, a synoptic literary mode with which he had become increasingly linked. This provided, as elsewhere in his addresses and writings, a cultural narrative fixating not on battles nor parliaments, but rather the process – through trial and error, induction and experiment, over the course of millennia – which had 'rendered physical science almost as stable as the system of nature it professes to describe' (p. 71). Beginning in prehistory, related in telegraphic jumps, Tyndall's account skipped from revelation to revelation, from the rudiments of experience to the fullness of a formalised and mathematicised theory of universal gravitation: 'In the drawing of a bow, the darting of a javelin, the throwing of a stone, in the lifting of burdens, and in personal combats, even savage man became acquainted with the operation of *force*' (p. 70). As man, according to Tyndall, became ever more adept at such rudimentary tasks, he found he had at his disposal additional 'time to look about him, and become an observer and inquirer', discovering through experience first the phenomena of magnetic attraction (and repulsion), then quantifying that experience – rendering it expressible in language, in terms of pushes and pulls – through 'a kind of poetic transfer', a process of analogy in which human activities (pushing and pulling) were seen to have clear analogues in inorganic behaviour (pp. 70, 71). From there, in the Tyndallic worldview, it is but the tiniest of intellectual leaps to Newton's G and Kepler's three famed laws: 'Having started with the savage and his sensations of molecular force, we pass on to the observation of force exerted between a magnet and rubbed amber, and the bodies which they attract, and rise by an unbroken growth of ideas to a conception of the force by which sun and planets are held together' (p. 72). Syntax recapitulates scientific history: each comma elides centuries of 'inactivity' (from the speaker's perspective), each phrase enacting conceptual revolution. The accumulation of physical knowledge is figured as organic, 'unbroken': worldly '[e]xperience […] furnishes the soil for plants of higher growth', that is, abstract theories themselves, which, suitably nurtured, 'grow out of the fruitful soil of observation' (pp. 71, 72). But not through induction alone. Imagination is also vital: 'you *imagine* where you cannot *experiment*', the scientist implores (p. 74).

Discussion of the actual geometric intricacies of crystallisation – the 'hard science' of such a scientific lecture – occupies a comparatively small proportion of it textually. Even this 'hard science' is couched in spiritual imagery and language, however. The dialectical rigour of Baconian method – hypothesis, experiment, revised hypothesis, subsequent experiment – is re-figured as quasi-religious rite or catechism, a call-and-response between the scientist and the irresistible 'voice' of externality: 'Looking at these beautiful edifices and their internal structure, the pondering mind has forced upon it the question, How have these crystals been

built up? What is the origin of this crystalline architecture?' (p. 79). Again, the suitably prepared 'pondering mind' is obligated to look beyond the superficially diverse phenomena of crystalline structure (readily apparent even to those inquisitive schoolchildren), and to search assiduously for some ordering principle beyond the visible, inaccessible to experiment, one perhaps arising from magnetism, a known microscopic cause with macroscopic consequences. He elaborated, saying that the mid-Victorian physical theoretician was

> compelled by bias towards unity of principle to transcend experience, and endow the atoms and molecules of which these crystals are made with definite poles, whence issue attractions and repulsions for other poles. In virtue of these attractions and repulsions some poles are drawn together, some retreat from each other; atom is thus added to atom, and molecule to molecule, not boisterously or fortuitously, but silently and symmetrically, and in accordance with laws more rigid than those which guide a human builder when he places his bricks and stones together. (p. 79)

He here has recourse to an explanatory trick widespread in popularised descriptions of molecular phenomena, then as now. 'In the specimens hitherto placed before you', Tyndall told his audience in Manchester's Free Trade Hall, 'the work of the atomic architect has been completed; but', he promised, soon enough – in a sequence of demonstrations he was preparing to begin – 'you shall see him at work' (pp. 79 - 80).

This fastidious 'atomic architect' thus took its place alongside Maxwell's demon, another wee beastie first 'discovered' in 1867, becoming one in a growing family of minuscule anthropoid creatures animating a deterministic, even homely, atomic or molecular world (in much the same way that Schrödinger's cat became a garden-variety *macro*scopic creature illuminating something unfamiliar – or alarmingly *in*human – about the non-deterministic, sub-atomic world of twentieth-century quantum mechanics).[1] Tyndall, in a critique of James Mozley's *Eight Lectures on Miracles* (1865), had once reflected that the 'concerns' of pre-Copernican cosmology – like its scale and temporal scope – were 'vastly more commensurate with man […] than those of the universe science now reveals to us' (*FoS*, p. 445). Equally, though, such 'disproportioning' awareness, in a curiously palpable way, even while it augmented in a literal sense, also contracted in a more symbolic one the gap between nature and individual. Two examples: '[t]he lightning flash', as Tyndall observed in a journal entry for 15 May 1848, 'is but an enlargement of the electric spark and the cracking of [?this] machine a microscopic thunderpeal' (p. 289). He was to replicate many such scale-bridging phenom-

[1] Maxwell's demon 'behaves like a pianoforte player, endowed with extreme molecular smallness and an enviable dexterity, but, despite all this, he is to be considered in no way supernatural', as described in *Nature* in a brief article of 1879 'The Sorting Demon of Maxwell'.

ena in his popular lectures, particularly at the RI. From the 1850s to the early 1890s, in dozens of darkened auditoria (on Albemarle Street as across the British Isles), he spectacularly produced 'artificial skies' and lights 'almost as brilliant as […] the sun', to quote his own self-publicity (*FoS*, pp. 148, 79). He was always to insist, moreover, that the *truly* inquisitive need never content themselves with simulacra, with mere reproductions of such 'tangible' things. The earth, as noted in another of his addresses (given before graduands at University College, London), 'is illuminated by a sun which, though nearly a hundred millions of miles distant, can be brought virtually into our closets and there subjected to examination' (p. 101). The grandest spectacles in nature, in other words – the sky's tint, noontime's blinding glare – could be not merely recreated, but constrained, held captive, in the comfortable confines of a Victorian domestic space, there to be analysed at will.[2] 'This bed thy centre is, these walls, thy sphere', Donne had said of the sun in 1633, describing the 'contracted' world of enraptured lovers (p. 107). Bunsen's spectroscopic science had, however, made this metaphysical conceit physically descriptive, even as 'modern' atomic theory, as elaborated by Tyndall, transformed the exigencies of inorganic crystallisation into the doings of a gentlemanly professional: the former, shrinking the cosmos; the latter, expanding it, making it (analogically) as big as life.

Tyndall's notion of an 'atomic architect' became something of a sensation. *Punch*, in particular, had for some time delighted in satirising the scientist, not so much for his Irishness (though that was a target, too), as for his earnestness, a naïve – if infectious – enthusiasm for the natural world which sought continuously, as Paradis puts it (in a phrase at once figurative and literally true, given the scientist's atmospheric investigations and vibrant lecture performances), 'to coin deeply mystical significance out of thin air' (p. 156). But, on 7 November 1874, a poem entitled 'Atom, the Architect' featured in the pages of the serial. It did not, however, lampoon the Manchester oration's sometimes syrupy lyricism. On the contrary, Mr Punch's intended target was far more specific: Tyndall's seemingly outrageous claim that the structure of the universe was not ordained on high but rather, as it were, on 'low', in that microscopic realm of atoms and molecules – in that realm, in short, of 'atomic architects'.

The first of four quatrains went as follows:

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[2] It can sometimes seem a gendered space as well: the smoking room, rarely the kitchen. Tyndall's language hinted as much in an aside (innocent perhaps) in 'On the Scientific Use of the Imagination'. There, in a digression on the infinitesimal amount of 'sky-matter' present in the atmosphere – matter which, by reflection and absorption, brings into being the full splendour of a 'deep blue firmament' – Tyndall wondered: 'What is its probable amount? I have sometimes thought that a lady's portmanteau would contain it all. I have thought that even a gentleman's portmanteau – possibly his snuff-box – might take it in' (*FoS*, p. 152).

THESE 'Architectural Atoms!' O 'tis fine
To see humanity so sadly dwindle!
Let MICHAEL ANGELO and WREN resign;
Atoms can build Cathedrals – so says TYNDALL.

Typical *Punch*, it would seem: take a debatable assertion; follow it through to some (logically questionable) conclusion. But there is beneath any frivolity a pummelling sanctimoniousness which refuses to allow the popular magazine's satire to be as light-hearted as it hopes. Note that the artist-architects who have, so to speak, been 'made redundant' are both best known for ecclesiastical commissions. Moreover, the first three quatrains – all of them, on the whole, fair jest – end with the refrain 'so says TYNDALL'. Not so the fourth, where *Punch*'s undisguised polemic seems particularly mean-spirited:

Shallow Professor! the eternal Fates
Sit silently and turn the fearful spindle;
And that great wheel of doom the moment waits
To crush the sceptic silliness of TYNDALL.

Tyndall was not slow to react to this further assault. He was quick as well to recognise that such 'satire' arose, not from careful consideration of the complete text of his lecture, but rather glib perusal of a few of its juiciest assertions. '*Punch*', he commented, 'has been my friend for more than thirty years. Here, I grieve to say, he has followed the multitude who commit the evil of condemning what they have never read' (*BA* [2], p. 68). Such a sin is one of which he often accused the more immoderate among detractors of his writings on scientific materialism in general (and the Belfast Address in particular) of having perpetrated as well. As he once said of the arguments put forward in '"Materialism" and Its Opponents' (an essay intended – somewhat tellingly – as 'an introduction to a forthcoming edition of the "Fragments of Science" […]', but which made its first appearance in the pages of *The Fortnightly Review*): 'To the judgement of thoughtful men I now commit them: the unthoughtful and the unfair will not read them, though they will continue to abuse them' (p. 579).

Tyndall's penchant for elliptical or unsophisticated philosophising was a forensic habit much criticised by colleagues: Oliver Lodge, for instance, in 1902, quipped that the scientist 'never failed to elaborate the simple' ('Tyndall', p. 517), while another contemporary, Henry Wace, in a survey article of 1878, 'Scientific Lectures – their Use and Abuse', reprimanded him for intruding his 'speculations into regions which are far beyond those which are properly [his] province […]' (p. 38); it was a tendency at Manchester perhaps most pronounced in some discursive asides on crystallisation. After almost wistfully lamenting the possibility that

there might not *be* a Higher Power in the universe – that is to say, that the 'atomic architect' might be the sole architect of consequence – John Tyndall, vehement materialist, nonetheless still found comfort in a surprisingly dualistic account of the scheme of things. This encompassed not just physical substance but also 'stereotypically' omniscient god-figure (rather weakly described as some 'power, being, or thing'). The impetus of theistic (or, at minimum, deistic) concern so evident in these concluding paragraphs was, of course, conveniently overlooked by the parodists at *Punch*. 'The *mechanism*', he explained, of crystallisation

> is rendered intelligible by the picture of atomic poles; but is there nothing but mechanism here? There is something, in my opinion, which the mind of man has never yet seized; but which, so far as research has penetrated, is found indissolubly joined with matter. I have seen these things hundreds of times, but I never look at them without wonder. And […] I would say that when standing at spring-time and looking upon the sprouting foliage, the lilies of the field, and sharing the general joy of opening life; I have often asked myself whether there is no power, being, or thing in the universe whose knowledge of that which I am so ignorant is greater than mine. I have said to myself, Can it be possible that man's knowledge is the greatest knowledge – that man's life is the highest life? (pp. 81 - 82)

There is much to enjoy in this passage, but grounds for mistrust as well: the displaced sexuality of Tyndall's evocation of 'sprouting […] opening life'; his legalistic wording (perhaps designed to insure that no conception of the divine was prematurely debarred); the Whitmanesque solipsism implicit in the scientist's lonely dialogue with nature.

Most crucially, however, Tyndall used his Manchester platform to correct, or admonish, critics and clarify – but hardly qualify or enfeeble – the bold assertions he had made not long before at Belfast. Many in the audience were awaiting such a rapprochement – or, at least, brief acknowledgement of ideological wrongdoing. Tyndall, pointedly, made no such apology. Such resolve (or pigheadedness, to the minds of some) also characterised the various revisions he made to the *text* of the Belfast Address over the years. Its editorial constancy through a half-decade period of republication and hullabaloo is perhaps best illustrated by examining, in five distinct variants, a few of the (very minor) modifications Tyndall made in the phrasing of one of its most divisive assertions. Each text is a snapshot in time. The first under consideration is the transcript of the Address taken from the London *Times* of 20 August 1874, the day after its delivery (it had been diligently telegraphed overnight); the second, the initial Longmans, Green, and Co. printing of 1874 (which incorporated some additions and elaborations; as Tyndall explained: 'It was [originally] written under some disadvantages this year in the Alps […]. When read subsequently, it proved too long for its purpose, and several of its passages were accordingly struck out. Some of them are here restored' [*BA*, p. v]); the third, that publisher's 'seventh thousand' edition, likewise of 1874. The lattermost edition also

featured, alongside a revised peroration, a thoughtful (and lengthy) preamble – 'I take advantage', he explained at its start, 'of a pause in the issue of this Address to add a few prefatory words to those already printed' (*BA* [2], p. v) – discussing, among other things, a range of the most damaging and unfair slanders levelled either at the substance of Tyndall's argument or the person of its author. One gains a sense of the rapidity of all this – surely, the *Address* must have been among the literary sensations of its day – when one notes that the two Longmans volumes were published in the space of a few months.[3] In copies held by the University Library, Cambridge, for instance, stamped imprints give acquisition dates of 20 October 1874 and 26 January 1875, respectively. For comparison, I have selected variants that appeared in 1876 and 1879. Both were included in that 'authorised' compendium of Tyndallic thought, *Fragments of Science for Unscientific People*, an anthology – which was so fantastically popular that it required a second edition within a fortnight of its initial publication – written, in its author's own words, out of a 'desire […] to extend sympathy for science beyond the limits of the scientific public' (*FoS*, p. ix).

The Address's most inflammatory contention by far – one that 'trace[d] back all existing things, both mental and physical, to the interaction of the forces, affinities and motions of the ultimate particles of matter', as ably summarised by John Quarry, Rector of Donoughmore and Canon of Cloyne Cathedral (p. 4) – provided a materialistic genealogy of consciousness, one overlooking animating agency or divine being in favour of the cooling and coalescing of insensate atoms in the pre-planetary nebula. This is how it appeared in *The Times*: 'Abandoning all disguise, the confession that I feel bound to make before you is that I prolong the vision backward across the boundary of the experimental evidence, and discern in that Matter, which we in our ignorance, and notwithstanding our professed reverence for its Creator, have hitherto covered with opprobrium, the promise and potency of every form and quality of life' ('BA', p. 4). Of its reception Tyndall commented: 'to call it a "chorus of dissent," […] is a mild way of describing the storm of opprobrium with which this statement has been assailed' (*FoS* [5], p. 546). Bernard Lightman notes that clear references to – even verbatim citations of – such a (perhaps too readily) quotable manifesto were made in an astonishing number of contemporary periodicals: the *Dublin Review*, the *Irish Monthly*, *The*

[3] I should also mention that there were, in the same period, a number of additional reproductions of (or excepts from) the Address in *Nature*, local and regional papers, popular serials, and so forth, not to overlook its appearance as centrepiece to the cumbersome (if encompassing) volume, *Report of the Forty-Fourth Meeting of the British Association for the Advancement of Science; Held at Belfast in August 1874*, overseen by the BAAS itself.

Spectator, *The Graphic*, *Fraser's Magazine*, even the *Athenaeum*, among others ('Scientists', p. 210).

The textual evolution of the sentence through those four subsequent editions, though, demonstrates how little public censure caused the scientist to either downplay his message or weaken its phrasing. 'By an intellectual necessity I cross the boundary of the experimental evidence, and discern in that Matter which we, in our ignorance of its latent powers, and notwithstanding our professed reverence for its Creator, have hitherto covered with opprobrium, the promise and potency of all terrestrial Life' (*BA*, p. 55): the most evident alterations between *The Times* transcription and this, the first supervised revision, include removal of a prefatory transitional phrase (less necessary in a printed, rather than spoken, context), and clarification of 'our ignorance' in terms of our 'ignorance of its [matter's] latent powers'. The ideas of 'latency' and 'power' are, of course, volatile ones in the rhetoric of Tyndall, someone well aware of the fantastically broad reach of the thermodynamic principle of energy conservation. Moreover, the new wording – which perhaps also preserves a modicum of uniqueness for man via the added modifier 'terrestrial' – strengthens Tyndall's reasons for 'cross[ing] the boundary': in the original, this inductive leap is something he feels compelled to 'confess'; not so in the revision, where he justifies it in terms of a mandate, an 'intellectual necessity'. A few reviewers remarked on this subtle shifting in emphasis. John Tulloch, for one, writing in *Blackwood's Edinburgh Magazine*, observed that, '[i]n his Address, as revised and published by himself, Dr. Tyndall has slightly modified the expressions of this significant passage […]', in so doing managing to impute its phrases with far 'more the semblance of reasoning, and less the air of a devotee eager to proclaim his gospel […]' (p. 533).

The 'seventh thousand' republication left this autocratic claim in wording identical to that of the first Longmans edition, as did the 1876 variant. The latter text, however, incorporated a footnote making the extremely pertinent point that 'cross[ing] the boundary of the experimental evidence', though marginally non-Baconian, was by no means an interpretive or investigative technique only recently 'invented in Belfast' (*FoS* [5], p. 524*n*1). Such an observation, of course, ties in with another of the scientist's constant themes: the need for imagination in both entheorisation and experiment (also inescapable in 'Crystals and Molecular Force'). Or, as phrased elsewhere in the Address: 'physical theories' – he cites as representative two of the most profound: Darwinian evolution and Newtonian gravitation – 'which lie beyond experience are derived by a process of abstraction from experience' (*BA*, p. 52). The 1879 text further emphasises this point, replacing that initial phrase ('[b]y an intellectual necessity') with the considerably more defensive and temperate '[b]y a necessity engendered and justified by

science' (*FoS* [6], 2: 193); such an emendation implies communal sanction, while also situating its exponent – a maverick no longer – within a vital and productive analytic tradition.

That was not the only statement from Belfast destined for popular disrepute. One nearly as infamous (and referenced) – and which likewise maintained a threatening semantic constancy throughout the course of several published variants – set out the militancy and imperialism of mid-Victorian scientific naturalism's emergent disciplinary orthodoxy. Here is the statement as reprinted in *The Times*, and it seems (particularly out of context, as so often encountered in contemporary journal articles and sermons) to be one leaving little room for either barter or arbitration: 'The impregnable position of science may be described in a few words. All religious theories, schemes, and systems, which embrace notions of cosmogony, or which otherwise reach into its domain, must in so far as they do this submit to the control of science, and relinquish all thought of controlling it' ('BA', p. 5).

That this sentence – like the materialistic proclamation it allegedly epitomised – did nonetheless still leave considerable room for *both* will be the subject of my next two sections.

IS THE WORLDLY NOT ENOUGH?: TYNDALL'S BELFAST ADDRESS

Satirists certainly thought they knew what Tyndall's Address was about.

In William Mallock's *The New Paul and Virginia*, a work of 1878, pugnacious Prof. Darnley spouts an amalgamation of the received 'wisdom' of his day to a pliant shipboard audience. 'Men of science', he lectures, 'can only see theology in a ridiculous light, therefore theology has no side which is not ridiculous. He [Darnley] then told them [the passengers] a few of the names that enlightened thinkers had applied to the Christian deity – how Professor Tyndall had called him an "atom-manufacturer," and Professor Huxley, "a pedantic drill-sergeant"' (p. 17). (Darnley himself seems more archaeological dig than discrete individual: excavate a bit and you encounter layer upon layer of scientific propaganda and pseudo-scholarly detritus, the flotsam and jetsam of agnostic, positivistic and materialistic debate from countless issues of the period's magazines and newspapers. Of such a figure I can think of no more barbed description than Mallock's own: 'His mind was like the sea, into which the other great minds of the age discharged themselves […]' [p. 9].) The author's earlier *The New Republic* (1877), a serialised satire which likewise caricatured many contemporary thinkers (albeit in the form of a far more blatant *roman à clef*), explored similar subject matter; in it, one woman, a Miss Merton, responds to one of Mr Stockton's (Tyndall's) scientific diatribes by

declaiming: 'But […] there is nothing religious *in* a gas. I don't see how anything religious can come out of it' (2: 62) – Stockton, moments earlier, had been holding forth on the essential sublimity, even religiosity, of the nebular hypothesis. A more reductionist and fearsome interpretation still of Stockton's views is offered by Mr Saunders (a clear stand-in for W. K. Clifford): '"Yes, yes, yes," cried Mr Saunders, recovering himself, his voice tremulous with excitement, "I know all that. I know that in their last analysis a pig and a martyr, a prayer and a beef-steak, are just the same – atoms and atomic movement"' (p. 220). Saunders has little patience, or enthusiasm, for Stockton's rhapsodies on the interpenetration (and indivisibility) of physics and poetry and philosophy, fixating instead only on the subtext, on the bit of Stockton's argument insisting that the world, that external nature, is to be interpreted and explained only in terms of paradigms irreducibly materialistic.

Saunders's take on the Tyndallic (or Stocktonian) worldview seems to be what many Victorians got out of the Belfast Address. And *Punch*, perhaps unsurprisingly, frequently chose to parody the sort of uncompromising scientific-*cum*-spiritual belief apparently advocated therein. To give two contrasting examples: a poem of 12 December 1874 (cited in my previous chapter), 'The Fine Old Atom-Molecule' (to be sung to the tune of 'The Fine Old English Gentleman'), ends with the ironic, if suitably jocular, injunction: 'And our Lord be the Atom-Molecule, / Of the young World's proto-prime!'. 'Democritus at Belfast', however, published 29 August of that same year – in other words, little more than a week after the Address's delivery – encodes in *its* final quatrain a far grimmer sense of both moral and theological dethronement:

> If TYNDALL's last word be indeed the last –
> Of Hope and Faith hence with each rag and tatter!
> A black cloud crowds out future as our past;
> Matter, the wise man's God: the Crowd's – no Matter!

Needless to say, Tyndall's position – as seen already in 'Crystals and Molecular Force' – was rarely so schematised as such charges suggest.

In truth, the Belfast Address, like its Mancunian successor, displays nearly to perfection each and every one of Tyndall's oratorical hallmarks. There are a cornucopia of allusions to the writings and doctrines of Carlyle, Wordsworth and Goethe; the requisite number of rhetorical questions. There are not one, but several, interpolated 'histories': of evolutionary thought, of atomism, of philosophical and scientific materialism. And each of these historical narratives carries with it its own associated saints and sinners as well; Tyndall enumerates

them with an admirable multiculturalism: 'During the [scientific] drought of the Middle Ages', he explains, 'the Arabian intellect, as forcibly shown by Draper, was active'.[4] Thus, Tyndall's history of atomism includes not only Greek and Roman metaphysicians but also Alhazen, an Arab who was 'the first to correct the Platonic notion that rays of light are emitted by the eye' (*BA*, p. 16). Moreover, just as the scientist's 'Crystals and Molecular Force' concluded with something of a headfirst dive (hardly unanticipated) into the turgid waters of metaphysical and theological conjecture, so, too, did his Belfast Address. Arthur Eddington, musing on the perspective afforded the 1920s by his own generation's novel theoretical conceptualisations, once wrote: 'The recent tendencies of science do, I believe, take us to an eminence from which we can look down into the deep waters of philosophy; and if I rashly plunge into them, it is not because I have confidence in my powers of swimming, but to try to show that the water is really deep' (p. 266).

Tyndall's justification would have been similar, though his stance never so secular. Indeed, he actively courted engagement with a variety of sacred concerns. During the 1840s and '50s, an anxious Tyndall, like many, had been 'looking for a replacement for traditional Christianity […]'; but by the 1870s, he was talking 'confidently of the survival of religion' – albeit redacted, made relevant (Lightman, 'Robert', pp. 296, 300). In that, Tyndall thought he and fellow publicists had a prophetic role. As a reviewer of the 6th edition of *Fragments* observed, many of its chapters set out, without reservation or apology, 'to investigate the higher questions connected with phenomena of life in which the border lands of science and religion are thought by some people to overlap, if not to come into antagonism' ('Science' [1879], p. 604). Such an investigative predilection – never more accentuated than at Belfast, where it attracted the fiercest condemnation – was, however, one to which preachers and pundits reflexively attributed a degree of immorality or scandalousness. What many of them failed to recognise – or, perhaps, simply refused to see – was that the Address, in the words of modern critic Ruth Barton, was merely 'the culmination of a series of essays and addresses that argued for a qualified materialism' (p. 132). This materialism, in the words of Tyndall himself (from the initial preface), insisted that, for *Homo sapiens* – a creature as much of heart as head – '[t]he facts of religious feeling are […] as certain as the facts of physics' (*BA*, p. vi). As such (this remarkable clarification comes from the 'seventh thousand' edition revision of the peroration, in which Tyndall amplified on the non-deductive compunctions of human aware-

[4] Tyndall, throughout his Address, makes quite explicit his indebtedness to such intellectual historians as Hume, Draper and, especially, Lange (whom he pointedly describes as 'a non-materialist' [*BA*, p. 3]).

ness, even while leaving the general methodological implications of his Address unaltered),

> There are such things woven into the texture of man as the feeling of Awe, Reverence, Wonder – and not alone the sexual love just referred to, but the love of the beautiful, physical, and moral, in Nature, Poetry, and Art. There is also that deep-set feeling which, since the earliest dawn of history, and probably for ages prior to all history, incorporated itself in the Religions of the world. You who have escaped from these religions into the high-and-dry light of the intellect may deride them; but, in so doing you deride accidents of form only, and fail to touch the immovable basis of the religious sentiment in the nature of man. To yield this sentiment reasonable satisfaction is the problem of problems of the present hour. (*BA* [2], p. 60)

In pleasing parallel, just as primeval man was forced by innate biology into the systematisation of the things and processes of the external world, so, too, was he drawn into the creation, interpretation and *admiration* of things having little (practical) to do with that world as such: literature and philosophy, painting, theology, sculpture, music. Tyndall put it eloquently towards the close of the updated peroration: 'The world embraces not only a Newton, but a Shakespeare – not only a Boyle, but a Raphael – not only a Kant, but a Beethoven – not only a Darwin, but a Carlyle. Not in each of these, but in all, is human nature whole' (p. 65). Exiling the 'immovable basis of the religious sentiment in […] man' is therefore, for Tyndall, as quixotic – or, even, inconceivable – a task as somehow banishing that of the intellectual.

He eschews 'high-and-dry light' – a flattening, glaring illumination redolent of outmoded, dehumanising or overly 'rational' schemes of philosophising: the severity of Mill's Utilitarianism, say, or Laplace's mechanistic determinism – in favour of a crepuscular materialism. His science embraces the incorrigible plurality of lived experience, the world in its fecundity and fullness, the entrancing spectacles of the sun's rising and setting, not merely the well-lit vistas of the geologist's microscope or anatomist's bench. Such a cosmos requires more, and messier, description than the eternally pristine mathematics of a Keplerian ellipse; it is one trembling with irreducible interconnections, resounding with melodies less metronomic, and more cacophonous, than the ticking of celestial clockwork. It demands spiritual appreciation as well as algebraic synthesis.

Tyndall's metaphors in this passage point towards two of the traditions through which he was best able to encapsulate, or articulate, this 'qualified materialism', and which will serve as subjects for my fourth and fifth chapters. His description of the 'woven-ness' of man's nature suggests *Sartor Resartus*'s symbology of transcendental conviction, in which Carlyle, 'via his clothes philosopher Teufelsdröck, uses the weaving of cloth, or the sewing of a suit of clothes, to represent the process of authoring beliefs and institutions. His [Carlyle's] emphasis on clothing as woven textile plays on the root of the word *text* – *texere*, to weave' (Vanden

Bossche, p. 43). Similarly, Tyndall's recognition of a necessary diachronic mutability within those satisfactions for the 'religious sentiment' deemed allowable, and pertinent, for the latter nineteenth century brings to mind the literary and philosophical labours of some of its earliest writers, particularly the visionary behind 'Tintern Abbey'. Tyndall had concluded the first British edition of the Belfast Address with approving citation of a dozen or so lines from that poem (in second and subsequent editions, these lines were moved to the start, where they serve as an epigraph). Myers, in his study *Wordsworth* (1880), captured the significance of the author's achievement for many Victorian thinkers wobbling in their faith. Disillusioned with Christianity – if retaining his undergraduate Hellenism – he explained that Wordsworth was the first to endow a spiritually impoverished century with its own native sense of surrogate divinity. Citing the four causes (prophecy, prayer, artistry and human love) enumerated by Plato as tending to make man 'percipient of an intelligence other and larger than his own', Myers contended that Wordsworth, to this list, 'has made an important addition. He has shown by his example and writings that the contemplation of Nature may become a stimulus as inspiring as these; may enable us "to see into the life of things" – as far, perhaps, as beatific vision or prophetic rapture can attain' (p. 128).

Unmistakable traces of Carlylean transcendentalism, of Wordsworthian natural piety, these certainly seem, as Tyndall phrased things in his second introduction, attributes of a '"materialism" vastly different from what you suppose […]' (*BA* [2], p. 56). Why, then, were they so easy to overlook? Why was it predominately the materialistic sentiments in his philosophy which drew public attention, and ridicule, in the 1870s and beyond? Even Barton, who dedicates most of 'John Tyndall, Pantheist' to advocating that the scientist's materialism was really little more than a disguised crypto-pantheism, concedes that 'in the context of the Belfast Address, Tyndall's conclusion about the limitations of materialism as a philosophy of life occupied a comparatively small place' (p. 121). This is, of course, entirely correct. (Oliver Lodge was not being disingenuous in proclaiming, in a volume of reminiscences, Tyndall's Inaugural 'the chief pronouncement of the materialism of the nineteenth century' [*Advancing*, p. 35].) The fittest explanation for this partiality – an asymmetry in the 'philosophy of life' limned by Tyndall – is simply that, in his Address, he was concerned primarily with Victorian science, and materialism, for him, was the proper framework in which to discuss the subject, a philosophy sufficient for interpreting all the myriad phenomena and processes of the physical world. Theology, so often an impediment to scientific advance, was to have no input. But, on a deeper level, behind any 'antireligious dogmatism' (in Theodore Porter's phrase [p. 116]),

was that Manchester dualism: a cleavage, ever-present in Tyndall's thought, between cultures of intellect and emotion. He, in the Address, before 'embattled' peers, was attempting to stress the disjunction, even as he hinted – blue-sky thinking? – at a future settlement: 'They are not opposed, but supplementary – not mutually exclusive, but reconcilable' (*BA* [2], p. 65). Unfortunately, however, just as *The New Republic*'s Mr Saunders was able to hear in William Mallock's ersatz Tyndall (Mr Stockton) only the claims of atheism, and Miss Merton only the counterclaims of theology (matter as antithesis of spirit), so also was the wider Victorian public predisposed to hear in the Belfast Address only what it wanted – or expected – to hear. The irony is that Mallock, amid such a rollicking satire as *The New Republic*, was therefore being far more sensitive to the richness of Tyndall's position than any number of that scientist's 'genuine' contemporary critics were ever disposed to be, many of whom were outraged by the hubris of an Address, given under the imprimatur of one of Britain's most influential organisations, 'which reviewed a wide selection of recent scientific developments and then concluded that these developments represented the highest level of human knowledge' (Basalla, Coleman and Kargon, p. 440).

It is perhaps, then, not altogether surprising that in August 1875, John Hawkshaw, incoming President of the BAAS, with the trauma of the previous twelve months clearly in mind, commented in his own Inaugural: 'Past Presidents have already discoursed on many subjects, on things organic and inorganic, on the mind and on things perhaps beyond the reach of the mind; and I have arrived at the conclusion that humbler themes will not be out of place on this occasion' (p. lxviii). So he prefaced a well-footnoted history of civil engineering through the ages, moving 'science' – at least publicly – back to territory less ideologically contentious, though hardly silencing the furore of debate.

In an intriguing instance, however, at least one specifically 'Tyndallic' dispute has had a peculiar afterlife, maintaining a vestigial presence into modernity. A recent opinion column in *The Daily Telegraph* penned by Alexander – fortunate son of Auberon, fortunate grandson of Evelyn – Waugh in praise of nepotism trumpeted those advantages which he (and his grandsires) have enjoyed: '[…] I am sure that my genealogy of nepotism stretches way beyond [immediate history], even unto the first protoplasmal primordial atomic globule among my ancestors […]'; his allusion is, of course, to a hammy recitative in Gilbert and Sullivan's *The Mikado* (1885) in which haughty Pooh-Bah sneers: 'I can trace my ancestry back to a protoplasmal primordial atomic globule. Consequently, my family pride is something inconceivable' (Sullivan, p. 8). Hubert Yockey has asserted that the librettist's ungainly phrase found

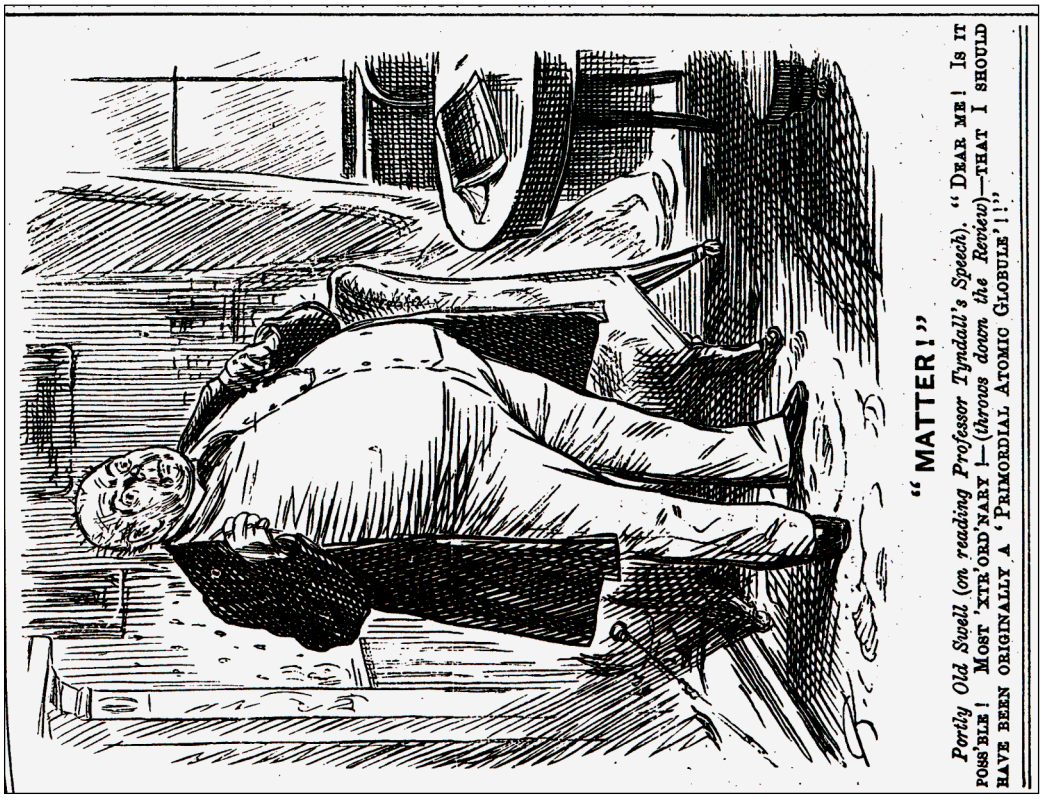

Figure 2 - 'Matter!', *Punch, or the London Charivari*.

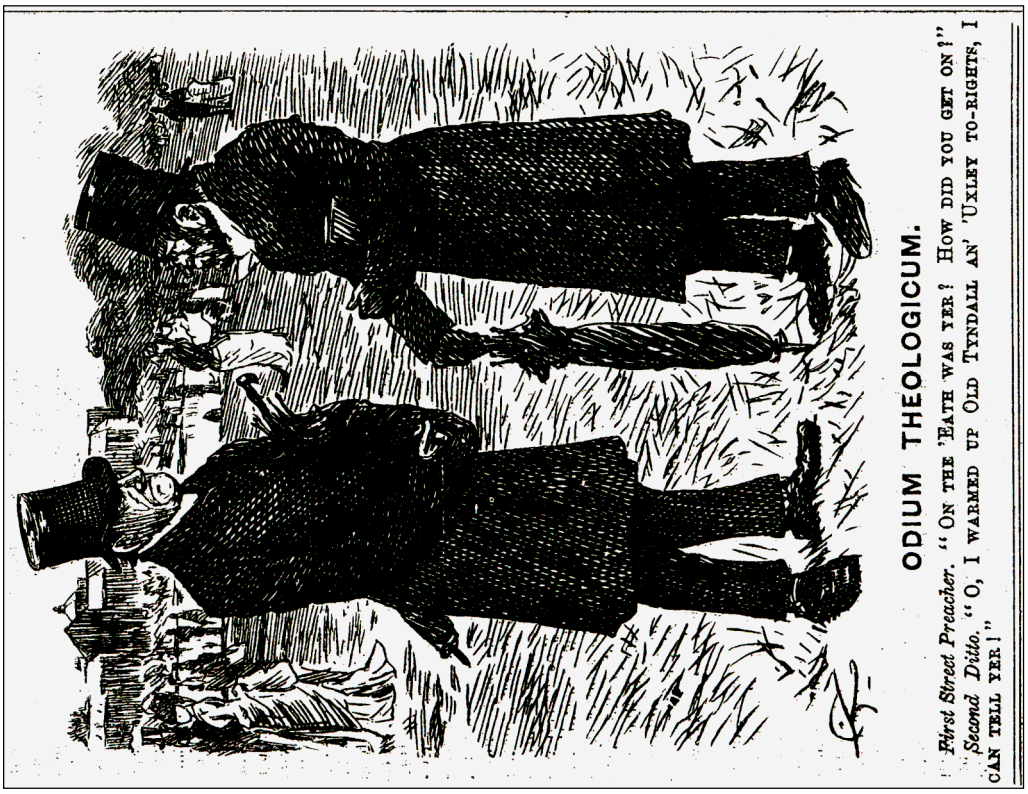

Figure 3 - 'Odium Theologicum', *Punch, or the London Charivari*.

origination in Ernst Haeckel's discussions in the 1860s of life's beginnings amid 'primordial albuminous combinations […]', but I think a more likely site – the word 'atomic' seems decisive – a marvelous cartoon (fig. 2) published in *Punch* around a fortnight after Belfast (3 October 1874). Entitled 'Matter!', it shows a '*Portly Old Swell*' (with torso nearly globular in scope), dressed in an overstuffed waistcoat and standing in a formal drawing room of some description; he is shown, a look of utter shock and disbelief plainly evident on his face, exclaiming to no one in particular: 'Dear me! Is it poss'ble! Most 'xtr'ord'nary! – (*throws down the Review*) – that I should have been originally a "Primordial Atomic Globule"!!'.

Scientific Progress and the Politics of Metaphor

Tyndall, not alone among his colleagues, was always one to choose his words carefully, selecting metaphors, not merely for explanatory efficacy, but for persuasive or cumulative force. At Belfast, he described primitive organic lifeforms in terms unabashedly inorganic: 'We come at length to those organisms which I have compared to drops of oil suspended in a mixture of alcohol and water' (*BA*, p. 55). He spoke of man's artistic instincts in terms of neural pathways and electrochemical interactions. He joked – not without ulterior motive – of his friend, Herbert Spencer, saying of the noted psychologist's elegant prose-style: 'it is to be inferred', based on such evidence, 'that the ganglia of this Apostle of Understanding are sometimes the seat of a nascent poetic thrill' (p. 49). He also provided examples of an imposing diversity of evolutionary processes: the gradual development of differentiated tissues from the lowest to the highest of organisms ('So of the other senses; they are special differentiations of a tissue that was originally sensitive all over' [p. 48]); the slow augmentation of intellectual capacity ('Thus it happens' – Tyndall is here quoting Spencer directly – 'that out of savages unable to count to the number of their fingers, and speaking a language containing only nouns and verbs, arise at length our Newtons and Shakespeares' [qtd., p. 52]). He emphasised as well the historical pedigree of evolutionary thought: 'Thus more than 2,000 years ago the doctrine of the "survival of the fittest," which in our day, not on the basis of vague conjecture, but of positive knowledge, has been raised to such extraordinary significance, had received at all events partial enunciation' (p. 5).

This move from 'vague conjecture' to 'positive knowledge' is a maturative one in Tyndallic science, and a number of the interpolated narratives in his Address are structured along those lines, each showing an analogy's progress from the realm of the academic to that of the

scientific, two of three dissimilar types of persuasive comparison analysed by Alan Gross in his valuable study *The Rhetoric of Science* (1996).

Both academic and scientific analogies are not only demonstrative – that is to say, they do not just illustrate or objectify abstract concepts – they, if cannily chosen, become simpler, more malleable substitutes for those concepts. Unlike academic analogy, however, scientific analogy finds additional support in the more or less agreed-upon apparatus of a time-tested scientific method, that 'complex of quantitative methodologies shared by scientists and central to their verification procedures' (p. 30). Early believers in the atomic theory of matter, for instance – Democritus, Epicurus, Empedocles, Lucretius – were engaged, Tyndall suggests, in an academic dispute; modern believers like Loschmidt, Stoney and Thomson, a scientific one. Ancient materialists, perhaps reasoning from the wear and tear of everyday objects (rings becoming thinner, clothes drying in the sun, and so forth), hypothesised that '[n]ature acts through invisible particles' (*BA*, p. 9). By contrast, Victorian physical scientists, convinced of the reality of such particles, sought, using the newest techniques and mechanisms of experimental investigation, 'to determine the sizes of the atoms, or rather to fix the limits between which their sizes lie […]' (p. 26). In these comparisons, Tyndall traced the fortunes of the 'atomic analogy' from the vagaries of pre-Christian philosophical dispute to the near-certainties (within well-understood limits) of the nineteenth-century physical laboratory. And he saw in that development a clear progression from the academic to the scientific, from the postulated to the inferred – and from the inferred, in time, to the known. His enthusiasm for historical parallelism was such that a number of contemporary critics believed he had merely rehabilitated a series of discredited or ramshackle hypotheses. This became so commonplace a contention that Clifford, in an article of 1875, felt compelled to intervene on Tyndall's behalf to protect him – and *inter alia* the basis of materialistic science – from further attack: 'the difference between the two [atomic theories] is mainly this: the atomic theory of Democritus was a guess, and no more than a guess', while that 'held by scientific men in the present day is not a guess at all' ('First', p. 466).

Tyndall's rhetorical strategies, moreover, instructed as they historicised. Analogies equating creativity with cerebral ganglia – or single-celled creatures with droplets of oil – conditioned the listener (or reader) to accept his eventual declarations about the inseparability of mind and brain. Likewise, analogies demonstrating the ubiquity of evolutionary transformations prepared the listener (or reader) for that startling induction to come, an imaginative leap enabling the scientist to discern life's – and intelligence's – origins in lifeless matter. Or,

as he phrased it elsewhere in his Address: the 'strength of the doctrine of evolution' – upon which he based that induction – 'consists, not in any experimental demonstration (for the subject is hardly accessible to this mode of proof), but in its general harmony with scientific thought' (p. 58). Nonetheless, Tyndall was willing to concede that in his philosophy there were any number of difficulties which remained to be surmounted – perhaps which were *never* to be surmounted: most notably, that of the transition between neurochemistry and personal consciousness. In his commentary on such present, or potential, unknowability, however, he never (quite) shaded into the assertion of a metaphysically Unknowable *à la* Herbert Spencer.

Spencer, according to Lightman, thought the Unknowable akin to a spiritual reservoir, a kind of transmogrified Providence, guaranteeing that 'beneath the seeming waste of the evolutionary process' – which he believed in wholeheartedly – 'lay an economy, order, purpose and harmony' (*Origins*, p. 89). Tyndall, by contrast, felt the likely unknowability of certain mental or physical processes an epistemological problem, not a metaphysical escape route: something that might not be comprehended by materialistic *scientists* must still, he argued, be governed by materialistic *principles*, as complex or unimaginable as they may be. Note in his remarks on the predicament posed by psychophysical parallelism the iterated fantasias on incompleteness and radical unattainability; note as well the vague but ineradicable *frisson* implicit in them of both a professional and endearingly personal species of explanatory anxiety (this passage is from the revised peroration to his Belfast Address):

> We can trace the development of a nervous system, and correlate with it the parallel phenomena of sensation and thought. But we try to soar in a vacuum the moment we seek to comprehend the connexion between them. An Archimedean fulcrum is here required which the human mind cannot command; and the effort to solve the problem, to borrow a comparison from an illustrious friend of mine, is like the effort of a man trying to lift himself by his own waistband. (*BA* [2], p. 59)

And here, too, from the preface to that updated text: 'While fearlessly accepting the facts of materialism dwelt upon in these pages, I bow my head in the dust before that mystery of mind, which has hitherto defied its own penetrative power, and which may ultimately resolve itself into a demonstrable impossibility of self-penetration' (p. xxx). There were, of course, quite a few nineteenth-century observers who remarked on Tyndall's uncharacteristically pessimistic stance – tantamount to an admission of science's probable failure – on a subject of such pivotal importance to any proselytising materialist. A commentator at *The Times* found in the classical past an apt precedent for Tyndall in this regard: 'The aspiring Professor lifts his voice, elevates his tone, searches the sky, and strides as did the Sibyl when she led the hero to the realm of prophecy, but he cannot go beyond this' ('Professor', 20 August 1874).

Gross discusses a third type of analogy as well – the political, a variety that invites 'an emotional reaction to a crisis' (p. 24) – and uses as his prime example Roosevelt's Inaugural Address of 4 March 1933, a speech animated by the President's memorably inflammatory comparison between the Depression and the actions of an invading army. Post-*Origin*, scientists (perhaps sensing the weakness of an exhausted and increasingly desperate opponent) frequently resorted to argumentative tactics of this sort. Andrew Dickson White, for one, president of Cornell University, published in 1876 a series of lectures under the revealing title *The Warfare of Science*; Tyndall provided White's volume with an enthusiastic introduction. Indeed, Tyndall himself – despite the comparative 'pacifism' (considering its fiery reputation) of his Belfast oration – was not averse to resorting from time to time to the use of language nearly as belligerent; in 'On the Scientific Use of the Imagination', he said of creationism: 'You may, however, rest secure in the belief that the hypothesis just sketched [the creationist] can never be stormed, and that it is sure, if it yield at all, to yield to a prolonged siege. To gain new territory modern argument requires more time than modern arms, though both of them move with greater rapidity than of yore' (*FoS*, p. 163). All the same, Roosevelt's Inaugural was governed by two distinct analogies: the Depression was an occupying force; the President, commander of an insurgency. Tyndall's own scheme of blatant 'political' analogy had, by contrast, a sharply changed architecture. Certainly, the armies of science were on one side; those of obstreperous or unenlightened religion, the other; but Tyndall hardly positioned himself as in any way a general, ready and eager to take command. On the contrary, he went to tremendous lengths to allow nature herself to assume that role. Her call, as suggested so stirringly at Manchester, is irresistible; her seductions, innumerable; her rewards, at once religiously fulfilling and aesthetically compensatory. The Belfast Address, accordingly, began by emphasising the historical or anthropological continuity of investigative enterprise: 'An impulse inherent in primeval man turned his thoughts and questionings betimes towards the sources of natural phenomena. The same impulse, inherited and intensified, is the spur of scientific action to-day' (*BA*, p. 1).

In a sense, then, Tyndall was engaged in his own ritual self-annihilation. Even as the narratives within his Address emphasised the odd stability of physical thought (nineteenth-century atomists as heirs to Lucretius, and so forth); the Address itself biologised – made 'inherent' – the particular attitude towards scientific inquest Tyndall himself was trying to espouse. Science needs no general, he says: nature provides leadership enough. Thus, at its conclusion, he could justly, in front of an audience of fellow combatants in an ongoing strug-

gle, rhapsodise about the day when 'you and I, like streaks of morning cloud, shall have melted into the infinite azure of the past' ('BA', p. 5). Tyndall's language here alludes to Prospero's dissolution of the nuptial masque in Shakespeare's *The Tempest*. Even more suggestively, it parallels that describing Teufelsdröck's attainment in *Sartor Resartus*, after arduous, occasionally debilitating struggle, of the '[…] EVERLASTING YEA, wherein all contradiction is solved, wherein whoso walks and works, it is well with him'. Carlyle's description of such a euphoric, bodiless state nonetheless presaged Tyndall's own rhetoric at Belfast forty years later: 'On the roaring billows of Time, thou are not engulphed, but borne aloft into the azure of Eternity' (p. 146).[5] Such redemptive anonymity was, however, something that, subsequent to Belfast, both Britain's mainstream press and established churches were in the short term loath to grant.

So a reluctant Tyndall was, for a brief while, forced into stewardship of an 'army' he believed favoured already with an unimpeachable source of both strategic and moral guidance.

EPILOGUE: THE TYNDALLIC AFTERLIFE – CAMBRIDGE 2006

> These our actors,
> As I foretold you, were all spirits and
> Are melted into air, into thin air […]
> - *The Tempest*, IV.i.148 - 50

It is extraordinary how closely linked Tyndall's and Huxley's names were in the Victorian satiric press. There were those passages in *The New Republic*, of course. A poem (printed early in 1875) in *Punch* like 'Address to an Atom', attributed to 'an Uncomfortably Conscious Automaton', conspicuously linked memorable lines from Tyndall's Address ('dry light', 'nascent thrills', 'promise and potency') with T. H. Huxley's own notorious Belfast catchphrase (his paper there was 'On the Hypothesis that Animals are Automata, and Its History'). Huxley, in his obituary for Tyndall, even quipped that there were those among their contemporaries who looked upon the famously chummy pair as a 'a sort of firm' ('Professor', p. 6). There was one

[5] On Wednesday, 26 August, Tyndall reiterated this concluding theme – described in *Blackwood's Edinburgh Magazine* as an especially galling example of forced 'rhetorical pathos' ([Tulloch], p. 530) – in the remarks with which he brought the Belfast meeting to a formal close: '[I]n the struggle for existence between truth and error there is the law of order in the universe always to check and control. I will say no more. I have no doubt that this process of selection will go on, and I shall be justified in the future, in so far as I shall be, to use the closing words of the address – "a mere vapour that vanisheth away." (Cheers). I thank you from the bottom of my heart for the exceedingly cordial manner in which you have received me' (qtd. in 'British', 27 August 1874).

cartoon, entitled 'Odium Theologicum' (fig. 3), which appeared in *Punch*'s 12 June 1875 number; it implied that the real threats to God-fearing English society were not to be found in the doctrines of evolution or atomism or thermodynamics per se, nor even in the teachings of those eminent figures closest linked with these discoveries. On the contrary, they were to be discerned in such materialistic propagandists as Huxley and Tyndall themselves. It depicts a pair of gravely dressed ministers returning from a stroll on a cold and (one presumes) blustery afternoon:

> *First Street Preacher*. "On the 'Eath was yer? How did you get on?"
> *Second Ditto*. "O, I warmed up Old Tyndall an' 'Uxley to-rights, I can tell yer!"

What a difference a century makes. Today, Huxley is popularly remembered, if at all, as 'Darwin's Bulldog', while poor Tyndall seems, if anything, even more neglected.[6] (In Purrington's *Physics in the Nineteenth Century* [1997], he merits one full sentence; that sentence? – 'In the words of Englishman John Tyndall, who succeeded Faraday at the Royal Institution, "in this single week he [Faraday] developed the laws of what are called electrodynamics"' [p. 44].) The names of Maxwell and Faraday and Darwin, by contrast, seem more or less untarnished; their importance, unforgotten.

Gross, in *The Rhetoric of Science*, comments perceptively: 'For scientists […] science has no past – or, rather, no past that does not wholly suit its present purposes. It is this absence, then, that nurtures the useful illusion: for scientists, the results of science depend not on science but on nature herself' (p. 32). This very self-image, however, the inescapability of this 'useful illusion' in twentieth- and twenty-first-century discourse, testifies in large part to the profound success of efforts by men like Huxley and Tyndall to stake out in the nineteenth some practically inviolable intellectual ground for future professional inquiry – beyond dispute, above politics, subservient to no other discipline or institution.

Contemporary science, in other words, believing this episode from its own heritage effectively superfluous, nowadays simply has no use for a Tyndall anymore. And so, truly, he has at last faded (as he himself foretold), like a streak 'of morning cloud', into that 'infinite azure of the past' of which he at Belfast spoke so rapturously – and so prophetically as well.

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[6] Such wholesale historical effacement is not merely a modern phenomenon, however. Even as early as the mid-1890s, it was acknowledged – in certain circles, at least – that Tyndall's star was already incontestably on the wane. 'It seems curious that the death of Professor Tyndall should have made so little stir in the world of science. How different', one obituarist conjectured in early 1894, 'it would have been twenty years ago! Captivated, perhaps, by the boldness of his thought and the confidence of his style, his admirers allowed their zeal to outrun their discretion. The inevitable swing of the pendulum has [now] carried the reaction too far' (D., p. 27).

CHAPTER 3

MATERIALISM'S AFTERLIFE IN THE POETRY AND THOUGHT OF W. K. CLIFFORD AND JAMES CLERK MAXWELL

pale despair and cold tranquillity,
Nature's vast frame, the web of human things,
Birth and the grave, that are not as they were.
- Shelley, 'Alastor; or, The Spirit of Solitude', 1816

F. W. H. Myers began his *Human Personality and Its Survival of Bodily Death* with a forthright challenge to his generation's science:

> In the long story of man's endeavours to understand his own environment and to govern his own fates, there is one gap or omission so singular that, however we may afterwards contrive to explain the fact, its simple statement has the air of a paradox. Yet it is strictly true to say that man has never yet applied to the [problem] which most profoundly concern[s] him those methods of inquiry which in attacking all other problems he has found the most efficacious […] – whether or no his personality involves any element which can survive bodily death. (1: 1)

He was right, on one level, and the spiritualised psychology he advocated (along with others like Arthur Sedgwick and Edmund Gurney) represented an attempt to interrogate seriously such a seeming lack. But, on another, his question sidesteps the 'paradox-producing' fact that late Victorian inductive science's mandate was primarily with analysis of the objective, the measured, the seen (howsoever: microscopically, telescopically, spectroscopically), not what remained, despite partisan claims for the lab-bench verifiability of paranormal phenomena, the subjective, unseen and *im*measurable. For all that, however, a fascinating array of contemporary thinkers were still far from mute on the topic. It was just that they, more often than not, put forth solutions which neither Myers nor his 'spiritualistic' colleagues preferred to hear.

This chapter is devoted to a pair of such responses, giving, firstly, an analysis of the ways in which two theoreticians, popularly known scientific visionaries differently committed to dissemination of what might *outwardly* appear an outlook of 'materialism', dealt with such theistic perplexities as personal immortality and the nature of a spiritual afterlife. Secondly, and closely integrated with this discussion, is more wide-ranging commentary on the specific

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Epigraph from Shelley, 'Alastor', p. 30; ll. 718 - 20.

utility of poetry – and, more generally, a 'poet's' sensibility – for a scientist engaged in the workaday business of mid-nineteenth-century physical investigation, particularly in attempts at elucidation or wider popularisation of research.

One of the most charismatic individuals involved in that business – by the late 1870s he was, so Dawson tells us, 'the nation's best-known scientific firebrand' (p. 263) – and the central figure here addressed, is W. K. Clifford. A mathematician, he was, as noted in my introduction, notorious both for a trenchantly unmollified espousal of the trinity of doctrines associated with materialistic thinking (atomism, energy conservation, evolutionism), and the persistent, public advocacy as well of a type of petulantly 'noisy atheism' (qtd. in Reid, p. 266).

My account focuses both on the manner in which a 'poetic apprehension of the world' provided Clifford with a variety of novel metaphors and models for communicating his ideas to audiences of specialists and non-specialists alike, and also on the fashion in which allusion to, and citation from, the literary tradition enabled him to buttress his more contentious philosophical and anthropological assertions by associating them with a storied heritage of past – and, if more controversially, present – verbal brilliance.

The second main scientist engaged with is Maxwell, a figure always prone to reference assumptions derived from natural theology and creationism, stances seemingly at odds with his continued analytical emphasis on mechanical modelling and the probabilistic underpinnings of thermodynamic behaviour. Indeed, as evidenced with particular clarity in privately circulated manuscripts and re-printings of his popular lectures, he founded his scientific and personal philosophy on belief in a benevolent God and the notion of a parallel imprinting: upon the soul of humanity, 'the divine image' (like the stamping on a coin of a sovereign's silhouette); upon natural phenomena, intelligible and immutable law. Together, these paired Paleyan conceits became, for the scientist, a providential guarantee, vouchsafing all at once 'the comprehensibility, unity, and relative autonomy of the world' (Kaiser, p. 294). His dislike of a reflex attribution of the label 'materialistic' to emergent theories, particularly his own, was acute, and, as Schaffer has noted, much of the scientist's 'public work of the late 1860s and early 1870s' – those years in which he was so busy promulgating his statistical theory of gasses and unifying the forces of electricity and magnetism – 'was designed to counter the materialist implications of Tyndall's molecular physics and Huxley's evolutionism' (p. 464).

He composed a rambunctious ballad – submitted by a friend (with Maxwell's approval) for publication in *Blackwood's Edinburgh Magazine* – in response to Tyndall's Address at Belfast, in which that (self-consciously) portentous retelling of civilisation's development from material-

ism's 'perspective' is condensed, and artfully caricatured, in a series of galloping, rhymed octameter couplets. The legalese of the source, for instance – 'They also fell back on experience, but with this difference – that the particular experiences which furnished the weft and woof of their theories were drawn, not from the study of nature, but from what lay much closer to them, the observation of men' (*BA*, p. 1) – is, in the Maxwellian burlesque, transformed into the most anticlimactic of asides: 'In the very beginnings of science, the parsons, who managed things then, / Being handy with hammer and chisel, made gods in the likeness of men'.

The parody's treatment of Tyndall's enshrinement of molecular self-organisation, with its interpolated commentary on the scientist's penchant for sometimes risible magniloquence, takes on a comparable pitch, seeming at once flippant and affectionate:

> So treading a path all untrod, the poet-philosopher sings
> Of the seeds of the mighty world – the first-beginnings of things;
> How freely he scatters his atoms before the beginning of years;
> How he clothes them with force as a garment, those small incompressible spheres!
> (p. 639)

Outside such works, however, Maxwell was rarely as boisterous as Clifford in setting out beliefs. This was in large part a consequence of temperament; as Basil Mahon has observed in a recent biography *The Man Who Changed Everything: The Life of James Clerk Maxwell* (2003), though the scientist's faith was simply 'too deeply rooted to be shaken […]', 'his probing mind would not allow any possible fissures between God and science to remain unexplored; they had to be surveyed and bridged. This was an intensely personal process, to be re-examined in the light of each new scientific discovery, whether his own or someone else's' (p. 37).

This was the impetus, and character, too – though the 'faith' which craved integration was wholly antithetical to Maxwell's, and the endeavour far less hushed – of Clifford's own poetic and rhetorical explorations of the troubled intersections of materialistic science with personal creed.

Accordingly, half this chapter is devoted to focused analysis of a number of 'private' or occasional texts written by Clifford and Maxwell in which scrutiny is directed as much at the assumptions of 'their' science as at the foundations, or ideological nuances, of their 'supplemental' systems of guiding doctrine: a journal entry and a pair of verse fragments by the former; several extended poems by the latter, notably 'To Hermann Stoffkraft, Ph.D., the Hero of a recent work called "Paradoxical Philosophy"'. More often than not, as I shall

argue, works such as these were composed in attempts to 'flesh out', humanise or otherwise elaborate and make more palatable the idiosyncratic worldviews each was trying to articulate. As such, they form, not accidentally, a sort of 'parallel text' for – or, more aptly, an authorised commentary upon – the more technical and precise, less sentimental or frivolous, sorts of writings with which the two men were throughout their lives more stereotypically associated.

However, despite an overriding assuredness (Maxwell in his Scottish Protestantism, Clifford in his agnostic humanism, both in the explanatory acumen of nineteenth-century science), these texts, more often than not, seem to have been composed more for personal comfort, or spiritual satisfaction and reassurance, than for that of any audience, real or foreseen. Such ameliorative labours seemed to many at the time a necessary exercise, however, though for some – souls perhaps not blessed with either scientist's convictions, working inside or outside or alongside the professional scientific community – the need was even more importunate. The science of the era, as discussed in my first chapter, seemed to be groping towards a conclusion – which many then resisted, through a sometimes dazzling variety of strategies and metaphysical evasions – memorably encapsulated by Myers in his 'Autobiographical Fragment', where he characterised the later 1860s and early 1870s 'as the very flood-tide of materialism, agnosticism – the mechanical theory of the Universe, the reduction of spiritual facts to physiological phenomena' (p. 14).

But there were collateral moral consequences to such physical – and, consequently, religious – belief, and these, to some, could seem particularly galling. 'To believe', as Rev. Martineau pointed out in 1877, 'in an ever-living and perfect Mind, supreme over the universe, is to invest moral distinctions with immensity and eternity, and lift them from the provincial stage of human society to the imperishable theatre of all being' (p. 343).

Victorian materialism thus precipitated an act of banishment, an existential relegation. Taking place in an age when 'the question of man's soul-less descent from the apes was the center of intellectual controversy' (S. Smith, p. xxii), such a further workaday affront could simply prove too hideous for some to endure. This monologue is from Tennyson's 'Despair':

> Oh we poor orphans of nothing – alone on that lonely shore –
> Born of the brainless Nature who knew not that which she bore!
> Trusting no longer that earthly flower would be heavenly fruit –
> Come from the brute, poor souls – no souls – and to die with the brute –
> (p. 1301; ll. 33 - 36)

So a saved man cries out to the minister who had pulled him from the sea, where he and his

wife had attempted to drown themselves (ironically, he does so in the same metre as Maxwell's Tyndallic satire, another, more optimistic take on the period's 'materialism', a work firmly anchored in the scientist's unshaken trust in heavenly dominion).

Here is Myers – despite periodic bouts of melancholy, he was never one to cow like Tennyson's histrionic survivor – commenting of the debris left behind by materialism's 'flood-tide':

> It was a time when not the intellect only, but the moral ideals of men seemed to have passed into the camp of negation. We were all in the first flush of triumphant Darwinism, when terrene evolution had explained so much that men hardly cared to look beyond. Among my own group, W. K. Clifford was putting forth his series of triumphant proclamations of the nothingness of God, the divinity of man. Swinburne, too, […] had given passionate voice to the same conception.
>
> ('Autobiographical', pp. 14 - 15)

Then, as now, such 'negating' sentiments aroused passionate counter-feelings, and the finding of something else at the bottom of things, a light in those dark places, was more than a parlour-game to those, like Myers and Tyndall, either closest to, or most threatened by, such unforgiving physical and evolutionary insights: spiritually pallid, epistemologically unyielding. Clifford – one of materialism's most voluble, impassioned and 'triumphant' advocates – felt this concern no less keenly.

His response, though, as hinted at in Myers's 'Fragment', could scarcely have been more dissimilar, as he overpraised neither the spirit (like the former), nor nature (like the latter), but joined rather the poet Swinburne in exulting, to the trepidation of many, a heretic's *Te Deum*: 'Glory to Man in the highest! for Man is the master of things' ('Hymn', p. 764).

POETRY AS AID TO EXPLANATION: W. K. CLIFFORD'S 'STREAM OF CONSCIOUSNESS'

'It was early in his school career', wrote J. J. Thomson in a centenary appreciation of the life and works of James Clerk Maxwell, 'that he began to write verses, a practice which he kept up all his life, to the great delight of his friends' (p. 5). He was, of course, not alone among Victorian scientists in so doing: Herschel (as noted in my first chapter) tried his hand at it, as did Tyndall – earlier in his life Tyndall had even submitted a few verses (preserved in the RI) to local papers and magazines under odd pseudonyms like Wat Ripton, Wat Ripton Snooks, or simply 'W. S.' – as did Clifford, too.

Though the existence of these works, mainly unpublished, a few circulated privately, would perhaps have been greeted by some controversialists among the London literati with a

snort of surprise, shading into perfunctory dismissal, such an uncharitable response would hardly have been global. Frederick Pollock, in a (borderline hagiographic) biographical assessment prefacing the first volume of Clifford's collected *Lectures and Essays* (1879), was not alone among contemporaries in realising – despite his half-joking assertion at the start – that

> It is an open secret to the few who know it, but a mystery and a stumbling-block to the many, that Science and Poetry are own sisters; insomuch that in those branches of scientific inquiry which are most remote from the grasp of the ordinary sensible imagination, a higher power of imagination akin to the creative insight of the poet is most needed and most fruitful of lasting work. (p. 1)

(Incidentally, Frederick Pollock, a legal scholar, was the son of Juliet Pollock, Tyndall's friend and frequent correspondent.) It is, of course, the remoteness of much abstract physical knowledge that concerns Pollock the most here, its removal from the commonsensical world of medium-sized dry goods (in twentieth-century philosopher of science J. L. Austin's memorable turn of phrase). The 'higher power' of scientific comprehension – a mental process figured as at once difficult and a murky 'mystery', certainly not something for the ordinary man on the street – peers into the world of the microscopically small or the cosmologically great and, through the agency of a strongly poetic 'creative insight', grasps truths that had been heretofore occluded. This was hardly original. The image of scientist as priest or seer privy to wisdom unknown, or grasping connections invisible, to us duller, more blinkered folk (a trope encoded in the connotations of one telling professional designation even by then – the late 1870s – still not wholly superseded: 'natural philosopher') was – and remains to this day – at once potent and familiar.

Maxwell, for instance, was renowned for his modelling of electromagnetic dynamics, in which he raided the depots of the railway engineer, blithely borrowing saw-tooth gears and idle wheels, in his quest for an enlightening, if grimy, correspondence ('How ingenious, both electrically and mechanically!', Sharlin says of this particular scheme of analogy [p. 95]), while Clifford, whose toils were largely confined to the incorruptible realms of pure analysis, was similarly praised for his trademark habit of initiating even the most multi-dimensional of mathematical excursions from within the home ground of a commonsense or 'geometrical view of numbers' (*SSC*, p. 159).

What is more interesting is the manner in which Pollock next begins to concentrate not merely on the inspirational or analogic function of such an underlying poetic sensibility, but also on its vital explanatory role. When it 'is joined', he explains, 'with quick perception and delicate sympathies, it can work the miracle of piercing the barrier that separates one mind

from another, and becomes a personal charm' (p. 1). The 'miracle', then, is not merely in the discovery, but in the communication (to scientific peers and, vitally, other cultural groupings as well) of formalised natural law, or particular interpretations of that law. Sometimes this could be achieved by linking the strange with the comforting, ordinary, or, perhaps, reassuringly banal. Clifford once explained the relative proportion of hydrogen to oxygen in a molecule of water subsequent to electrolytic disassociation by recourse to one of the homeliest metaphors imaginable (given his audience): '[I]t is clear that each of those 50 molecules of hydrogen must have been divided into two [in the hundred molecules of water], because you cannot put 50 horses into 100 stables, so that there shall be exactly the same amount of horse in each stable; but you can divide 50 *pairs* of horses among 100 stables' ('Atoms', p. 188). Here, in a telling conjunction, electrochemistry meets country life. Later, in the same talk, a popular lecture first delivered 7 January 1872 before an approving (and predominately genteel) crowd as part of a Sunday afternoon series, Clifford referenced a similarly bucolic simile suggested by William Thomson: 'He expresses the result in this way – that if you were to magnify a drop of water to the size of the earth, then the coarseness of the graining [between molecules] […] would be that of something between cricket-balls and small shot' (p. 189). The scales remain staggering, but a point of purchase is found.

A hint of scandal or romance could be intimated as well. In an essay on 'The First and Last Catastrophe', Clifford escorts the states of matter into the salons of polite society, describing molecules in a gas dancing the 'Sir Roger de Coverly'; those in liquid, 'the grand chain in Lancers'; while those in a solid, where each particle has 'a place which it keeps […]' (p. 467), are nonetheless still found to be fidgeting with the incessant twitter of thermodynamic agitation. Are the lattermost, one must wonder, eager to rejoin more 'energetic' comrades on the microcosmic dancefloor?

Such a gift for poetic metaphor and model was not the only one that was useful to the scientist anxious to make his ideas better understood, whether to a duly attentive audience at a well-publicised RI lecture series or, perhaps, some interested, though necessarily anonymous, reader poring over one of the era's great generalist journals, venues in which the 'verbal and conceptual interconnectedness of the sciences, politics, theology, and literature were both sustained and revealed by their juxtaposition in periodical articles' (Dawson, Noakes and Topham, p. 30). It was equally true that an often quite *literal* poetic sensibility had a wide-ranging and highly pedagogic utility in the performance of this task as well, particularly if coupled with a suitably synthesising awareness of the nineteenth-century literary tradition.

Dozens of works situated within that tradition, after all, were routinely mined by the scientists of the era in search of seemly quotations and tropes, even as the great poets themselves, figures like Milton and Shakespeare and Tennyson, were – often quite unwittingly, to be sure (though a man like Tennyson well knew his function in this regard) – conscripted into the grand and noble endeavour of relentless scientific advance, foot-soldiers alongside their platoon mates in the lab. As Pollock says of Clifford: 'He had a fair general knowledge of English literature (by which I mean considerably more than is yet supposed necessary for an Englishman's education), with a preference for modern' – a mid-Victorian codeword for 'radical' – 'poetry […]'. Clifford was, moreover, one always to reserve – again, rather pragmatically – particular admiration for individual works and authors such 'as gave expression to his own ideas' (p. 8). (The same could, of course, be said of a range of Clifford's colleagues as well, themselves alive to potentialities and registers of meaning secreted in verse beyond those deemed merely illustrative – though each, needless to say, had his own personal pantheon of poetic favourites from which to draw both inspiration and support.)

It is, for instance, entirely possible that no substantive allusion was meant to *King Lear* in the following phrase, one lifted from a lengthy critical essay of 1875 (partly a scathing appraisal of Stewart and Tait's *The Unseen Universe; or, Physical Speculations on a Future State*) authored by Clifford for *The Fortnightly Review*. Speaking of the manner in which the sane mind, housed in a body infused with the full vigour of youth and health, 'rebels once [and] for all against its own final and complete destruction', Clifford goes on to add: 'And forasmuch as so many and so mighty generations have in time past ended in death their noble and brave battle with the elements, that we also and our brethren can in nowise hope to escape their fate, therefore we are solely driven to find some way in which at least the image of that ending shall be avoided and set aside' ('Unseen', pp. 778 - 79). Clifford's concluding clause echoes, faintly if unmistakably, an image in Act V of Shakespeare's apocalyptic tragedy. Lear is near madness, despairing at the sight of Cordelia's corpse, yet clinging simultaneously to the hope that some life still remained in her; he asks therefore of an attendant, possibly Kent or Edgar:

> Lend me a looking-glass;
> If that her breath will mist or stain the stone,
> Why then she lives.
> KENT Is this the promis'd end?
> EDGAR Or image of that horror? (V.iii.261 - 64)

Perhaps such a fleeting congruence was wholly accidental, so pervasively was Shakespearean

language and imagery by then interwoven with contemporary metaphor, idiom and cliché.

However the earlier text coheres too well with Clifford's argument for this to be fully convincing: we flee, not merely death itself, but also its apparitions and reminders, 'image[s] of that ending'. We seek, like grieving Lear over his daughter's lifeless body, a measure of solace instead, so Clifford explains it, in our identification with something greater than ourselves while still alive (a faith, an army, a creed) or, perhaps, in a fervent, though unfounded, belief in some sort of life subsequent to this one (a prospect dismissed by Clifford as 'not orderly, not natural, not healthy, but monstrous or *super*natural […]' ['Unseen', p. 779]). Edgar's eschatological visions elide with Clifford's of our own necessary extinction. The allusion, though sly, is metaphysically apt. And, atop it, cadences, diction – and an undisguised chivalric subtext – indebted to, if not worthy of, *Le Morte d'Arthur* provide a further, likewise antiquarian, flourish. Redolent of a hazily recalled Golden Age, such an implicit parallelism summons to mind a double triumph: that of 'traditional' English character (Does not the death of that king represent one of the most rousing archetypes in Western literature of 'noble and brave', if foredoomed, 'battle with the elements'?), and that of 'traditional' Anglo-Saxon prosody (manifested at its most plainspoken and 'muscular' in Mallory's late medieval romance).

In another – less clandestine – illustration, from later in the same appraisal, of Clifford's use of literary intertextuality in the service of his politicised philosophical ends, we note the scientist this time making profound poetic indebtednesses at once more explicit and more precise. Excerpted lines are indented, italicised, set off from the main body of a mid-Victorian text in a manner consonant with the fashion in which a significant equation might be highlighted in a modern one. He, in the course of an argument, deploys a couplet (unattributed) from Swinburne, always one of his favourites. (Is it any wonder that the irrepressible Clifford found so much to admire in the verse of that intriguing figure, perceived by all as something of an artistic libertine, one well known for his interest in ideas and subjects on the very borderlines of social propriety? By contrast, most of Clifford's fellow publicists, nervous about the potential professional repercussions of such immoderate literary affiliations, or by nature more conservative politically and aesthetically, 'tended to ally themselves with older more respectable poets' [Dawson, p. 266].[1]) Clifford is here writing of the intractable, and indissoluble,

[1] Another of those 'modern' poets prominent in Clifford's writings is Walt Whitman (in 'Cosmic Emotion', he editorialises on a passage from *Song of Myself*: 'So sings one whom great poets revere as a poet, but to whom writers of excellent prose, and even of leading articles, refuse the name […]' [p. 420]). In that preference, too,

bond between mind and matter, relating the idea of the 'stream' of personal consciousness – a metaphor nowadays often reflexively associated with the 1890 appearance of William James's epochal text, *The Principles of Psychology* – with the flow of water molecules constituting a river: 'Consciousness is not a simple thing', the scientist explains, 'but a complex; it is the combination of feelings into a stream. It exists at the same time as the combination of nerve-messages into a stream' ('Unseen', p. 790).

Clifford's split emphasis – on the stream-like nature of the recognisable contents of consciousness (i.e., thought) as well as on the uninterrupted nature of the manifold sensory and other stimuli goading such awareness – anticipates the psychologist's later definition. In it, emphasis is likewise placed on the continuity and intermingling of those different currents – 'a teeming multiplicity of objects and relations […]' (1: 219) – which, upon merger, collectively contribute to a unitary and interpretable mental state, that singularly enabling illusion. These diverse inputs, as James writes in a famous chapter, can be unnoticed or acknowledged, circumstantial or willed. Asserting first that consciousness, though integrating effortlessly such a manifold of competing input-sources, 'is nothing joined; it flows', he emphatically concludes: 'A "river" or a "stream" are the metaphors by which it [consciousness] is most naturally described. *In talking of it hereafter, let us call it the stream of thought, of consciousness, or of subjective life*' (1: 233).

Though Clifford's usage of such an 'aquatic' metaphor is here basically phenomenological, behind it is the same sense, as Owen Flannigan has phrased it, present in James's *fin de siècle* conception of the 'stream' of personal or subjective consciousness, a thing 'continuous, forward-moving and in constant change':

> Consider a mountain rill. It runs down in the sunshine, and its water evaporates; yet it is fed by thousands of tiny tributaries, and the stream flows on. The water may be changed again and again, yet still there is the same stream. It widens over plains, or is prisoned and fouled by towns; always the same stream; but at last
>
> 'even the weariest river
> Winds somewhere safe to sea.'
>
> When that happens no drop of the water is lost, but the stream is dead. ('Unseen', pp. 790 - 91)

Such a concept of the 'flowing stream' provides Clifford with an extensible and pliant model to expound his own ideas of consciousness, a process, he insists, shaped both by incident ('It widens over plains, or is prisoned and fouled by towns […]') and the inexorable 'downward'

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was Clifford remarkably progressive for his time and place, an individual, it seems, as forward-thinking in aesthetic sensibilities as he was in his own – practically unmatchable – mathematical, evolutionary and sociological ones.

passage of remorseless time (in the 'forgetting' of evaporation, or the 'acquisition' of both shaping experiences and new competencies through the trickling contribution of effectively innumerable 'tiny tributaries'). The Heraclitean truism – '[…] all things are in motion and nothing at rest; he [Heraclitus] compares them to the stream of a river, and says that you cannot step into the same river twice', in Jowett's 1871 translation of Plato's *Cratylus* (p. 673) – is also implicit, recoded as 'never the same person twice', an acknowledgment of the irrefragable flux of temporal being, that perpetual evolution and metamorphosis of character amid the hurly-burly of personal circumstance.

The citation from Swinburne's 'The Garden of Proserpine' thus, on one level, merely completes the scientist's figurative identification between watercourse and mind. In a materialistic philosophy of consciousness, the stream lost in the sea – and yet not lost, for the constitutive, albeit 'lifeless', water molecules persist – is equivalent in a metaphysical sense to a human personality extinguished by death.[2] The process is irrevocable; the personality (like the totality of the stream itself), irretrievable. The principle, it seems, of matter conservation (so integral to mid-Victorian physical science) restricts significantly the sorts of afterlives material bodies may experience – for Clifford, at least.[3]

But the use of Swinburne's 'Proserpine' couplet provides a further context, too. It is, in other words, not merely illustrative, or argumentative, or a way of phrasing parsimoniously – while, at the same time, memorably – a concept or critique which would otherwise sprawl over several uneconomical or, perhaps, graceless lines of prose. Nor is it merely a way of capping a metaphoric arc with a canonically poetic keystone. Rather, it serves also to cohere nicely with the scientist's own thoughts (elaborated more fully elsewhere, in such writings as 'Cosmic Emotion' and 'The Influence upon Morality of a Decline in Religious Belief') on the role of mankind in a world in which theology is discredited, in which the prospect of an eternity to be spent in either heaven or hell offers up to us neither promise nor fear. As he

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[2] The philosopher of mind Barry Dainton remarks in his study *The Stream of Consciousness: Unity and Continuity in Conscious Experience* (2000) that 'in some respects streams of consciousness are more like their liquid counterparts than some enthusiasts for such comparisons have recognized' (p. 237).

If this is so, it raises the question: for a materialist, what happens to the 'water' (memories, learned skills, and the like) after death? Clifford's theory of 'mind-stuff', discussed later in this chapter, provides one possible answer: consciousness, having arisen from an ocean of itself, merely disperses back into that ocean, the dissipation of like into like, as a river into the sea.

[3] Stewart and Tait, extrapolating from their own understandings of the same precept, found for it a radically divergent signification (examined in more detail in the next section). Explicated cogently in *The Unseen Universe* – and, as noted, hatcheted mercilessly, by Clifford, in *The Fortnightly* – it held that 'we are supposed to follow universal physical laws [like mass conservation] to a belief in the immortality of the soul' (G. Myers, 'Nineteenth', p. 62).

explains in 'The First and the Last Catastrophe', those who hold such beliefs, who deny the continuity of spiritual essences or the rewards and privations of an afterlife,

> must just face the fact [of mortality] and make the best of it; and I think we are helped in this by the words of that Jew philosopher, who was himself a worthy crown to the splendid achievements of his race in the cause of progress in the Middle Ages, Benedict Spinoza. He said: "The freeman thinks of nothing so little as of death, and his contemplation is not of death but of life." Our interest, it seems to me, lies with so much of the past as may serve to guide our actions in the present, and to intensify our pious allegiance to the fathers who have gone before us, and the brethren who are with us; and our interest lies with so much of the future as we may hope will be reasonably effected by our good actions now. (p. 484)

Clifford's vocabulary is decidedly ecclesiastical (our 'fathers', our 'brethren', 'our pious allegiance'), though his message seems anything but. 'Do I seem to say', he adds a little further on, '"Let us eat and drink, for to-morrow we die?" Far from it; on the contrary, I say, "Let us take hands and help, for this day we are alive together"' (p. 484). So he ends a popular science article on the nebular hypothesis and the end decreed by thermodynamics for all life upon this earth. Like such positivistic thinkers as his contemporary Frederic Harrison (a good friend [*SSC*, p. 87]) and, more notoriously, the Parisian social theoretician Auguste Comte, Clifford believed that the end of each and every life of achievement and sacrifice served to auger the establishment of a true 'kingdom of Man' upon this earth, and that, consequently, every man's death was a martyr's death *if* his life had been lived conscientiously, devoted equally to the service of others and the betterment of self.[4]

Unlike some of those thinkers, however – Harrison, in an essay of 1877, decried the 'corrupting doctrine' telling 'us that devotion is a molecular change in this and that convolution of grey pulp […]' ('Soul', p. 630) – the scientist expressed little remorse about the fundamental nature of the world as he had come to understand it. For Clifford, then, our mortality, even our materiality, becomes a blessing, a fortunate fate, not something to be feared by the right-thinking man; it compels us towards action, towards cooperation ('*band-work*', he termed it, viscerally anglicising a word which still then seemed something of an obtruding Latinism ['Cosmic', p. 250; see *OF*, p. 209]), towards achievement, away from sloth and idleness. The Swinburne he chose for citation in his review comes from a stanza which also makes clear this point:

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[4] Passages presaging the arrival of a benevolent 'Republic' or 'kingdom of Man' are common throughout Clifford's non-mathematical work – for instance, this line, from the essay 'Cosmic Emotion', provides as corollary the scientist's unambiguous renunciation of the Christian covenant (cf. Mark 1: 15): 'Much patient practice of comradeship is necessary before society will be qualified to organise itself in accordance with reason. But those who can read the signs of the times read in them that the kingdom of Man is at hand' (p. 429).

From too much love of living,
    From hope and fear set free,
We thank with brief thanksgiving
    Whatever gods may be
That no life lives for ever;
That dead men rise up never;
That even the weariest river
    Winds somewhere safe to sea. ('Garden', p. 171)

Clifford's neurophysiology finds its counterpart in Swinburne's metaphor of the 'weariest river' slouching homewards, even as his 'positivism' finds support in the poet's celebration of mortality, or, perhaps more to the point, his shrinking from an etiolated immortality. Swinburne was one who habitually used the sea as a metaphor for death and dissolution.

So did Clifford, and elsewhere in the article he found in another maritime phenomenon a singularly apt *memento mori*, an emblem of, and an analogue for, human finitude. No man, Donne tells us in Meditation XVII, may be an island, but could he perhaps be a wave?

'But for you', Clifford proclaims, 'noble and great ones, who have loved and laboured yourselves not for yourselves but for the universal folk, in your time not for your time only but for the coming generations, for you there shall be life as broad and far-reaching as your love, for you life-giving action to the utmost reach of the great wave whose crest you sometime were' ('Unseen', p. 780). Such an outlook, of course, represents in part a philosophy of negation ('in your time not for your time', 'yourselves not for yourselves'); it encodes a refusal, renunciation of despair, a denial of Thanatos. It provides an alternative to heaven (the smugness associated with knowing that we live on in our progeny), even as it offers a different take on the difficult concept of immortality (not an infinite vista of deathless-ness, but rather the prospect, mildly comforting, of an ever-more-advanced and ever-more-humane human future). Elsewhere, he wrote of the sea's height: 'it increases and decreases, and increases and decreases again at definite intervals'; if you mark a point by putting 'a cork upon [the sea's] surface, you will find that the cork will rise up and down; that is to say, there will be a change or displacement of the cork's position, which is periodic in time […]' ('First', p. 468). So, Clifford suggests, like a cork upon the sea we are borne up briefly from stillness, teeter upon the crest (maturity), and then fall gently again to rest – the wave coursing resolutely on, oblivious to our, to *any*, absence. The imagery, like the language and the seductive sonority of the prose, feels familiarly Swinburnian, having parallels in 'The Garden of Proserpine' and elsewhere (perhaps most evocatively in one late work, 'The Lake of Gaube'); the message, though, suffused with its odd blend of resignation alongside a defiant sociological optimism,

seems singularly indebted to positivism. Its publicists, not coincidentally, likewise had a penchant for watery metaphor; as Harrison demonstrates:[5] '[I]n some infinitesimal degree, the humblest life that ever turned a sod sends a wave – no, more than a wave, a life – through the ever-growing harmony of human society' ('Soul', p. 837).

The novelty in Clifford's employment of such symbology arises from the fluency of his comparisons, that concourse within his writings of a range of discourses, coupled with the fact that, in terms of 'his' materialism's psychology (with its idea of consciousness *itself* as flowing, as having a 'stream-like' quality), these comparisons become more than merely poetic or descriptive, but phenomenologically precise.

The chance or glancing allusion, the direct citation, the echo of mood or metaphor, these techniques provided Clifford with further methods of propagandising his own 'scientific' agenda. Such a poetic awareness or affinity, as Pollock remarked in his introduction to Clifford's *Lectures and Essays*, such an openness to the literary resources of analogy and reference, allowed that scientist simultaneously to describe the world in what would have seemed to him an accurate enough manner even as it granted him license to, in a sense, remake it wholesale, refashioning it, at once subtly and idiosyncratically, into a shape and hue of his own devising. Pollock put it thusly: 'This living and constructive energy' – one defining characteristic of the naturally gifted science-writer, he insists – 'projects itself out into the world at the same time that it assimilates the world to itself' (p. 1). Hence, many such author-figures as Clifford were, in a sense, cosmogonists as well, fabricating whole universes, self-made worlds malleable and internally consistent in which their contentions (whether scientific or not) made sense. Each of these private 'universes' was, in the main, peculiar and distinct, if not in every instance altogether unique: Clifford's borrowed more than a little from Tyndall's, even as Huxley's elaborated – ambivalently, here; uncompromisingly, there – on Darwin's beatific vision, limned (limbed?) in *The Origin*, of the 'great Tree of Life, which fills with its dead and broken branches the crust of the earth, and covers the surface with its ever branching and beautiful ramifications' (p. 107). Moreover, Clifford, like many colleagues and competitors, availed himself fully of the common currency provided by household works of poetry, fiction and theology. By and large, even as members of the Victorian public were better acquainted with the science of their era than seems the case in postmodernity, so, too, were they more

[5] That is, when they were not advancing tuneful substitutes – bringing to mind George Eliot's 'choir invisible', whose 'music is the gladness of the world' ('Choir', p. 50) – in its stead, as Harrison does towards the end of this quotation.

conversant with many aspects of both its then-present and its more ancient humanistic heritage. Clifford's readership likely knew, if only by reputation, the licentiousness of a Swinburne, the Romanticism of a Wordsworth or Shelley; they recognised, for the most part, the cadences of the King James Bible or the metre of an *In Memoriam* stanza. For some this competence was gained through close, full reading of the source text; for others, recollection of fragments from school or sermon, or perusal of, say, a popular anthology of cherished verse extracts (Palgrave's *Golden Treasury* was first published in 1861), unregulated manners of acquisition rendering the 'poetic' lines at once context-free and more amenable to recapitulation and cunning redeployment.

And, to be sure, some scientific propagandists even today make use of like techniques, if perhaps more subtly.[6] Richard Dawkins, in his recent neo-Darwinian synthesis *River Out of Eden* (1996), after cheerfully dismissing the entire prospect of either a teleology behind, or a purpose hidden somewhere within, the cosmos's multitudinous affairs – 'the universe', he tells us, matter-of-factly and without hope of appeal or reprieve, 'we observe has precisely the properties we should expect if there is, at bottom, no design, no purpose, no evil and no good, nothing but blind pitiless indifference' – then concludes a chapter entitled 'God's Utility Function' by quoting a fragment of verse, co-opting its lines in a fashion which can only be described as Cliffordian:[7]

> As that unhappy poet A. E. Housman put it:
>
> > For Nature, heartless, witless, Nature
> > Will neither care nor know
>
> DNA neither cares nor knows. DNA just is. And we dance to its music. (p. 155)

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[6] 'Serious' scientists do occasionally use the same as well. A 2005 article in the *Journal of High Energy Physics*, discussing spacetime topological deformations wrought by closed string tachyons, ends with full citation of Yeats's 'The Second Coming', a poem put forth as 'anticipating' the authors' thesis; they even gloss its opening with their own strophic updating. 'TURNING and turning in the widening gyre / The falcon cannot hear the falconer; / Things fall apart; the centre cannot hold […]' (Yeats, pp. 210 - 11) becomes, for instance, '*Vortex-induced / causal disconnection / follows tachyon condensation* […]' (Adams *et al*., p. 31). Their tone, though, remains aloof and wry, acknowledging the absurdity of such Yeatsian precognition, and the primacy (or, at best, separateness) of science. The appendix in which it occurs, 'Towards a transformative hermeneutics of off-shell string theory', even evokes that egg-on-face pillorying of ill-judged interdisciplinarity, Alan Sokal's 'Toward a Transformative Hermeneutics of Quantum Gravity'.

[7] Dawkins, though, subtly misrepresents – the kind of mistake committed (or, less charitably, the sort of wilful deception perpetrated) at best infrequently by Clifford – the overriding theme of that 'unhappy poet' in his chosen usage of the Housman. The lines selected are taken from a piece which, if anything, attacks the pathetic fallacy alone, the belief that there is an ineradicable correspondence (ubiquitous in Romanticism, of course) between human feelings and the 'emotional states' of an inappropriately anthropomorphised external world. Here is the excerpted stanza in full: 'For nature, heartless, witless nature, / Will neither care nor know / What stranger's feet may find the meadow / And trespass there and go, / Nor ask the dews of morning / If they are mine or no'. Hence, it is human arrogance, not natural cruelty or indifference per se, that seems to have been the poet's – and poem's – intended target.

As it had for so many predecessors of more than a century previous, the epigrammatic yet oddly encompassing scope of the aptly chosen poetic quotation provides Dawkins with a temporary, if superficial, respite from the nihilism encroaching stealthily beneath the surface of his own evolutionary narrative, a fleeting glimpse of beauty and coherence in a world denuded of meaning. And thus in the very ambivalence and inscrutability of biology is Dawkins able to find a new music, a new meaning, even as Clifford was able to discover a compelling sublimity and a tantalising exuberance in the vastness and comprehensibility of his own era's vision of a nature rendered 'heartless, witless'.

'We are all to be swept away', Clifford wrote, 'in the final ruin of the earth. The thought of that ending is a sad thought; there is no use in trying to deny this. But it has nothing to do with right or wrong; it belongs to another subject. Like All-Father Odin, we must ride out gaily to do battle with the wolf of doom even if there be no Balder to come back and continue our work' ('Modern', p. 356). Such a course of action, he insists, is neither suicidal nor pointless. Not for Clifford the paralysis of Myers's 'Would God It Were Evening', a morose sonnet in which, in the era's newly 'material' cosmos, even the promises of Keatsian Romanticism are quashed: 'Alas! a melancholy peace to win / With all their notes the nightingales complain, / And I such music as is mine begin, / Awake for nothing, and alive in vain'. There is, for him, too much yet to live for. Humanity's future, hence, elides with Norse mythology, not Christian theology; with *Ragnarök*, not John's Apocalypse.[8] Clifford's eschatological visions, his 'image[s] of that horror', evince, accordingly, a grand and triumphal burst of glory before the ultimate conflagration, even though he, of all people, knew only too well the manner in which all cosmologically scaled thermodynamic processes must inevitably play out – and in that conflagration, truly, he'd say, we would meet the absolute and inescapable ending of all ponderable things.

In the meantime, what joy could be found, beyond duty, in Clifford's philosophy was provided by 'cosmic emotion' (Henry Sidgwick's coinage), 'an emotion which is felt in regard to the universe or sum of things, viewed as a cosmos or order. There are two kinds of cosmic emotion – one having reference to the Macrocosm or universe surrounding and containing us, the other relating to the Microcosm or universe of our own souls' ('Cosmic', p. 411). Clifford,

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[8] Clifford was not alone among Victorians in his deliberate evocation of this mythology. Carlyle, as Gillian Beer points out, gave in 1841 'a synopsis of the Balder legend in *Heroes and Hero-worship* […]'; moreover, Matthew Arnold, in 'Balder Dead', an epic-length poem of 1853, provided his readers with a characteristic '[…] Christianizing of the myth in which Balder is identified with Christ' (*OF*, p. 227*n*19).

in an essay on this queer concept, suggests a 'star-full' sky as one spectacle ideally suited to produce 'cosmic emotion of the first kind'; exultant contemplation of man's 'moral faculty', perfect to incite the second (pp. 411, 412). These were, however, compensatory comforts which seemed paltry to many. Mallock, in *The New Paul and Virginia*, tartly punctured the narcissistic solemnity of such a doubly focused 'sensitive' atheism (Darnley's 'bosom swelled violently, and he cried aloud, his eyes still fixed on the firmament, "Oh, important All! oh, important Me!"' [p. 37]), while in 'Is Life Worth Living?', a meditative essay of 1877, he went even further, mocking the absurd presumptuousness of *all* naturalistic guides to conduct, saying of their advocates:[9] 'But the knowledge which has qualified them to destroy religion, has no bearing whatsoever on the knowledge that will qualify them to replace it' (2: 271).

More pessimistic still was the appraisal put forth in Rev. Watson's *Gospels of Yesterday*. Peering into the depths of Clifford's oceanic metaphor, having skimmed off pretty rhetoric and all the humanistic froth, he discerned beneath those 'waves' an unquenchable emptiness, the abysmal unendurability of any cosmological system denying the agency of Christ:

> And there is no remedy. For men, for societies, for the whole human race, one law holds in the vast dominion of force. The mightiest nation is but a wave in the weltering ocean which beats from cosmic shore to cosmic shore, unceasingly active, eternally impotent. What is it to a man that the wave of which he forms a part will have its flashing crest for a moment as it rolls in on some resounding beach? He is nothing; the ceaseless movement is all. (p. 177)

Was a conciliation to be found?

One scientist who *could* seemingly manage to reconcile a viable accounting of the natural world with the Revelation denied by Clifford was Maxwell. He, like many among the polemicists' fraternity, appealed frequently to the tenets of molecular physics, though derived from them antithetical conclusions, 'that neither the kinetic theory of gasses nor the laws of thermodynamics implied materialism' (Harman, p. 202). The manner in which he was able to do so will be the focus of my next section.

THERMODYNAMICS AS ALLEGORY: MAXWELL'S CRITIQUE OF *THE UNSEEN UNIVERSE*

John Herschel said of the infallibility and instantaneity of atoms, in 1865: 'Their movements, their interchanges, their "hates and loves," their "attractions and repulsions," their "correlations," their what not, are all determined on the very instant. There is no hesitation, no

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[9] These issues (anti-materialism, anti-positivism) truly energised Mallock. He later expanded 'Is Life Worth Living?', already formidable, to book-length. Verdict? – tentatively affirmative, after 247 pages.

blundering, no trial and error' ('Atoms', p. 84). Maxwell, echoing Herschel, and stirred simultaneously by Christian faith and the grandeur of nineteenth-century scientific conceptions of the phenomenal world, famously believed that at least one among several conceptual entities – specifically, molecules – deployed in the paradigms of contemporary theoretical physics provided evidence, as it were, of the 'flawless'-hence-'manufactured' beginnings of physical substance. Molecules, he wrote (in a celebrated article of that name), 'continue this day as the day they were created – perfect in number and measure and weight […]'; their perfection, in a sense, mirrors the perfection of God, as 'they are essential constituents of the image of Him who in the beginning created, not only the heaven and the earth, but the materials of which heaven and earth consist'. One wonders, having heard this, what of the Second Law? What of its decree, wholly unanswerable, that all order – including molecular order – must in the end dissolve?

Maxwell, predictably, had thoughts on this as well. 'Natural causes', he enthused,[10]

> as we know, are at work, which tend to modify, if they do not at length destroy, all the arrangements and dimensions of the earth and the whole solar system. But though in the course of ages catastrophes have occurred and may yet occur in the heavens, though ancient systems may be dissolved and new systems evolved out of their ruins, the molecules out of which these systems are built – the foundation stones of the material universe – remain unbroken and unworn. (p. 154)

Immutable, eternal, 'steadfast', exempt from the ravages of entropy, molecules must have seemed to provide Maxwell with palpable confirmation of his faith, proof positive of his long-held contention that the elements of structuring, in sublime ensemble with all the voices of our experiential world (indeed, with a perhaps unique expressiveness), 'Tell the same unending story – / "We are Truth in Form arrayed"'. So he had rejoiced in his undergraduate composition 'A Student's Evening Hymn' (p. 595).

In other words, for Maxwell, the study of molecules opened wide a window on the numinous. But that should not be confused with the belief that they – that worldly things themselves – constitute the numinous. In a speculative essay submitted to the Cambridge Apostles, Maxwell had two decades prior to 'Molecules' cautioned against this line of argument, against slippage from recognition of potential signs of cosmic design to assertion of metaphysical certainties (about, for instance, corporeal, or spiritual, or ethereal, afterlife) based on those signs. Such a prejudicing 'hope' – a debilitating urge to find scientific evidence for that which necessarily lies, or so he insisted, beyond the reach of scientific evidence – 'has

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[10] Tyndall, in his Address, found room to comment on the 'ethic glow' and 'very noble strain of eloquence' so unmistakable in these lines, while nonetheless critiquing their theistic implications (*BA*, p. 26).

prompted many speculations of natural historians, who would be ashamed to put it into words' ('What', p. 226).

Peter Guthrie Tait, Maxwell's untiring correspondent, apparently felt few such scruples. Though J. D. North's entry for Tait in the *Dictionary of Scientific Biography* makes no mention of it – yet another instance of the selective amnesia of the scientific community – he and his friend, Balfour Stewart, were perhaps best known in the 1870s for two popular works. They were *The Unseen Universe* (that so tempting target for Clifford's invective), and its sequel, *Paradoxical Philosophy* (1878). Both deployed concepts from physics – energy conservation, the permeability of the ether – in defence of some, to modern sensibilities, curious speculations concerning the perfect and eternal 'durability' of the human soul. The scope of such inquiries, as explained in *Paradoxical Philosophy*, was justified on the grounds that 'the only result of drawing a hard and fast line between the natural and the revealed has been to divide us into two separate and seemingly hostile camps, the one under the banner of science and the other under that of religion' (p. 33).

The Unseen Universe, in particular, despite its potentially impervious subject matter, was to prove a sensation, going through numerous re-printings (fourteen editions in thirteen years [G. Myers, 'Nineteenth', p. 55]), as nervous Victorians found solace in its vision of harmony between personal immortality and the transience decreed by atomistic and thermodynamic science. The authors aspired for more, however, beyond comfort-giving; as P. M. Heimann has observed: 'Though the *Unseen Universe* can be regarded as a popularization of science for an ideological purpose, it was intended as a contribution to the philosophy of nature' (p. 73).

In fact, an assortment of contemporary thinkers attempted an array of comparable projects, at once psychologically resuscitative and theoretically aware. Like *The Unseen Universe*'s authors – searching amid entropic ruin, amid the waste of lives and worlds, for spiritual redemption – each typically discovered at least redemption's vague promise, a hope cheering if equivocal. A few even undertook multiple such 'quests', returning diverse travelogues: not least, Tait himself. He, fifteen years prior, had co-authored, with William Thomson, an article on thermodynamics for *Good Words*. A text far more explicitly Christian than *The Unseen Universe*, it was unambiguous in making apparent to a theologically and culturally conservative readership the 'synergism' between cosmological narrative and Biblical apocalypse, directly relating guttering 'heat death' to the cleansing of Genesis's primordial flood. The dead cosmos of distant futurity, as the authors dutifully explain, is doomed to endless mouldering in 'chaos and darkness as "in the beginning." But before this consummation can be attained, in

the matter of our solar system, there must be tremendous throes and convulsions, destroying every now existing form' (p. 606).

Transcendental geometer C. H. Hinton, in his extraordinary allegory 'The Persian King' (1886), likewise found in the thermodynamic arrow of time an unwavering pointer to celestial Providence. The tale provides a convoluted parable in which an invisible, magnanimous and (effectively) omnipotent monarch is able to goad his unwitting subjects from inactivity by making certain actions 'feel' more pleasurable than certain other actions. To it is appended Hinton's moral – and inductive – justification: 'They [the subjects] might have reasoned. […] [The] universal condition of anything happening must be the cause. Energy goes from a higher to a lower level. That which causes the difference of level is the cause, and the cause of the difference of level must be that which accompanies such a transference of energy from a higher to a lower level' (p. 126). Thus is God, Mover of Aquinian scholasticism, discovered. He is found in the day-to-day, peeking out from – and furiously pulling levers behind – the now-translucent 'curtain' of thermodynamic directionality. He seems a materialist's Wizard of Oz.

If anything, though, *The Unseen Universe*'s synthesis, the era's most valiant and persuasive attempt at salvaging a fiction of meaning from otherwise implacable physical precepts, went further than either Tait and Thomson's article or Hinton's entropic fable, dragooning poetry along with religious prophecy in support. (Few peers had unmitigated sympathy with this approach, but it seemed 'correct enough' to many.) In the course of just the epigraphs for seven chapters, Stewart and Tait quote *The Tempest* (Prospero's ubiquitous soliloquy on '[…] this insubstantial pageant, faded, / Leav[ing] not a rack behind' [IV.i.155 - 56]), Thomas Campbell's 'The Last Man', Virgil, Milton's *Paradise Lost*, Pascal, Plato's *Phaedo*, Tennyson (*In Memoriam*, more than once), Pope's *Essay on Man*, St Paul's Epistle to the Romans, *Macbeth*, and – for purposes, one imagines, of a kind of spiritual compendiousness – that codification of ancient Judaic oral tradition known as the *Mishna, Pirke Abot*. This is in addition to all the inset quotations and allusions evident in the text proper, which – alongside scores of explicit Scriptural references and metaphoric parallelisms – include citation of further works by such major, and heterodox, figures as Byron, Lucretius, Matthew Arnold, John Stuart Mill, Pope again ('The Dying Christian to his Soul'), Plato again (the *Gorgias*). And, bestrewn among all these, a variety of more ephemeral – or, perhaps, more 'irremediably Victorian' – personages: Henry Baker and James Montgomery, James Martineau and the Rev. Charles Parsons Reichel, B.D. *Pilgrim's Progress* makes an appearance on the verso of the title page, right beneath a few lines

from Hadrian.

As 'science', the text – subtitled *Physical Speculations on a Future State* – feels at once accurate and wilfully misleading, an appraisal not exclusively modern.

Inside, official-sounding phrases, communal terminologies, and a hotchpotch of both overtly and subliminally 'Christian' sayings and literary extracts are intermixed. This is done in a manner which would, among other things, have appealed to prejudices, post-Belfast Address – Scots algebraist Alex Macfarlane deadpanned, in a 1901 lecture: '[I]t is certainly remarkable to find in the same book a discussion of Carnot's heat-engine and extensive quotations from the apostles and prophets' (p. 90). The authors piggyback on the writings of such 'precursors', borrowing cachet, assimilating presumptions. They reject 'any attempt to separate the natural from the miraculous' (Heimann, p. 75), and assign to the 'unseen' a role not incongruous with that of the Holy Spirit (the existence of such an underhanded correspondence was one of Clifford's chief complaints). The materialists' presupposition of continuity of energy and law becomes rather a statement, for them, of the continuity of intelligence, of human personality liberated from the corpse-coffin of matter, made undulatory, and set adrift amid waves of ether. So is that individual rendered, for practical purposes, undying.

The Unseen Universe, accordingly, ends with an accounting of jovial congruence, the overlapping of thermodynamic with New Testament revelation:

> If then we regard the universe from this point of view we are led to a scientific conception of it which is […] strikingly analogous to that system with which we are presented in the Christian religion. For not only are the nebulous beginning and fiery termination of the present visible universe indicated in the Christian records, but a constitution and power are assigned to the Unseen Universe strikingly analogous to those at which we may arrive by a legitimate scientific process. (p. 210)

Entropy, in such a reckoning, becomes a means to both an end, and an ending, a gateway rather than gallows; thermodynamics, a way of at once ordering the visible universe and stocking Stewart and Tait's purported invisible one. 'In other words', they explain, 'the tendency of heat is towards equalisation; heat is *par excellence* the communist of our universe, and it will no doubt ultimately bring the system to an end' (pp. 90 - 91). As Greg Myers has observed, the 'reference to a *communist*, four years after the fall of the Paris commune, would have carried a specific meaning for Stewart's and Tait's readers. The social order and the cosmic, the end of the universe and the end of capitalism, are conflated' ('Nineteenth', p. 57). Yet this collapsing of merged economic and physical organisations ushers in the emergence not of nothingness, nor of chaos, but instead a better organisation, one reified in the ether, made incontrovertibly eternal yet somehow preserving the priceless 'currency' of ontological

distinctiveness.

Though *The Guardian*, for one, had described *The Unseen Universe* as 'a perfectly sober inquiry, on scientific grounds, into the possibilities of a future existence' (qtd. in 'Macmillan', p. 17), Maxwell himself remained rather less convinced. He frequently chastened his colleague, in both epistolary and an assortment of discursive contexts, for holding such unsupportable – and, to his mind, irresponsible – beliefs. He ended the otherwise laudatory verse ode 'Report on Tait's Lecture' with a joke playing on Tait's assertions about the destiny of matter: 'While you, brave Tait! who know so well the way / Forces to scatter, / Calmly await the slow but sure decay, / Even of matter' (p. 648). Of course, Maxwell, convinced of its absolute permanence, believed atomic matter altogether incapable of any sort of decay. On 7 September 1878, upon hearing news of the planned publication of *Paradoxical Philosophy*, a collection of further 'hymns' to a posthumous ethereal existence, Maxwell wrote a letter to Tait. In it, he commented (riffing on *The Unseen Universe*'s concept of 'spiritual evolution') that it 'is said in Nature that UU is germinating into some higher form. If you think of extending the collection of hymns given in the original work, do not forget to insert "How happy could I be with ether"'. ('How happy could I be with either' – melody: '*Have you heard of a frolicsome ditty*' – is a philander's lament sung by Macheath in Gay's *Beggar's Opera* [p. 53; II.xiii], perhaps Maxwell's comment on Tait attempting to 'have it both ways' with a 'scientised' Christianity.)

In a subsequent review of the book for *Nature*, he observed, in tones imbued with the full weight of the serial's editorial voice: 'On opening this book, the general appearance of the pages, and some of the phrases on which we happened to light made us somewhat doubtful whether it lay within our jurisdiction, as it is not the practice of NATURE to review either novels or theological works' ('Paradoxical', p. 141). He was to dedicate the remainder of the article, unsurprisingly, to analysis of the scientific non sequiturs and lapses in logic present in many, perhaps most, of *Paradoxical Philosophy*'s conceptually misguided, if unquestionably earnest, crypto-pagan imprecations. Maxwell, however, could hardly resist using the platform of a formal review in *Nature* (especially given its topic) to elaborate on his own beliefs about what 'science has to say about the soul': 'The progress of science […]', he concluded, 'has added nothing of importance to what has always been known about the physical consequences of death, but has tended rather to deepen the distinction between the visible part, which perishes before our eyes, and that which we are […]' (p. 143). In effect, Maxwell suggests looking inward, towards Revelation and the boggling perplexities of self-consciousness, rather than outward, at the relative mundanity (in all its senses) of entropic convulsion and energy

conservation; for, in so doing, we might find authentic guarantees – avatars, even – of post-mortem continuance.

As Theodore Porter has noted, in Maxwell's view, '[b]oth science and religion […] needed to be protected from mistaken claims of their incompatibility' (p. 79); evidently, though, they required also vigilant defending from hyper-unificationism, epitomised in Tait and Stewart.

Hermann Stoffkraft (such a surname conjoining the two halves of Büchner's – and nineteenth-century scientific naturalism's – cosmology: *Stoff*, 'matter'; *Kraft*, 'energy') is the pivotal character in *Paradoxical Philosophy*, a Teutonic rationalist embodying the doctrines of materialism, and who, appropriately, voices a litany of objections to the metaphysical arguments offered therein. Yet, as Maxwell chides in his review, he 'makes it his chief care to brandish his materialistic weapons as not to hurt the feelings of his friends […]' ('Paradoxical', p. 141). Indeed, Stoffkraft's defence of materialism is so attenuated that, by book's end, he has fully embraced the peculiar beliefs about immortality held by the several members of the so-called Paradoxical Society. To him Maxwell dedicated his poem 'To Hermann Stoffkraft, Ph.D., the Hero of a recent work called "Paradoxical Philosophy"'. Maxwell's decision to, as it were, 'redistribute' responsibility for the work's content – a move suggested by the poem's title – from its two authors to Stoffkraft himself can perhaps be explained by a letter, ostensibly written by the fictitious character, which appeared in *Nature* not long after the volume's publication. 'There are […] *strong scientific analogies*', the missive's 'Hermann Stoffcraft' insists, 'which lead us [the members of the Paradoxical?] to believe that the thinkable antecedent of the present [cosmological] system was a spiritual unseen, which not only developed but which now sustains the present order'.[11]

Maxwell's 'To Hermann Stoffkraft' opens with an evocation of a human soul envisioned in terms of entangled atomic vortices, Maxwell's preferred model for atomic structure, derived from Helmholtz and Thomson, a model in which mysterious forces need not be introduced to account for emission and absorption spectra, the apparent profusion of chemical elements, the interlinking of atoms into molecules and compounds, and so forth. The 'vortex atom', he explained elsewhere, is 'qualitatively permanent, as regards its volume and its strength, – two independent quantities. It is also qualitatively permanent as regards its degree

[11] Incidentally, though 'Stoffkraft's' communiqué could have been penned by Tait or Stewart, it seems so deliriously narcissistic – sample argument: 'Is it therefore necessary that I should in like manner help to sustain some inferior universe?' – that I am fairly sure it was submitted by some satirist, perhaps Maxwell himself.

of implication, whether "knottedness" on itself or "linkedness" with other vortex rings' ('Atom', p. 202). (Clifford liked the concept too, praising such atoms as, 'if […] not the foundation of the final theory of matter, […] at least imperishable stones in the tower of dynamical science' ['Unseen', p. 784].) 'My soul is an entangled knot, / Upon a liquid vortex wrought / By Intellect, in the Unseen residing', 'To Hermann Stoffkraft' begins (pp. 649 - 50), rehearsing, in vortex vernacular, just the sort of description ubiquitous throughout *Paradoxical Philosophy* and, earlier, *The Unseen Universe*.

Such lines hint at the element in the speculations of Stewart and Tait to which their author took the gravest exception. Maxwell, a rational empiricist, presumed the ether to be an entity comprehensible to science, potentially a quantifiable substance obeying discoverable rules, knowable if not yet fully known. 'If aether is molecules', he reasoned in manuscript notes, 'be the molecules $\frac{1}{1000}$ or $\frac{1}{1000000}$ [in size] of those of hydrogen, the aether is a gas tending to equality of temperature with other bodies […]' ('Notes'). For Maxwell, the ether was a thing, and, as a thing, the ether was of this world. And, as something of this world, it seemed a dreadfully unsuitable destination for the human soul, something Maxwell believed profoundly *im*material, intrinsically *un*worldly. We are thus meant to interpret the following lines of his ode with suspicion:

> Till in the twilight of the gods,
> When sun and earth are frozen clods,
> When, all its energy degraded,
> Matter to æther shall have faded;
> We, that is, all the work we've done,
> As waves in æther shall forever run
> In ever-widening spheres through heavens beyond the sun. (p. 650)

Now, it is evident that Maxwell did not really *mean* any of this – such a rhapsody, in effect, merely describes the *Götterdämmerung* of Stewart and Tait's post-conversion Stoffkraft. Maxwell, with his well-documented ardour for the principle of molecular incorruptibility, thought the idea of matter degrading to ether – of matter, in truth, degrading to anything, given his generation's unfamiliarity with radioactive decay – ludicrous, borderline nonsensical. His unshakeable insistence that the physical world was incapable of 'assembling' the human soul – 'atoms', he once quipped, 'are a very tough lot, and can stand a great deal of knocking about, and it is strange to find a number of them combining to form a man of feeling' (qtd. in *LJCM*, p. 391) – has as its logical corollary the contrary supposition: that the same physical world (irrespective of 'paradoxical' properties) is equally incompetent to effect the soul's disassembly,

facilitating individual personality's energetic preservation.

Many years after its drafting, Maxwell affixed an alternative title, 'Does the existence of Causal Chains prove an Astral Entity or a Cosmothetic Idealism?', to his undergraduate piece 'What is the Nature of Evidence of Design?' (*LJCM*, p. 226*n*1). This alteration points once more to Maxwell's continued concern with unjustified inference from tokens of continuity in the universe – the conservation of force, and so on – to a belief that, consequently, human spirit itself is regulated by analytical laws, demonstrating corresponding complexities. The final stanza of 'To Hermann Stoffkraft' – understood as dramatic monologue, rather than Maxwellian *volte-face* – is written from the perspective of an individual altogether secure in such a fallacious hypothesis. It is, however, a hypothesis which would be called immediately into doubt by any evidence suggesting that causality isn't inviolate, that energy isn't conserved. And, thus, Maxwell (or, more accurately, his poetic alter-ego, a stand-in for Stoffkraft or, perhaps, some ordinary member of the Paradoxical) implores: 'Oh never may direct Creation / Break in upon my contemplation; / Still may thy causal chain, ascending, / Appear unbroken and unending' (p. 651).

There is a bit of truth in these lines for anyone, of course: sceptic or spiritualist, Hermann Helmholtz or Hermann Stoffkraft. A scientist like Maxwell depended – perhaps even more so than those characters in *Paradoxical Philosophy* – upon causality, upon regularities in natural law, upon inviolable conservation principles. But, for him, such considerations provided not evidence for posthumous continuation (in any sort of strange or ethereal form, like resonances in Stewart and Tait's 'unseen'), but rather further confirmation of his long-held belief that, as he wrote in a buoyant little ditty, the 'end that we live for is single /' – the glorification of God – 'But we labour not therefore alone, / For together we feel how by wheel within wheel, / We are helped by a force not our own' ('Tune', p. 697).

The entirety of 'To Hermann Stoffkraft', in other words, is parodic, written in mock celebration of another theoretician's personal beliefs, beliefs with which Maxwell passionately disagreed. It was perhaps the fact that the 'other theoretician' in question was his treasured friend P. G. Tait that caused the scientist to soften, even mask, the exuberance of the work's satire, though, it must be said, Maxwell's humour was frequently at once both subtle and self-effacing, and many of his poems (not merely this one) disguise beneath their superficial placidity a kicking wit. Tait himself would later note as much. In an overview of Maxwell's publications and research interests (published in *Nature* not long after the scientist's death), he found room to comment, if hyperbolically, both on the felicity of Maxwell's poetic skills and the

ferocity of his satiric ones. 'No living man', he explained, 'has shown a greater power of condensing the whole marrow of a question into a few clear and compact sentences than Maxwell shows in these verses. Always having a definite object, they often veiled the keenest satire under an air of charming innocence and *naïve* admiration' ('Clerk-Maxwell's', p. 321).

In Defence of 'Scientific' Poetry

In his preface to *The Oxford Book of Victorian Verse* (1912), the ubiquitous 'Q', Arthur Quiller-Couch, ever mindful of his formidable responsibilities as a selector and arbiter of popular taste, remarked that there were some among his contemporaries who believed that 'the anthologist does his best service in recapturing fugitive, half-forgotten poems – frail things that by one chance or another cheated of their day have passed down to Limbo' (p. vii). He, however, never found such an occupation profitable. Instead, Quiller-Couch insisted that intrinsic worth (as he judged it!) should be the sole criterion for a given work's inclusion.

Few indeed of the 'scientific' or occasional poems addressed in this dissertation would have survived – or even risked – passage through such an uncompromising sieve. Yet many of them provide intriguing documentation of a wide range of cultural anxieties, both in the scientific sphere and in that of mid-Victorian society at large. This being granted, it would, of course, be disingenuous to argue that these verses, considered as a group, constitute a significant artistic achievement in the same sense that, say, those of Tennyson constitute a significant artistic achievement; at the same time, it would also be to do them a tremendous disservice not to concede that several of their number, if not indisputably high art, must nonetheless be considered of high merit. It is, however, merit of a peculiar sort, as it often seems to arise less from conventional literariness and more from each individual poem's curious cultural location somewhere between lecture and literature, scientific explanation and (perhaps dubious) moral, aesthetic or philosophical expostulation.

James Najarian, querying the idea of 'minorness' in Victorian verse, wonders: '[W]hy [minor] poets access the modes they do – what were these poets reading, and how were they reading in order to form their subjectivities and express them in that most literary of forms, poetry, in ways that were (deliberately?) outwardly lacking originality?' (p. 573). These issues are central, whether analysing William McGonagall's verse or James Clerk Maxwell's.

But 'scientific' poems pose scientific questions too, and must be interrogated as both informing and, concurrently, being informed by non-literary arenas. Certainly, they must be

read with the milieu of the mid-century in mind, a space of lectures and laboratories, professional alliances and scandalously public disputes. But they must also be read in the context of normal paradigms, and a scientist's own theories and suppositions about the nature, governance and description of the physical world. (Sometimes in the context, too, of the unfamiliar or challenging minutiae of those theories and suppositions.) Maxwell's 'To the Committee of the Cayley Portrait Fund', for instance, addressed to certain Fellows of Trinity College, Cambridge, presupposes a range of specialist literacies. An encomium in form and flavour, its author animates conceptual entities associated with Arthur Cayley, a pure mathematician who during the course of his career both formalised matrix algebra and elaborated the theory of quarternions (though always one to remain sceptical about their practical benefit, he eventually contributed an analytical chapter to the 3rd [1890] edition of Tait's *Elementary Treatise on Quarternions*). Accordingly, phalanxes of noughts and ones, and some stranger numbers, are marshalled by Maxwell in homage, arrayed into the ranks and files of rectilinear algebraic matrices: 'First, ye Determinants! In ordered row / And massive column ranged, before him go'. Next, the poet commands, 'Ye powers of the n^{th} roots of -1! / Around his head in ceaseless cycles run, / As unembodied spirits of direction'. The final reference is at once punning and arcane: the (imaginary) roots of negative one not only form the basis of complex analysis, but also its mid-century generalisation, quarternion algebra; in that 'hypercomplex' system, the non-real components of each quaternion 4-tuple – as suggested by the curious phrase 'unembodied spirits of direction' ('unembodied' since imaginary) – are deemed to represent three-dimensional extension. Moreover, delightfully, iterated powers of the square root of negative one *do* in fact 'in ceaseless cycles run' – the scientist's playful literalisation of a tricky mathematical concept – as every fourth power of i is taken to equal itself: $i^n = i^{(n+4)}$.

The vitality of such connectedness, such tight enmeshing of poetic word with personal world, in textual artefacts of this sort must be kept constantly in mind if one is to avoid the sort of honest misreading proffered for 'To Hermann Stoffkraft' – admittedly one of Maxwell's more cryptic efforts – by twentieth-century physicist J. J. Thomson. Of that poem's concluding stanza Thomson wrote: 'It has some lines which are a remarkable anticipation of the speculations which are now [circa 1931] so common about the destiny of matter and energy' (p. 5).

These rhapsodic 'speculations' of Maxwell, however, are only to be taken seriously, as I have argued, in so much as they predict the condition of the universe in the far downstream: without potential, paralysed by entropy. They say nothing, except by indirection, of Max-

well's *own* beliefs about the 'fate' of molecules condemned eternally to wander such a sepulchral domain. As with *In Memoriam*'s prescient 'evolutionism', then, the seemingly 'forward-thinking' aspects singled out by Thomson in 'To Hermann Stoffkraft' are actually responses to – even critiques of – pre-existing theory, not prophecy at all.

Of such 'poetic' works by mid-Victorian scientific thinkers some are, of course, ephemeral. Others, even in view of the most blindly charitable of critical appraisals, of an at best debatable degree of either literary or socio-historical merit. A very small number indeed are both these things. Take this 'inverted doxology' proposed by Clifford; it is preserved in Edward Carpenter's *My Days and Dreams* (1914), a curmudgeonly memoir. In a description of his days at Cambridge, Carpenter, later a fully ordained minister but then an idealistic young curate nonetheless far from averse to mixing with a crowd of freethinkers often less than sympathetic towards his chosen vocation, recalls that Clifford would preside over gatherings of an informal colloquium devoted to discussion of literature, theology (or, as was more likely, its immediate, wholesale abolition), sexual and domestic politics, and other topics of pressing intellectual interest. Clifford, he tells us, 'was a kind of Socratic presiding genius at these meetings – with his Satyr-like face, tender heart, wonderfully suggestive, paradoxical manner of conversation, and blasphemous treatment of the existing gods' (p. 60), a man who apparently delighted in his own self-consciously scandalous declarations of radical religious unbelief:

> O Father, Son and Holy Ghost –
> We wonder which we hate the most.
> Be Hell, which they prepared before,
> Their dwelling now and evermore! (qtd. in Carpenter, p. 60)

This is crude, of course – indeed its generic baseness was part of its design, composed as it was to shock and startle a Cambridge which only in 1871 relaxed its statues concerning religious affiliation and the taking of Holy Orders by Senior Members, mocking the seeming simplicity of officially mandated spiritual declarations by the making of an equally facile counterclaim. However, aside from a brief glimpse into the author's iconoclastic personality proffered by the daring novelty of its form, the piece adds little to our knowledge of either Clifford the man or the sort of scientific rationality he represented.

He was, after all, in no one's estimation a closet atheist. In that extended review, for instance, of *The Unseen Universe*, he addresses the work's authors as deluded, if not yet quite beyond redemption, comrades in science, even while denigrating their juvenile and, he hints, unwholesomely atavistic hankering after an effectively repugnant system of Christian belief:

'That which you keep in your hearts, my brothers', he explains, 'is the slender remnant of a system which has made its red mark on history, and which still lives to threaten mankind'. (This was a radical tactic: contrast the extremity of Clifford's stance with Tyndall's respectful re-channelling and reworking, rather than comprehensive renunciation, of those same drives in the bulk of his own philosophy.) A few sentences earlier Clifford had gone so far as to characterise the theological predisposition seemingly inherent in humankind as little more than the 'sickly dreams of hysterical women and half-starved men […]' ('Unseen', p. 793). Adrian Desmond points out, in his biography of T. H. Huxley, that even John Morley, liberal editor of *The Fortnightly* and redoubtable advocate for many authors of unconventional or unpopular stripe, had more than once had 'his fingers burnt' over his – and his serial's – continued advocacy of W. K. Clifford (p. 466). Not all Victorians, it seems, were eager to tolerate the scientist's habitually wild-eyed diatribes against both organised religion in general and Protestant Christianity in particular. (That's not to say that *some* didn't find such anti-theological diatribes endearing – or energising, for that matter. '[M]y great social success of the period [the mid-1870s], not now to be sniffed at, was gained by outdoing poor Clifford in a contest of schoolboy blasphemy', so Robert Louis Stevenson once reminisced of his years of literary apprenticeship among the radicals and positivists of London [qtd. in Reid, p. 266].)

By contrast, a poem Clifford addressed to Lucy – his wife, and a woman who was, after his early death, to become a prominent author in her own right, though one sometimes prone to decidedly 'un-Cliffordian' bursts of sentiment – seems at once to provide humanising biographical insight while simultaneously deepening our appreciation for the *thoroughness* of the scientist's materialism.

It begins with a familiar motif, a likening of death to the end of summer: 'The summer dies out, sun by sun; / The lily droops to the ground and dies; / Dies, but the root in the ground lives on. / That shall one day rise' (qtd. in *SSC*, pp. 36 - 37). The manoeuvre is Whitman-esque, even as it describes with admirable rectitude the processes of organic degeneration and biological rejuvenation. His prophecy of resurrection, however, is wholly natural, not theological, and, as extended in the following lines, becomes a metaphor associating his own mortality with his 'deified' wife, perceived as transcendent, but in an earthly way:

> Is it thus with me, O sun of my days?
> Shall death lay hold on me, after you,
> Till you shine again, and the fresh warm rays
> Revive me too?
> The old tales tell of a soul of things,

> How earth and sky are made of his breath,
> How in one man's flesh he folded his wings
> And died the death. (qtd. in *SSC*, p. 37)

The Christian narrative (one of those 'old tales') is referenced (the Incarnation figured as a stilling of divine motility, a 'fold[ing] of wings'), and then dismissed. Clifford, in its place, substitutes a seventeenth-century conceit, with his whole mental world (and its phenomenal manifestations of externality) attributed to a personal and loving monism: 'All my world is of one love made; / Earth and sky are the limbs thereof; / Life and death are its life and shade, / And the soul is love'. This seems a far more considered and 'positive' paganism than that encountered in the quatrain preserved by Carpenter, though, of course, it remains equally dismissive of theological conviction.[12]

Similarly, we gain a far more substantive insight into the social ideology of the scientist through an entry in one of his later Cambridge notebooks. Though not in verse, it apes the form's density, seeming a quasi-Swinburnian paean to scientific – and, implicitly, political – revolution, a song to a rationalistic sunrise. (Pollock, with evident disdain, dubbed the affair 'half-poetical' [p. 37]). Within, we encounter Clifford grappling with issues raised by the spectre of materialism; we note as well the atheistic bluster of his public pronouncements (and persona) muted, even as we observe both an explanation of, and a justification for, his vision of a post-theological, empirically based humanism, one seemingly at once far more rigorous and far more reasoned than most of the kindred lines of argument lurking elsewhere among his published essays and reviews. All by way of a lengthy prose meditation on that celebrated – and widely circulated, in a dizzying variety of Victorian literary and cultural contexts – injunction prefacing William Blake's 'Auguries of Innocence': 'To see a world in a grain of sand / And a heaven in a wild flower, / Hold infinity in the palm of your hand / And eternity in an hour' (p. 589; ll. 1 - 4). Clifford's opening sentence seems a masterpiece of pragmatic understatement (language or bicycle), just the kind of thing we might expect to hear from such a practically minded individual; thereafter, though, we are exposed to something new:

> Whosoever has learnt either a language or the bicycle can testify to the wonderful sudden step from troublesome acquirement to the mastery of new powers, whose mere exercise is delightful, while it multiples at once the intensity and objects of our pleasures. This, I say, is especially and exceptionally true of the pleasures of perception. Every time that analysis strips from nature the gilding that we

[12] It is fascinating to compare Clifford's effort with an (equally touching) poem Maxwell dedicated to his own wife; his work, however, makes embodied love entirely subservient, and approximate, to divine blessing: 'Strengthen our love, O Lord, that we / May in Thine own great love believe / And, opening all our soul to Thee, / May Thy free gift receive' ['Wife'], p. 609).

prized, she is forging thereout a new picture more glorious than before, to be suddenly revealed by the advent of a new sense whereby we see it – a new creation, at sight of which the sons of God shall have cause to shout for joy.

What now shall I say of this new-grown perception of Law, which finds the infinite in a speck of dust, and the acts of eternity in every second of time? Why, that it kills our sense of the beautiful, and takes all the romance out of nature. And moreover that it is nothing more than a combining and re-organizing of our old experiences, never can give us anything really new, must progress in the same monotonous way for ever. But wait a moment. What if this combining and organizing is first to become habitual, then organic and unconscious, so that the sense of law becomes a direct perception? Shall we not then be really seeing something new? Shall there not be a new revelation of a great and more perfect cosmos, a universe fresh-born, a new heaven and a new earth? *Mors janua vitæ*; by death to this world we enter upon a new life in the next. A new Elysium opens to our eager feet, through whose wide fields we shall run with glee, stopping only to stare with delight and cry, "See there, how beautiful!" […]. (qtd. in Pollock, pp. 36 - 37)

Mors janua vitæ: 'Death is the door to life'.

But not bodily death, of course – death rather to preconceived notions of natural order, the abandonment of worthless, though bedazzling, gilding formerly prized or deemed in some fashion precious to us. As in 'The Unseen Universe', Clifford's language is again grounded in that of the King James Version, as he proposes a secular sacredness to both painstaking experimentation and subsequent entheorisation, processes, in his worldview, often profoundly, irreversibly transformative of souls and civilisations alike. Compare, for example, the celestial city, the New Jerusalem, so vividly prophesised in the final chapter of the Book of Revelation: 'And he [the angel] showed me a pure river of water of life, clear as crystal, proceeding out of the throne of God and of the Lamb. In the midst of the street of it, and on either side of the river, *was there* the tree of life, which bare twelve *manner of* fruits, and yielded her fruit every month: and the leaves of the tree *were* for the healing of nations' (22: 1 - 2). It is science, however, Clifford intimates, not theology, that promises to make real, in a manner of speaking, St John's extraordinary vision, that will provide us with entry into a 'great[er] and more perfect cosmos, a universe fresh-born, a new heaven and a new earth', even as it will be the texts of that science (Darwin's *Origin*, Spencer's *First Principles*, Maxwell's *Treatise*, along with countless other germinal works as yet unwritten, though dimly foreseen) that will be as sacred documents heralding liberation, the books – written by several authors and on sundry topics – of a scientific, secularised and defiantly humanised 'Newer Testament'. It will be they that will provide duly faithful and open-minded readers with tantalising glimpses of better worlds still to come, of 'new revelation[s]' as yet unimagined (and as yet unimaginable, as we are not yet endowed with cognitive faculties adequate to their perception); it will be they that will serve to unlock for us – or the Victorians – the gates to paradises renewed and revivified.

But while the Christian heaven is a markedly static place, a Tennysonian lotus-land,

free of struggle and strife and (reciprocally, it must be remembered) either mental attainment or any teleology of ethical or personal progression, where the Blessed for all eternity content themselves in the glorification and sight of the Lord, William Kingdon Clifford's is most assuredly not. St John in Revelation 22 figuratively brings the Bible full-circle, back once more to Genesis, to verdant, luxurious Eden with its blossoming 'tree of life'. Clifford's revelation, by contrast, his own characteristic depiction of a utopian future for ennobled and enlightened man, is pro-, not retrogressive, and from it further revelations can – and must – be achieved. Moreover, it is entirely of *this* life, not the next; entirely of *this* earth, not some further realm, at once unattainable and logically incomprehensible. Carlyle, too, had earlier in the century secularised this forceful conceit; of a sudden spiritual resurgence Teufelsdröckh, repurposing Revelation 21: 1, declaims: '[T]he heavy dreams rolled gradually away, and I awoke to a new Heaven and a new Earth' (*Sartor*, p. 142). Likewise is Clifford's paradise a local one, at least potentially, not situated somewhere paradoxically beyond space or the grasping reach of time.

Presaging Kuhnian epistemology's notorious notion of a 'paradigm shift' – in consequence of which it 'is rather as if the professional [scientific] community had been suddenly transported to another planet where familiar objects are seen in a different light and are joined by unfamiliar ones as well' (Kuhn, p. 111) – Clifford's ecstatic vision of novel worlds without end would seem also to suggest that each would appear effectively incommensurable to those that dwelt in the previous, like 'a new picture more glorious than before, to be suddenly revealed by the advent of a new sense whereby we see it'. And as the Bible's New Jerusalem brings about 'the healing of nations', so, also, will science's, Clifford explains, if coupled with a braveness and a stoicism in the face of mortality, echoing the ethical stance advocated by positivism. Self-sacrifice will be necessary too, to maintain such a paradise, another point of agreement: 'He [Clifford] would not gauge the worth of human life […] by its degree of happiness, but with a touch of the ascetic bade men forego happiness as their goal in favour of tribal efficiency', as James Sully wrote in 'Scientific Optimism', an article of 1881 (p. 579). (Harrison, in 1877, proclaimed a positive 'religion, of which the creed shall be science; of which the Faith, Hope, Charity, shall be real, not transcendental, earthly, not heavenly – a religion, in a word, which is entirely human, in its evidences, in its purposes, in its sanctions and appeals' ['Modern', p. 346].)

Christianity is quietist, even selfish – 'failings' noted as much by Clifford as by Harrison (or, near contemporaneously, Friedrich Nietzsche). As such, the scientist would have

humanity bound by terms set forth in one of the most atypical of all Wordsworthian odes, that to 'Duty', an allusive and at times despondent work in which the compunctions of that uncompromising virtue are heard to resound in the poet's consciousness as if echoing the very Voice of God:

> STERN Daughter of the Voice of God!
> O Duty! if that name thou love
> Who art a light to guide, a rod
> To check the erring, and reprove;
> Thou, who art victory and law
> When empty terrors overawe;
> From vain temptations dost set free;
> And calm'st the weary strife of frail humanity! (p. 385; ll. 1 - 8)

Clifford quoted these lines in the early portions of his own elaborate ode to moral and humanistic duty, the essay 'Cosmic Emotion' (p. 411). And they suggest the dark side to his vision of distant, green lands revealed under the light of fresh-risen suns, of brave, new worlds 'at sight of which the sons of God shall have cause to shout for joy' (qtd. in Pollock, p. 36). Nature (as much human as external), the poet observes in the opening stanza of his emphatic 'Ode', reveals to us – 'weary' representatives of a suddenly 'frail humanity' – 'empty terrors' which 'overawe'. Later, in the same work, a troubled and doubting Wordsworth implores, asking humbly of 'duty' herself, that stern, though often mastering (for the mindful, it is 'a rod / To check the erring'), personification of positivistic virtue: 'Give unto me, made lowly wise, / The spirit of self-sacrifice; / The confidence of reason give; / And in the light of truth thy Bondman let me live!' (p. 386; ll. 53 - 56).

Such terrors, apprehensions and hopes are implicit in Clifford as well, and his metaphysics vacillate, in mood and effect, between darkness and illumination, between a world 'progress[ing] in the same monotonous way for ever', in which science 'kills our sense of the beautiful, and takes all the romance out of nature' (suggested as one possibility in the passage discussed above), and one in which an epiphanic, liberatory, 'moralised' science provides an ever-hopeful human race with a succession of cheering and alluring 'new creation[s]' of its various till-then benighted world-pictures, each one, he intimates, 'more glorious than before' (suggested as another – and, for the moment, favoured [qtd. in Pollock, pp. 37, 36]).

But, surely, it would seem to be darkness, in the end, that predominates, as implicit in Clifford's account of successive revelations is a belief as well in successive trying, even brutal, skirmishes to achieve them. And his *Ragnarök*, the final thermodynamic doom prophesied in 'The First and Last Catastrophe', remains unimaginably far ahead, with, as he would reso-

lutely insist, no consummating assumption into Valhalla of the bold, the weary – or even the worthy – in its wake. (Clifford, in bald précis, had 'one very simple message – […] no God, no soul, no future life', as W. H. Mallock put it ['Late', p. 487].) There will be, in other words, no real, tangible reward for anyone, regardless of stature or the part for good or ill he or she may have played, in its terrible aftermath, as, by definition, 'heat death' – Clifford's 'last catastrophe' – can have no aftermath. In the meantime, then, the 'final battle' rages on, with momentary respites, perhaps, but those the exception, not the norm. Such an eschatological scheme could hardly be more out of step with those posited by most Western faith-traditions.

For his, at base, is a nominally Darwinian view of things, in which struggle and advance represent the natural state of affairs – intellectually, socially, ethically, scientifically – and such a presumption, he insists, is one hardly to be contested.[13] Cliffordian society, it seems, cannot afford to rest upon its laurels, though at least it, unlike the apparently aleatoric affairs of lower species, has a teleology – provided by science and tending, for now, towards the better.[14] Nevertheless, as is made equally clear, even this general progressive tendency could, he fears, be countermanded by the stultifying demands of unreasoning piety. 'Take heed', he wrote in his lengthy review of *The Unseen Universe*, warning his readers – by way of a confused horticultural analogy – against allowing in their own time any resurgence of sacerdotal Christianity ('that awful plague') or, for that matter, some other equally debased form of 'non-scientific' worship, 'lest you give soil and shelter to the seed of that awful plague which has destroyed two civilisations, and but barely failed to slay such promise of good as is now struggling to live among men' (p. 793).

What, however, was the nature of the materialism – and the 'Darwinism' – he ranged against faith? And was it in fact as 'un-coddled' as he liked to think?

CLIFFORD'S 'MIND-STUFF': THE IDEAL MATERIALISM?

Clifford's materialism was at once hard-headed and tender-hearted. He was, as many have noted, an impassioned advocate of Darwinism – indeed, his initial departure from High

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[13] As a sympathetic columnist at *The Times* observed, the fierceness of such conviction, coupled with sincere pedagogic aspirations, forbid Clifford from 'rest[ing] content until he had made us taste with him the philosophy, the polity, the morality, and even the poetry of the new era [post-*Origin of Species*, post-Belfast Address, post-*Songs Before Sunrise*, post-*First Principles*, etc.]' ('Professor', 22 October 1879).

[14] '[S]cientific thought', Clifford (towing the positivistic line) told the assembled membership of the BAAS at Brighton late in the summer of 1872, 'is not an accompaniment or condition of human progress, but human progress itself' ('Aims', p. 512).

Church orthodoxy had come under the influence of *The Origin* and those writings of its earliest hermeneuticists. Always a passionate evangelist for the causes of science, before his death from tuberculosis at thirty three he had plotted to recast his writings for the periodical press into a volume to be entitled *The Creed of Science* (Pollock, p. 71).

The appearance to him of evolutionary doctrine, in particular, had, as he described it, the radiance of an emergent revolutionary paradigm, a transfixing, even solar, providentiality about it; it represented, or so he argued, a disciplinary moment so singular as to justify what might have seemed to some of his contemporaries professional over-infatuation with the idea: 'When the sun is rising, we pay special attention to him and admire his glories […]' ('Cosmic', p. 423). Furthermore, '[h]e belonged', Lightman explains in *The Origins of Agnosticism*, 'to a circle of young men […] who looked to evolution for a new system of ethics which would combine the precision of the utilitarian with the poetical ideals of the transcendentalist' (p. 159). Clifford's natural philosophy had its quirks, too, evincing an analogous double focus, seeming at once unyielding and agnostic. He, for instance, with an empiricist's skepticism overruling a mathematician's innate inclination towards abstraction and idealisation, always remained decidedly dubious about the validity of assertions concerning actions taking place 'forever', 'though all space', 'unchangeably', 'with exact precision'. Similarly, he was never one to trust that lines in, say, absorption spectra were absolutely coincident from atom to atom; that each molecule of a given substance was, following on from Maxwell, not only experimentally, but actually, indistinguishable; that the laws of physics and chemistry were universally or eternally applicable.

These had been foundational precepts of the species of naturalism expounded by Tyndall, Huxley and others, where they had the status of dogma, almost beyond proof. (F. W. H. Myers remarked in 'Modern Poetry and the Meaning of Life' – a spiritualistic shimmy becoming drolly apparent in his concluding prepositional phrase – that such overriding theoretical assumptions, 'even if as yet but dimly and narrowly understood, may conceivably be valid for the whole universe, on all possible planes of being' [p. 93].) Clifford, by contrast, while granting local and limited validity to such concepts (atoms seem identical, or near enough; matched spectral lines can be reasonably assumed to possess equivalent frequencies; generalised physical laws can be used with broad certainty of correctness) – after all, Clifford knew, how else could science prosper and progress? – he found for them a pragmatic utility. In his periodical contributions, in defence of such a tendency towards epistemological conservatism, he deployed arguments – and phrasings – of a jurisprudential circumspection. Witness

this tiptoeing disclaimer, from 'The Unseen Universe': '[T]he laws of motion and the conservation of energy are very general propositions which are as nearly true as we can make out for gross bodies, and which, being tentatively applied to certain motions of molecules and the ether, are found to fit' (p. 789).

'The figure of speech or of thought', Maxwell pronounced in one presidential address, 'by which we transfer the language and ideas of a familiar science to one with which we are less acquainted may be called scientific metaphor' ('Section', p. 422). Clifford's justification of psychophysical parallelism – in which he cites as evidence the linguistic theorisations of Müller and the physiological researches of Helmholtz – is based on a sense of equivalent complexity, suggesting (by way of one such metaphor) that

> A spoken sentence and the same sentence written are two utterly unlike things, but each of them consists of elements […]. Now the relation between the spoken sentence and its elements is very nearly the same as the relation between the written sentence and its elements. There is a correspondence of element to element; although an elementary sound is quite a different thing from a letter of the alphabet […]. ('Nature', p. 61)

So, too, he suggests, is there a mapping from consciousness 'ejective' to neural perturbation, linking cognitive functioning not only with the higher processes of language, but with verbal ghostings of self-awareness, utterances like 'I am'. Responding to those who, daunted by such prospects of material imbrication, fall back onto theological orthodoxy, denying any credibility to scientific theories enveloping thought in convolutions of neurobiology, he seems more exasperated than anything else: 'To say: "Up to this point science can explain; here the soul steps in," is not to say what is untrue, but to talk nonsense', he insists (p. 60).

Moreover, he follows Tyndall in refusing subjectively, even invidiously, to demarcate vitality, or to stipulate absolute criteria for sentience; he writes of the precepts implicit in 'his' theory of mental evolution: 'For if that doctrine be true, we shall have along the line of the human pedigree a series of imperceptible steps connecting inorganic matter with ourselves. To the later members of that series we must undoubtedly ascribe consciousness, although it must, of course, have been simpler than our own. But where are we to stop?' (p. 64). His question is rhetorical. So he continues his investigation, discerning in base matter not only Tyndall's 'promise' of terrestrial life, but, with greater force, its potency – even its kinship – too, discerning a glimmering, or the germ, of sentience, of higher Mind itself, all the way down. In his article 'On the Nature of Things-in-Themselves', he heads the final section '*Mind-stuff is the reality which we perceive as Matter*', asserting in its second sentence that a 'moving molecule of inorganic matter does not possess mind, or consciousness; but it possesses a small

Index of Levels	Products of Emotional Development.	Products of Intellectual Development.	The Psychological Scale.	Development of Individual Man.	Idiots.	Deaf Mutes.
37	Cosmic Emotion (?)	Science	Existing Man	Adult.	....	Educated.
36	Highest Religious Emotions	Metaphysics	Highly Civilised	15 years		
35	Religious Emotions, Sublime Love, Melancholy.	Theology	Civilised	10 years.		
34	Lowest Religious Emotions, Reverence, Remorse, Courtesy.	Polytheism	Savages and Partly Civilised	5 years	Feeble-minded.	
33	Art, Awe	Fetishism	Low Savages	3 years	Imbeciles	Half-educated.
32	Ethical Emotion, Æsthetic, Avarice, Envy, Hate, Hope, Vanity, Mirth.	Superstition	Lowest Savages	30 months	High Idiots.	
31	No Evidence	Definite Morality	Primitive Man	28 months	Counting Idiots	Partly Educated.
30		Self-consciousness	Partly Brutal Man	26 months.		
29		Recollection	Very Brutal Man	24 months	....	Uneducated.
28		Judgment	Almost Brutal Man	22 months.		
27		Speech	Almost Human Ape	20 months	Talking Idiots.	
26		Concerted Action	Very Human Ape	18 months.		
25		Use of Tools	Partly Human Ape	15 months.		
24		Articulating Ape	Articulating Ape	12 months.		
23		Indefinite Morality	Anthropoid Apes	9 months	Babbling Idiots.	
22	Pride, Shame, Deceitfulness, Passionateness, Cruelty, Ludicrousness.	Reason	Monkeys, Dogs, Elephants	7 months.		
21	Sympathy, Curiosity, Revenge, Gratitude.	Understanding of Words	Horses, Pigs, Cats, &c.	5 months.		
20	Emulation, Jealousy, Joy, Grief	Dreaming	Birds	18 weeks	Low Idiots.	
19	Anger	Recognition of Persons	Reptiles	16 weeks	Cretins.	
18		Recognition of Offspring	Fish and Insects	15 weeks.		
17	Social Feelings, Play	Recognition of Places	Spiders and Crabs	14 weeks	Low Cretins.	
16	Emotions conducive to Sexual Selection; Sexual and Paternal Affection.	Secondary Instincts	Lower Crustacea	13 weeks.		
15	Pugnacity	Association of Ideas	Lowest Crustacea (?)	12½ weeks.		
14	Fear	Memory	Higher Mollusca (?)	12 weeks	Microcephalic.	
13		Pleasure	Lower Mollusca (?)	9 weeks.		
12		Pain	Lowest Mollusca (?)	7 weeks.		
11		Consciousness	Worms (?)	3 weeks.		
10		Primary Instincts	Medusæ	Birth	Acephalic.	
9			Unknown Animals (Probably Coelenterata)	Embryo.		
8						
7						
6		Non-nervous Adjustments	Cellular Organisms			
5						
4						
3						
2		Protoplasmic Motion	Protoplasmic Organisms	Germ.		
1						

Figure 4 - George Romanes, *Mental Evolution: A Lecture*, p. 5.

piece of mind-stuff' (p. 65). Turner has noted that 'Clifford's mind-stuff was essentially an idealistic monism' ('Victorian', p. 340); it provided an explanatory mechanism sidestepping all at once the mind-body problem, the question of the origin of awareness and vitality, and the paradox presented by the fact that matter (in the brain) can fabricate some conception of itself. As William James commented in *Principles*, Clifford's insight had the deep virtue of allowing him to insist that, in his universe, 'no new *natures*, no factors not present at the beginning, are introduced at any later stage' (1: 149).

A more modern thinker like Arthur Eddington, in *The Nature of the Physical World* (1928), used the label 'mind-stuff' to assert a perceptive necessity: 'by "mind" I do not here exactly mean mind, and by "stuff" I do not at all mean stuff', as he qualified his declaration 'the stuff of the world is mind-stuff' (p. 266). For Clifford, however, who believed exactly that, such a statement suggested something *true* and *precise* about ontology, something genuinely mind-like about cosmological matter.

Tess Cosslett has charted how, developing in parallel with, but separate from, theories of organic evolution – a discontinuity which became in time the source of marked discomfiture – were theories dealing with the progression of intelligence (pp. 32 - 38). In a popular lecture of 1880, George Romanes, eminent Darwinian and close academic colleague of Clifford in London, suggested that the 'problem' of intellectual development was a 'subject […] second to none that has ever occupied the attention of our race' (p. 3). His talk focused on a 'somewhat formidable-looking diagram' (fig. 4) presenting 'the whole course of mental evolution […]' (p. 6). With a taxonomist's zeal, he identified thirty-seven levels of physical development (embryo to adult Englishman), psychological sophistication (reflex 'pugnacity' to Sidgwick's 'cosmic emotion'), and mental refinement (from none, via fetishism and monotheism, to scientific awareness). He also represented cultural attainment diagrammatically – the 'low savage', for instance, having, at best, the intellect of an English toddler (p. 5).

But Clifford, through advocacy of 'mind-stuff', blurs such gradations, refusing absolutism while recognising difference – and shirking in the process that Victorian propensity for category and easy ranking. This was in him so ingrained a tendency that it coloured his judgment on non-biological matters as well. In his physics, even his nothings become a something, prospectively – indeed, as he hints in pleasingly Parmenidean fashion, maybe even the *same* something. His most audacious speculation in 'The Unseen Universe' concerns the most extreme of all possible monisms, a viewpoint linking not only the inorganic with the organic, not only the insentient with the sentient, but his generation's proxy for nothing or

emptiness (ether) with its something-surrogate (matter): 'Until, therefore, it is absolutely disproved it must remain the simplest and most probable assumption that they are finally made of the same stuff, – that the material molecule is some kind of knot or coagulation of ether' (p. 784). Space, matter, life, thought: all become congruent, even coincident, in an insight so radical, so ahead-of-its-time, that it might, as Clifford biographer Monty Chisholm dreamily speculates (in a chapter co-written with her husband, a mathematician working on Clifford algebras), 'provide a future clue to a "Grand Unified Theory"' (p. 165).

And there are, the scientist avows, moral consolations, and consequences, of such materialistic beliefs as well. Evolution, for one, though it may seem to unmoor some of the old certainties – 'the loss of the immutable and eternal verities […]' of both traditional and even Paleyan theology – provides, or so he conjectures in 'Cosmic Emotion', as unforeseen benefit a scientifically calibrated 'conception of a *good* action, in a wider sense than the ethical one' (p. 423). For him, a 'good action' is one which augments our organicity, his chosen barometer of race advancement, elevating us 'up' the ladder – the geometric conceit at once biologically conventional and an analogue for theistic damnation or salvation – away from insensate in-organicity. Becoming, for Clifford, trumps being: 'In this way the human race embodies in itself all the ages of organic action that have gone to its evolution. The nature of organic action […] is to personify itself, and it has personified itself most in the human race' (p. 424).

'We more and more need a religion that can deal with this world', Frederic Harrison wrote in *The Present and the Future: A Positivist Address* (1880), 'which has something to say to the intellectual and social problems of our age, which can show us how to live on earth, not how to prepare for heaven' (p. 35). He here makes explicit the role of positivism as bespoke faith, as culturally contingent a belief-network as *fin de siècle* spiritualism, oriented towards Victorian problems, satisfying (albeit, for some, only temporarily or inadequately) Victorian aspirations and wants. 'Positivism', as the modern political theorist John Gray has delineated it, 'is a doctrine of redemption in the guise of a theory of history' (p. 105), a displacement of the Christian hope for individual salvation onto that of the species as a whole. Clifford's conception of evolutionism becomes the biological co-conspirator of positivism's moral imperative; his 'natural selection', a surrogate god, or all-Mother.

He quotes a 'splendid hymn' of 'Mr. Swinburne's' as if in evidentiary support of this hypothesis:

> MOTHER of man's time-travelling generations,
> Breath of his nostrils, heartblood of his heart,

God above all Gods worshipped in all nations,
Light above light, law beyond law, thou art. ('Triumphalis', p. 804)

These lines are from 'Mater Triumphalis', a panegyric to democratic upheaval, to the dreams of those French revolutionaries, with the 'mother triumphant' a personification of liberty, justice, fraternity: a secular idol – and ideal. Clifford, in 'Cosmic Emotion', deploys them in support of his judgments about evolution, that womanly apotheosis of Swinburne's republican ode becoming, by insinuation, a biogenetic as well as a socio-political Marianne (pp. 424 - 25).

As this essay was first published in the tolerant *Nineteenth Century*, he felt boldly able to cite the name of his preferred muse – in 'The Unseen Universe' he had, by contrast, left the couplet from 'The Garden of Proserpine' to reverberate anonymously – at a time when Swinburne was usually referred to in the periodical press, if at all, by indeterminate epithet ('a singer', 'a living English poet'); this decision, Gowan Dawson tells us, 'seems to have provoked little attention at the time, but it would soon become a central issue in the [typically negative] portrayal of Clifford immediately after death' (p. 265). The implicit coupling would have been unmistakable to educated readers, however: the social forces of political rebellion and cultural progression are inextricably yoked to the processes of biological evolution and morphological transformation, processes which, in Clifford's worldview, are predominately directed 'upwards'. ('If I have evolved myself out of something like an amphioxus [a primitive fish], […] I have become *better* by the change; […] I have become more organic', he explains in 'Cosmic Emotion', arguing for just the sort of undisguised progressivism certain to quail the present-day evolutionist [p. 423].) This, though an alliance foreign, even wrongheaded, in most twentieth- and twenty-first-century construals of 'true' Darwinian insight, was nonetheless a supposition not out of character with its period; as Dale confirms: '[George] Lewes, Spencer, [Leslie] Stephen, Clifford, Tyndall, Darwin himself, and many others all tried to turn evolutionism to good account' (p. 205). Clifford, in 'On the Scientific Basis of Morals', a study in evolutionary ethics, even found the justification for social altruism in an individual's sense of duty to tribe, 'one of the primary units on which natural selection works in *homo sapiens* […]', from his perspective (Dale, p. 182).

For Clifford, then, an imperative towards novelty and incessant improvement impels both nature and human nature; that Swinburnian mother, enemy of the *ancien regime*, friend to insurrectionists, wrecks all old orders, nurturing or giving birth to new and better ones. Such a line of metaphor returns us to Clifford's notebook entry, which likewise celebrates the stripping away of those gilded monuments associated with religious (and crypto-religious)

iconography: 'The temples and the towers of time though breakest, / His thoughts and words and works, to make them new', Swinburne says of his exultant mother ('Triumphalis', p. 804). So, too, Clifford suggests, does evolution refine and perfect physiology. Though this might suggest the meliorism of someone like Henry Drummond – who proclaims of nature in *The Ascent of Man* (1894): 'Evolution, development, progress are not only on her programme, these are her programme' (p. 435) – Clifford never forgot, or ceased to fear, the possibilities of degeneration: spiritual, cultural, intellectual, social, even biological. He was hardly alone among Victorians in doing so, however. His muse Swinburne had already in own writings documented comparable worries of recidivism, particularly in moral and political spheres. 'Mater Triumphalis', accordingly, finds its glum counterpart in another, less optimistic piece in the collection *Songs Before Sunrise* – 'Mater Dolorosa': 'mother of sorrows', an appellation applied since the Middle Ages to the bereaved Mary, Mother of Jesus – a title, and a conjunction, making the poet's (and, by association, the scientist's) usurpation of the theological by the secular and humane utterly unmistakable. 'This is she for whose sake being fallen, for whose abject sake, / Earth groans in the blackness of darkness, and men's hearts break' (p. 800): this couplet describes the pitiful state of Swinburne's sorrowful mother before the firebrand of populist revolution is lit – or wherever, and whenever, it has been prematurely extinguished.[15]

But, for Clifford, the linguistic parallelism, and punning, between *mater* and 'matter' serves further to insist that this revolt is as much against a retrogressive 'in-organicity' – those tableaux of bestial, primitive anthropoid history (which haunt also Tennyson's 'The Dawn': 'Red of the Dawn! / Is it turning a fainter red? so be it, but when shall we lay / The Ghost of the Brute that is walking and haunting us yet, and be free?' [p. 1453; ll. 21 - 23]) – as it is against the oppressive features of the modern patriarchal state, and those equally suffocating strictures imposed by the tenets of Revealed Religion.[16]

Repentance, Redemption and Human Fallibility: The Case of James Clerk Maxwell's George Herbert

Clifford championed Swinburne, that up-to-the-moment bard of godlessness. Is it not apt,

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[15] Comte's symbolic Flag of Positivism was to depict a 'young mother, carrying her infant son […]', thus rendering positivism the heir of Catholicism – the 'Virgin coming to be regarded as the personification of Humanity' (Willey, p. 199).

[16] Tyndall also accentuated such a phonetic parallelism: Giordano Bruno, he reminds us, always insisted that '[m]atter is not the mere naked, empty *capacity* which philosophers have pictured her to be, but the universal mother who brings forth all things as the fruit of her own womb' (*BA*, p. 20).

therefore, that the poetry of Maxwell seems to find its model in the more devout Metaphysicals: Donne, to an extent, but especially Herbert? On his deathbed, in fact, a witness testified, beyond the conventional pieties, to the scientist reciting 'the morning after an unusually bad night, the five stanzas of [Herbert's] "Aaron" without a mistake' (qtd. in *LJCM*, p. 415).

In the poetry of Herbert, a spiritual cycle – sin, suffering, death and heavenly resurrection – is brought to completion through the agency of Christ. That same cycle is in 'Aaron' given a modulated, even mildly dissonant, tonality, however: though a conversion poem, it seems one having at its nucleus, as Helen Vendler has phrased it, 'a fever of self-obliteration' (p. 120), not merely the rational, 'reasoned through' obviation of a niggling spiritual doubt. Aaron himself was Moses's brother, yet another instance of the sort of typology which confers upon the poet a theological as well as a metaphoric richness. He serves as an archetype for the figure of the priest, more specifically, the vaguely mystical priest, the Old Testament cleric-conjurer, a wrathful emissary of the divine more than capable of duelling with Pharaoh's court magicians. He seems a preternatural figure (one, needless to say, at a great remove from any dottering village vicar), a sort of Moses for the recently deceased, 'raising the dead / To lead them unto life and rest' (ll. 4 - 5). Herbert contrasts such an idealised priest with his own spiritual self-perception, figuring himself a poor Aaron indeed, predestined by his own inadequacies to spend eternity in that place where there 'is no rest' (line 9). But then he remembers Christ, '(who is not dead, / But lives in me while I do rest)', a spiritual intercessor unknown to ancient Aaron (ll. 23 - 24). In Christ, he imagines, he *could* have rest, rest of the peace that passeth understanding sort; in Him, he could be reborn, 'That to the old man' – himself, an imperfect servant of God – 'I may rest, / And be in him [Christ] new drest' (ll. 19 - 20).

Similar play between these multiple senses of 'rest' – rest, repose; rest, death; rest, respite; rest, relaxation – first strikes the reader of Maxwell's poem 'On St. David's Day'. In its final stanza, the Lord, we're told, will grant sinners 'Rest of Life and not of death, / Rest in Love and Hope and Faith, / Till the God who gives their breath, / Calls them to rest from living' (p. 599). This feels nearly as packed as the Herbert, while seeming similar in its architecture: Maxwell's 'rest of life' recalling Herbert's realm of 'life and rest'; Maxwell's gratitude for divinely bestowed 'rest from living' echoing Herbert's praise for a Christ, 'Without whom I could have no rest' (line 14).

Maxwell's is a devotional poem, of course, not a 'scientific' one, but it suggests also a more general hierarchy of allusion and symbol, while indicating something of the depth of his religiosity. However, if perceived first and foremost as a recasting of 'Aaron', it must, at least

in part, be considered a failure – and yet a failure remarkably consonant with the cultural sensibilities of its time. Vendler has written of the nineteenth-century spiritual climate that would have compelled one contemporary adapter of 'Aaron' for choral singing to excise many of the work's grimmer undercurrents, its harbingers of damnation and requiem.

This represents no superficial change, however, altering, to Vendler's mind, the very essence of the poem, producing something

> certainly not like Herbert, who is far more primitive, saying there is a hell, there are the dead, sins threaten an eternity of no rest, the priest has the *super*natural power to raise the dead, and the priest should take care not to be himself one of the dead. These thoughts, rather archaic for the nineteenth-century "enlightened" mind, are silently passed over […]. [T]he priest emerges not as a sacred intermediary possessing supernatural power, but rather as a helpful minister – sound, harmonious, pure, engaged in finding rest for the sinful. (pp. 117 - 18)

How, though, was a figure like Maxwell able to maintain a kindred complacency? It might seem uncanny that a scientist whose name remains so associated with theories suggesting a godless materialism – thermodynamics, electromagnetism, statistical mechanics – managed nonetheless to maintain throughout his life such an unstrained, even cheerful, relationship with theological orthodoxy. But that is precisely what Maxwell did, and he espouses – in his versification, in particular – a piety that seems to embrace both the Christian Trinity *and* aspects of that materialistic one identified by T. H. Huxley, except, of course, where aspects of the latter conflicted with the former: in any insistence on the banishment of the soul, the indifference of a Creator, or the silence of a world with no Word to sustain it. For instance, his poem, 'A Vision. *Of a Wrangler, of a University, of Pedantry, and of Philosophy*', composed while a student at Trinity College, Cambridge, gives details of one particularly vivid hallucination, telling of a crisis of faith expeditiously averted (one finding origin, ultimately, in the precepts of a 'too mechanistic' epistemology).

It tells how Maxwell, wearied by long hours of revision, sat half-asleep in a chair. His mind, however – endlessly active and as yet uneasy – contrived to insure that any dozing would be at best sporadic, conjuring up for him a gallery of grotesques, nightmare-figures embodying the university itself: 'Fathers there, of every college / Led the glorious ranks of knowledge' (p. 614). These, in turn, fade into the shadows, supplanted by a hideous, nominally feminine, apparition – a Frankenstein monster for the obdurate materialist, bereft of spirit, animated by malice and machinery: 'Angular in form and feature', 'Hair of pens and skin of paper; / Breath, not breath, but chemic vapour', 'Eyes of glass, with optic axes / Twisting rays of light as flax is'. Through such eyes, he imagines, 'all Nature / Seems reduced

to meaner stature. / If you had them you would hate your / Symbolising sense of sight' (p. 615). Though Maxwell here concedes the body's role in perception ('symbolising […] sight'), he clearly considers this by itself insufficient. For him, any existence would be unendurable in which spirit did not supplement the meagre data provided by such brusquely 'analytic' organs.

The creature then addresses Maxwell directly, admonishing him for his lack of focus, advancing the 'cause' of pedantry and ignorance:

> "Of the [natural] Philosophic Spirit
> Richly may my son inherit;
> As for Poetry, inter it
> With the myths of other days.
> "Cut the thing entirely, lest yon
> College Don should put the question,
> Why not stick to what you're best on?
> Mathematics always pays." (p. 616)

Soon, a second figure enters the dream (this time, a decidedly beatific one), eclipsing that first monstrosity – for surely it is Maxwell's demon: his truest nemesis, the corporealisation of all those loathed tenets of psychological materialism – and banishing *it* to the shadows. This new vision's appearance serves to remind Maxwell (who, again, never *really* seemed to doubt such an assertion) 'that creation / Bears the test of calculation, / But that Man forgets his station / If he stops when that is done'. Men of science, he insists, must, in consort with the vast and unscientific majority, 'Learn' – or, if necessary, be reminded how – 'to worship as we ought' (p. 617). George Herbert, in 'Vanity [I]', had two centuries prior expressed a not dissimilar conviction. The 'fleet astronomer' of that era, he had suggested, too easily 'thread[s] the spheres with his quick-piercing mind' (ll. 1 - 2). Maxwell's modern spectre is likewise capable of 'Seeing planets in their courses / Thick beset with arrowy "forces"' (p. 615). (Note as well the incidental critique of Newtonian 'action at a distance'.) Herbert's 'subtle chemic can devest / And strip the creature naked […]' – in other words, he can reduce man to the thing itself, the very condition of soulless mechanism – 'till he find / The callow principles within their nest' (ll. 15 - 17). Maxwell, in 'A Vision', confronts just such an abomination (obvious archaisms emphasising his literary indebtedness: that first visitation had 'Breath, not breath, but chemic vapour').

In a sense, the scientist, with Herbert, asks in chorus of the uncontemplative investigator: 'What hath not man sought out and found / But his dear God? […]' ('Vanity', ll. 22 - 23). His natural philosophy, in other words, often seems an extension into the 'materialistic' mid-century of a paradigm associated with the natural theology of its earlier half, even of

Herbert's Christian humanism. It would seem, then, that what differentiates the scientifically inspired verse of Tennyson (and other such thinkers distressed about the horrors or implications of materialism) from the scientifically inspired verse of Maxwell (a professional investigator labouring methodologically within an *apparently* materialistic paradigm) is, at its heart, a matter of trust: in Maxwell – a believer never wavering in his conviction concerning the essential truth of, say, Psalm 19: 1: 'The heavens declare the glory of God; and the firmament sheweth his handywork' – there is no authentic doubt about the relationship between science and the precepts of faith; that doubt is reserved instead for the relationship between *scientists* and the precepts of faith. He, through his writings, affirms a kind of partitioned worldview: the universe, sometimes to be understood as if it were material, is never perceived as solely that, rarely described as solely that.

As Kaiser has observed, for Maxwell 'the laws of [human] mind and the laws of nature were both aspects of reality created by God, but only partial aspects. One could, therefore, arrive at a view of reality entailing either freedom or determinism depending on how one focused the instruments of observation and analysis on the events involved' (p. 295). For these same reasons, some of Maxwell's theories can seem 'materialistic'; others, dynamistic; still others, not comfortably reducible to *either* overarching paradigm.

Despite this necessary partiality, however, the world remained for him a blessed spectacle, with scientific inquiry 'a divine vocation', as Schaffer has characterised it (p. 460). In 'A Student's Evening Hymn', Maxwell refers to God as 'Thou that fill'st our waiting eyes / With the food of contemplation' (p. 594). And it is through such enlightened contemplation that Victorians, scientists or not, can know Him, themselves and their world – and in such a way deemed harmonious with the particular talents (gifts themselves of God, surely) of their own era. Thus, the poetry, and thought, of James Clerk Maxwell provides an intriguing counterpart to that of W. K. Clifford, indicating how two totally irreconcilable worldviews – and two radically contrasting matrices of allusion and reference – can coexist, and can, at the same time, both perform, and contribute to, the discovery, and promulgation, of excellent science.

CHAPTER 4

HEATED EXCHANGES: JOHN TYNDALL, THOMAS CARLYLE, AND THE RHETORICS OF THERMODYNAMIC CONSERVATION

> We were told lately that a great scientific man, in his best hours, when he looked at the boundless universe as far as it was revealed to his power of observation, could not but have forced upon his mind the belief that there was some Mind far greater, and Power more powerful than any human mind, before which all these truths which he was feebly groping after were clear and plain.
>
> - The Archbishop of Canterbury, 20 November 1874

Many Victorian intellectuals were excited by Tyndall's invitation at Belfast, stirred to action, reaction, delineation or redefinition. C. H. Hinton, author of 'The Persian King', was one. 'We are bidden […]', he wrote in 'Professor Tyndall and the Religious Emotions', published four months subsequent to Tyndall's Address in *The Contemporary Review*, his phrasing seeming that of the apprentice – or acolyte: 'We are bidden to seek some thought respecting the Universe and our relationship to it that shall do two things: in the first place, shall satisfy the religious Emotions, and, in the second, shall not contradict the results of the exploration of the universe by our senses and our intellect' (p. 94).

He proposes a solution, a reconciliation, a synthesis of matter and heart. It seems, in retrospect, a hollow one, wholly unsatisfactory, at once un-filling and unfulfilling, a rhetorician's gambit leaving urgent spiritual hungers unsated, while doing few favours, if little outright damage, to the causes and crusades of science (or scientism) itself. All the same, it is striking that Hinton, like so many others in the century's latter half (secularists and atheists as much as spiritualists and divines), felt challenged enough to make it. His own technique involves confrontation with the facts of materialism head-on, the wholesale redefinition of concepts: the dumb processes of physical causation, of one thing ('a') leading inexorably to another ('b'), for instance, are by him re-inscribed in a variety of Judeo-Christian sacrificial meta-lingo, becoming 'the visible image of the giving up of one's life for another's being' (p. 97), of a rock falling so that the thump might be heard, that the ground might be shaken and

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Epigraph from [A. Tait], p. 94.

warmed. As Huxley once remarked in a well-known letter of 23 September 1860 to Charles Kingsley, novelist and Chaplain to Queen Victoria: 'Whoso clearly appreciates all that is implied in the falling of a stone can have no difficulty about any doctrine simply on account of its marvellousness' (p. 217). Huxley boggles at the perfection and comprehensibility of physical transformation, apprehending it as a wonder far surpassing any of the unsubstantiated claims of Protestant theology.

Hinton goes one better, finding in thermodynamic metamorphosis itself a proxy for such refuted and 'inadequate' belief-systems. For him, the conservation of matter, of force, becomes a kind of metempsychosis of energy, a passing on of 'volition', a higher-level phenomenon not unworthy of his vision of a redacted and improved materialism nonetheless denying simple mechanism: a 'heartless' supposition he believed both metaphysically naïve and scientifically simplistic. Hinton's chosen language is that of exhortation, of the preacher (or the mountebank). His sentences – in the main, short, declarative, straightforward in their diction; each pressing the message clearly onwards, scarcely pausing, or allowing room, for 'extraneous' clauses of evidence or counterargument – are suffused with the vehemence of a proselytising missionary, and their contents, likewise, seem intended to soothe, cajole – and, ultimately, one supposes, convert.

In the Belfast Address, there seems, by contrast, an asymmetricality, a sort of sketchy, self-conscious minimalism, to Tyndall's worldview (as there presented), an incompleteness in his own attempts at promulgating a fortifying 'materialism plus' for the considered use, or edification, of the latter Victorian age. This, in part, was the subject of a preceding chapter, where a number of rationales for such lopsidedness – the predicament of a personal philosophy celebrating the complementary nature, the *necessarily* complementary nature, of scientific reasoning and 'the religious Emotions', which nonetheless appears frustratingly reticent about fully one-half of that psychological equation – were put forward: Tyndall's conviction that contemporary science, unlike contemporary religion, was a public matter, a magisterium in which broad consensus was both attainable and, within limits, to be desired, coupled with the predominance in popular discussion, in prior cultural history, of a view antagonistic to this, diametrically so; his own (shaky) adherence to the remit of a President's Address before the BAAS; the uncertain politics of response, those ex post facto interactions between the expectations of figures in attendance, outside commentators (religious or not), and that vastly greater audience, less policeable and infinitely heterogeneous: the broadly literate population of Great Britain, circa August 1874. And yet, as also discussed, there were even in the Belfast

Address vantages provided, glimpses of Tyndall's spiritual topographies, of private accommodations achieved between those conflicted, conflicting domains of scientific agnosticism and theistic belief.

Some individuals, blessed with restraint or liberal tolerance, were prepared to listen without undue prejudice. So, too, were certain organisations – *The Times*, for instance: 'Professor Tyndall's Address', an editorial which appeared 20 August 1874 (that is, within twenty-four hours of the Address's delivery), insisted, with an enlightened equanimity: '[T]here is no theological reason for recoiling from the conclusion to which Professor TYNDALL would conduct us […]. His analysis of the world's history leaves out one half of man, and he finds it impossible to deny to this other side of man's nature a reality as absolute as that which he claims for his physical faculties and for his understanding'. Even Archibald Tait, then Archbishop of Canterbury, in acknowledging such a noteworthy lack (in the quotation used as this chapter's epigraph), believed it admirable, rather than blasphemous, while his own incisive allusion to the consternation shown by a 'great scientific man' demonstrates as well both the imaginative penetration of the Address's argument and the social notoriety of its deliverer.

Both Tyndall and Hinton used rhetoric and the manifold resources of language to their own ends, of course. How could they not? Tyndall's counter-engagements, his rebuttals and re-brandings of 'sterile' naturalism, are, throughout his Address, secreted in plain sight, by meshes of literary referral and poetic invocation. Hinton's in that article – objections arising out of his own affinities for 'higher-dimensional' analysis, his familiarity with the sorts of transcendental conundrums posed by the 'scientised' spiritualisms then becoming popular (if geometry can be conceptualised in spaces beyond the Euclidean, why not matter in planes beyond the reductively material?) – seem, conversely, more stated than implicit, more surface than depth, confident and conspicuous rather than camouflaged or qualified.

Both, moreover, in confronting, or counterbalancing, the implications of contemporary scientific naturalism, found their own sources of spiritual comfort and moral affirmation, although in wildly different arenas. (Each conjured, in effect, a patchwork and provisional 'faith'.) Hinton (as exuberantly expressed in 'Professor Tyndall and the Religious Emotions') immersed himself in the conjectures of 'frontier' mathematics, in the untapped possibilities of spirit and mind. Tyndall, by contrast (sounding far more muted in his Belfast Address), looked, not to extreme scientific speculation, but rather the softer consolations of literature. He discovered there – in the vernaculars of poets and the tropes of the past, in its writers and

writings, its triumphs and traditions – a compensatory solace equal to, yet aesthetically dissimilar from, that achieved by his 'admirer'.

This chapter, like the next, is an examination of *how*, and *why*, he went about doing so. It is also a study of the effects Tyndall achieved, how they interacted with, commented upon, or strained against those great under-mentioned over-themes outlined in my first chapter: the conservation of energy, and the cosmic teleology implicit in those laws and suppositions associated with the 'new' physical science. As Gillian Beer has written: 'Deepest habits of mind often leave only slight traces on the surfaces of writing' (*OF*, p. 228). This is a tracing of those traces – an archaeology in one individual of 'deepest habits' of thermodynamic reasoning and materialistic rationalisation – examining the fashion (following on from my discussion in chapter two) in which Tyndall's choices of language and metaphor tend to channel, imply, distort or amplify manifest meaning, shaping perception, colouring interpretation and final response. The central theme here examined – for such linguistic practices are only interesting in terms of concrete instances – is the metaphoric persistence, clearly underpinned by those mental habits, throughout Tyndall's thought of a kind of 'solar' deification of human achievement, with primeval man imagined as fire-worker, as tool-shaper, first and foremost. And Thomas Carlyle and, though to a lesser extent, Tennyson – living contemporaries and, later in life, cherished friends of the scientist – are the dominant figures here engaged with.

'[T]he image of fire runs like a bright thread through everything he wrote', so John Holloway observed of the former, in his unreprovable *The Victorian Sage* (1962; p. 28). I would argue that a like stitching binds Tyndall's own arguments together as well, at once knitting divergent genres and literary traditions into a cohesive whole, and patching them to, or with, both the textured vernaculars of Carlylean rhetoric and the vestures of Carlyle's 'outmoded' transcendental beliefs. For Tyndall, like his mentor, seized upon the suggestive, even archetypal, power of a certain complex of incandescent images – fire-worshippers, labouring blacksmiths, the polymorphic manifestations on this earth of solar warmth – in his varied characterisations, not merely of brute physical processes (like the conservation of energy), but also intellectual fecundity and prowess. The sun provides radiant heat; the sage, spiritual illumination. And so, similarly, Tyndall argues, do their strange energies circulate. Moreover, such parallels – given the intellectual climate of mid-Victorian England – with fire, light and heat necessarily had for many at the time, not just Tyndall, resonances beyond the literal. This chapter looks at a few of these as well, particularly with reference to their function in defining their author's relationship with, on the one hand, the material, that stuff making up

our day-to-day world, and, on the other, the intellectual, poetic and literary, those unique products, seemingly without broader purpose, of the conscious, self-aware mind.

The questions at this chapter's core, in other words, are those very ones posed, with an unmistakable yearning, in a suggestive passage from Tyndall's popular study of 1872, *The Forms of Water in Clouds & Rivers, Ice & Glaciers*: 'But what is the sun? We know its size and its weight. We also know that it is a globe of fire far hotter than any fire on the earth. But we have to learn definitely what is the *meaning* of solar light and solar heat […]' (p. 8; my italics).

JOHN TYNDALL, SUN-WORSHIPPER

John Tyndall, towards the end of a series of lectures at the RI on the public life and scientific achievements of Michael Faraday (later collected and published in book-form under the title of *Faraday as a Discoverer* [1868]), provided a strange, even startling, analogue for the intellectual character of his departed friend: 'Thus his fire was that of a solid combustible, not that of a gas, which blazes suddenly, and dies as suddenly away' (p. 179). Elsewhere, he wrote in similarly incandescent terms of Faraday's affection for his wife, Sarah Barnard, over the course of their nearly half-century of marriage: 'Never, I believe, existed a manlier, purer, steadier love. Like a burning diamond it continued to shed, for six-and-forty years, its white and smokeless glow' (*FoS*, p. 355).

Tyndall, of course, was well known – and sometimes gently chided – for his popular laboratory demonstrations involving 'singing' flames and fluorescing gasses.[1] He, however, enlivened both his prose, whether alpine or scientific, and his public lectures with not dissimilar pyrotechnics as well, the analogic as much as the rhetorical. Both comparisons above, for instance, represent a kind of anti-anthropomorphisation or de-personification; they remake the sentient into the elemental, phenomenal and inert; they encode, seemingly, the total materialising of the spirit, the deepest loss of will. At the same time, however, they revivify the

[1] Maxwell, for one, seemed to view some of Tyndall's achievements as unnecessarily showy, even unseemly, in particular his laboratory demonstrations on the composition and colour of the sky. These performances are restaged in one poem, dryly subtitled '*A Tyndallic Ode*', as quasi-vaudevillian, as scientific snake-charming: 'The atoms clash, the spectra flash, / Projected on the screen, / The Double D, magnesium *b*, / And Thallium's living green'; or, later: 'I shout, I whistle, clap my hands, / And stamp upon the platform, / The flame responds to my commands, / In this form and in that form' ('Chief', p. 634).

Indeed, in the highly idiosyncratic correspondence between P. G. Tait and Maxwell – a correspondence characterised by both a cryptographic compactness and a constantly punning linguistic allusiveness (here, for example, the technical nomenclature of the tensor calculus is gleefully plundered) – Tyndall figured as '*T″* because *T″* represents a tensor of the *second rank*' (Goldman, p. 96).

commonplace. We pass over without undue reflection cant attributions of idealised or everlasting love, but linger for a moment on such amatory phrasings as these, similes oddly involving immolated allotropes and incandescing gasses. *They*, by comparison, seem innovatory, conceptually jarring, though their intents and effects remain largely cliché. Beyond this, when examined in the overall context of the scientist's thoughts and writings, the presence of such allusions to fire, and warmth, and flame enact more than literary novelty; they highlight concerns and preoccupations, underscoring Tyndall's obsessions with the manifold signifying properties afforded by the concepts of thermodynamics. For, like planets orbiting a central star (or, more glumly, disconsolate mourners encircling a pyre), clustered around the emblems and ideas of heat, of heat's circulation, renewal and final dissipation, lurk in Tyndall's rhetoric a range of looming matters: the inviolability of causality, the potentialities of life, the strictures of energy conservation, the pre-eminence of the material in the physical world and, within that world, the capacity of mind, of unyoked thought, to transcend 'materialistic' limitations, allowing the scientist to re-envision matter, not as dull clod, but rather something rich, poetic and re-invigoratingly strange.

It was through heat and its metaphors that Tyndall was able to explore and interrogate the seeming paradox central to his thought, what William Irvine described as the scientist's admission that 'there was as yet no bridge between consciousness on the one hand and molecular activity on the other', while nonetheless still insisting that insensate matter, 'properly understood', remained the 'magic substance by which all mysteries would be penetrated and all contradictions resolved – the very principle and symbol of progress, uniting invisible atomicity with invisible intelligence and both with infinite possibility beyond' (p. 344).

A claim symptomatic of this difficulty, Tyndall closed his response essay of 1875, '"Materialism" and Its Opponents', with a line that seems *prima facie* absurd, one foretelling, with due solemnity, a paradisiacal future in which 'purer and mightier' minds than ours strive to attain a 'deeper knowledge of matter […]', while evincing a 'more faithful conformity to its laws' (p. 599). Mallock lampooned these desiderata via *The New Paul and Virginia*'s overbearing Prof. Darnley.

Here, the professor, a celebrity aboard the good steamship *Australasian*, expounds the unpalatable truths of nineteenth-century materialistic science to fellow passengers – an audience, minute by minute, increasingly demoralised. (It is, by any standards, a bravura diatribe.)

'However,' he [Darnley] proceeded, 'of one thing we can be quite certain: all that is, is matter; the laws of matter are eternal, and we cannot act or think without conforming to them; and if,' he said, 'we

would be solemn and high, and happy and heroic, and saintly, we have but to strive and struggle to do what we cannot for an instant avoid doing. Yes', he exclaimed, 'as the sublime Tyndall tells us, let us struggle to attain a deeper knowledge of matter, and a more faithful conformity to its laws!'. (p. 18)

As implicit in Mallock's account, this could seem a lunatic's imprecation.

Earlier in the article Tyndall had declared, with analogous evangelical sweep: 'Matter I define as that mysterious thing by which all this is accomplished' ('Materialism', p. 598) – the magisterial relative clause (with its encompassing subject, 'all this') subsuming every facet of reality, both experienced and conjectured. Nevertheless, while, on one level, this represents a fully adequate declaration of materialism's central belief, on another, it appears frustratingly incomplete, as it apparently leaves out agency, slighting thereby one player in a vital partnership: for it is, after all, the *interaction* of matter, not matter itself, that 'makes' structural accomplishing. To the mid-Victorian scientific naturalist, force and matter, in all their protean manifestations, were closed systems, subject to conservation laws, neither created nor destroyed (Einstein, however, with his iconic mass-energy relation, $E = mc^2$, would in 1905 link them in a more elementary monism), but, equally, the first without the second would have been inefficacious (having nothing on which to *act*), and the second without the first, without form and void. Even Faraday, never one to classify himself as one of those 'high and piercing intellects' transgressing beyond science's 'exalted' theoretical frontiers (he classified himself, rather self-deprecatingly, as one of its 'persevering labourers' instead), was moved by the formalisation, and increasing importance within all research, of the First Law to a series of more grandiose pronouncements: 'for we know matter only by its forces […]', he asserted on 27 February 1857 in 'On the Conservation of Force', an RI Friday Evening Discourse (p. 1).

Four years previously, in another such evening discourse, Tyndall had made an equivalent assertion, exemplifying that aspect of the naturalistic hypothesis about which those two proclamations from '"Materialism" and Its Opponents' (both eminently quotable, but effectively doomed to caricature and misprision when excised from any argumentative context) had seemingly been silent: 'There are no two words with which we are more familiar than *matter* and *force*. The system of the universe embraces two things, – an object acted upon, and an agent by which it is acted upon; – the object we call matter, and the agent we call force' ('Influence', p. 1).

Needless to say, it is force that effects the Biblical transformation, that sketched in Genesis, through its (to naïvely, if Tyndallically, anthropomorphise) 'beckonings' and commands, decrees made in accordance with nano-Lilliputian taskmasters. (These were the 'atomic architects': unseen, infallible and autocratic.) Maxwell, in a more jolly metaphor,

here turning elemental cohesions into panting courtship, wrote of those 'microscopic spaces / Where molecules with fierce desires / Shiver in warm embraces' ('Chief', p. 634); his final line represents a fine scientific pun, encompassing, in the two senses of 'shiver' ('to vibrate' and 'to break apart'), both the oscillation of matter due to intrinsic heat and the sundering of chemical bonds in the formation of new compounds.

'Architecturally' arrayed? or 'romantically' compelled? Either way, over billions of years, the ultimate consequences of such molecular behaviour – or, perhaps, molecular *mis*behaviour – for the cosmos as a whole are unquestionably Miltonian:

> order from disorder sprung.
> Swift to their several quarters hasted then
> The cumbrous elements, earth, flood, air, fire;
> And this ethereal quintessence of Heaven
> Flew upward, spirited with various forms,
> That roll'd orbicular, and turned to stars (Milton, p. 185; 3.713 - 18)

Beyond their science, Maxwell had his faith; Tyndall, despite the challenges of agnosticism, his belief in the 'mysteriousness' and vibrancy of all substance. Both described a scientific cosmology, but in neither formulation does it appear automatically a hateful or nihilistic one.

Myers, by contrast, writing in the tradition of unmediated materialism (that is, materialism as it was often stereotypically perceived), supplanted Milton's divine fiat with a new 'One Law' – a prescription not heavenly, but horrifically, degradingly material – in 'A Cosmic History', that poem introduced in my first chapter. In its account of celestial ordering, one at once paralleling, and mocking the anthropic presumptuousness of, say, *Paradise Lost*'s sublime and humanistic vision, we encounter a dour and rationalistic updating of this ancient trope, one likewise relating how the stars were 'roll'd orbicular' (and – now aimlessly – patterned into reassuring constellations), but enacted this time in a thoroughly 'modern', de-theologised universe of energy conservation and impersonal molecular impingements:

> Then lone in space the comet hung;
> Then waxed the whorls of cloudy glow;
> Then each on other swept and swung
> Enormous eddies, formless flow;
> One Law, one Force, and Manifold,
> Bestrewed high heaven with sparkling fire,
> Burned in Orion's belt of gold,
> And lit the dragon and the Lyre. (p. 187)

Gravitation leads to nebular compaction; compaction to heating; heating to stellar ignition and subsequent fluorescence: this is all true; but it would be hubris itself, the poet insists, to

consider such a firmamental spectacle one forged for man's contentment and delight.

Tyndall's cosmology is, on the whole, congruent with that of 'A Cosmic History', but rarely interpreted, or described, so gloomily. His treatment of solar hegemony is typical. Like many Victorians, Tyndall, goaded by the tenets of his science, had a veneration for, and a fascination with, the sun. And, alongside Clifford (and many other thinkers, both scientific and otherwise), he followed John Herschel – he quoted these lines from Herschel's *Outlines of Astronomy* (1833) towards the close of his own textbook on *Heat* (1863) – in observing that '[t]he sun's rays are the ultimate source of almost every motion that takes place on the surface of the earth' (p. 237; qtd., p. 526). Life, ultimately, for Tyndall, was one of those motions; its growth and maintenance, like geology, like climatology, a consequence of heat-driven metamorphosis. 'In this sense', he explains in his address on 'Matter and Force', 'we are all "souls of fire and children of the sun"' (*FoS*, p. 92).

The allusion, slightly obscure, is likely to the first line of a couplet cited in the American John Prescott's *History of the Conquest of Peru* (1847), then a work of considerable renown. Prescott had used it in a description of Incan tribal retributivism (p. 153). Such feral contexts are excised in Tyndall's materialistic re-inscription, though one perhaps persists. Prescott had remarked of Incan belief: 'The deity whose worship they especially inculcated, and which they never failed to establish wherever their banners were known to penetrate, was the sun. It was he who, in a particular manner, presided over the destinies of man; gave light and warmth to the nations, and life to the vegetable world' (p. 39). Similarly, in a postscript Tyndall affixed to a discursive account he had written of his 1863 ascent of the Jungfrau – one interlaced with speculations on the sun's omnipotence, on the earthly authority of solar radiation – he quipped: 'Eight years ago I was evidently a sun-worshipper; nor have I yet lost the conviction of his ability to do all here ascribed to him. – J. T., 1871' (*Hours*, p. 191*n*).

Such language is liturgical, an ascription of the potency of Christian divinity to a material object: he is thus, or so it is implied, putting forth a creed at once recidivistic and up-to-the-moment. Accordingly, the first half-dozen or so pages of his *The Forms of Water* (published as the premier volume in the International Scientific Series, a selection of texts 'embodying the results of the latest investigations in the various departments of Science at present most prominently before the world' ['Catalogue', p. 31], such an honorific or endorsement hinting at the importance popularly ascribed to Tyndall's inquiries), trace a droplet of moisture from the ocean to its nominal source, a discussion comparable to that referenced by Clifford in Swinburne's 'Garden of Persephone'. But this progress ends neither in morose thanatophilia,

nor aquatic dissolution of individual identity, but rather triumphant reconfirmation of the sun's dominion and a concurrent affirmation of the interpretive power of nineteenth-century science: 'Thus, by tracing backward, without any break in the chain of occurrences, our river from its end to its real beginnings [in rain, in glaciers], we come at length to the sun' (*Forms*, p. 6).

If there is a subtext in Tyndall's prose, it is an awed solarism akin to this, a leitmotif resounding throughout an astonishing range of compositional contexts and circumstances. Nevertheless, even this most purportedly unassailable of doctrines remains a conjecture about which he does – from time to time – articulate a fugitive unease, though without ever truly shading either scientifically into doubt, or morally into the nihilism of Myers's cosmic hallucination. So is it more generally with the scientist and his naturalistic preoccupations.

In their excellent analyses, both Steven Kim and Ruth Barton try to fix a label to Tyndall's philosophical stance circa Belfast: he suggests 'transcendental materialism'; she, 'pantheism'. Both likewise note the admixture within it (with components deemed less 'idealistic' dominating as 1874 drew close) of antithetical trends: German Romanticism, Lucretian atomism, and so forth. This is correct, but practically to miss the point. I suggest that far more significant than any interpolated trajectory is the back-and-forthness – the *play* – of Tyndall's argumentation. For in many of his writings we encounter precisely that: internal dialogue and debate, an attempt at the working out of contraries, a struggle enacted both rhetorically (in the substance and structure of arguments) and linguistically (in the author's – or, sometimes, orator's – selection and manipulation of allusive contexts and explanatory vernaculars). Hence, I argue that one of the most striking things about most any work by Tyndall is its curiously fractal nature, the fashion in which it enacts, in miniature or elaboration, via the embellishment of a peroration or in the studied sobriety of an explanation of laboratory procedure, concerns which inform the whole of his *oeuvre* – as we saw in those 'twinned' addresses at Belfast and Manchester. Each seems self-similar, in its own peculiar way, with the collective, evincing a kind of 'interchangeability', encapsulating within its paragraphs a lifetime of arguments, concerns, personal prejudices. Thus, also, the remarkable ideological and metaphoric coherence and continuity evident in so much of his writing.

As pronounced in the *Biographical Review of Prominent Men and Women of the Day* (an American production of 1888, published in Chicago, indicating something of the esteem in which Tyndall was held on both sides of the Atlantic): 'In a life of the duration of nearly three score years and ten, this able man has wielded his pen in the cause of science with a steadiness

of purpose and a persistency of will that is worthy of praise and emulation' (Herringshaw, p. 408).

Over that same period this 'steadiness of purpose' was coupled, too, with a consistency and striking unity of idiosyncratic worldview; and *beneath* this consistency, we can discern always the same roil of discontents, thus discovering another kind of continuity, a topic to be addressed at some length in this dissertation's concluding chapter.

On the Beach: Tyndall as Mid-Victorian Poet-Scientist

On 28 June 1856, Tyndall was on the South Coast, preparing for an excursion the next day to the Isle of Wight, site of geological and ecological interest, home to Tennyson, a retreat from the bustle of London life, and, especially after the Queen selected it in the 1840s as the site for the construction of her vacation home, a favoured holiday spot for well-to-do and middle-class Victorians, men and women who thronged to ports such as Lymington, Bournemouth and Portsmouth (themselves already congested with merchants and fishermen) to book passage on the many steamers and sailboats which regularly made their brief crossings over The Solent, a narrow, salt-water strait separating the island from the mainland. He had been feeling poorly for nearly a week. It was, moreover, a malaise which seemed, despite all best efforts, unshakeable – his journal entry for 24 June reports one of several futile attempts at self-repair: '[V]ery unwell all day, spent some hours in Kensington Gardens, thence took an omnibus to Wimbledon, walked round through Wandsworth and home by train[.] Still felt ill'. He resolved, accordingly, to make a pilgrimage to Wight, what one mid-Victorian guidebook euphorically dubbed the 'Madeira of England, – a sanatorium of the highest repute, and of daily growing acceptance to the valetudinarian' ([Nelson *et al.*], p. 6). Tyndall – like many of his compatriots, well aware of the salutary effects of a brief stay on the island, far from the tumult and pollution of urban life, and at a remove from the drudgery of professional and personal routine – sought also 'spiritual' benedictions, the medicine of enlarging landscape, a curative beyond those 'materialistically' derived from physical exertion or the benefits of Wight's 'climate softer and drier than any in England […]' (p. 5).

Lounging adjacent to The Solent he wrote that afternoon a brief note to his friend, Mrs Pollock. In it, we encounter a line of reasoning so compressed, wide-ranging and telegraphic – it seems a *History of the World in 10 $\frac{1}{2}$ Clauses* – that it verges on self-parody: the 'scene setting' at its onset, a phrase or two of dolorous natural description, a sudden shifting of

register from the particular to the great, as his missive swerves, or blunders, unapologetically into issues of design, mechanism, the role claimed by science (and, if in unstated opposition, philosophy and literature) in the training of an individual's imagination. There's a citation of his beloved mentor, a digression into the biological ramifications of physical ordering, a glance at the evolution (future and past) of sentience, even an otherworldly peroration – suitably 'elevated', likewise fashioned in perfect miniature – which, as with that at Belfast, evaporates into mellifluous literary quotation. From country pleasantries to cosmic destinies, with a dollop of edification in the middle. (He must have been a maddening correspondent.) And over it all presides the 'original grand engineer', that source, ultimately, of terrestrial life and light – the sun, whereof all this is accomplished:

Mudeford near Christ Church
28th. June 1856.

My dear Mrs Pollock,

Miss Herries's note, but not her book, has reached me this morning. I shall be in London on Wednesday next, and my first act after I return will be to attend to her request. I am trying to be idle here for a week, and thus to permit my brain and muscles to regain their normal toughness. At my feet is the sea, splashing and booming and causing the pebbles to rattle up and down along the beach. Right opposite are the white cliffs of Alum Bay [on Wight], it seems that I could swim to them with ease, and yet I am told they are eight miles off. What glorious weather this is, the central day is hot, but the morning and evening are delicious; the deep quiet, and the perfume of the honeysuckle and beanflowers are a slight improvement upon the growls and gully holes of London. I wonder does science really injure a man's imagination? Sometimes when looking at the sprouting flowers I endeavour to follow the <u>mechanical</u> action of the sunbeams upon the atoms of matter whereby they are caused to arrange themselves into these beautiful structures, and to die their petals in these splendid colours. You remember Mr. Faraday's experiment with the iron filings which you liked so much. These iron filings when acted on by a magnet, moved towards each other and clung together in a peculiar manner. The sunbeams appear to act in a somewhat similar manner: they shake up the particles of matter and cause them to arrange according to certain laws, and the result being the formation of grass, gooseberries, and flowers. We eat the gooseberries; but the grass is too much for us and so we cunningly submit it first to the digestive apparatus of the ox and sheep; but the sun is still the original grand engineer to whom we owe the architecture of our bodies. Behind these of course are the questions which beset us now, but which are perhaps to be answered by a race of beings bearing the same relation to us that we do to the tadpole and [?]. The vision which is rudimentary in us may in them be developed into perfect day: and thus

"The something in this world amiss
May be unravelled by and by"

I will not afflict you longer – goodbye[.]

Yours ever sincerely,
John Tyndall

Those 'questions which beset us now' are, of course, the very ones set forth in the finale at Belfast, and to which Hinton made his own fervent reply.

The 'particles of matter' shaken by sunlight, set to molecular jiggling by the imparting of heat (a mode of motion inducing motion); the rhetorical evasion of 'somewhat similar' (magnetic flux dispersing and reorienting 'iron filings' along lines of force: a coldly 'mechanical' affair, as most would consent. But can the same be said, without quibble, of the actions of radiant light, of solar energy, on those germ-stuffs yielding 'grass, gooseberries, and flowers'?); the inspecificity of 'certain laws' (they exist, he insists, but remain pragmatically unsketched); the evocation of a Jovian over-presence for the sun, God-like in 'his' ability to draft and animate mammalian 'architecture', to shape organic existence: these are recurrent themes and phrasings, the rhetorical-*cum*-argumentative atoms comprising Tyndall's own structures of explanation.

And they are, as ever, set in an overall narrative of change, of death and life and death again, of long darkness followed by rapturous dawning: of literal light, of metaphoric enlightenment. Tyndall's letter becomes an evolutionary progress, morphing amoebas into humans, exalting humans into bafflingly unknown – or, ominously, superseding them by wholly alien – species or races of superior intelligence. These, too, were among his (and materialism's) emblematic themes; as said by Mallock of one of Darnley's speeches: 'He showed them how viewed by modern science, all existence is a chain, with a gas at one end and no one knows what at the other; and how Humanity is a link somewhere; but – holy and awful thought! – we can none of us tell where' (*Paul*, pp. 17 - 18). Similarly, Tyndall's slight, and partial, misquotation of Tennyson's 'The Miller's Daughter' – the original reads: 'There's somewhat in this world amiss / Shall be unriddled by and by. / There's somewhat flows to us in life, / But more is taken quite away' (p. 373), lines which associate human existence with irretrievable loss, with the transience of earthly adoration – emphasises, by contrast, the speculating scientist's underlying hopefulness (he looks forward to a time when a problem is solved, not a truth painfully learnt), even as his accidental emendation ('unravelled' for 'unriddled') subtly entangles this discourse amidst the warp and woof of Carlylean 'weaving' metaphors.

Three days later, Tyndall, returned from Wight with health fully restored, added a brief (and atypically buoyant) entry to his daily journal; it read, in part: 'Walked to Bournemouth: spreading plaid on the pebbles and lay there for nearly two hours watching the roaring waves, and writing the above […]. Felt unusually strong' (Journal, 1 July 1856).

He was referring to a chronicle he had written of his trip, an account in the form of several hundred lines of (reasonably) accomplished blank verse, much of which had evidently been subjected to extensive revision. Interesting for a number of reasons, most compelling is

the focus it places on the role, if any, to be played by abstract literary imagination in the framing, and popular elaboration, of his evolving system of 'scientifically derived' aesthetics, an approach to perceiving and understanding the phenomena of the physical world which Tyndall thought non-theological, though hardly non-spiritual, in terms of its essential presumptions.

Such an antithesis merely restates Huxley's perspicacious verdict on *Sartor Resartus*: a work which had abetted his own realisation that 'a deep sense of religion was compatible with the entire absence of theology' (Letter, p. 220). 'My friend', he later noted of Tyndall's relationship with the author of that volume, 'was disposed to regard Carlyle as a great teacher; I was rather disposed to take him as a great tonic; as a source of intellectual invigoration and moral stimulus and refreshment, rather than of theoretical or practical guidance' ('Professor', p. 3) – as we shall see, however, Tyndall was in fact prone to regard Carlyle as a bit of both simultaneously, prophetic instructor as well as instructing prophet.

There have been, since the mid-1800s, a wide range of studies and appreciations of Tyndall, a figure who was, after all, a 'personality' of so many interests, a media-darling before there even was such a concept, profligate in both publications and the friendships he cultivated. Mid-Victorian pamphleteers and journalists attacked him as an unrepentant materialist; Jeans approached him as a propagandist for science and electrical engineer; Huxley, as a confidante and comrade-in-arms. He merited two obituaries in *The Alpine Journal*: one on his function as scientist (by 'H. D.'); another, on his achievements as a mountaineer (by C. E. Mathews). Eve and Creasey – co-authors of the biography *The Life and Works of John Tyndall* (1945), a project of several decades' gestation partly overseen by the scientist's widow – described him with the respectful caution, and nostalgia, of the eulogiser. Modern academics have tended to study the man as cultural phenomenon first and foremost, perhaps inadvertently perpetuating the unkind appraisal put forth by Oliver Lodge in the 10th edition of the *Encyclopædia Britannica*. (This, though, was considerably softened – by the editors – in time for the mighty 11th.) Tyndall's 'scientific achievements were none of them of the very first magnitude', he averred, 'it was not so much what he did as who he was that is of permanent interest […]' (p. 520).

Inevitably, a subtly 'different' Tyndall to such synoptic summations becomes apparent in the 'journal entry', the final drafting of which, posted to Mrs Pollock, was dated 18 July 1856. For above all else, this account composed, revised, and diligently recopied, of a journey to Wight on 30 June 1856 accentuates *ordinariness*, depicting a 'nice enough' fellow trying to

pursue his interests amid a bustle of others all trying to pursue theirs. (Paul Sawyer's pleasing contention is thus provided with fascinating – and generous – support: 'In so many ways [was] Tyndall […] a Victorian, often to a platitudinous degree', he wrote in 'Ruskin and Tyndall' [p. 228].) Though hardly a dense poem, it seems a deep one, a superficial placidity of surface texture – and a degree of critical translucency – allowing clear apprehension of elaborate, submerged matrices of social and literary convention. We note, for instance, behind its pages, and often only barely overwritten (or suppressed?), ancillary texts, literary and otherwise, documenting diverse mid-nineteenth-century traditions and norms: geological primers and Thomas Cook's illustrated travel brochures; *Sartor Resartus* and paddle-steamer timetables; well-thumbed accounts of Helmholtz's scientific lectures and leather-bound editions of Keats's collected verse. It is similarly, and with like inevitability, a palimpsest of its author's considerable erudition, particularly in literature. Always one 'keenly alive to the influence of poetry […]', as Eve and Creasey tell us, he 'loved to learn long pieces which he used to recite to himself when walking and of which he used to speak "as a stimulant much better than wine"' (p. 286).

A telling précis of a few of his favourite authors was provided by Louisa Charlotte Hamilton Tyndall, the scientist's widow, in notes prepared for Jonathan Hutchinson not long after her husband's tragic death: 'Shelley, Byron, Keats, Wordsworth, Cowper, Campbell, Burns, were all laid under contribution – to say nothing of the German poets [particularly Goethe], in whom he took great delight. But perhaps the bits most frequently quoted [by him], and serving as a perpetual source of inspiration, were passages from Tennyson and the American poet Emerson' (qtd. in *LWJT*, p. 286). Several of these influences are recognisable in this lively, magpieing account.

A sense of its vibrancy as cultural document – and a demonstration of Tyndall's uneasy 'fitted-ness' in proletarian society – can be gleaned from its telling of the frenzied first few minutes of his stay. Full of anarchic or improbable incident, overloaded with a wealth of evocative and clearly seen descriptive detail, this section of narrative seems also to provide ample evidence of sociological disjunction (is Tyndall's tone one of bemusement or, as I suspect, palpable distress?), showing a man unmoored from mundanity, caterwauling at the intransigency or indifference to 'lofty' naturalism of ordinary folk. Having disembarked, he tells us, the scientist busied himself inspecting the geological curiosities presented by the rock formations ringing Alum Bay: 'the courses of the flint, / Running contorted through the massive chalk, / Which too had suffered through the mighty jerk / That set the neighbouring

sandstone cliffs on edge'. Intrigued next by the prospect of a sea-hollowed cave, he rushed within, trustingly abandoning his scarf near its entryway – and unwisely so: it is quickly pilfered by 'two yellow boys / Yellow with dirt and tan […]' ('DP', p. [4]). Having retrieved his scarf – the youths, variously described by Tyndall (equivocating diplomatically about the innateness of criminality) as 'varlets' and 'urchins', on whose faces 'the natural law or evil use / Had written foul expression […]' (p. [5]), were surprised by the scientist's ranging gait – he and his companions entered the grotto, only to be roused from duly sedulous contemplation of its semi-aquatic flora by the sound of 'lower-class' mockery (these are lines excised from the manuscript sent to Mrs Pollock): 'Two stranger maids were near us at the time; / One stooped and raised a leaf and holding high / The dripping shred, exclaimed in accents coarse / "What can she [Mrs Wright] want with rubbish such as this"?' ('DP' [1], p. [5]). By turns flirtatious, naïve, prejudiced, ingenious, arrogant, quixotic, enraptured and awesomely stubborn, keenly aware of both the nuances of his own personality and his own at times exceedingly specialised desires, often wilfully oblivious to those of the dozens (and, on several instances, hundreds) of others around him, fellow travellers – or tourists, a differentiation then becoming semantically charged (Buzard, p. 1) – and local residents alike, this lengthy work reveals the man in delightful complexity, showing Tyndall away from the podium, outwith the comforting chumminess of his London circle.

For the Isle was decidedly no annex to the RI's cloistered laboratories, though rather too frequently it seems as if Tyndall tried to treat it as such, and it is this disparity, this jarring incongruity between actions and surround, which gives rise to a good deal of the comedy present in the poem. Of these episodes the majority seem frivolous and warm-hearted.

In a description of one young beauty, Tyndall quips, his rhyming couplet ranging in its diction from sub-*Pyramus and Thisbee* to strict Newtonian proportionality: 'Oh Light! oh Sound! Oh Beauty rich and rare, / Diminishing inversely as the Square' ('DP', p. [11]). But some feel of more dissonant pitch, tinged with desperation, veering towards pathos or monomania.

After an account of souring banter with an attractive barmaid – he repeatedly fixates on her 'creamy' or 'milky' complexion – Tyndall falls to whimsical lamentations on the weighty lot of the harried scientific professional, envying the 'simpler state' of a local porter sitting nearby. Yet, even in so doing, his phrasing remains that of the materialist on holiday. He dissects a public house into Euclidean planes and foci, figures the glow of a woman's face in terms of optic wavelengths:

athwart the tavern bar
I see a bagman puffing a cigar.
Oh! jolly Day – like you to linger here
I'd give up chemistry and take to beer,
Banish la lampe electrique from my sight.
To make experiments on other light;
And hold the red end of the spectrum low,
If placed in competition with the glow
Of cream and coral, now concentered where
The plane of the first lobby cuts the stair. ('DP', p. [11])

All things considered, it would seem that if the Victorian naturalist was – to some minds – the apotheosis of his society, he was also, at times, its antithesis, too, lonely and misunderstood.

Beyond such instances of sociological suggestiveness, far more telling (for the purposes of this study) is the additional light which Tyndall's verse-narrative sheds on the sometimes contradictory impulses defining the intellectual range of his own personal ideology. For in it, we are offered glimpses – though hardly a cipher, unwilling or incapable of voicing his own discontents and influences, these seem even by his standards particularly unimpeded – of his abiding affection for Romanticism; of the epistemological bases underlying a number of his most earnest rationalisations for the love-hate nature of his relationship with stringent scientific materialism; of the close, albeit volatile, affiliations (at times alternating almost willy-nilly in tone between the contentious and the cordial) he cultivated with – and laboured assiduously to maintain, through regular meetings and a voluminous correspondence – several pre-eminent figures in nineteenth-century letters, and so forth. He was to count among his confidantes Ralph Waldo Emerson and, of course, Tennyson himself. (At their first meeting, Tyndall recalls, the poet was pleased to discover that the scientist did not number among 'those who disdain to quote *Maud*' [qtd. in *LWJT*, p. 75].)

It is, however, to Tyndall's relationship with Thomas Carlyle, sage-like theorist of historical and social energies and triumphant recipient (at least by proxy, in the person of his Prof. Diogenes Teufelsdröckh) of a 'Spiritual New-birth' – a sacrament of mystical renewal and ethical reconfirmation he called (in a famous, if slightly impenetrable, phrase) a 'Bathometric Fire Baptism' (*Sartor*, p. 129) – that we now turn.

TWIN PROPHETS OF THE COSMOS AS STEAM-ENGINE?

'The mistake, not infrequently made', Tyndall explains near the conclusion of 'Personal Recollections of Thomas Carlyle',

> of supposing Carlyle's mind to be unscientific, may be further glanced at here. The scientific reader of his works must have noticed the surprising accuracy of the metaphors he derived from Science. Without sound knowledge such uniform exactitude would not have been possible. He laid the whole body of the sciences under contribution – Astronomy, from the nebular theory onwards; mathematics, physics, chemistry, geology, natural history – drawing illustrations from all of them, grinding the appropriate parts of each of them into paint for his marvellous pictures. (*NF*, p. 385)

Frank Turner, in 'Victorian Scientific Naturalism and Thomas Carlyle', concurs with Tyndall's (perhaps biased, one suspects, by friendship and long familiarity) opinions in this regard: 'He [Carlyle]', Turner explains, 'was anything but ignorant of physical science […]. He had translated encyclopaedia articles on scientific topics and had reviewed scientific books. His use of scientific metaphors was frequent and exact' (p. 328).

Tyndall, though anxious to reclaim an often wayward soul for the noble cause of his profession, nonetheless still recognised that the fit between materialistic natural philosophy and the worldview espoused by Carlyle was far from perfect. Turner has described Carlyle's attitude to such beliefs as, at the best of times, 'ambiguous' (p. 328), while one nineteenth-century commentator went so far as to say that '[e]verything like [scientific] analysis was repugnant to him' ([Call], p. 486). Tyndall's writings, however, demonstrate the lengths to which the scientist would go to smooth over such problematic joins. 'Yes, Friends', Carlyle's Teufelsdröckh announces in *Sartor Resartus*, 'not our Logical, Mensurative faculty, but our Imaginative one is King over us […]' (pp. 167 - 68).

These are lines which Tyndall passes over with the observation that it was not the methods and (duly qualified) assertions of mid-Victorian natural history and natural philosophy in and of themselves to which their author objected (one common interpretation); rather, '[i]t was the illegitimate science which, in its claims, overstepped its warrant – professing to explain everything, and to sweep the universe clear of mystery – that was really repugnant to Carlyle' (*NF*, p. 388).

Moreover, how could Carlyle be deemed unscientific, reasoned Tyndall, if he, in a sense, could be given the 'credit of poetically, but accurately, foreshadowing the doctrine of the Conservation of Energy' (*NF*, p. 386)? That justly famed, globally synthesising physical 'doctrine', an abstract statement of universal principle, encompasses, as discussed in my first chapter, in the cold equations of its formalism a range of cosmological (and spiritual) consequences both fundamental and profound; it is a precept which, in any survey of Tyndall's scientific philosophy, must be granted – even over the theory of Darwinian competitive evolution – absolute pride of place.

As a notably conscientious man of science well acquainted with the both long and by

no means uncomplicated history of the slow progress and often only reluctant assimilation of such novel discoveries into the folds of paradigmatically 'normal' thought, Tyndall recognised that the philosophical heritage of the First Law could, of course, be traced back quite easily to an era predating, not only that of Carlyle, but even that of Francis Bacon himself, who, in *The Advancement of Learning*, had postulated: 'Is not the observation, *Omnia mutantur, nil interit* [everything changes, nothing dies], a contemplation in philosophy thus, that the *quantum* of energy is eternal? […]' (pp. 84 - 85). Such an eerily prescient sentiment – particularly in its use of the word 'quantum', a linguistic talisman almost fetishistically associated by many modern intellectual historians with the sub-atomic theorems of the early and mid-twentieth century – still does not, however, 'make Francis Bacon', as Greg Myers has joked, 'the discoverer of conservation of energy, as some of the more eager anglophiles in nineteenth-century priority debates claimed' ('Nineteenth', p. 38). (Nor of quantum mechanics, he might have added.)

Indeed, in *Heat: A Mode of Motion*, Tyndall found the genesis of that basic thermodynamic precept in ancient Hebraic lore: 'This law [of energy conservation] generalises the aphorism of Solomon, that there is nothing new under the sun, by teaching us to detect everywhere, under its infinite variety of appearances, the same primeval forces' (p. 503). What, however, inspired the scientist to trace its genealogy not merely in rehabilitated Biblical commonplaces, nor even the collected papers of Joule and Mayer, but also the ramblings of Carlyle's clothes-addled Teufelsdröckh?

'Harking back to 1831' – a year, Tyndall elaborates a bit further on, in which, for all intents and purposes, that pair of pioneering thermodynamic theorists must be considered as yet 'scientifically unborn' – 'we find him [Carlyle] at Craigenputtock, drawing this picture […]' (*NF*, p. 386):[2]

> As I rode through the Schwarzwald, I said to myself; That little fire which glows star-like across the dark-growing […] moor, where the sooty smith bends over his anvil, and thou hopest to replace thy lost horse-shoe, – is it a detached, separated speck, cut off from the whole universe; or indissolubly joined to the whole? Thou fool, that smithy-fire was (primarily) kindled at the sun; is fed by air that circulates from before Noah's Deluge, from beyond the Dogstar [Sirius]; therein, with Iron Force, and

[2] Moreover, it was science – as Tyndall slyly suggests in *Heat: A Mode of Motion* – that has been the human enterprise that has come closest (in 1792 – a quarter-century, in other words, before Carlyle ever put pen to paper) to providing the world with a bone fide Teufelsdröckh, 'the indefatigable [Count Benjamin] Rumford […]'. Rumford, however, predicated his studies, not on wildly discursive literary and anthropological speculation, but rather 'an elaborate series of experiments on the conductivity of the substances used in clothing' (p. 217).

Although I cannot be entirely certain that Tyndall was solely responsible for the preparation of the excellent index for this volume, I can only imagine that it was to him a source of great amusement to have this particular sub-section referenced under the heading: 'Clothes, their philosophy […]' (p. 507).

> Coal Force, and far stronger Force of Man, are cunning affinities and battles and victories of Force brought about: it is a little ganglion, or nervous centre, in the great vital system of Immensity.
> (*Sartor*, pp. 55 - 56)

'With its parts in "æterne alternation", Tyndall goes on to say, the whole of 'the universe presented itself to the mind of Carlyle' (*NF*, p. 386); he perceived an interconnected world inconceivable in its vastness, one of flux, recapitulation and transformation, of ceaselessly circulating processes, but never spontaneous caprice or creation. The cosmic gavotte Carlyle envisaged encompassed all scales, from homely ('that smithy-fire') to celestial ('kindled at the sun'), even as it ranged fully over both axes of abstract mensuration, temporal ('from before Noah's Deluge') as well as spatial ('from beyond the Dogstar').

Tyndall, in his essay, quotes this passage, though only up to the phrase 'kindled at the sun', just past the interrogative, excising in the process Carlyle's allusions to air 'beyond the Dogstar' and 'Noah's Deluge' (see *NF*, p. 386). I suspect the reason for his not citing these latter two qualifiers – despite the fact that they metaphorically cohere with his own grand conceptions of the explanatory scope throughout all space and time of thermodynamic calculus – can be in part attributed to the fact that they, from a strictly materialistic perspective, have only a poetic truth about them. Tyndall, of course, was no fan of the Bridgewater Treatises, those curious attempts, in the 1830s and '40s, at establishing 'that Natural Theology was itself a science, and that it had a place within Christian Theology' (Robson, p. 77); let alone did he abide more heavy-handed efforts at proving begrudging accommodation between Revealed historiography and dug-up palaeontology: thus, no deluge for him, Noachic or otherwise. Nor would he ever have allowed air (the ether, perhaps, but not breathable air) to circulate freely through sidereal space – an attenuated vacuum, according to science.

Nevertheless, while they may have disagreed about specifics, he, like Carlyle, believed wholeheartedly in the interconnectedness of phenomena. Carlyle's achievement, Tyndall suggests, was providing a contemporary literary and philosophical context for a scientific understanding of such a 'primeval' force's mutable nature, and, even more significantly, for suggesting something of the wholly self-enclosed 'anatomy' of our world's (and, by materialistic extension, our universe's) network of thermodynamic exchange, of the fact that everything, by definition, is inextricably enmeshed, a 'ganglion' within 'the great vital system of Immensity'. Indeed, such an overarching belief in continuity, Tyndall speculates, is what allowed a man like Carlyle, despite his preternatural, even knee-jerk, 'dislike of anything savouring of materialism […]' (*NF*, p. 374), to nonetheless concede the rightness of his observations about the illogic behind the concept of spontaneous generation; hence, 'the conclusion to which […]

[Tyndall's] experiments [on spontaneous generation] pointed', he explains, 'that life was derived from antecedent life, and was not generated from dead matter, fell in with his [Carlyle's] notions of the fitness of things. Instead therefore of repelling him, the experiments gave him pleasure' (p. 351).

In parallel with this process of scientific rehabilitation, Tyndall engages in a spot of moral redaction as well. 'And now I come to the charge so frequently made against him [Carlyle], that he was the apostle of Might', Tyndall, persisting in the role of impromptu apologist, writes in 'On Unveiling the Statue of Thomas Carlyle' (*NF*, p. 396). Certainly, he concedes, martial virtues were prominent in the man's philosophy – Darwin, for one, could fixate on little else; in his *Autobiography* he recalled that Carlyle's 'views on slavery were revolting. In his mind might was right' (p. 67) – but such prominence, Tyndall insists, was the result primarily of a sense of cultural pragmatism combined with a keen awareness of history, not inherent bellicosity. More than that, in Carlyle there remained an overriding assumption that, on a meta-historical level, strength – military or otherwise – is only efficacious if coupled with moral steadfastness and good virtue.

The scientist dedicated the dozen or so lines concluding his poem 'A Morning on Alp Lusgen' to making this point, if somewhat oddly (through decidedly martial analogies and a sideways glance at Napoleon):

> You [Carlyle] spoke of Might and Right; and many a shaft
> Barbed with the sneer, 'He preaches force – brute force,'
> Has rattled on your shield. But well you knew,
> Might, to be Might, must base itself on Right,
> Or vanish evanescent as the deeds
> Of France's Emperor. Reflect on this,
> Ye temporary darlings of the crowd.
> To-day ye may have peans [sic] in your ears;
> To-morrow ye lie rotten, if your work
> Lack that true core which gives to Might and Right
> One meaning in the end. (*NF*, p. 500)

Tyndall justifies such a cheering interpretative slant by allusion to an assertion in Carlyle's *Chartism* (1839), made in the text by another in the author's pantheon of fictitious interlocutors, a 'Herr Professor Sauerteig': 'Might and Right do differ frightfully from hour to hour; but give them centuries to try it in, they are found to be identical' (pp. 158 - 59; qtd. in *NF*, p. 396). But, ultimately, for Tyndall, it is the precepts of evolutionary theory, not those of economic, social or political philosophy, which confirm the propriety of Sauerteig's/Carlyle's 'melioristic' historiography: '[A]dvocacy of Might is not, in the abstract, offensive', he writes,

'for it meant at bottom the assertion that, in the end, that only is mighty which has the "Law of the Universe" on its side. With Carlyle, as with Empedocles, Lucretius, and Darwin, the Fit survive' (*NF*, p. 396).

His historical evolution, however, despite Tyndall's best efforts to reinterpret it otherwise, seems, if anything, proto-Lamarckian, guided by will and consensus, not aleatoric sequences of mutation, accidents of fertility or auspicious circumstance. Similarly, Carlyle's 'energy' was not materialism's. Nor was his 'force', at least not fundamentally. Rather the presence of such terms in, say, *Sartor Resartus*'s sartorial-aesthetic vocabulary – as Holloway observes in *The Victorian Sage*: 'Time and again Carlyle's images are of some power or force or energy, disorderly perhaps, but passionate, violent, irrepressible' (p. 28) – served to articulate Carlyle's belief in, beyond matter and the measurable, things – *essential* things – non-material and stupendous. Through constant iteration, like Homeric epithets, words and images such as these accumulate significance, becoming refrains and responses, the recruiting slogans for a cosmological sect repudiating, on one level, mechanistic interpretations of lived reality, while conceding, on another, a local, pragmatic utility for such interpretations; always they function to pose the insistent question: 'Are we not spirits, shaped into a body, into an Appearance; and that fade away' – Teufelsdröckh's language here melting into that of *The Tempest*'s soliloquy, itself quoted at the end of 'Natural Supernaturalism' (the keystone chapter in *Sartor Resartus*) – 'again into air, and Indivisibility?' (p. 200).

Tyndall's readings, and handlings, of Carlylean argumentation, in other words, can seem selective and incomplete, even dishonest. Sawyer makes this point as well, asking the apposite, if rhetorical, question: 'In his readiness to exchange Carlyle's metaphors for scientific terms – Energy for Force, or the philosophy of Might for the survival of the fittest, or the Unity of All for the Conservation of Energy – does Tyndall sacrifice the emotional power of the original vision and reduce both science and religion in the process?' (p. 241).

Carlyle was inconsolably terrified by the prospect of an ateleological universe (a possibility precipitating 'The Everlasting "No"' which had reduced Prof. Teufelsdröckh to dejection, and near suicide). He judged such a purposeless world, one beyond the reach of human agency and, apparently, malignly oblivious to all common concerns, 'unendurable', a 'permanent Injustice' visited by 'an Infinite Power', and counselled:

> If men had lost belief in a God, their only resource against a blind No-God, of Necessity and Mechanism, that held them like a hideous World-Steamengine, like a hideous Phalaris' Bull [a fabled method of torture and execution], imprisoned in its own iron belly, would be, with or without hope, – *revolt*. They could, as Novalis says, by a 'simultaneous universal act of suicide,' *depart* out of the World-

> Steamengine; and end, if not in victory, yet in invincibility, and unsubduable protest that such World-Steamengine was a failure and a stupidity. (*Chartism*, p. 134)

Loss of faith in God is here – a characteristic equation in the writings of Carlyle – a proxy for the failure of divine Providence, for modern science's enervating revelation of a world incommensurable with older or more humanistic concerns. It is, in effect, a shorthand for the universe of philosophical materialism, a cosmos of the specification popularly, if in large measure misleadingly, associated with the names of John Tyndall and Charles Darwin, Herbert Spencer and T. H. Huxley.

Carlyle, obviously, was never able to respond to Tyndall's acts – in poetry, and such articles as 'Personal Recollections' – of posthumous reinterpretation. If he had, no doubt he would have reprimanded Tyndall, perhaps reiterating the reproachful words of Teufelsdröckh: 'We speak of the Volume of Nature: and truly a Volume it is, – whose Author and Writer is God. To read it! Dost thou, does man, so much as well know the Alphabet thereof?' (*Sartor*, p. 195). Tyndall, earlier in life, had answered Carlyle's challenge with a trace of triumphalism. In a journal entry from 1848, he reiterated an explanation he had given his students at Queenwood College when asked about his decision to pursue a doctorate at the University of Marburg: '[W]hat are sun, stars, science, chemistry, geology, mathematics, but pages of a book whose author is God! I want to know the meaning of this book, to penetrate the spirit of this author and if I fail then are my scientific attainments apple rinds without a core' (qtd. in Barton, p. 127).

Long before the time of his Address at Belfast, however, such hubris had been chastened into something approaching humility, his deistic certainty into winsome nostalgia for lost theological consensus; his stance had begun to evince both guardedness about the possibility of unimpeachable physical knowledge and ceaseless acknowledgement of the human need for something more than unimpeachable physical knowledge.

A letter written 17 April 1859, seven months prior to the first edition of *The Origin*, that hinge of nineteenth-century thought, gives particularly unambiguous voice to these 'Carlylean' reservations about materialism's adequacy as guiding doctrine. Telling of Tyndall's peregrinations on another restorative holiday, this time in the Lake District, where topographies can seem ghosted through with an ineffable aura of transcendentalism, it finishes in a diminutive peroration evoking obliquely the 'spinning' symbology of Thomas Carlyle. In his writings, the loom, a (too obvious) totem of incipient modernity and material improvement, becomes also, and relatedly, an icon, on a corporeal level, of dehumanising industrial machineries. On a

non-corporeal one, cloth, the loom's output, becomes an agnate – equally loaded – symbol: simultaneously, a metaphor for the integrity and deep connectedness of the cosmological 'fabric', and a metonym for the inseparable (if, potentially, hoodwinking) interweaves constituting the 'smooth' manifold of Newtonian 4-D 'spacetime'. '[Y]our two grand fundamental world-enveloping Appearances, SPACE and TIME […]', Teufelsdröckh says of these homologies, 'spun and woven for us from before birth itself, to clothe our celestial ME for dwelling here, and yet to blind it, – [which] lie all-embracing, as the universal canvass, or warp and woof, whereby all minor Illusions, in this Phantom Existence, weave and paint' (*Sartor*, p. 197).

'[T]here was something in the nature of the light which gave the mountain [Helvellyn] a light and unsubstantial appearance', Tyndall's Lakeland missive concludes (his phrasing once again deliberately evoking both *Sartor Resartus* and Prospero's peerless speech), 'as if it indeed consisted of ether in a slightly more condensed form […]. There is something in this universe different from the spinning of cotton, different also from the investigation of mere physical law. But I wont [sic] moralize' (Letter, 17 April 1859, pp. 1957 - 58). Teufelsdröckh had similarly rebelled, denouncing those who insist, following (among others) the reductive materialism of de la Mettrie's *L'Homme machine* (1748), that human life – more pointedly, that human sentience – was the production of a physiological clockwork; he raged against the conjecture that 'I am a mere Work-Machine, for whom the divine gift of thought were no other than the terrestrial gift of Steam is to the steam-engine; a power whereby cotton might be spun […]' (*Sartor*, p. 196).

The scientist's chastened, even flustered 'apology' for inadvertently donning mid-letter a garment entirely inappropriate for the preening naturalist, those worn vestments – flaunted by C. H. Hinton, among countless other contemporary intellectuals – of 'humanistic' or 'spiritual' distress, shows that, on occasion, both he and Carlyle/Teufelsdröckh were wont to frequent the same tailor.

FIRST MAN AS TYPE OF SMITH

Despite the persistence – and ineradicability – of difference, the scientist was always one to idolise Carlyle. His influence – and that of his writings – is inescapable in Tyndall's thought. As Gillian Beer has noted: 'Metaphor, translation, chiasmus, heterogeneity of reference: such are the modes by whose means Carlyle translates the reader from the fixed grid of here and now' (*OF*, p. 207). These are techniques, particularly evident in less rote or 'procedural'

specimens of his prose, which Tyndall seems to have internalised as well, presumably in part through literary encounters with the Sage of Chelsea. The Belfast Address, for instance, a survey of materialism beginning in pre-history and culminating in that sacred moment of the scientist's oration, invites comparison with *Sartor Resartus*'s overview of 'clothes philosophy', incorporating such Carlylean rhetorical devices as an interpolated dialogue between a disciple of Lucretius and Bishop Butler, demonstrating a comparable polyglot multiculturalism in its resources.

In addition, it derives its spiritual and ethical underpinnings, admittedly to subtly divergent effect, from the same 'German Renaissance' philosophers and thinkers – Fichte, Schiller, Goethe – that had been so vital, earlier in the century, in restoring 'faith' to a questing Carlyle. That faith, theretofore compromised, was 'in a transcendent spiritual order which underlay the apparent world and gave it whatever reality it might possess' (Le Quesne, p. 18) – and it was existentially vital to Tyndall, too, and often equally under threat, even after decades of 'materialistic' progress.

Herr Prof. Teufelsdröckh's lonely walk across a benighted Schwarzwald likewise made a tremendous impression on the scientist, as did his apprehension, in the gloaming, of that forlorn 'fire which glows star-like across the dark-growing […] moor, where the sooty smith bends over his anvil' (p. 55). For, like heat-energy itself (mutable in manifestation, thrown off from the smithy and subsumed by the night-time air), kindred thermal allegories circulate and re-circulate throughout much of Tyndall's prose, both expository and descriptive, recuperating and making literal Carlyle's own penchant for fiery metaphor. Far more than sparks fly from a blacksmith's anvil, it seems, and blacksmithery – the tempering and shaping of malleable metals, achieved through a carefully mediated commingling of natural agency and strenuous effort (at once abstract and intellectual as well as back-breaking and menial) – becomes an unmistakably meticulous motif recurring prominently throughout the scientist's symbolic vocabulary.

And aptly so, in a world verifiably remade through the joint agency of steel and steam: witness its paddle-boats and railways and sewage pumping stations. (We observe, for instance, in Tyndall's poetic description of his trip to Wight, a document once again casting splendid illumination on aspects of common social experience, the rapid onset around mid-century of adolescence in the 'new economy' founded on mass-tourism, a wide-ranging cultural transformation predicated, in part, on the technological harnessing of heat: 'We reached the steamer [in Lymington] where with heart of fire / Beside the quay she lay. A human swarm /

Already filled her decks, and we to swell / The throng stepped forward […]' ['DP', p. [2]].) Strikingly, Faraday, Tyndall's immediate predecessor as Professor at the RI, was himself the son of a smith, a fact the two men both made much of from time to time. It is interesting to note how he – and this was a passage particularly dear to Tyndall's own heart; he cited it in full in a review of Bence Jones's *The Life and Letters of Faraday* (1870) – moved all but effortlessly from almost banal celebration of the quaintly picturesque charms of rural life, through a meditation on blacksmithery, to an aside which, as his protégé would later suggest, seems to embrace nothing less than the universe entire, thereby elevating the modest details of journalistic autobiography into something approaching a grand statement on the human condition:

> They dry fruits here [Interlaken, in Switzerland, a village in the shadow of the Jungfrau] in the sun, as cherries, apples, pears, &c.: for this purpose they spread them out on boards surrounded by little raised ledges. These boards are blackened, that they may absorb the rays of the sun and become hot.
>
> Clout-nail making goes on here rather considerably, and is a very neat and pretty operation to observe. I love a smith's shop and anything related to smithery. My father was a smith.
>
> (qtd. in Jones, 2: 146)

John Tyndall, years later, remarked rather dizzily on what seems an ineffable expansion of grammatical and, perhaps, anthropological reference: 'This [entry]', he observes in his review, 'is from his [Faraday's] journal; but he is unconsciously speaking to someone – perhaps to the world' (*FoS*, p. 367). That Faraday should from time to time have referenced blacksmithing was inevitable; after all, as observed in a recent biography, '[w]e do not know how much time Faraday had spent with his father in the smithy, but the family had lived over the shop for years, and the sounds, sights, smells and conversations were close at hand' (Hamilton, p. 154).

By contrast, Tyndall's own preoccupation, ungrounded in any form of biographical detail, was pointedly not so much reflective as ideological and ostentatiously applicable to his own understanding of naturalism. It had its roots in that dualism discussed earlier, that necessary wedding, or welding, of action with agent, of *Kraft* ('puissance') with *Stoff* ('substance' or 'material'). (*Stoff*, moreover – in a fine, and Carlylean, pun – can be translated as 'cloth' or 'textile' as well.) Like a blacksmith, then, thermodynamic or 'structural' force acts with 'deliberation' on the raw molecular resources of the cosmos, shaping things into themselves. There was an element of nostalgia, too: even in the mid-nineteenth century, the solitary blacksmith was increasingly a figure of folklore, cultural memory, not daily experience; as John Light observes: 'When one considers […] that a smith from the late 19th century had many tools and machines not available to earlier craftsmen […] then it is not at all fanciful to

observe that the general blacksmith of 1800 probably had more in common with his ancestor of 1,000 years than he did with his direct descendant of 100 years' (p. 662). *Sartor Resartus*'s Schwarzwald artificer thus became, for Tyndall, a fulcrum of continuity, uniting past with present, energy with matter, in a hammer-blow.

'The art of the smith is the most ancient of human handicrafts […]', so it was characterised in *The Smithy and Forge*, a technical treatise of 1883 (Crane, p. v). It is transformed into something far more noble than even that, however – becoming an endeavour both interpreted and described in a broadly mythological, if not archetypal, fashion – in one memorable illustration central to Tyndall's well-wrought essay on the curious biological principle (thoroughly discredited, from his own point of view) of 'vitality', or living-force:

> To most minds, however, the energy of light and heat presents itself as a thing totally distinct from ordinary mechanical energy. But either of them can be derived from the other. By the friction of wood a savage can raise it to the temperature of ignition; by properly striking a piece of iron a skilful blacksmith can cause it to glow, and thus, by the rude agency of his hammer, he generates light and heat. This action, if carried far enough, would produce the light and heat of the sun. (*FoS*, p. 437)

His final sentence is revelatory, taking Carlyle's abstract fable of continuity and showing the manner of its literal truth. Teufelsdröckh's allegories of perpetual transmutation – 'with Iron Force, and Coal Force, and far stronger Force of Man, are cunning affinities and battles and victories of Force brought about' (*Sartor*, pp. 55 - 56) – become, in the precise terminology of Tyndall's scientific re-inscription, wholly quantifiable processes of exchange and substitution, the sort of dry subject-matter fit for accountants and City clerks, not merely metaphysicians and Oxbridge theologians.

Tyndall was not the first scientist to avail himself of such imagery. Tait and Thomson, in an 1862 article in *Good Words*, wrote in language probably plagiarised by Tyndall ('Vitality' first appeared anonymously in *The Reader*, on 29 October 1864 [Barton, p. 130*n*55]): 'Thus the savage who lights his fire by rubbing together pieces of dry wood, expends his muscular energy in producing heat. By mere hammering, a skilful smith can heat a piece of iron to redness' (pp. 603 - 04). What Tyndall adds is the further step, and it's a doozy: to the flames of the sun. (This extrapolation was also, perhaps, influential: C. William Siemens, in 1882, promulgated a theory of 'fan-like' solar maintenance based on the 'action of the heat recuperator in the regenerating gas furnace' [p. 22], a concept culturally appealing, but entropically verboten.)

And implicit in Tyndall's passage we apprehend as well another recurrent theme: a hint that man (on some primal level) is, by his very nature, a type of smith, a maker and

manipulator of fire. F. W. H. Myers, in a stanza from an unpublished poem, captured this sentiment adroitly:

> I [?learnt] the inheritance of fire
> From wise Prometheus falls again; –
> A single and a last desire
> Unites me with primaeval men. (['Sometimes'])

Conversely, the transition from ape (or *Australopithecus*) to skilled artisan is, in a manner of speaking, both correlated with, and occasioned by, blacksmithery, not to forget its many associated competencies. Carlyle put it thusly, his half-rhetorical ponderings closely in line with Tyndall's: 'Or was the smith idle, hammering only wartools? He had learned metallurgy, stithy-work in general; and made ploughshares withal, and adzes and mason-hammers' (*Chartism*, p. 158). Some nineteenth-century anthropologists (Max Müller memorably characterised two of their theories as the 'pooh-pooh' and 'bow-wow' [*Lectures*, 2: 93]), following on from Lord Monboddo's insights in the eighteenth, attributed the ascent of man to, say, the onomatopoeic origination of speech, or an urge towards animal mimicry, or some insuppressible human need for music-making.

Tyndall, however, would give to fire-starting and steel-tempering and iron-forging that role of vital evolutionary boost. And the fact that, in miniature, Faraday's personal progress (from working-class son of a London smith, to journeyman bookbinder, to pre-eminent natural philosopher of his age) paralleled *Homo sapiens*' own slow cultural and social advance since the time of the last glaciation would, for Tyndall, have added poignancy, and grace, to the comparison.[3]

Even Tyndall's lowly savage, we note, holds, potential, in the palm of his hand, the transformative flames of the sun – a vast store of heat-energy which is itself re-imagined, in any sufficiently rigorous tabulation (such as that mandated by contemporary thermodynamic science), as little more than a further line-entry in that cosmic ledger, from which subtractions, and to which additions, could be (and are) unfailingly made. From such a perspective, Tyndall explains, 'The energy of Nature is a constant quantity, and the utmost man can do in the

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[3] 'Everyone now knows', Tyndall wrote at the start of his review (appealing to the necessary and culturally affirming myth in skewed or hierarchical societies of the 'poor boy made good'), 'the story of the philosopher's [Faraday's] birth; that his father was a smith; that he was born at Newington Butts in 1791; that he slid along the London pavements, a bright-eyed errand boy, with a load of brown curls and a packet of newspapers under his arm […]'. Tyndall's narrative, indeed, seems almost Dickensian in its sweep, right down to the detail of the 'lad's' (his term) stern yet understanding taskmaster, 'a kindly man, who became attached to the little fellow and in due time made him an apprentice [bookbinder] without a fee […]' (*FoS*, p. 349).

pursuit of physical knowledge, is to shift the constituents of the never-varying total, sacrificing one if he would produce another' (*Heat*, p. 503) – and anyone who thought otherwise might as well, as he phrased it in his (frequently ribald) exposé 'Science and the Spirits', 'maintain the story of "Jack and the Beanstalk" in the face of all the science in the world' (*FoS*, p. 435).

Carlyle likewise chafed at those who thought the universe little more than an unconnected assemblage of random occurrences spread haphazardly throughout space and time, filled with detritus past use, the tattered end-products of exhausted chemical, biological and physical processes. Instead, such remnants, he insisted, were not worthless debris, destined to be no longer considered part of any useful ordering, but rather, when '[r]ightly viewed', humble tokens of Being itself:

> The drop which thou shakest from thy wet hand, rests not where it falls, but to-morrow thou findest it swept away; already, on the wings of the Northwind, it is nearing the Tropic of Cancer. How came it to evaporate, and not lie motionless? Thinkest thou there is aught motionless; without Force, and utterly dead? […].
>
> Detached, separated! I say there is no such separation; nothing hitherto was ever stranded, cast aside; but all, were it only a withered leaf, works together with all; is borne forward on the bottomless, shoreless flood of Action, and lives through perpetual metamorphoses. The withered leaf is not dead and lost, there are Forces in it and around it […]. Despise not the rag from which man makes Paper, or the litter from which the Earth makes Corn. Rightly viewed no meanest object is insignificant; all objects are as windows, through which the philosophic eye looks into Infinitude itself!
>
> (*Sartor*, pp. 55 - 56)

Although Tyndall, in an analogous passage, replaces Carlyle's inchoate 'force' with the more thermodynamically specific concept of heat, he, too, like his predecessor, requests that we permit our inner 'philosophic' (or, in his terminology, 'mental') eye to track its gradual progress.

We are then shown a carefully delimited sequence of such 'perpetual metamorphoses':

> The mental eye can, indeed, follow the emission [of heat] from its source, through the ether as vibratory motion, to the ocean, where it ceases to be vibration, and takes the potential form among the molecules of aqueous vapour; to the mountain-top, where the heat absorbed in vaporization is given out in condensation, while that expended by the sun in *lifting* the water to its present elevation is still unrestored. This we find paid back to the last unit by the friction along the river's bed; at the bottom of the cascades where the plunge of the torrent is suddenly arrested; in the warmth of the machinery turned by the river; in the spark from the millstone; beneath the crusher of the miner; in the Alpine saw-mill; in the milk-churn of the châlet; in the supports of the cradle in which the mountaineer, by water power, rocks his baby to sleep. All the forms of mechanical motion here indicated are simply the parcelling out of an amount of calorific motion derived originally from the sun; and at each point at which the mechanical motion is destroyed, or diminished, it is the sun's heat which is restored.
>
> (*Heat*, p. 493)

In short, we have an interplay of literary tropes with armchair *Gedankenexperiment*, of a nineteenth-century scientist's personal prejudices with nineteenth-century scientism's impersonal

'truth'. Observe, for instance, how Tyndall moves, in the course of explanation, from a pair of examples drawn from (quintessentially Victorian) heavy industry ('the warmth of the machinery', 'the crusher of the miner'), to another associated mainly with a conventional domestic space ('the milk-churn of the châlet'), and, finally, to one firmly anchored in that most sacrosanct and homely domain of them all, the bedroom of a newborn child ('the supports of the cradle in which the mountaineer […] rocks his baby to sleep') – all by way of telling references to millstones grinding iconically away. Note also the financial vocabulary, the way heat becomes a finite, parsimoniously conserved commodity, one that is at first 'parcell[ed] out' and then, in due time, 'paid back to the last unit'.

Even so, as he had done with Carlyle's teachings on historical change, Tyndall, in attempting to parallel (or buttress) his own convictions regarding the conservation of energy with those implicit in 'Teufelsdröckh's' transcendentalism, perpetuates a subtle, perhaps totally subconscious, act of misconstrual and faulty transmission. His conception of cosmic wholeness, as noted earlier, was never precisely equivalent to that of the First Law. (Carlyle had written, for instance, in *On Heroes and Hero-Worship* [1840] of our estrangement as conscious beings from the reductively or mechanistically material, not Tyndall's unity with such things, giving as his definition of the universe: 'That it is a Force, and thousandfold Complexity of Forces; a force which is *not we*. That is all; it is not we, it is altogether different from *us*' [p. 8].)

However, though such a wilful misrepresentation on the scientist's behalf might seem uncharitable, it was far from unprecedented.

Even the aggrieved Carlyle had himself been prone, throughout his career, to committing a comparable indiscretion. He, too, from time to time, mangled teachings, vernaculars and metaphors derived – or inherited – from his own illustrious spiritual and stylistic 'progenitors'. A. L. Le Quesne remarks:

> He [Carlyle] repeatedly distorted and coarsened their distinctions and definitions, usually in the interest of deriving a simpler moral message from them […]. Carlyle's habitual method was to seize on isolated ideas and phrases from their work – *Entsagen* (renunciation), *Selbsttodtung* (self-annihilation), *Ernst ist das Leben* ("Life is earnest"), and so on – lift them out of context, and reinterpret them in ways that suited him […]. (p. 31)

Nonetheless, for all their divergences, these were both writers convinced of the beauty of a principle that either coheres with – or could be construed as precursor to – the doctrine of energy conservation, even if Tyndall conceptualised energy, and energy conservation, far more expansively, tracing all present motions, animate and inanimate, back to solar potency.

Yet the sun itself, as he would have insisted, represents a far from infinite – though, in

all fairness, still unimaginably bountiful – reservoir of obtainable warmth. Tyndall asked, his science as yet unable to answer (the radiative emission from, and disaggregation of, uranium salts not being discovered till 1896), a question of staggering contemporary import towards the close of his textbook *Heat*. ('As soon as it was realised [by scientists] […] that the sun was running down, it became important to them to discover the source of its energy', as Frank James has summarised, with little understatement ['Thermodynamics', p. 174].)

> [H]ow is its [the sun's] […] [fire] maintained? How is the perennial loss [of mass through 'combustion'] made good? We are apt to overlook the wonderful in the common. Possibly to many of us – and even to some of the most enlightened among us – the sun appears as a fire, differing from our terrestrial fires only in the magnitude and intensity of its combustion. But what is the burning matter which can thus sustain itself? (*Heat*, p. 478)

So, while Tyndall's science could calculate to the erg the expenditure of energy required to raise a climber from the base to the summit of Mont Blanc (equal to that 'derived from the combustion of about two ounces of carbon' [p. 499]), it could not even begin adequately to explain the origin of 'solar light and heat', two phenomena, of course, which in consort constitute 'the very mainspring of […] life' (p. 495).[4]

These, presumably, were questions with answers. Other riddles, however – and this, as discussed in chapter two, would be a paramount theme at Belfast as well (though one often overlooked by commentators) – require more for 'resolution' than mere empiricism or molecular theory. 'As regards knowledge', Tyndall explains in 'Vitality', 'physical science is polar. In one sense it knows, or is destined to know, everything. In another sense it knows nothing. Science knows much of this intermediate phase of things that we call nature, of which it is the product; but science knows nothing of the origin or destiny of nature' (*FoS*, p. 442). Hence, science, as he conceived it, is at once omniscient ('it knows') and ignorant (it 'knows nothing'), though this dualism for Tyndall did not present any intractable paradox, nor did it invalidate (or belittle) the unsurpassed progress already made under a materialistic banner. He announces boldly, for instance, in the concluding sub-section of *Heat: A Mode of Motion*, that, 'presented rightly to the mind, the discoveries and generalisations of modern science constitute a poem more sublime than has ever yet addressed the human imagination. The natural philosopher of to-day may dwell amid conceptions which beggar those of Milton' (p. 502) – the key phrase, of course, being Tyndall's first: 'presented rightly to the mind'.

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[4] He once computed that he could ascend a particular peak in the Alps on the energy derived from eating nothing more than a single sandwich. He then did precisely that, just to prove his point. (This famous anecdote, incidentally, is the sole reference to Tyndall in Adam Hart-Davis's *What the Victorians Did for Us* [2001; p. 72].)

Who, then, given the evident insufficiency of Milton, certainly in an ontological sense (with reference to things that are: a domain now triumphantly annexed by science), could give warmth and quasi-religious fullness to what must have seemed to many Victorian minds the essential poverty of such a 'beggaring' combination of beliefs?[5] This was that brew of unrelieved Baconianism, 'Lucretian' materialism, and the 'new' biology and cosmology of mid-century, so central to Tyndall's thought – and, increasingly, or so it seemed, to the thought of science more generally.

'[A] CELESTIAL COAL FOR EVER BRIGHT': THE VICTORIAN SEER AS TYPE OF SUN

Carlyle, for one, seemed to Tyndall, seemed to many, an ideal seer to reveal these emergent connections between religion and science. ('Professor Tyndall calls him our greatest spiritual teacher', as W. M. W. Call observed in an article of 1881 [p. 486].) He, on several occasions, imagined him a prophet. Carlyle, for instance, was once the featured speaker at a graduation ceremony at the University of Edinburgh, a ceremony at which both Tyndall and T. H. Huxley were to receive honorary degrees. Nonetheless, on the day, Tyndall, though undeniably thrilled by the prospect of personal academic recognition, found himself for a few moments far more intrigued by the audience's reactions to Carlyle. Sitting before ranks of graduands, 'Looking […] at the sea of faces below me – young, eager, expectant, waiting to be lifted up by the words of the prophet they had chosen – I [Tyndall]', as he explains in his essay 'Recollections', 'forgot all about the degrees [to be conferred]' (*NF*, p. 363).

'Let the world say what it will regarding Carlyle', he wrote in a letter of 18 May 1862 to Juliet Pollock, 'I am not acquainted with his equal. Among my acquaintance in the literary world which of course is but a small acquaintance he has nothing like an equal – an intellect of the very strongest fibre horsed on an imagination of the most fiery quality […]' (pp. 1992 - 93). Such equine imagery is arresting: reason as stalwart knight astride animal imagination, bridled yet impetuous. He, elsewhere, utilises precisely the same conceit in a portrait of able scientific rationality as well, a process in which imagination is understood by him to be investigative endeavour's absolutely necessary accompaniment. (This is a theme exemplified in his discourse 'On the Scientific Use of the Imagination', with, as phrased in the third [1872]

[5] In a lecture of 1869 at London University, Tyndall strongly cautioned his audience (invoking Milton's manifesto in *Paradise Lost* 1.26) against those ubiquitous, if scientifically and theologically retrogressive, 'expounders of the ways of God to men, who offer us intellectual peace at the modest cost of intellectual life' (*FoS*, p. 105).

edition, its intriguing definition – subtly steeplechasing – of science as 'a leap of the prepared imagination' [p. 6].)

In a notebook entry of October 1887, Tyndall explains:

> The term imagination has been discredited by the misuse of the faculty. Pranks have been played with it in all ages of the world, and pranks will continue to be played with it to the end of time. But side by side with those who make this illegitimate use of imaginative power, others have existed, and will exist, who have taught us, and will continue to teach us, how to use it aright. Instead of suffering themselves to be carried away by it, ~~such men direct and rule~~ <these stronger ones, when they use it govern> the force of imagination as a mighty rider controls and guides his charger with bit and rein. To such spirits, adventurous and ~~strong~~ <firm>, we are indebted for our deeper knowledge of the methods by which the physical universe is ordered and ruled. ('Sky')

Here, again, Tyndall affirms that the scientist and the poet bring similar aptitudes to bear on explicating and categorising phenomena; both use their peculiar talents to frame new approaches, new languages – literary or mathematical, abstract or representational – which gradually enter the wider vernacular.

But a perhaps more apt analogue for a social prophet like Carlyle – and one which likewise appears commonly in Tyndall's prose – can be found in solar phenomenology, in images of the sun. The sun, after all, he reminds us, a ball of 'living fire' seeming far more than the site of mere burning, is not simply an example of terrestrial combustion writ large. Rather, it is an (in every practical sense) inexhaustible source of vital energy, the source and fount of everything. A popular astronomical work by Richard Proctor, *The Sun: Ruler, Fire, Light, and Life of the Planetary System* (1871), encapsulates much in its title of the central orb's prominence in the cultural, scientific, literary and, indeed, mythic imaginations of the period (and, correspondingly, their multiform discourses as well), providing further confirmation of the cultural heliotropism addressed in this dissertation's opening chapter. Moreover, Tyndall was, if anything, perhaps the most influential (and, surely, the most eloquent) among that broad-based fascination's instigators and exponents in mid- to late-Victorian intellectual life.

A self-conscious solarism, for instance, informs this description of his initial sighting, on the trip to Wight, of Tennyson's house. Told that evening by his travelling companion, Mr Wright, of its proximity, and with vision constrained by the superstructure of the carriage in which he was riding,

> I tried my best
> To see the house, but beech and cedar flung
> Their sheltering arms between the road and house.
> I saw a corner gleaming through the trees,
> It went – a second for a moment came,

> And that was all, still it was something worth
> To glance upon the corner of a house
> Which holds a poet. One in whose clear mind
> Burns a celestial coal for ever bright!
> No smoke, no glare, but smoke and glare condensed
> To living fire which warms the souls of men. ('DP', p. [7])

We note in his description the equivalence between the qualities of the sun as (mis)understood by nineteenth-century science ('a celestial coal for ever bright') and those of Tennyson's 'clear mind'. Its illumination, like that provided by the sun itself, demonstrates neither 'glare' nor 'smoke', appurtenances (trochaically emphasised) of terrestrial fires – and, by extension, common, muddled apprehensions. It continues on, rather, serenely undiminished: a 'living fire which warms the souls of men'. Indeed, in his dedicatory essay 'On Unveiling the Statue of Thomas Carlyle', though a much later work, he likewise deployed conspicuously solar iconography in posthumous tribute: 'A friend and I agreed some time ago to describe him [Carlyle] as "dynamic," not "didactic" – a spiritual force, which warmed, moved and invigorated, but which refused to be clipped into precepts' (*NF*, p. 394). Light and energy from the sun, of course – similarly irreducible, equally 'dynamic' – share these same animating attributes. If man is by nature a type of smith (an image, some decades later, to inform Stephen Dedalus's conception of transcendentally impersonal artistry in Joyce's *Portrait of the Artist as a Young Man*), then the true seer, it would seem, is a type of sun.

Tennyson's residence, situated along a road from Freshwater to Alum Bay, was destined to become (much to its owner's displeasure) one of the Isle of Wight's premier tourist attractions, though it was still not quite that when Tyndall made this visit in early summer 1856. 'The Poet Laureate […]', Marianne Lane explains in *Piers of the Isle of Wight* (1996), 'and his family came to live at Farringford, Freshwater in 1853, where they entertained many important guests, including H. R. H. Prince Albert, Charles Darwin, Charles Kingsley, Edward Lear and celebrated artists such as Holman Hunt, G. F. Watts and Millais […]' (p. 7). Tyndall was himself invited, in 1858, to join such an elite – and deliciously eclectic – group.

He describes a discussion that evening in an undated letter to Mrs Pollock, presumably of May 1862:

> After Mrs. Tennyson went away we continued to talk, and after that again I ascended to the upper story, into the poet's own holy place; here he filled a pipe for me, lighted it himself and transferred it to my lips, and we smoked and talked for another hour. We talked of Maud and its critics[,] of peotry [sic], of Mr. Buckle's lecture, which he and [?Jowett] had glanced at and thought empty, of Christianity and the influence of the imagination. Tennyson does not dazzle, but there is that about him which pulled me like the force of gravity – a thorough candour and brotherliness, if I may use the expression, an absence of all artificial fences, so that there is no hindrance to the play of natural affinities.

Tyndall's prose again evokes the celestial, if somewhat less exuberantly (a slight change in register perhaps a consequence, not merely of the more restrained rhetorical standards of an epistolary context, but also the demythologising impulse associated with personal familiarity). Tennyson, he suggests, like the all-pervading central force of solar gravitation – that which caused the sun and planets to condense out of the primordial nebula in the first place, and which has ever since governed them magisterially in their orbits – is naturalised, made an irresistible, even universal, phenomenon.[6]

And the transference of the lit pipe, replicating (perhaps unintentionally, certainly with a degree of whimsy) the Promethean myth, also recapitulates in miniature the actions of our solar furnace day in and day out.

PROMETHEUS UNSOUGHT

'No one can stop us now / 'Cause we are all made of stars'.
- Richard Melville Hall [pop star 'Moby'], 2002

Nonetheless, Tyndall's cultural historiography, conditioned in large part by his intractably materialistic interpretations of mid-century cosmology and evolutionary theory, mandated a 'Promethean' myth with, at its heart, no Prometheus-figure.

Put another way, in his beginning, his Book of Genesis, there was the nebula, and only the nebula. Everything, literally everything, proceeded from that. (Modern astrophysicist-poet Rebecca Elson described creation's simplicity, and isolation, thus: 'Begin with particles which could be dust / Or stars, it makes no difference / And put them in a box from which they can't escape'.) As a natural philosopher, Tyndall conceptualised cosmogenesis from the top down, imagining the birth of the world in a 'fiery cloud', a cloud governed by the laws of gas dynamics, in which basic physical principles such as the conservation of energy held ineluctable dominion. For him, the starting point for extrapolation was not fossils in the ground, nor evidence of geological uniformitarianism (both ready-to-hand terrestrial indications of the earth's extraordinary antiquity), but rather a set of equations on a blackboard, themselves doctrines derived from repeated experiment. An analysis based on such principles,

[6] Not only did Tyndall envisage Tennyson in oddly stellar terms, the circumstances of their first meeting, to hear him tell it, even had a touch of the Newtonian – if not, maybe, the astrologically preordained – about them as well. Thinking back years later on the event, he observed: 'I had often wished to meet the poet, but had never made a move towards securing this pleasure. "It is wonderful," I remark in my journal, "how things gravitate in this world. Here is a great pleasure and a great privilege come to me without my seeking"' ('Glimpse', p. 471).

he wrote, would lead inevitably to the realisation that the planets were once 'parts of the same undislocated mass; that matter in a nebulous form preceded matter in a dense form; that as the ages rolled away, heat was wasted, condensation followed, planets were detached, and that finally the chief portion of the fiery cloud reached, by self-compression, the magnitude and density of the sun' (*FoS*, p. 159).

Speaking of these conjectures on solar and planetary evolution, he once famously posed the question: 'For what are the core and essence of this hypothesis?':

> Strip it naked and you stand face to face with the notion that not alone the more ignoble forms of animacular or animal life, not alone the nobler forms of the horse or the lion, not alone the exquisite and wonderful mechanism of the human body, but that the human mind itself – emotion, intellect, will, and all their phenomena – were once latent in a fiery cloud […]. Many who hold it [the nebular hypothesis] would probably assent to the position that all our philosophy, all our poetry, all our science, and all our art – Plato, Shakespeare, Newton, and Raphael – are potential in the fires of the sun. (pp. 163 - 64)

Tyndall's smith, in other words, his primordial man, had only nature from which to learn. There was no divine 'tap on the shoulders' telling him to do *this* and not *that* with the sputtering flame he had harnessed.

And, similarly, Tyndall's seers – his Tennysons and Carlyles, his Newtons and Darwins – had only collocations of matter from which their genius was derived.

Yet such figures also represent the process coming full-circle, as they themselves (and their works) become sites of origin, of potential and boundless intellectual encouragement. Generations untold, Tyndall insinuates, will be warmed by – and perceive things more clearly because of – their light (an Alfred, Lord Tennyson that 'does not dazzle'; a Michael Faraday whose 'fire was that of a solid combustible, not that of a gas […]' [*Faraday*, p. 179]), shining bonfire-like through centuries, across cultures and continents, illuminating diverse interdisciplinary cubby-holes. In a journal entry of 15 May 1847, Tyndall, referring to Carlyle, made such an analogy explicit in words at once tritely conventional and wholly his own: 'His position is sometimes startling – to many he will appear impious […]. I however thank the gods for having flung him as a beacon to guide me amid life's entanglements' (qtd. in Barton, p. 125).

But this sentiment is itself (at least, in part) neo-Carlylean, like so many other such 'Tyndallic' tropes. In the first lecture of *On Heroes and Hero-Worship*, that author had commented on the role of the courageous 'great man', even in a dilapidated age like the Victorian:

> But I liken common languid Times, with their unbelief, distress, perplexity, with their languid doubting characters and embarrassed circumstances, impotently crumbling-down into ever worse distress

towards final ruin; – all this I liken to dry dead fuel, waiting for the lightning out of Heaven that shall kindle it. The great man, with his free force direct out of God's own hand, is the lightning. His word is the wise healing word which all can believe in. (p. 12)

Fittingly, Tyndall (as W. T. Jeans observed in 1887) was himself destined to become a local luminary, one lesser light or flaring nova of brief though piercing radiance: '[B]y his [Tyndall's] writings he has probably done more than any other man in England to kindle a love of science among the masses […]' (p. 1).

Such figures brighten beyond their state; they make evident and ennoble; they inspire creativity and precipitate endeavour – and, in so doing, they take the place of those supernatural forces rendered irrelevant, though hardly superfluous, by the dictates of materialism, but so often invoked in such inspirational capacities.

'In regard to metaphors drawn from science, your father [Tennyson], like Carlyle, made sure of their truth', so Tyndall explains in another posthumous tribute-essay 'A Glimpse of Farringford, 1858; and "The Ancient Sage," 1885', a piece commissioned by Hallam, the poet's son, for a volume of memoirs:

To secure accuracy, he [Tennyson] spared no pains. I found charts in his room of isothermals and isobars intended to ensure the exactitude of certain allusions of his to physical science. In illustration of this, the late Lord Houghton, […] once told me that, having composed an exquisite poem upon a flower, Tennyson discarded it because of some botanical flaw. In comparing him with Carlyle, I notice that the latter drew his imagery, for the most part, from what we call inorganic nature. Physics and chemistry were well advanced when Carlyle wrote, but modern researches in biology had scarcely begun. These later fell into your father's hands, and he has made noble use of them from "In Memoriam" onwards. (p. 475)

Here, as he had done for Carlyle, Tyndall is attempting to rehabilitate Tennyson – though, to be fair, that poet's credentials (Fellow of the Royal Society, and so forth) never looked for a moment even half as suspect – as 'friend to science', or, at worst, regrettably, or intermittently, estranged confederate. Even he, however, has to concede that Tennyson was never entirely comfortable with the doctrines of scientific materialism, with those theologically destabilising ramifications derived from the nebular hypothesis, natural selection, organic evolution, the conservation of energy. 'Your father's interest in science was profound', he observes in the article, 'but not, I believe, unmingled with a fear of its "materialistic" tendencies. This, however, is to me a point of secondary importance' (pp. 469 - 70).

Why should this have been? Why, in other words, should the poet's 'fear' have remained relatively untroubling to such a committed and outspoken exponent of scientific naturalism, particularly one so notoriously prone to proselytising and prejudgement?

In the preface to the second edition of *Fragments* (reprinted in most later editions as

well), Tyndall gave definition to the shape of his 'ideal scientist'. He did the same for that of his 'ideal artist'. They are identical, hardly surprising given his predilections for poetry and the complementary nature of his own intellectual upbringing, with two ersatz fathers, Faraday and Carlyle (the first, a quintessentially 'masculine' scientist; the second, an equally 'masculine' artist-prophet), splitting his affections, each vying, perhaps, for the dominant role. (Tyndall's attitude towards Faraday seemed, as noted by Eve and Creasey, 'filial rather than brotherly' – arising out of a 'deep and sincere affection' [p. 124], despite troubling religious differences – while his behaviour towards Carlyle was, by many, identically characterised, T. H. Huxley describing it, in an obituary, as evidencing 'almost filial devotion' ['Professor', p. 3].)

> The problem which presses for solution is, how, amid the wreck of [religious] forms now imminent, to preserve the reverence and loftiness of thought and feeling which in times past found in those forms organic expression. This is not to be done by science only, still less by routine utterances about God and the human soul. From 'society,' or from aggregates of men in societies, whether 'Christian' or otherwise, no voice of guidance as regards this question can possibly come. But if nature have in store a man of the requisite completeness – equivalent, let us say, to Milton and Helmholtz rolled into one – such a man, freed by his own volition from 'society,' and fed for a time upon the wild honey of the wilderness, might be able to detach religious feeling from its accidents, and restore it to us in a form not out of keeping with the knowledge of the time. (*FoS*, pp. vi - vii)

As in his essay 'Vitality', we observe the same know/not-know duality, here extended, however, to encompass the non-scientific and synthesising alongside the scientific and reductionist. (We note also that this preface, dated May 1871, effectively epitomises the argument of his Belfast peroration, delivered late August 1874.) Tyndall, it seems, heard something rather cheerier on the shingles near The Solent in June 1856, from Matthew Arnold's 'melancholy, long, withdrawing road […]', ('Dover', p. 242; line 25) – words published in 1867 but, likely, composed in June 1851 (Allott, p. 239).

His 'man of the requisite completeness', though, even he concedes, has an almost Zarathustrian aura of realistic unattainability, a prospect of realisation, if ever, only at some point in utopic futurity. In the meantime, then, Tyndall would insist, and irrespective of the success or failure of such rehabilitative efforts as those he so often attempts, such 'solar' figures as Carlyle and Tennyson (or, on the other side of the aisle, Hermann von Helmholtz and Michael Faraday), are the nearest approximations which we, or the Victorians, could ever hope to find.

CHAPTER 5

TYNDALL AMONG THE GLACIERS: THE MID-VICTORIAN SCIENTIFIC MATERIALIST AS ROMANTIC SURVIVOR

> She wraps man in darkness, and makes him for ever long for light. She creates him dependent upon the earth, dull and heavy; and yet is always shaking him until he attempts to soar above it.
>
> - Goethe, 'Nature: Aphorisms'; Huxley's translation, 1869

An undated, unfinished draft letter found (misplaced?) between the pages of a bound volume of notebooks in the Tyndall Archives at the RI (and written in the hasty scrawl of that scientist) seems at first an isolated curiosity. It is tagged with the address of his Alpine holiday home: Alp Lusgen, Brieg, Switzerland. It lacks an addressee or salutation. Its text amounts to two full sentences, neither auspicious: 'There is gloom upon the mountains, gloom upon the glaciers, while clouds hang dusky fringes downwards from a heaven of gloom. Our hills are left [?with] us desolate, bald and bare, shorn of their herbage, forsaken by their flocks, with no sound save the dull hum of the distant torrent which sulkily shakes the air' ('Loose'). This is surely too precious (did he realise this? is that perhaps why it was left incomplete?): the alliteration in every clause; the grammatical and metrical identity between those two object-phrases taken by the initiating verb; the paired sibilances, both in 's', hissing menacingly, sandwiching that dental consonance made by 'dull hum' and 'distant torrent'; and, above everything else, the droning, liturgical cadence of it all, iambic and unrelieved. It seems a knowing parody of Romanticism, at once linguistically overwritten and symbolically over-wrought: too many gothic portents, too much adolescent 'literariness'.

Perhaps, one muses darkly, it was *deliberately* misplaced, if misplaced it was.

Nevertheless, more charitably, this brief fragment once again highlights Tyndall's care in composition, while hinting also at a number of the scientist's own (hardly suppressed) literary and philosophical influences.

By contrast, a Romanticism of a different sort – ideological this time, not just meta-

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Epigraph from Goethe, 'Nature', p. 9.

phoric, existing beyond the superficial plane of language and figuration – pervades this phrase from his landmark textbook, *Six Lectures on Light* (1873); it seems one expressing a fact at once tautologically true (modern science must, by definition, adhere to some first-hand conception of the external) and epistemologically suggestive: 'Indeed, it may be doubted whether the real life of science can be fully felt and communicated by the man who has not himself been taught by direct communion with Nature' (p. 219). William Wordsworth would have concurred, if perhaps substituting for 'science', 'poetry'. Tyndall's choice of 'communion' to characterise such behaviour is both apt and familiar; it looks simultaneously backwards towards the ideologies associated with poets earlier in the century and sideways towards prominent rhetorical and lexical proclivities explicit in his own writing. After all, as discussed in chapter two, those Manichean categorisations of good and bad personages in the history of science, of a black and white distinctiveness between correct and false physical knowledge, invariably evanesce into chiaroscuros of colour and shade – the 'azure' of the Belfast peroration, for instance – when subjects under discussion transcend empiricism, when they venture beyond the terrain (admittedly expansive) claimed as the sole provenance of materialistic investigation.

Gillian Beer, among others, has remarked on this, delighting in the scientist's literary resourcefulness, his playful erudition and sense of semantic expansiveness, tendencies marshalled, from time to time, in the service of evasiveness and chary equivocation. Such cultivated ambiguity, she notes, is to be discovered not merely at the level of denotated meaning but also within the wording of argumentation itself – in the impressionistic vibrancy of his linguistic palette, for example. Indeed, when caught wandering beyond the scientifically certain, monochromatic 'high-and-dry light' – Beer's phrasing here fittingly references that of the peroration at Belfast – 'is not Tyndall's medium; he prefers the liberal oscillation within sentences, the vigour of metaphor, and the ardent recomposition of ideas. To that degree his views temptingly ran alongside the religious, even while they repudiated religious authority' (*OF*, pp. 259 - 60).

Surrogate religiosity was a feature as well of the nineteenth-century Romantic tradition, as many of the more perspicacious thinkers of the age intuitively understood, and it is with this tradition that Tyndall's 'scientific' sentiments seem sometimes most pleasingly to harmonise. This chapter, then, is an exploration of borderlands in his thought, focusing more generally on the latent – or, as I argue, reconstituted – romanticism inhering in Tyndall's interpretations and elucidations of nineteenth-century naturalism. The power of place, embodied in sites of enlightening or pedagogic 'communion', so emphasised in the artistic

pronouncements of Romantic poets and prophets is likewise strikingly underscored in Tyndall's own literary productions, not just in prose but in verse as well. Yet considered attention to the verbal *representations* of this concern, my subject in the middle sections of this chapter, provides ample evidence of both the continuities linking, and the disjunctions distinguishing between, two separate attempts at engagement with (distinct, even irreconcilable) de-theologised interpretations – that early in the century, made most iconically by Wordsworth; that midway through, put forward by one ardent exponent of scientific materialism (and poetic amateur) – of the phenomena of natural and mental worlds, their quandaries and confusions. It will, accordingly, be instructive to start by looking at the 'high altar' at which Tyndall most frequently 'worshipped', and from which he derived the most fervent and long-lasting inducement: those peaks, glaciers and foothills encountered amongst the Alpine range.

SALVAGE OR SYNTHESIS?: TYNDALL AND THE 'WORDSWORTHIAN PROJECT'

In 1871, Sheldon Amos, writing in a section of *The Westminster Review* devoted to coverage of recent publications in the fields of politics, sociology and travel, made (perhaps inadvertently) his own minor, though characteristically irksome, contribution to ongoing, cross-cultural debates concerning the respective intellectual domains of the sciences and the arts in mid- to late-Victorian Britain. These were debates, of course, which by the 1950s were to lead to C. P. Snow's celebrated pronouncements in *The Two Cultures*, though at the time there was still widespread hope for some sort of future metaphysical rapprochement. Contrasting *Hours of Exercise in the Alps*, a work on mountaineering, with the same author's *Fragments of Science for Unscientific People* (both first published that year), the reviewer noted that, from his own perspective – and no doubt, he supposed, from that as well of many among his readership – '"Hours of Exercise in the Alps" is the title which Professor Tyndall gives to a volume of short papers supplementary to that of his "Fragments." The previous volume contained sketches of his working life, as the second does that of his holiday-making' (p. 249).

Tyndall himself, though he fully recognised that the two 'halves' of his own personality (Professor at the RI, pioneering Alpinist) were not perfectly contiguous, would never have endorsed such a bifurcation. Nor would he have countenanced one work being considered supplemental, or somehow ancillary, to the other. ('A short time ago', he explains in prefatory notes to *Hours of Exercise*, 'I published a book of "Fragments," which might have been called "Hours of Exercise in the Laboratory" […]' [p. v].) He would, moreover, have insisted that

disjunctions pale when viewed in comparison with strange or unexpected affinities, that distinctions of value are both subjective and invidious, pointing out that mountains provided him with a respite from work even as they informed the course of his research, while cramped London laboratories enabled him both to study and, from time to time, to replicate phenomena he in many instances had first encountered while traversing the altitudinous spaces of Switzerland and France. It was inarguably the case, even there, amid grandiose geographies of summits and ice, that it was the methodologies of mid-Victorian inductive science that guided his footfalls and directed his vision, all the while conditioning his more general spiritual and aesthetic sensibilities as well.[1]

In *Recollections of an Old Mountaineer*, a volume of memoirs first published in 1910, Walter Larden recounts a meeting with Tyndall amid just such monumental topographies; the year was 1881 or 1882:

> Once a lean, strong-faced man (the image is dim to me now) came across to lunch; I saw it was Tyndall. I wish I had had the assurance to introduce myself to him as (in a small way) a scientific man! It would have been a memory worth possessing. Those old climbers did more than conquer mountains, with alpenstocks in place of the modern ice axe, and inefficiently-nailed boots, for they conquered the fears of men and the superstitions that clung about the unknown. And Tyndall took the mountains in a large spirit; he had imagination and perception. I wish I had once talked to him!
>
> (p. 21)

This is retrospective canonisation, in part, but it testifies to the complexity of Tyndall's cultural 'function' while trekking and climbing. It suggests something as well of an essential paradox, as Bartlett has noted in 'Preaching Science': the irony that, in interpreting and writing about his experiences among mountains, 'being a scientist made Tyndall more "romantic," more willing or able to draw upon tropes of the sublime, than were non-scientist fellow-members of the Alpine Club' (pp. 101 - 02).

Nor should it be forgotten, as Larden intimates, that the Alps were always, for Tyndall, supreme experimental venues, essential locations for study and empirical investigation, every bit as significant as the basement laboratories of the RI. This intercourse was not merely intellectual, however, taking place between disciplines alone. It was textual as well, and because of it many of Tyndall's works slip ready or uncomplicated generic classification. Extended passages, for instance, from his travel writings reappear in more 'scientific' contexts

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[1] Indeed, early on, his climbing even received, as it were, an apt 'scientific benediction': Tyndall was presented with his alpenstock (a steel-tipped 'climbing stick' then absolutely essential for serious mountaineering) by the botanist and noted Himalayan explorer J. D. Hooker; Hooker, however, to mark its ownership, scored Tyndall's initials, not with a knife, but rather by singeing its wooden surface with ordinary sunlight focused through a pocket magnifying lens (Clark, p. 61).

(several chapters of *Hours of Exercise*, to take but one obvious example, appeared eventually in *New Fragments*, the 1892 'sequel' to *Fragments of Science*), even as the intractability of physical reference within his 'straightforward' tales of mountaineering and high adventure render them curiously resistant to labelling. They, in other words, only infrequently seem 'travel literature' first and foremost, while, conversely, his various and wide-ranging works on 'natural philosophy' rarely confine themselves exclusively to the bald elucidation of facts and equations, graphs and physical tendencies. What *sort* of text, for instance, is the following, an evocative extract from Tyndall's *Glaciers of the Alps* (1860)?

> The anticipated storm at length gave notice of its coming. The sea-waves, as observed by Aristotle, sometimes reach the shore before the wind which produces them is felt; and here the tempest sent out its precursors, which broke in detached shocks upon the cabin before the real storm arrived. Billows of air, in ever quicker succession, rolled over us with a long surging sound, rising and falling as crest succeeded trough and trough succeeded crest. And as the pulses of a vibrating body, when their succession is quick enough, blend to a continuous note, so these fitful gusts linked themselves finally to a storm which made its own wild music among the crags. Grandly it swelled, carrying the imagination out of doors, to the clouds and darkness, to the loosened avalanches and whirling snow upon the mountain heads. Moored to the rock on two sides, the cabin stood firm, and its manifest security allowed the mind the undisturbed enjoyment of the atmospheric war. We were powerfully shaken, but had no fear of being uprooted; and a certain grandeur of the heart rose responsive to the grandeur of the storm. Mounting higher and higher, it at length reached its maximum strength, from which it lowered fitfully, until at length, with a melancholy wail, it bade our rock farewell. (pp. 163 - 64)

A reader, too, one suspects, might be 'powerfully shaken'; Tyndall's prose, like the storm it describes, is here breathless, sensual, tempestuous. Nature is personified as warring, chivalrously giving advance 'notice of its coming'; it emits at times a 'wild music', a melancholic 'wail'; it bids 'our rock farewell'. His argument glances at Aristotle, meteorology, wave-mechanics, the theory of sound and harmony. Their mountain cabin becomes a ship 'moored to the rock', battered by undulating troughs and crests of wind. Most notably, a Romantic correspondence is established, the orgiastic fury of the storm inciting in the heart a certain sympathetic 'grandeur'.

Comparable passages appear throughout a range of Tyndall's more technical works as well, many of which devolve from time to time into personal or subjective narrative, into, in vital particulars, travellers' tales. Indeed, this multivalency, and these crossings-over, between forms of scientific and peripatetic description, between forms of realist and imaginative representation, are often in and of themselves sources of charm and glancing profundity. *Pace* that reviewer, in both *Fragments* and *Hours of Exercise*, as in all his popular works (and not a few of his 'specialist' ones as well), science is refigured as quest narrative, with a plot and real excitement, at the same time that the new-fangled sport of mountaineering – dubbed pejora-

tively, and not altogether unfairly, 'pinnacle chasing' by Charles Dickens (qtd. in Bartlett, p. 124) – is remade into something far less simpleminded and chest-thumpingly 'masculine'.

The remainder of this chapter interrogates some of these overlappings through examination of, among other things, the role of place in Tyndall's prose and occasional verse, before turning at its conclusion towards broader discussion of the significance for such a thinker of materialistic conceptions of an 'organic' or 'symphonic' cosmology, metaphors which were, as we shall see, closely enmeshed. It also incorporates an analysis, growing out of these considerations, of the role canonical, late-eighteenth- and early-nineteenth-century English Romanticism – an aesthetic stance heavily indebted to notions put forth by those 'idealistic' philosophers cited in my previous chapter – played in the framing of the scientist's worldview. Wordsworth, in particular, is a powerful presence, as, after a fashion, Tyndall took it upon himself to refine (and, if possible, bring towards fruition) what might loosely be termed the 'Wordsworthian project' – a lofty goal, to be sure, but one not wholly out of keeping with either the man or his times. This 'redacted' project – to borrow, and upend, a phrase from M. H. Abrams (itself borrowed, of course, from *Sartor Resartus*) – was the evincing of a form of 'supernatural naturalism', a way of looking at the world wholly scientific and yet imbued with the strength and wonder of earlier philosophies. Abrams explains: 'The title *Natural Supernaturalism* indicates that my recurrent […] concern will be with the secularization of inherited theological ideas and ways of thinking' (p. 12). This was accomplished by writers in the first half of the nineteenth century with varying degrees of flamboyance, individuals often starting from a variety of divergent presumptions.

Such particularities resulted in a compelling diversity of early and mid-Victorian 'romanticisms', distinguishable if interrelated. Carlyle, writing in the 1830s and afterwards, inspired by German alongside English precedents, became so insistent in his annexation of Biblical concepts and phrasings as to suggest, not merely analogy, but 'a deliberate attempt to blur the differences between traditional Christian beliefs and the subjectivity of Romantic regeneration' (McSweeney and Sabor, p. xxvii). Tyndall's own 'supernatural naturalism', a production of the 1850s and '60s, represented, nonetheless, a far more radical break, moving from the secularisation of faith to its actual materialisation, the promulgation of a form of naturalised religion, a 'worship' of the real and evidenced. It was a small but vociferous denomination. Of its adherents Rev. Watson observed, in 1889: 'Now a notable thing in regard to the preachers of Nature-religion is the way they press Gospel phrases and ideas into

their service […]' (*Gospels*, p. 182).

Yet, in this behaviour, 'the preachers', Tyndall among them, were merely partaking in, and augmenting, a productive and varied discursive tendency; it was one extending back at least (here further to mythologise the event) to the publication in 1800 of Wordsworth's 'Preface to *Lyrical Ballads*'. As such, Tyndall's relationship with the 'Romantic tradition' – a movement at once homogenised and simplified in his writings – provides a fine case-study in mid-Victorian scientific intertextuality at the same time that it counterpoints Tyndall's own subtly different engagements, likewise often intertextual (though not exclusively so), with Thomas Carlyle. There was, as I argued previously, a compendiousness in Tyndall's responses to Carlyle, and the scientist's reactions (whether right or wrong) were, more often than not, informed by the whole of his oeuvre, not just *Sartor Resartus* but also *Chartism*, not just *Past and Present* but also *The French Revolution* and *On Heroes, Hero-Worship and the Heroic in History*. They were friends, of course, reading each other's works, frequently discussing them at length.

Tyndall's familiarity with Wordsworth and his contemporaries, by contrast, while thorough, was never so personal. Thus he felt less inhibited by context. For him, Wordsworth and Keats, like Pope or Milton, like Marlowe or Shakespeare, were part of the literary heritage, something past, to be responded to, re-appropriated and imaginatively recast, not necessarily engaged in reciprocating dialogue or addressed on equal terms. Yet Wordsworth and Keats, far more than any of those other figures, chimed with Tyndall's sensibilities, and hence his 'supernatural naturalism' represents a double inversion: Romanticism as ethos first restrained and then rehabilitated by the selfsame thing, the doctrines of mid-century materialism. This was, however, not a process of inversion yielding identity (as in mathematics or formal logic), but rather telling difference (as in English rhetoric, where the phrase 'he is not un-handsome' is only exceptionally a way of attributing a wholly unqualified attractiveness). Tyndall's 'litotic' romanticism, then, while superficially congruent with that of, say, Wordsworth, encodes a world of difference, in part, of course, by quite literally encoding a different world: the world as known to, and as described by, mid-Victorian molecular, evolutionary and thermodynamic theory.

It was precisely through such a cobbled neo-romanticism that Tyndall attempted to synthesise, or perhaps salvage, an aesthetic stance simultaneously adequate to the challenges posed by materialistic science and responsive to the questions raised by his own literary 'forbearers': those sainted translators of the Authorised Version; Milton; and, above all others, Carlyle and the Romantics. Positing a sensibility he hoped would revivify the perceived

sterility of a thuggish materialism, he re-forged thereby – or reclaimed – an aesthetic-*cum*-philosophical standpoint in which observation and elucidation could be understood as providing the 'unheard music' which, half-a-century prior, had so haunted the young Keats, endowing the experiential world with a shimmering, quasi-mystical counterpart to sensible awareness. This would be a verifiable analogue to, at once alike and unlike, *The Prelude*'s (and M. H. Abrams's) 'correspondent breeze'.

Sometimes this 'unheard music' was sensed at the microscopic level: in the melodies of molecular crystallisation, for example; at others, a macroscopic one: in the singing of stars in distant space, or the sough of ethereal waves. In *Mountaineering in 1861*, these two levels of natural song are epitomised in two quotations, both from Emerson: the first, from 'Monadnoc' ('For the world was made in order, / And the atoms march in tune' [p. 77; qtd., p. 221]); the second, from 'The House' ('She lays her beams in music, / In music every one, / To the cadence of the whirling world / Which dances round the sun' [pp. 140 - 41; qtd., p. 264]).

Sometimes, too, an 'unheard music' was felt on a further, *truer* level as well: as tunefulness internal, interacting in fugal fashion with such 'external', sustaining voices. These were those sympathetic melodies stirred within the brain – a harp caressed by the breeze, in Coleridgean terms – of the well-tempered scientific analyst upon hushed and reverent attention to a 'silently symphonious' cosmology. (Put succinctly, Tyndall's '"materialism" vastly different from what you suppose […]', that motto from his much-revised Belfast peroration [*BA* [2], p. 56], merely amplified – or un-muted – sequestered orchestrations.)

At other times such a subliminal world was figured visually instead, as a secret beauty, or hidden pattern. Jacob Korg, in an essay on the influence of Romanticism on pedagogy at Cambridge between 1820 and 1840, wrote: 'The difference that Romanticism (as a specific historical movement) stood for – one that bound men together in generational bonds whatever their "discipline" – was a perception that superficial appearance, wherever studied, concealed quite a different kind of order than had previously been suspected' (p. 53). This is what Tyndall recollected of his initial crossing to the Isle of Wight on a private charter:

> And I to ~~give~~ rub the rust from chest and arms
> Seized a relinquished oar; and long I tugged,
> And then I steered again, and saw our craft
> Proudly o'ertake and pass with conquering sweep
> Her canvassed sisters of the Solent sea.
> We tacked and tacked, for so the wind decreed;
> While I with hand upon the helm took in
> The boatman's hints, and ~~but~~ linked his facts to laws.

> He knew the how, and I resolved the why,
> And through the light of principles discerned
> A beauty in his acts he did not see. ('DP', p. [3])

Similar private wonders were discerned in the stars above, in atoms beneath boot-soles. Such modes of responsiveness to phenomenological input are everywhere evident in Tyndall's published output; they provide the philosophical foundations for his scientific sense, one not absolutely secure, though remarkably resilient, its fracturings and aporias becoming most conspicuous in his outpourings of verse, despite such uneasinesses as articulated in discursive prose works like the Belfast Address, 'On the Scientific Use of the Imagination', and others.

This seems logical, that Tyndall's poetry should at once best express his philosophy while making most plainly manifest its faults and contradictions. The form has a habit of doing precisely that. It is a platitude at once tritely ignorable and timelessly correct that the era makes the poet as much as the poet the era; as one commentator observed in the 1860 *Encyclopædia Brittanica* – casually dismissing the obviousness, on one level, of such an assertion, while continuing to insist, upon another, on its radical, even dictatorial, authoritativeness –

> That poetry which seeks to please through our sympathies must shift and vary, both in its themes and in the manner of treating them, with the changes of society, is a truism on which it is needless to enlarge. If the opinions of men change, if their habits and the objects and associations which interest them alter, poetry must adopt itself to this altered state of things. It does so indeed unconsciously; it cannot avoid doing so; for the poet's own nature has partaken of the change. ('poetry', p. 96)

Tyndall's science, the 'opinions of [those] men' on whom he had most relied, had, no doubt, undergone a materialistic, teleological turn, effectively irreversible, in the years after mid-century, post Darwin and Helmholtz and Thomson.

His poetic and metaphysical sensibilities struggled to match that turn fitly, to adapt their underlying architectures to what was, quite profoundly, an 'altered state of things', an observation-based, not merely *ad hoc* 'metaphysical', materialism. That the rest of the world, that ordinary *Victorians*, were less aware of such a transition was the task Tyndall set himself remedying in public. He could seem cocky, immoderate, even blasphemous in doing so.

In private, however – as memorialised in verses, in letters, in journal entries – his tone was to remain far more circumspect; such was particularly the case later in the century, as the scientist's own material ending inescapably approached.

On the Description of Nature / On the Nature of Description

Tyndall, of course, was well aware of the ameliorative effects which a subtle change in situa-

tion could sometimes work on an individual's mindset, not least through personal experience. Once, for instance, while wrestling with conceptual difficulties underlying a fundamental problem in electromagnetism ('The experiments', he later remarked, 'which everybody seems to understand are the ones that trouble me most […]' [qtd. in *LWJT*, p. 53]), he took some time out to draft a letter. It was to Thomas Archer Hirst. A friend and constant correspondent, he was also a figure who had himself 'emerged' – alongside such righteous publicists as Huxley, Spencer, Wallace, and, of course, the author – around mid-century 'from a spiritual crisis to become one of the leaders in a new faith in science'. (As James Secord has quipped, the familiar, retrospective narrative [p. 338].) In it, Tyndall told his protégé of how it was often the case that slight glimmerings of theoretical or mathematical insight could swiftly rekindle even the most rapidly flagging of enthusiasms. On such occasions, he explained, 'I have found myself […] converted from a miserable, complaining, rebellious wretch, into a loyal and happy worker, in less time than it has taken to write this sentence. A thought has rifted and scattered the cloud of discontent, as the wind disperses the mist upon the hills' (qtd. in *LWJT*, p. 53).

His meteorological metaphor was far from accidental. In fact, he likewise believed that it was not merely minor alterations in awareness, changes in *internal* mental state, which could enact upon the psyche such profoundly disproportionate effects. External transformations could work equivalent wonders.[2] He noted habitually the transformative physical and psychological powers – all at once instantaneous, revivifying and inspirational – wrought by Alpine vistas or, perhaps, as on that daytrip to Wight, the merest glimpsing of a comely barmaid's charms. In one untitled poem, for example, preserved in manuscript at the RI, he observed:

> The thickset trees which crowd the Undercliff –
> The scented woodbine on the neighbouring knoll –
> The foxglove shaking all its purple bells –
> And roses blushing mid the tender green –
> All blend into a bouquet for the sight;
> But not for sight alone, for beauty sends
> Its finer essence down into the heart […]

[2] As one epigraph to *Hours of Exercise* Tyndall selected a passage from the (largely forgotten) American poet James Russell Lowell arguing this precise point: 'the brain / That forages all climes to line its cells / Ranging both worlds on lightest wings of wish, / Will not distil the juices it has sucked / To the sweet substance of pellucid thought / Except for him who hath the secret learned / To mix his blood with sunshine, and to take / The wind into his pulses […]' (p. 330; qtd., p. xii).

Tyndall, however, in typical fashion, left out (one must presume: deliberately) Lowell's line referring to 'both worlds'; in all likelihood, he did so because such a line argued for a dualism of metaphysics anathema to mid-Victorian scientific naturalism's strict monism/anti-Platonism.

while a much later essay of his, in a specimen of prose remarkable as much for its dynamism and calculated lyricism as for its unimpeachable scientific precision, reiterated with still greater vehemence such 'quasi-Romantic' presumptions.

He, within, was reporting details of an excursion he had made between stops while on a whirlwind lecture-tour of a number of cities along the North-eastern seaboard of the United States, an excursion on which he first had the opportunity to see (and listen to) the cacophonous splendour of famed Niagara Falls:

> Here my guide [to the river beneath the Falls] sheltered me again, and desired me to look up; I did so, and could see, as before, the green gleam of the mighty curve sweeping over the upper ledge, and the fitful plunge of the water, as the spray between us and it alternately gathered and disappeared. An eminent friend of mine often speaks to me of the mistake of those physicians who regard man's ailments as purely chemical, to be met by chemical remedies only. He contends for the psychological element of cure. By agreeable emotions, he says, nervous currents are liberated which stimulate blood, brain, and viscera. The influence rained from ladies' eyes enables my friend to thrive on dishes which would kill him if eaten alone. A sanative effect of the same order I experienced amid the spray and thunder of Niagara. Quickened by the emotions there aroused, the blood sped healthily through the arteries, abolishing introspection, […] and enabling one to think with tolerance, if not with tenderness, of the most relentless and unassailable foe. ('Niagara', p. 52)

This description may seem off-kilter – perverse in some particulars, grotesque or clinical in others – as if it were cast in 'incorrect' language for evocation of what, to many, even today, would surely have seemed a manifestly transcendent, or spiritual, experience. (That is, of course, assuming that the present-day visitor could somehow manage to overlook the honeymooning kitsch of the place!)

It was, though, entirely apposite for a thinker like Tyndall. For here, as ever, his prose remains that of the trenchant scientific materialist, the ever-stubborn natural philosopher who never once conceived of a psychological effect without a physiological cause.

But it also contains echoes – somewhat muted, perhaps, though for all that unmistakable – of the displaced Lake-land poet as well, of the vernacular of men and women ripped from turn-of-the-century inns or taverns and dropped, rather unceremoniously, into the dissecting rooms or public lecture theatres of fifty years subsequent. There, suddenly finding themselves inhabiting a world of steam engines and electromagnetic telegraphy, rather than ruined cottages or rustic carriage-ways, they nevertheless still felt compelled, by force of habit, to inscribe in verse using the language they thought best suited to their purposes, not, this time around, a Cumbrian tarn or the village of Grasmere, but rather the grander spectacles of Niagara or Alp. Thus we have those eminently logical segues – from Tyndall's perspective – from the sort of (self-conscious, fussily 'poetic') rhetoric associated with countless derivative

mid-nineteenth-century intimations, and imitations, of the Wordsworthian sublime to that drawn more from a Victorian anatomical guidebook. He does not, as might be expected from someone more prototypical, veer in such instances towards either the diction or the metaphors associated with a theological or even a (conventionally) philosophical treatise or lecture. '[A]mid the spray and thunder of Niagara', Tyndall's 'soul', accordingly, never once swoons, nor does his heart – considered metaphorically, of course, most certainly not cardiovascularly – even for a moment 'leap up'; rather, freshly oxygenated blood speeds exultingly through 'arteries', thereby perfusing his body's multifarious 'viscera'.

It would seem that, at its core, even Tyndall's romanticism, his metaphysical sensibility, was fully grounded in what remains by its definition the stuff of the obstinately, even ostentatiously, physical.

The first drafting of his poem about Wight, for instance, commences with just such a jarring flourish of materialistic imagery. In its opening lines, he celebrates his morning repast in terms poetically unfortunate but gastro-intestinally precise: 'For breakfast – we attacked it – […] / They to their tea, I to my cocoa mild / Which Mrs. Leary mixes every morn / With milk, thus forming a nutritious mud!' ('DP' [1], p. [1]). (In the fair copy of the poem sent to Mrs Pollock this section was excised, perhaps for reasons of decorum.) His later (infinitely more felicitous) excursus on the motive potential of a domesticated horse, by contrast, seems somehow less reductively radical, or 'morally' caustic: 'We put our pony in the hostler's hands, / And bade him to be bountiful with corn, / And charge each fibre of the beast with force / To bear us homeward cheerily at eve' ('DP', p. [2]). Yet horse and human alike are both fuelled through analogous processes of ingestion, a piquant challenge to exceptionalism.

Tyndall's lifelong affinity for Wordsworth was, in fact, particularly acute, never suffering a falling off, let alone (as infamously related by Darwin, in the *Autobiography* [p. 83]) extinction. It is, moreover, evident, and evidenced – if often inconspicuously, in linguistic echo, or small gesture – throughout the range of his writings, for both scholarly and popular audiences.

When, in a review of Bence Jones's extensive biography of Faraday, he remarks that '[t]he first volume [of Jones's work] […] reveals to us the youth who was to be father to the man' (*FoS*, p. 360), it must have seemed to many among his readership that the scientist was invoking nothing more than what must have seemed by then a rhetorical commonplace, not making any sort of direct or spiritually significant allusion to 'My heart leaps up'. Perhaps, they reckoned, Tyndall, aware of the intended audience for his critique (it was to be published in *The Academy*, a recently established highbrow and highly literate monthly), half expected

some of his readers to re-contextualise such a reference as one evocative of the species of 'natural' – contrasting with scriptural – piety so central to that lyric.

But this explanation does not fully convince, and the quotation, in my opinion, was neither accidental nor off-hand. Tyndall knew precisely what he was doing with such a shop-worn phrase, at once suggesting, *explicitly*, the continuity of his mentor's temperament through the long course of his lifetime, and also, *implicitly*, the closeness of Faraday's own scientific struggles to those of the nature poet, a soul similarly endeavouring to transform 'a discrete, dead, and alien milieu into a human, integral and companionable milieu in which man finds himself thoroughly at home' (Abrams, p. 377). Like 'double-minded' rationales, I suggest, underpin many of Tyndall's 'romantic' invocations elsewhere, too: in his poetry, his prose and, not infrequently, in his professional and personal correspondence.

A letter to Mrs Pollock of 17 April 1859, mentioned in my previous chapter, told of some perambulations in the Lake District, and of that region's (famously tempestuous) climate. Note the effulgence of the scientist's description of speedily unfurling weather fronts, not to mention the sideways glances plainly evident in his language, not merely at the Romantics, but also Thomas Gray's *Elegy*. This latter aspect becomes perhaps most conspicuous in Tyndall's concluding remarks on the picturesque attributes of the poet's final resting place, where a lone 'black cypress gives character to the scene'.[3] Consider also the telling conjunction in this text of the monumental figures of William Wordsworth with Humphry Davy (simplistically: 'co-founder' of Romanticism, pioneering post-Lavoisian physical chemist), two names deliberately isolated out of a 'hundred' others, both of whom came to national prominence in the opening decades of the nineteenth century. As such, they form a *de facto* grandfatherly counterpart to that 'patriarchal' pairing of Michael Faraday with Thomas Carlyle:

> I reached Windermere at 6 o'clock and before dinner walked to Orrest Head and saw Wordsworth's "beautiful romance of Nature". Next morning at 9 o'clock we rowed from Windermere to Ambleside – the lake was smooth and sunny when we departed, but it became black and rough, and to shelter ourselves from one storm we pushed ashore and landed on a wooded knoll. Near the spot stood a granite cross marking the spot where two young men had been drowned the year before within 18 feet of the shore. Remember Walter must be taught to swim. The storm howled over us spitting heavy snow flakes against us. The little lake looked quite grand, black as ink under the black scowl of heaven with the crests of its little sputtering waves rendered doubly white by contrast. The slate rocks all over the knoll were carved and sculptured by some local madman, who had a passion for chiseling [sic]. There were Wordsworth, Davy, and a hundred other names, some deeply cut, others in relief, the rock around the letters being chiseled [sic] away. We landed at Ambleside, walked thence to Rydal mount,

[3] Compare these lines in Gray's *Elegy Written in a Country Church-yard*: 'Beneath those rugged elms, that yew tree's shade, / Where heaves the turf in many a mould'ring heap, / Each in his narrow cell for ever laid, / The rude Forefathers of the hamlet sleep' (p. 92).

> and looked round Wordsworth's nest. Thence to Grasmere, and stood for some minutes beside his grave. A clear stream rushes near it, a few trees are at hand; one black cypress gives character to the scene, and there the poet sleeps, while the plainest slab of black slate which contains only his name, marks his resting place. If I can manage it I will be buried in a country churchyard. I hate town burials. (pp. 1954 - 55)

This Davy/Wordsworth conjunction points the way towards the most significant of Tyndall's double-codings, the published Belfast Address, where, in the first Longmans edition, he chose emblematically to conclude, and qualify, the body of his argument – in which a 'parallel message' had always been latent – with extended quotation from 'Tintern Abbey' (*BA*, p. 65).

He was not the first science writer to attempt such retroactive defusing. Gideon Mantell, notes Stephen Gill in *Wordsworth and the Victorians* (1998), added to the 1839 edition of his *Wonders of Geology* (1838), a similar coda, quoting the same poem, thus (hopefully) 'reassur[ing] any nervous reader that this scientific work was in no way irreligious […]'; that 'these facts and diagrams could be summed up in a poet's "prayer"' (p. 23). Tyndall's aspirations were comparable, if more pantheistic. The presence, one imagines, of such a refrain in such a venue could hardly have been overlooked. Nevertheless, its significance was still often dismissed (a topic broached in chapter two) – by audiences hostile, unimaginative, or inattentive – as ornamental, rather than essential, to the heritage and meaning of the scientist's overall 'materialistic' epistemology. (Whether Mantell had any more success remains obscure.)

Wordsworth's critical vitality, though perhaps not popular reputation, reached something of a nadir in the first decades after mid-century – thereafter it revived, somewhat. 'Throughout the 1850s and 1860s', Gill observes, 'received ideas about Wordsworth were promulgated, a particular slant being given by the writers' opinions, but there was little probing or questioning. Only in a few articles was there any sign of either a considered review of the grounds for asserting Wordsworth's continuing importance, or dissent from the consensus judgement which would provoke debate' (pp. 209 - 10). Yet the scientist's writings through this period, and after, surely could be classified – albeit at second-hand – among the former. At a time when, as Arnold sighed, it was 'quite permissible to speak of Wordsworth's poetry, not only with ignorance, but with impertinence' ('Wordsworth', p. 37); at a time when Ruskin openly lamented the tempering of an adolescent delight in the 'pure childish love of nature which Wordsworth so idly takes for an intimation of immortality' (*Præterita*, 1: 334), Tyndall's fondness, it seems, remained irony-free, not so much qualified as refined, made substantial.

One poem in particular exemplifies this. Anyone befuddled by the 'Wordsworthianism' of the Belfast Address, confronted by 'A Morning on Alp Lusgen', would have been hard-

pressed to reach the same impasse.

Anthologised in *New Fragments*, this late work – drafted c. 1890 – makes unambiguous the scientist's various, deeply resonant spiritual and artistic debts to the writings of that paradigmatic figure, praised – in a study of 1897, by Charles Herford – as a poet who 'loved "common" things, because they were common […]', and who 'loved those rare and strange aspects […]' of common things 'that called forth or "caught" imagination' (p. 159). Tyndall, within, typified the panorama from Alp Lusgen, an isolated retreat, with suitably 'Wordsworthian' style and strength, moving swiftly, as had many devotees before him, from the prosaic business of topographic description to the rather more interesting task of spiritual and cosmic speculation. The poem, in short, embodies (if in an updated, Continental *mise-en-scène*) affections singled out by Herford. (It does so in blank verse of considerable vigour and conviviality; C. E. Mathews was not being disingenuous when he – writing a portion of Tyndall's obituary notice for *The Alpine Journal* – described 'A Morning on Alp Lusgen' as a 'poem of considerable power […]' [p. 27].[4]) It integrates also, over a few score lines, Tyndall's thoughts on mountaineering, on morality, and, as noted, personal perspectives on both the late Thomas Carlyle's achievement and popular observations on its incompleteness. It encompasses as well Tyndall's materialism, percolating contemporary critiques of that materialism, and his own lingering doubts about the fairness and final sufficiency of such a reductionist philosophy.

But above these specifically 'Tyndallic' tropes, born of the late-nineteenth-century natural philosopher, lurks the spectre of the man who had undertaken, in midsummer 1798, a nostalgic tour of the countryside; one of his poems, written in documentation, announces:

> again I hear
> These waters, rolling from their mountain-springs
> With a soft inland murmur. – Once again
> Do I behold these steep and lofty cliffs,
> That on a wild secluded scene impress
> Thoughts of deep seclusion; and connect
> The landscape with the quiet of the sky. (p. 163; ll. 2 - 8)

By contrast, Tyndall's own recasting of Wordsworth's opening to 'Tintern Abbey' in 'A Morning' reminds us of the 'parochialism' (meant, however, by its author in no pejorative sense) of his predecessor's limited perspective, of the fact that Tyndall's world of skyscraper

[4] Not all critics were quite as impressed as Mr Mathews: Eve and Creasey, for instance, pronounced at best 'ephemeral' Tyndall's 'From the Alps: A Fragment', a precursor to 'A Morning on Alp Lusgen' first published in the *Pall Mall Gazette* (*LWJT*, p. 225). (Incidentally, that early title nicely 'scientises' the poem, incorporating it, by implication, in the great body of his work, *Fragments of Science*.)

peaks and tumbled moraines, quite literally, 'overtops' all the features of those British landscapes which so frequently moved Wordsworth to rapture and artistry.

As Tyndall notes, writing from an aerie midway up the mountainside,

> The plummet from this height must sink afar
> To reach yon rounded mounds which seem so small.
> They shrink in the embrace of vaster forms,
> Though, placed amid the pomp of Cumbrian Fells,
> These hillock crests would overtop them all.
> Steep fall the meadows to the vale in slopes
> Of freshest green, scarred by the humming streams,
> And flecked by spaces of primeval pine. (*NF*, p. 498)

While the scientist's language clearly parallels that of his prototype, he adumbrates a world quantitatively, not just qualitatively, removed from the one Wordsworth captured so many years prior, his pentameter encoding not simply a change in geography, but a shifting in worldview. It was, for instance, a place made far older ('*primeval* pine') and rendered less domestic and hospitable in its scope by developments in geology. Tyndall's rugged lowlands 'shrink' in the shadow of the 'vaster forms' of the local terrain, one 'flecked' indiscriminately by copses of ancient pine, and 'scarred' by the ceaseless processes of erosion and sedimentation wrought by myriad fast-flowing Alpine streams (these, needless to say, almost certainly emit no restful 'soft inland murmur' like Wordsworth's gentle 'waters […] rolling from […] mountain-springs').

Nevertheless, despite such belittling magnifications in scale, despite nearly a century of convulsions in theoretical paradigm, Tyndall would still have concurred wholeheartedly with the famously brash assertion, made by Wordsworth in the 'Prospectus to *The Recluse*', that it was 'the Mind of Man […]' which was to be his 'haunt, and the main region of [his] song' (p. 590; ll. 40 - 41).[5, 6]

He would likewise, no doubt, have seconded the poet's (equally audacious) celebration, twenty-one lines later, of a splendid, sympathetic 'fitted-ness'; it is between, on the one hand,

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[5] In 1874, writing in defence of his Belfast position, Tyndall characterised one of his adversaries, the Bishop of Manchester, as a frustrated and bitter anachronism, a soul fated to occupy most of his time 'running to and fro upon the earth […] wringing his hands over the threatened loss of his ideals […]', utterly incapable – or unwilling – to believe 'undoubtingly that in the mind of man we have the substratum of all ideals' ('Crystals', p. 83), that it was the precepts of his own Christianity, not those of 'materialism's' enlightened humanism, which might come to seem superfluous.

[6] Edward Manier, in 1978's *The Young Darwin and His Cultural Circle*, argued that *The Excursion*, to which these lines were prelude (and which expresses similar sentiments), 'provided powerful poetic expression for some of Darwin's deepest philosophical concerns and convictions', though conceded that evidence for such formative influence was 'only circumstantial' (p. 89).

the sensory and analytic powers of the 'Romantic' mind, and, on the other, the examined phenomena of nature:

> my voice proclaims
> How exquisitely the individual Mind
> (And the progressive powers perhaps no less
> Of the whole species) to the external World
> Is fitted: – and how exquisitely, too –
> Theme this but little heard of among men –
> The external World is fitted to the Mind;
> And the creation (by no lower name
> Can it be called) which they with blended might
> Accomplish: – this is our high argument. (p. 590; ll. 62 - 71)

Gillian Beer says of this: 'Mind and world have a hoped-for appropriateness to each other – a "fitness". The notions of just proportions, exact craftsmanship, sexual harmony, healthful mutuality, are all poised within the repeated "fitted"' (*Darwin's*, p. 44). Emergent synergisms, captured here, at once inspired – and guided – Tyndall.

His letter of 17 April 1859 to Mrs Pollock includes a lengthy, topically discursive account of how he and Edward Frankland, his walking companion, had managed in horrid weather to traverse the high fells between Ambleside and Grasmere. In it, he elaborates on the fashion in which the play of light and shadow on the rumpled topography could at times seem evocative of specific mental states, at one point even a brooding psychological condition suggestive of dark 'supernatural horror'. 'But the blackness' of the clouds overhead, he wrote,

> was above all description grand, and the contrasts wonderful. The boundary of the storm was marked with perfect definition: outside of it rocks and fells, and lakes lay bathed in sunlight; in front of the gloom the hills were of a grimness that suggested a kind of supernatural horror. Frankland said that if a little nitrate of [?] were ignited on Scawfell pike, so as to redden the clouds, we should have a fair representation of a certain locality. (p. 1957)

Hellish premonitions – shared with Frankland – were not the only ones troubling the rambler. He later comments on the 'calm delight' with which a break in the weather filled him, making explicit one crucial presumption of canonical Romanticism, derived from the 'Prospectus' (pathetic fallacy linking mindscape with mountain): 'I cannot describe them', he said of some luminous cloudbanks abruptly visible, 'and the calm delight they imparted suggested a relationship between them and the human soul' (p. 1958). Even as a child, Tyndall had been aware of, and believed in, this identification.

The outdoors, needless to say, had long been a powerful presence in the scientist's life, from the time of his boyhood in Ireland to that of his death, at age seventy three, in Hindhead,

a growing – too rapidly, he thought – village on the outskirts of London.[7] In an (undated, though obviously late) draft manuscript, he wrote of his never-ending quest for Romantic solitude and his lifelong love of nature, quoting from his *Lehrjahren* – roughly, 'apprentice journal', a diary of intellectual maturation and personal discovery. (The 'screen', by the way, was a lofty contrivance of larch-poles and heather matting erected to interrupt sightlines between Tyndall's house in Hindhead and some unattractive outbuildings on a neighbouring property [*LWJT*, pp. 259 - 60].)

My story of "the Screen" at HindHead

Large has my love for Nature been,
I loved her from a child.
I loved her in her summer sheen
And when the winter wild
Wrapped storms around her awful brow,
And ocean formed a throne,
To bear her, Queen and conqueror,
My love was her's [sic] alone.

Thus I wrote in my Lehrjahren. The lines ~~were~~ are worthless, but they mark a tendency. ~~When~~ As an imaginative ~~little boy~~ youngster I often crept into the hollow of a tree in windy weather, and listened with elation to the sound of the swaying branches overhead. In my youth I have walked miles upon a stormy night to reach a cliffy coast from which I might <see and> hear ~~and observe <view>~~ the raging of the sea. This stamp of natural tendency has never been effaced. For six and thirty years it took me to the Alps, ~~where sixteen years ago, I built~~ <causing me finally to build there> a nest ~~amid <above> the heather and bilberries <of Alp Lusgen>~~ at a height of over 7000 feet above the sea. A retreat in England [tear in manuscript] […] to the "sunset of life" was less easy to find.

This entry, even as it echoes the portentously apocalyptic squall detailed in *Glaciers of the Alps*, perhaps also brings to mind William Irvine's brusque dismissal of Tyndall's prose: 'diluted Wordsworthian nature rhapsody', is how he described his tendency to deliquesce, in 'height-ened' passages (p. 33). (Maybe Tyndall, aware of his limitations, would not have considered this remark so cutting?)

Beyond 'Tintern Abbey', that paragon of the British Romantic tradition, one incontestable further influence on 'A Morning on Alp Lusgen' was an extended verse ode written in praise of an American peak by Ralph Waldo Emerson, foremost among the school of New England transcendental thinkers who, 'beginning in the 1830s, seized upon and expanded the assertions by Coleridge, Wordsworth, Carlyle, and their German contemporaries concerning

[7] Bertrand Russell, in his *Autobiography*, recalls his childhood awe at Tyndall's monumental presence in this village: 'In the year 1883 my Uncle Rollo bought a house on the slopes of Hindhead, where, for a long time, we all visited him for three months in every year. […] I was frequently taken to see Tyndall, and he gave me one of his books, *The Forms of Water*. I admired him as an eminent Man of Science, and strongly desired to make some impression upon him. Twice I had some success […]' (p. 42).

the power of renewal in the eye of a man who sees as a child sees' (Abrams, p. 412).

'I can almost hear his [Tyndall's] melodious voice ringing out with Emerson's apostrophe to the mountain "Monadnoc", so often repeated among rocky solitudes in Switzerland […]', recalled Louisa Tyndall to a mutual friend not long after her husband's passing (qtd. in *LWJT*, p. 286); here is an excerpt:

> Ages are thy days,
> Thou grand affirmer of the present tense,
> And type of permanence!
> Firm ensign of the fatal Being,
> Amid these coward shapes of joy and grief,
> That will not bide the seeing!
> Hither we bring
> Our insect miseries to the rocks;
> And the whole flight, with pestering wing,
> Vanish […] (pp. 81 - 82)

So declaims a pilgrim in the audience of that New Hampshire immensity, one of those 'coward shapes' at once cowed and cured by the mountain's enormity in space, persistence in time.

Here landscape overwhelms, eternities threaten; menaced by the infinite, the 'insect' soul bewildered by Monadnoc seems a fitter analogue for Tyndall upon Alp Lusgen than reposing Wordsworth, overlooking that homely Welsh vista of 'hedge-rows, hardly hedge-rows, little lines / Of sportive wood run wild: these pastoral farms, / Green to the very door […]' (p. 164; ll. 15 - 17). Indeed, Richard Proctor, in an essay of 1882, even explicitly likened his generation's dawning conception of infinite space and endless time to his generation's increasing acquaintance, via travel and exploration, with the Cyclopean geological forms presented by the Alps. Spiculated outcroppings and vertiginous emptinesses, crushing weights and straight-faced pinnacles, these could challenge *mens sana*, not just *corpore sano*.

'Who can wonder', he writes, 'if from these awful depths [of an 'expanded' cosmos] men have turned in weariness of soul, nay almost in affright, as when the Alpine traveller, peering over some fog-enshrouded precipice, sees down […] to deeper and deeper abysses […]' ('Newton', p. 996). The focus of my next section will be Tyndall's wary encounter with just such a prospect, and the fashion in which it both tested, and affirmed, beliefs.

THE ROMANCE OF THE REAL: MATERIALISM'S TRANSCENDENTALISM

For all the perfect similarities in terms of aesthetic sensibility between materialistic and Ro-

mantic (or transcendentalist) ideology, there were always, for Tyndall, differences in elementary philosophy.

For him, Wordsworth's – and, by crude extension, high Romanticism's – cohering symmetry between internal and external worlds was no miraculous boon, nor blessed accident. On the contrary, it testified, directly, to the fact that the intellect seems fitted to the world because it is of the world, that nature seems comprehensible to the mind because the mind is of a piece with it. This, needless to say, was Tyndall's 'high argument', his '[t]heme […] but little heard'; in truth, if there could be said to be one principle unifying (and summarising) all his multifarious writings – essays and books and reviews covering the disciplines of biology and physics, mountaineering and epistemology, sociology and practical epidemiology – it would be that of the very completeness of this absolute and ineluctable identity between mind and matter, where he, following his mentor Fichte, unfailingly insisted that 'the brain and the moral and intellectual processes were, insofar as experiences could tell […], known to be indissolubly associated with the physical laws found paramount in nature' (Kim, p. 134). Consequently, Tyndall was open to criticisms of the sort levied by William Blake in marginal comments (found in his personal copy of Wordsworth's 'Prospectus'): 'You shall not bring me down to believe such fitting & fitted. I know better […]. Does not this Fit, & is not this Fitting most Exquisitely too, but to what? – not to Mind, but to the Vile Body only & to its Laws of Good & Evil & its Enmities against Mind' ('Marginalia', pp. 823 - 24).

In rebuttal, Tyndall repeatedly emphasised that neither is the body vile, nor the mind exalted. Rather, both, in essentials, are interchangeable, at once eternally and inextricably aligned – if low, equal in lowliness; if sublime, identical in sublimity. In one famous essay, he illustrated such exegetical proclivities via a matrimonial twist, linking mind and matter, like husband and wife, in allegorical sacrament: 'They degrade neither member of the mysterious duality referred to', he said of himself and his materialistic brethren; 'but they exalt one of them from its abasement, and repeal the divorce hitherto existing between both. In substance, if not in words, their position […] is: "What God hath joined together let not man put asunder"' (*FoS*, p. 165).

Mallock, like many among his contemporaries (and like Blake himself, decades prior), baulked at such levelling, at materialism's propensity for knocking everything down to a common ground-state: the matter of the stars above, the soil below – or ontological equivalence with the most grubby proto-hominid. One such animal, having a fugitive presence throughout *The New Paul and Virginia* (it is glimpsed fleetingly in dense jungle by Prof. Darnley

and quickly becomes for him the grail itself), is meant as a comical stand-in for anthropology's fabled 'missing link', though it is at the tale's conclusion revealed to be nothing more than a trained and servile monkey 'wearing' a piece of women's jewellery. Darnley, who frequently quotes Tyndall (often verbatim) in his diatribes, opines at one point of such a debased entity: 'The missing link is the token of the solemn fact of our origin from inorganic matter. I did but catch one blessed glimpse of him. He had a silver band about his neck. He was about three feet high. It is through him that we are related to the stars – the holy, the glorious stars, about which we know so little' (p. 118). Such overblown rhetoric is meant to invite ridicule and censure; such pomposity to incite laughter at the sorry spectacle of circus animal 'worshipped' by haughty intellectual, a thinly disguised composite of mid-Victorian England's scientific propagandists. Mallock's entire scenario is, in effect, carefully gauged to reveal materialism's (like evolutionism's) ethical poverty.

Tyndall, again, throughout his career, put forth an (unvarying) counterproposal, pointing out that gradations of worth are meaningless – and egotism no refuge – when confronted by the majesty of a unified and wholly material creation, even if it is a creation that does, by definition, include both the sacred and profane, the self-aware mind and that jibbering monkey.

He, of course, made many score, if not thousands, of declarations, spread throughout an entire lifetime of lecturing and active publication, of this, his foundational belief. The following passage, however – meditative, suggestive and precise – represents, to my mind, their apotheosis. Indeed, it is written in the form of a prose-poem, an estimation apparently confirmed by its reappearance as a full-page 'epigraph' in *Fragments of Science* for, tellingly, Tyndall's celebrated discourse 'On the Scientific Use of the Imagination' (*FoS*, p. 124). 'Old Alpine Jottings' – excerpted from *Hours of Exercise in the Alps*, republished initially in *Macmillan's Magazine*, and later reprinted in the catch-all volume *New Fragments* (again, evidence of cross-generic, intertextual pollination) – concludes with several observations on the Matterhorn, pointedly focusing not on the peak's aggressively 'masculine' power or seeming indomitability, but rather on the way its physical appearance, as with that of Niagara Falls, testifies to 'the irresistible and remorseless character of those forces whose summation through the ages pulls down even the Matterhorn'.

'Hitherto', he explains, 'the impression it [the mountain] had made was that of savage strength, but here we had inexorable decay' (*NF*, p. 495). In *Modern Painters* IV (1856), John Ruskin, commenting on the Rochers des Fys (his phrasing, incidentally, bringing to mind the

valiance of Maxwell on behalf of 'steadfast' or incorruptible molecules, as discussed in my third chapter), had described that Alpine precipice as particularly 'frightful', exemplary of the geological type 'nourishing no root in their crevices, touched by no hue of life on buttress or ledge, but, to the utmost, desolate; knowing no shaking of leaves in the wind, nor of grass beside the stream, – no motion but their own mortal shivering, the dreadful crumbling of atom from atom in their corrupting stones […]' (pp. 254 - 55). Such oppressive spectacle encodes, for Ruskin, one 'of those terrible and sad truths which the universe is full of' (p. 256).

'At their most troubled moments', Paul Sawyer observes of Ruskin's later scientific mediations, they

> come close to nightmares – raging struggles of sanctity against blasphemy, purity against the devil, life against death; mythopoeia draws close to hallucination, and one senses the darkness of the morning in 1878 when Ruskin awoke to find the Evil One in his room. By contrast, the Lucretian universe of Tyndall, purged of troublesome projections, seems blandly salutary; for Tyndall feared neither analysis, nor Mother Earth, nor life, nor death. (p. 240)

(Ruskin, though nearing such despondency in his commentary on the Rochers des Fys, evades it via painterly description – an aesthetician's stratagem, his acculturation of the sublime.)

In comparison with that of Ruskin, Sawyer is certainly right to describe the Tyndallic cosmos as 'salutary', but it is neither 'bland' nor without projections, often troublesome. They, however, tend to be irksome in the interpretive rather than ethical sense, appearing less baleful than confounding, like invitations to deep rethinking rather than outrageous assaults on the idea of humanity itself. For instance, having extrapolated forwards towards its overthrow, Tyndall's peripatetic 'thought' is then drawn backwards, by the inexorable necessities of causal reasoning and the twinned laws which govern the conservation of mass and energy,

> to a period when the Matterhorn was in the full strength of mountainhood [….] [and] to its possible growth and origin. Nor did it halt there, but wandered on through molten worlds to that nebulous haze which philosophers have regarded, and with good reason, as the proximate source of all material things. Could the blue sky above be the residue of that haze? Would the azure which deepens on the heights sink into utter darkness beyond the atmosphere? I tried to look at this universal cloud, containing within itself the prediction of all that has since occurred; I tried to imagine it as the seat of those forces whose action was to issue in solar and stellar systems, and all that they involve. Did that formless fog contain potentially the *sadness* with which I regarded the Matterhorn. Did the *thought* which thus ran back through the ages simply return to its primeval home? If so, had we not better recast our definitions of life and force? for if life and thought be the very flower of both, any definition which omits life and thought must be inadequate, if not untrue. (*NF*, pp. 495 - 96)

His chosen language – Tyndall's evocation of his own peculiar paths of '[t]hought […] [that] wandered on through molten worlds to that nebulous haze' – even as it answers Ruskin's slanderings of geological degradation, subtly parallels diction deployed in *The Prelude*: specifi-

cally, Wordsworth's description of Roubiliac's statue of Newton in the Antechapel of Trinity College, Cambridge.

So, too, does the manner in which he characterises his own idiosyncratic interpretive habits serve to betoken an understated affinity between that celebrated 'precursor' and his latter-day self. They were a pair of thinkers, nonetheless, separated by far more than the mere matter of a hundred and fifty years. Newton's achievement, in Tyndall's opinion, was that he recognised that 'what is true of the earth as she swings to and fro in her yearly journey round the sun, is also true of her minutest atom […]'; thus he busied himself studying, like a curious watchmaker analysing the workmanship of an unfamiliar, yet comparable, master-craftsman, all the measurable world's 'wheels within wheels […] [its] rhythm within rhythm' (*FoS*, p. 24). (Incidentally, it would seem that even by the mid-nineteenth century such a parable of watch and watchmaker was already considered among the literati overly threadbare.[8]) Tyndall, by contrast, aspired to learn of much vaster and more occulted things. He tried to apprehend nothing less than the presumed 'utter darkness beyond the atmosphere'; he hoped to peer into the 'universal cloud' which, through condensation and gravitational collapse, was over untold millennia 'to issue in solar and stellar systems, and all that they involve'. And he recognised that in this looking backwards there was also an element of looking inward, an apprehension, not just of the self, but also that part of the self capable of feeling awe, of gazing silently into the darkness, filled with amazement and asking (often unanswerable) questions. 'Did the *thought*' – Tyndall directs this urgent query apparently as much at himself as at any hypothesised reader – 'which thus ran back through the ages simply return to its primeval home?' For it seems, like Newton before him, Tyndall, too, possessed 'a mind for ever / Voyaging through strange seas of Thought, alone' (*Prelude*, p. 508; 3.62 - 63).

As T. W. Heyck has noted: 'For the early Victorians, Newton stood as the heroic figure in human progress, for they saw him, as had their predecessors in the eighteenth century, as having demonstrated the perfection of the divine plan' (p. 52). For somewhat more secular reasons he remained so, later in the era. But while that natural philosopher, perhaps while overlooking the courts of Trinity, surveyed a universe of like regularity, of clockwork planetary motion, set to spinning by the hand of God, a universe of ponderous order through and

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[8] 'To prove design […] Caro has recourse to the old analogy of "the watch"', remarks the author of 'Science and Positivism', a philosophical appraisal from *The Saturday Review* of 4 April 1868; he continues: 'An argument is no worse for being old, but all the better, if it has often been used but never refuted. But this is not the case with "the watch" as implying a watchmaker – an argument which was not true even when it was new' (p. 455).

through, Tyndall beheld from his own craggy, mountainside perch those many years later – *Hours of Exercise* appeared in 1871 – one both far less human in its scale and far less reducible in a mathematical sense.[9]

Tyndall's world, unlike Newton's, was not predictable in any total way, its large-scale behaviour remaining defiantly inexpressible in terms of any conceivable, finite sequence of algebraic relations. Newton's cosmos – as noted in my opening chapter – by a simple act of scalar substitution (or negation) for the time-variable *t* (in his own elegant formulations of Kepler's three laws for planetary motion), could be run backwards in time, with infinite accuracy, as reliably as forwards.[10] Tyndall's, however, governed by what are (so satisfactorily) called the *irreversible* processes of thermodynamic transformation, admits of no such simple divination. Simply put, one can't un-stir coffee, howsoever one might try. Nor can one, beholding the world as it is, fully reconstruct or even begin adequately to comprehend, in any 'quasi-omniscient' sense, that fulminating primordial cloud, the nebula which did, or did not, contain the seeds of the '*sadness*' with which Tyndall 'regarded the Matterhorn'.

It is difficult to determine how much of this he knew, or merely suspected – such ideas were at once in the air, and confused. Edward Daub has demonstrated how, in mid-Victorian entropic science, priority disputes, fuzzy analysis and lexical inconsistency led to widespread mystification. Moreover, as Stephen Brush has noted, even in the 1870s, after Boltzmann had proved via his *H*-Theorem that randomness, irreversibility and disorder were deeply linked, 'it was difficult for scientists to abandon the view of Laplace that one assumes phenomena to be random because of lack of knowledge rather than because of any inherent indeterminism' (p. 584). Tyndall's passage embraces – perhaps embodies – such ambivalence. There may be, it suggests, complete and universal determinism ('the prediction of all that has since occurred'), or, then again, there may not. But, either way, the answer to such a riddle, due to limitations (theoretical? informational?), remains forever beyond the reach of absolute computability. The 'hope' encapsulated in a jovial couplet penned at the turn of the twentieth century by Cambridge mathematical physicist A. A. Robb – 'No tolerance will be shown to any sort of

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[9] This was the precise analogy drawn by William James to describe F. W. H. Myers's services to Victorian psychology, cited in my opening chapter.

[10] Such an epitome, though prevalent post-Enlightenment, actually refers more to the neo-Newtonian computational determinism of Laplace than to the beliefs of the natural philosopher himself, who was rarely absolutist. He famously believed, for instance, that instabilities in orbital motion required continual divine correction. Moreover, 'he [Newton] never insisted that universal gravitation was essential to matter – largely because he was always concerned with how his laws of motion would correspond with the presence of God in the world […]'; thus, Christopher Lukasik argues, 'his system could not be strictly classified as a mechanistic theory […]' (p. 226).

mystery, / As soon as we can calculate all past and future history' (p. 9) – was thus understood, even then, at the macroscopic level, to be hokum.

Tyndall also knew well that he was by no means exempt from the equations he wielded with such alacrity, an impartial observer watching nature unfold, as if in a terrarium, from outside, at a distance. This was a fact acknowledged in an entry defining materialism in the 1865 edition of Brande and Cauvin's *A Dictionary of Science, Literature, & Art*: 'That metaphysical theory which is founded on the hypothesis that all existence may be resolved into a modification of matter, including, of course, the conscious subject' (p. 722). But (this seems a subtle proviso), 'conscious subject' includes not only others perceived, it includes the self perceiving, the eye – ultimately, the brain – of the conscientious scientist interacting with matter and its spectral emanations. This Tyndall recognised, discerning an aspect in his own era, and in his own science, of the one great truth of quantum mechanics: that the observer's role was as much that of the watched as the watcher, and that neither could be un-implicated in the affairs of the other.

Yet, like so much of his thought, this 'axiom', too – far from novel – had Romantic origins, or precedents: 'Do not forget, then, what thou hast now clearly understood', an inquisitioning spirit announces, in Fichte's *Die Bestimmung des Menschen* (The Vocation of Man; 1800); '*In all perception thou perceivest only thine own condition*' (p. 412). Mid-Victorian developments in science, coupled with his own convictions about the intractably material nature of consciousness – mediated, one suspects, by both a latent idealism, and a recollection of Wordsworthian self-questioning (*à la* 'Tintern Abbey') – forced Tyndall to admit that a search for origins was also a search for self. Thus, any mental voyage into 'formless fog' was inevitably circular, landing the traveller once again on the slopes of some lesser peak, in Matterhorn's shadow, peering upwards – in Ruskinian horror? or Tyndallic delight? – at its time-ravaged silhouette. From self to cosmos and from cosmos to self, from matter to mind and back again, the journeys are indistinguishable when looked at from any remote enough vantage point – such as that afforded Tyndall by the terrain of the Alps. One unidentified wag at *Punch* was, in fact, being far more perceptive than he probably realised when, in the number for 12 December 1874, he observed, in a throwaway quip, tucked in the bottom corner of a page: 'THE HORN OF THE DILEMMA FOR TYNDALL. – The Matter-horn' – the joke's genius, of course, a visual one, residing in that hardly incidental mark of hyphenation (['Horn']).

Where else, though, beyond the monumentally sublime, was 'poetry' to be found in Tyndall's accounting? An echo of ethereal Keats, not rustic Wordsworth, offers one indica-

tion (though the earlier Romantic expressed not dissimilar sentiments in his own verse from time to time).

Keats, in his justly famed 'Ode on a Grecian Urn', explained that

> Heard melodies are sweet, but those unheard
> Are sweeter; therefore, ye soft pipes, play on;
> Not to the sensual ear, but, more endear'd,
> Pipe to the spirit ditties of no tone […] (p. 261; ll. 11 - 14)

a conviction with which Tyndall would seem to agree. In 1875, the scientist, responding in *The Fortnightly* to a critique of his unshakeable – when was it not? – belief in the capacity of a flower to direct its own growth and development (made by the Rev. James Martineau, an eminent Unitarian theologian as well as one of the scientist's most able and persistent antagonists), included in the text of his argument what amounts to a brazen declaration of aesthetic principle, every bit as radical in its own way as that made by Keats those many years before:

> I went some time ago through the greenhouse of a friend. He had ferns from Ceylon, the branches of which were in some cases not much thicker than an ordinary pin – hard, smooth, and cylindrical – often leafless for a foot or more. But at the end of every one of them the unsightly twig unlocked the exuberant beauty hidden within it, and broke forth into a mass of fronds, almost large enough to fill the arms. We stand here upon a higher level of the wonderful: we are conscious of a music subtler than that of the piano, passing unheard through these tiny boughs, and issuing in what Mr. Martineau would opulently call the "clustered magnificence" of the leaves. Does it lessen my amazement to know that every cluster, and every leaf – their form and texture – lie, like the music in the rod, in the molecular structure of these apparently insignificant stems? ('Materialism', p. 594)

Here is the romanticism, then: in that element of self-evidencing pattern seen inhering in worldly things themselves, suggesting the 'subtle' and 'unheard' music of molecular interaction. It is this recognition of design without insistence on a Designer – this belief in the banishment of all divisions between matter and rarefied mind – that would, for Tyndall, have served to augment, rather than extinguish, any sympathetic artist's perception of the truly miraculous amid a superfluity of the mundane.[11] 'I see what he [Martineau] sees with a wonder superadded', he writes further on; 'To me as to him – nay, to me more than to him – not even Solomon in all his glory was arrayed like one of these [fern-branches]' (p. 594).

Biblical allusion – the phrase cited is borrowed from Luke 12: 27, a verse simultane-

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[11] 'It is worth pausing', he remarks in *Forms of Water*, 'to think what wonderful work is going on in the atmosphere during the formation and descent of every snow-shower: what building power is brought into play! and how imperfect seem the productions of human minds and hands when compared with those formed by the blind forces of nature!', before castigating himself (and others) for such ungenerous choice of adjective: 'But who ventures to call the forces of nature blind? In reality, when we speak thus we are describing our own condition. The blindness is ours […]' (pp. 31 - 32).

ously luxuriating in the prodigy of material creation and praising the boundless munificence of its Creator: 'Consider the lilies how they grow: they toil not, they spin not; and yet I say unto you, that Solomon in all his glory was not arrayed like one of these' – serves to further buttress his point. Nature is religious, he insists, though not in the unexamined, or 'retrograde', fashion associated with Martineau's theology, which would, of course, never have endowed even a molecule with animating power or capacity, while persistently denigrating matter as unworthy of Mind. By contrast, as the whole of the 'animal world […]', from Tyndall's perspective, is simply 'a distillation through the vegetable […] from inorganic nature', faith and reason themselves are enthralled to the atomic and, thus, drastically, even paradigm-shiftingly, akin to rocks and trees, liquids and gasses ('Materialism', p. 596). Few 'literary' writers earlier in the century would have dared to suggest as much – save, perhaps, for Emerson. The 'unheard music' is therefore not merely Keats's poetic imagination in and of itself, but also that startling moment of perception by a suitably prepared observer of emergent signs of continuity between mind and matter, of ordering born of chaos. Hence, a loss of distinction between subject and object, artist and landscape, percipient soul and that which it both espies and delights in, is not to be mourned by the poet or philosopher. On the contrary, in it is to be found a new portal to the numinous, that 'higher level of the wonderful' which Tyndall celebrates with such enthusiasm in his ruminations on the Ceylonese ferns of a friend.

Wordsworth, in 'Tintern Abbey', describes about midway through a *volte-face* in his attitude towards nature, one which had taken place a number of years previously (after that period of 'thoughtless youth'). He does so in the course of those very lines Tyndall had chosen to cite subsequent to the concluding paragraphs of the first authorised edition of his Belfast Address; they read, in part:

> For I have learned
> To look on nature, not as in the hour
> Of thoughtless youth; but hearing oftentimes
> The still, sad music of humanity […] (p. 164; ll. 88 - 91)

This is a subtle transformation. Ian Ousby says of it: 'No longer merely a stimulus to be exploited or a spectacle to be judged, nature has become for Wordsworth […] a living force embracing the individual soul and communicating with it, to console, uplift and ennoble' (pp. 178 - 79).

Perhaps Tyndall's obvious affinity with these sentiments can be explained by the fact that he, too, in adulthood had come to recognise both the beneficence of this 'living force' and

its interpenetration with human affairs, though, needless to say, in a fashion far more necessary, if not far more profound, than even Wordsworth could ever have dreamed.

THE MATERIALIST AND THE MUSTARD SEED

'Tintern Abbey', fixed at a moment of introspection, expresses a serenity, as well as a rapturous certainty, of conviction. Tyndall, in his work, let alone throughout his life, was not always so cheerful, nor dogmatic. Indeed, his 'materialism', if strong, was ever a precarious balance, unresting and active.

Often self-doubting, pragmatically self-aware, it seemed, at times, in need of vigilance, tiny recalibrations or tweakings of assumption and epistemological belief. Misgivings about design (or Design), fears of nihilism and extinction, concern about the roles claimed for anthropomorphism and reductionism, constantly tussle in his prose with more optimistic passages, paeans to scientific progress or all-conquering rationality. As with Clifford, these instabilities – materialistic 'heresies' always threatening – become most glaringly evident in works of verse, where the discipline required by poetic composition, in consort with the putatively private or confessional nature of the form, conspire to insure compactness and memorability of phrasing. As Yeats once remarked, with typical acuity: '[W]e make out of the quarrel with others rhetoric, out of the quarrel with ourselves, poetry' (qtd. in Henn, p. 104). Far more so than in rhetoric, though, poetry's inward 'quarrellings', beyond ideology, encompass a variety of idiomatic contretemps as well, internal altercations and unsteady alliances between divergent vernaculars and modes of description. As such, those revelatory collisions – or acts of collusion – so prevalent in Tyndall's prose, between 'plainspoken' language (and striking instances of unadorned physical explanation), with Biblical reference (and invocations of Romantic terminology and conceit), surprise with still greater force, and emerge with much greater regularity, within the more intimate venues afforded him by the conventions of versification. He therefore dedicated much to its careful crafting and considered revision.

An overlapping of scales is, of course, evident in much of Tyndall's expository writing, where emphasis is continually being placed on the *extensibility* of materialistic explanation, on strict causal law's draconian implementation across all orders of magnitude in space as well as time. This became an abiding poetic theme, and concern, of his as well. 'To the moon', an unpublished piece dated Valentine's Day 1863, addresses one of his lifelong loves, what Keats

in 'Ode to a Nightingale' referred to as the 'Queen-Moon […] on her throne, / Cluster'd around by all her starry Fays' (p. 258; ll. 36 - 37). (Tyndall, for comparison, invokes 'that heaven / Where thou dost reign, the Queen of all the Stars'.) The scientist's is a promiscuous affection, however, and his verse, in its first stanzas, ranges over creation, offering a classic libertine's rationale for romantic inconstancy (that vice, of course, archetypically associated with Luna as heavenly body), attempting thereby to justify the wantonness of his own aesthetic ardours by appeal to (our charmingly personified) satellite's sense of 'perspective' and cosmic proportionality:

> Say does the crimson of the drooping rose
> When soft it falls upon delighted eyes
> Close up those eyes against the glorious sun
> Which gives all flowers their odours & their bloom?
>
> Or does the song of lark and nightingale
> Mingling at dawn along the Devon shore
> Make the full heart less fitted to enjoy
> The grander music of the gleaming Sea?
>
> Is it not rather so, that where a love
> So large as fills my soul for thee
> Unlocks the doors, the smaller loves of earth
> Troop in without disturbance to the great?
> Dismiss thy fear; retract thy strong reproach,
> And bend thy beauty o'er me as of yore. –

Tyndall's ode 'To the moon' serves thus as a sort of tonic to Keats's own for a nightingale, obliquely invoking the earlier poet's meditations on the burdens of consciousness and mortality, dreads occasioned by the warblings of that 'light-winged Dryad of the trees' (p. 257; line 7), only to dismiss them. He finds, instead, in the several 'musics' of nature, a restorative, rather than premonition or dirge. His final lines, for instance, recast Keats's melancholic 'Adieu! Adieu! […]' (p. 260; line 75) into a cheerful, even cheeky, leave-taking: 'Thou'rt bright once more, – come nearer then my love, – / Still nearer – stoop – a little lower – there! / I kiss thy silver cheek ~~and say~~ <goodnight!> goodnight!'. (The scientist's scribbled emendation is telling, further accentuating the poem's literary parallelisms and allusive genealogy.)

They were different, of course, Keats's project and Tyndall's. Moreover, their poetic gifts could hardly have been more unequal. Yet both wrote night pieces. Keats sought his escape on 'viewless wings of Poesy' to a kind of timeless, quasi-narcotic rapture; he abjures the world in which 'but to think is to be full of sorrow' (p. 258; ll. 33, 27). Tyndall's own transport, by contrast, comes by *virtue* of thought, through his recognition of the interconnectedness

of things, of the animating role of sun and tide-governing moon, those celestial bodies (as he phrased it in an earlier poem) 'command[ing] the plastic Sea / Which rolls around the world its silvered brine' ('Queenly'). Yet thought's temptations, those enticements of laboratory bench and spectroscope, do not supplant his direct experiences of external nature, but, instead, serve to augment them, adding to the Romantic's litany of conventional wonders a few undreamt of in earlier philosophies. Such bonuses somewhat, though not fully, compensate for the lack that many judicious Victorians were later to surmise in, say, the Belfast Address.[12]

In 'To the moon', a justification of the poetic allure of his generation's science, Tyndall lists two chemical elements – the first isolated in 1826; the second, 1774; both ironically toxic to man – as well as the moisture cycle of evaporation and condensation (itself, of course, the embodiment on a homely level of the principles of matter and energy conservation), as potential distractions for a nineteenth-century materialist. But he then slides immediately from proactive confession into protestations of a higher, more constant and fundamental fealty: 'Nor Bromine richly brown, nor Chlorine green – / Nor Aqueous Vapour which the praying earth / Swings from her censors underneath thy beams, / Has ever caused my love to swerve from thee'. Tyndall's metaphors of adoration are applied not just to exalted *Homo sapiens*, but to those other patternings of matter and force (a 'praying earth' which, priest-like, 'swings […] her censors' beneath evening's cathedral vault, for example); these 'worshipped' objects – inert and insensate, perhaps – are, he hints, likewise 'enlivened', set dancing by thermal and gravitational energies derived, ultimately, from heavenly bodies: from sun and moon.

The peroration of Tyndall's poem on his visit to Wight similarly hinges on such conundrums of scale, on the telescoping magnitudes of his own aesthetic entrancements (though this time he plays no favourites).

He is here describing the coach ride back to Wright's house in Mudeford. Perhaps most notable is the sense of equilibrium conveyed, of the poet's contentedness with his place, and precedence, in the Chain of Being – and that other chain, less abstract, of biological beings as well. He becomes at once the focus of attention and an attribute of the scene, at once the Adamic orderer of phenomena and something ordered among those phenomena.

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[12] An editorial in *The Times* of 20 August 1874 identified as the oration's argumentative gist: 'The strain of reason and the emotions of his physical nature will not rest unrecognized; and when the end of the Professor's Address is reached we echo his own thoughts if we say, – "There are more things in Heaven and Earth than are dreamt of in his philosophy"' ('Professor').

He has seemingly achieved a sense of locale and proportionate significance; his inner mental state – an attribute uniquely of sentience, magnified and contextualised in the psyche of the pontificating materialist (a soul, he suggests, inclined to canny regard for the 'actual' disposition of physical things) – in soothing accord with the serenity and sanctity 'evidenced' by that external world surrounding him. He here puts forth, in all essentials, a scientific pastoral:

> And soft and calm the saintly evening drooped
> In silence o'er the earth, – the world within
> As warm and tranquil as the world without.
> Cradled in foliage lay the smiling fields;
> The soft green of the pastures gleaming through
> Their umbrous frames of hazel and of elm.
> The bean fields came to meet us with their scent,
> And the pink woodbine netted through the hedge
> Poured out in sweetness all its floral soul.
> And when the twilight darkened into night
> The knolls on either hand were like the sky
> Studded with twinkling stars – the grass was gemmed
> With glow-worms, one of which I knelt beside
> And saw it like a little sun illume
> In emerald light the leaves and grasses near […] ('DP', p. [12])

Tyndall seemingly shrinks to nothing in these lines, becoming a perceiving presence only, a Whitman-esque observer.

The synthesising, 'labouring' theorist reasserts himself – encoding a generic modulation from scientific pastoral into scientific georgic? – in a passage absent from the copying out of the poem as sent to Mrs Pollock. (Removed for reasons – fairly self-evident! – of social appropriateness, I suspect.) Having noted the microcosm of glow-worm and grass blade, a planetary system writ domestically small, Tyndall returned to the waiting carriage, where he

> sought
> To make the nature of this wondrous thing
> Called Light, as far as science has explored
> Its essence, manifest to Mrs. Wright.
> Poor Wright was silent – afterwards I learned
> That while we talked of ether and of waves
> His stomach, shaken sadly of [sic] the sea
> Began to totter, and when he resigned
> His charge at Mudeford, he quite gave way. ('DP' [1], p. [10])

This (embarrassing) impingement of the physical on the mental provides another arresting instance of Tyndall's curious otherworldliness, his obliviousness to the concerns of others. But the implicit paralleling of ether waves with physical waves, of shaken atoms with scrambled

passenger, has a certain niceness. Tyndall's cosmos, here as elsewhere, is a decidedly orchestral one. A sense of melody, of an undulatory or 'singing' external world, of that ever-present, if unheard, Keatsian music, is for him a common conceit, at once poetically pleasing (conveying a sense of real 'aliveness' and anticipation in nature) and scientifically accurate (with omnipresent heat as 'mode of motion', its energies oscillating atoms and molecules).

The overture to his poem 'A Morning on Alp Lusgen', for instance, glances in its first lines at the opening couplet of the first quatrain of the *Rubáiyát of Omar Khayyám*, before moving from poetic convention to theoretical insight *made poetic* through extension of the 'rippling' imagery perfusing FitzGerald's Persian paraphrase ('Awake! for Morning in the Bowl of Night / Has flung the Stone that puts the Stars to Flight', in the text of the 1859 first edition [p. 69]):

> The sun has cleared the peaks and quenched the flush
> Of orient crimson with excess of light.
> The tall grass quivers in the rhythmic air
> Without a sound; yet each particular blade
> Trembles in song, had we but ears to hear. (*NF*, p. 498)

Associations vibrate without bound in such a cosmology: between objects, between events, connecting the great with the little, the here with the there.

'We on the earth's surface live in the midst of ætherial commotion', as Tyndall informs us in a manifesto on 'The Constitution of Nature'. It is the hum and throb, the restless, rustling energy, of electromagnetic vibration that he overhears, as if it were the purring of some titanic engine – one aural landscape increasingly familiar to Victorian senses – apprehended in the background of all.[13] 'To the conception of space being filled', Tyndall immediately elaborates, 'we must therefore add the conception of its being in a state of perpetual vibration. The sources of vibration are the ponderable masses of the universe' (*FoS*, p. 8). Each of these – whether star, fluorescing nebula, solar planet (illuminated by reflected radiation) – throws its light out. The waves propagate through the hypothesised ether ('this all-pervading substance') like concentred ripples rushing outwards from a pebble carelessly tossed into a pool of still water.

Tyndall's language is Carlylean here, with its breathless intimations of a quivering under-fabric to the structure of reality itself, of a universe never stilled save in death (or thermodynamic equilibration, which is precisely the same thing): 'This all-pervading sub-

[13] Tyndall's statement has a literal truth about it as well when one recalls the accidental, though fortuitous, discovery in the mid-1960s (by the radio astronomers Penzias and Wilson) of the primordial echo of the Big Bang itself, that low-level buzz omnipresent in the 3°K Cosmic Microwave Background Radiation.

stance takes up their [stars', nebulae's, planets'] molecular tremors, and conveys them with inconceivable rapidity to our organs of vision. It is the transported shiver of bodies countless millions of miles distant, which translates itself in human consciousness into the splendour of the firmament at night' (*FoS*, p. 4).

Carlyle, Beer has noted, deploys 'prodigious linguistic energy […] into recuperating the past and reviving the marvel of the everyday' (*Darwin's*, p. 75). Tyndall couples a compositional virtuosity indebted to Carlyle's transcendentalism with, as here, a scientific philosophy having at its base the urge to make manifest 'the bridge between the sensible and the insensible – the manifestations in sound, light, and motion of the forces acting on molecules' (Sawyer, pp. 228 - 29). As such, the world Tyndall describes comes to seem at once verbally alive and materially vital.

His was to prove a compelling and seductive vision, contributing to an enduring mode of literary expression and aesthetic appreciation. The (much later) hallucinatory pantheism plainly evident in any number of Dylan Thomas's most celebrated lyrics ('The force that drives the water through the rocks / Drives my red blood; that dries the mouthing streams / Turns mine to wax', so he writes in the second stanza of 'The force that through the green fuse drives the flower' [1934]), seems to bear its imprint, as does, more certainly, the nature prose of Richard Jefferies, particularly that composed during the 1870s and 1880s. In a notebook entry from 1887 (reproduced in the recent compilation *At Home on the Earth* [2001]), that author, so reverential towards living things, so sympathetic towards the wonders of landscape, comes to seem equally energised by the undelimited possibilities of Tyndall's – or, more generically, mid-nineteenth-century scientific naturalism's – enlightened admiration for the most 'base' of imagined substances: 'Life a property of Matter. Intelligence a property of matter, and infinite capacities unrecognised. No fear therefore in becoming matter (being matter now) as that is only becoming that which is life and intelligence' (p. 165). The ordinary or unremarkable, throughout Jefferies's prose, as throughout Tyndall's thought, is transfigured into the extraordinary; the everyday, imbued with a kind of jolting alterity; matter, too, estranged and made familiar, if not familial, all at once.

Many among their contemporaries found such conceptual rejiggings unsettling, even sinister (a recurrent theme, of course, throughout this dissertation). Rev. Watson, so harsh on Clifford's idea of 'man as wave', put things with characteristic starkness in *Gospels of Yesterday*, taking Tyndall's soothing and melodious cosmic hum and replacing it with the din of a maelstrom – and that deafening silence of materialism's banished God: 'And ever there is

darkness upon the rhythmic deep, darkness within it, a roar of energy, an awful heat of motion, but no eternal truth, no love that endures, no life that is not a movement towards death' (p. 178).

Ruskin, equally horrified by materialism, was less extreme in *The Ethics of Dust: Ten Lectures to Little Housewives on the Elements of Crystallization* (1865), where he targeted one of Tyndall's explanatory proclivities in dialogic form:

> L[ecturer]. I do not see why it should be provoking to be asked what it is to be alive. Do you think you don't know whether you are alive or not?
>
> *(ISABEL skips to the end of the room and back).*
>
> L. Yes, Isabel, that's all very fine; and you and I may call that being alive: but a modern philosopher calls it being in a 'mode of motion.' It requires a certain quantity of heat to take you to the sideboard; and exactly the same quantity to bring you back again. That's all.
>
> ISABEL. No, it isn't. And besides, I'm not hot.
>
> L. I am, sometimes, at the way they talk. (p. 46)

Such a stance, such an openness to connection and theoretical unification, was also something that could be taken, by some, to debilitating extremes. One of Tyndall's acquaintances, Thomas James Cobden-Sanderson, confessed to an almost paralysing sense of interrelatedness. Some years later, Virginia Woolf, in a review, described the woozy sensation while reading Cobden-Sanderson's memoirs of encountering a world *washed through* with meaning, its occupants, like its objects and occurrences, inundated by interpretability, each, as it were, a Rorschach blot. 'Everything seems to suffer a curious magnification', she writes; 'Nothing exists in itself but only as a means to something else. The solid objects of daily life become rimmed with high purposes, significant, symbolical. The people that drift through these diaries – even Swinburne and Morris – have become curiously thin; we see the stars shining through their backbone' (p. 372).

Tyndall never went so far. All the same, for him, the world-as-understood remained somehow other to the world-as-experienced, suffused with a palpable quivering. Sometimes such a prospect appeared a blessed revelation granted via science and rationality, sometimes (though more rarely) an enervating curse. The allusion, therefore, to Mark 4: 9 in 'A Morning on Alp Lusgen' (Jesus's admonition to His disciplines: 'And he said unto them, He that hath ears to hear, let him hear') hopefully figures the materialist as secularised apostle, as chosen possessor – and, in time, charged proselytiser – of Higher Truth, comprehending the world's allegory, glimpsing beneath its masks and superficialities authentic, pulsatory meaning. (Coleridge, in reflecting on Wordsworth, likewise invoked this verse, towards similar ends. In *Biographia Literaria*, he noted of 'the wonders of the world before us', that they are 'an inex-

haustible treasure, but for which, in consequence of the film of familiarity and selfish solicitude we have eyes, yet see not, ears that hear not, and hearts that neither feel nor understand' [2: 6].)

The start of Mark 4 is given over to the parable of the mustard seed. Encountering incomprehension, or obtuseness, among one of His followers, Jesus addressed the group with an exasperated aside:

> And he said unto them, Unto you it is given to know the mystery of the kingdom of God: but unto them that are without, all these *things* are done in parables: That seeing they may see, and not perceive; and hearing they may hear, and not understand; lest at any time they should be converted, and *their* sins should be forgiven them. And he said unto them, Know ye not this parable? and how then will ye know all parables? (4: 11 - 13)

The elementary parable of sower and sowed, then, an allegory underpinning all other allegories in Christian theology, finds a scientific counterpart in the mystery posed by a different kind of planting. That trembling world underlying daily experience apprehended by Tyndall beneath worldly appearance has, of course, its own buddings and fruits, unignorable mustard trees arising serendipitously from minuscule, sometimes unnoticed, often unremarkable, beginnings: those hothouse fronds, the petals of a water-lily, green pines growing in an Alpine declivity. This is the conviction which characterises much of Tyndall's published work. Even if does seem to flicker from righteous orthodoxy here and there, it still manages, more often than not, to resolve into apology, or the acquiescence of a humble – or, more precisely, humbled – servant, departing with a deferential bow.

But not always. Indeed, at times Tyndall's unfaith – and it is manifested most plainly in his poems, or in those letters quoted already – seems to go far beyond that of Jesus's quizzical discipline. Not simple doubt, beyond mere contrarian quibble, it toys with apostasy. Later in 'A Morning', for instance, Tyndall's scientific sense seems, for a moment, overwhelmed by his visual one. Befuddled by the seeming Design evident in (what intellect tells him to be) a uniform grove of conifers made to appear uniform solely by chance and those haphazard inducements of natural selection, he exclaims:

> Unplanted groves! whose pristine seeds, they say
> Were sown amid the flames of nascent stars –
> How came ye thence and hither? Whence the craft
> That shook these gentian atoms into form,
> And died the flower with azure deeper far
> Than that of heaven itself on days serene?
> What built these marigolds? What clothed these knolls
> With fiery whortle leaves? What gave the heath

> Its purple bloom – the Alpine rose its glow?
> Shew us the power that fills each tuft of grass
> With sentient swarms – the art transcending thought,
> Which paints against the canvas of the eye
> These crests sublime and pure, and then transmutes
> The picture into worship? […] (*NF*, pp. 498 - 99)

The buzzing motif continues: the 'sentient swarms' capering in individual tufts of grass suggest both a penumbra of insects and the internal jostling of sun-warmed molecules, the atoms deterministically 'shaken' into final form: whether mountain, pine, observing naturalist, flowering shrub. There is a reiterated concern with colour, partly poetically conventional, of course, partly occasioned by his own meteorological and atmospheric obsessions. He marvels at the Belfast Address's 'azure' of heaven surpassed in that of the Alpine flower, the purple of the heather, the redness of the whortleberry plant. But there is an unease with the project of materialism as well, not seen so clearly before, nor expressed as pithily. The plangent 'whats' prefixing these lines convey a poignancy and pathos through insistent repetition: what might seem at first a mood of childlike inquisitiveness descends soon enough into something nigh petulance. Job's litany of accomplished wonders, some rendered counterfactual by Victorian science – a God 'Which commandeth the sun, and it riseth not; and sealeth up the stars; Which alone spreadeth out the heavens, and treadeth upon the waves of the sea; which maketh Arcturus, Orion, Pleiades […]' (Job 9: 7 - 9) – is here referenced not just semantically, but syntactically as well. But Tyndall's queries, unlike Job's, do not have the surety of catechism, while those frustrated 'whats' leave teasingly unspecified the nature, even the possibility, of demiurge. (Forceful, transitive verbs reinforce this notion, communicating a nature 'built' or 'clothed', a spectacle rendered wondrous by – uncrafted? – 'craft'.)

Moreover, statements in a draft of a lecture given at Queenwood College, preserved as his journal entry for 15 May 1848, demonstrate that such discomposing existential anxieties had, in fact, long preoccupied Tyndall. 'Can man by searching find out God exclaimed Job in his day and the syllables echo on', he had announced to his students, 'a question without an answer through the ages of prospective eternity' (p. 291).

If not quite riposting Job, Tyndall, in *Hours of Exercise in the Alps*, a study of 1871, nonetheless provided the unwavering response of contemporary naturalism to the specific puzzlement articulated so clearly in 'A Morning on Alp Lusgen'.[14] (It was an answer to be adroitly lampooned in the anonymous tract *Materialistic Views of Professor Tyndall and Harriet*

[14] Bartlett also provides a useful discussion of a section of this passage (pp. 153 - 54).

Martineau Criticized [1879]: 'And here we may fancy Tyndall to exclaim: O wise Sun, and as sagacious Ocean; O virtuous and all-powerful pair, how can we enough honour thee?' [p. 10].)

> And as I looked over this wondrous scene towards Mont Blanc, the Grand Combin, the Dent Blanche, the Weisshorn, the Dom, and the thousand lesser peaks which seemed to join in celebration of the risen day, I asked myself, as on previous occasions: How was this colossal work performed? Who chiselled these mighty and picturesque masses out of a mere protuberance of earth? And the answer was at hand. Ever young, ever mighty – with the vigour of a thousand worlds still within him – the real sculptor was even then climbing up the eastern sky. It was he who raised aloft the waters which cut out these ravines; it was he who planted the glaciers on the mountain-slopes, […] and it was he who, acting through the ages, will finally lay low these mighty monuments, rolling them gradually seaward […]. (*Hours*, pp. 190 - 91)

Tyndall's veneration for the sun encompasses the prophecy of Luke 3: 5 ('Every valley shall be filled, and every mountain and hill shall be brought low; and the crooked shall be made straight, and the rough ways *shall be* made smooth'), supplanting divine with thermodynamic equilibration, turning the narrative of salvation into a horror of geological dilapidation and entropic ruin.

But, as so often, this leaves him spiritually undernourished, for the question he poses in 'A Morning' seems more akin to that posited by Carlyle in *Heroes and Hero-Worship*, one refusing to allow 'the sun' to serve as its pat resolution – an 'answer' which answers nothing:

> We call that fire of the black thunder-cloud 'electricity,' and lecture learnedly about it, and grind the like of it out of glass and silk: but *what* is it? What made it? Whence comes it? Whither goes it? Science has done much for us; but it is a poor science that would hide from us the great deep sacred infinitude of Nescience, whither we can never penetrate, on which all science swims as a mere superficial film. This world, after all our science and sciences, is still a miracle; wonderful, inscrutable, *magical* and more, to whosoever will *think* of it. (pp. 7 - 8)

Carlyle, among the nineteenth century's earlier thinkers, had not been alone in raising such awkward 'ontological' questions. They were a particular preoccupation of the American transcendentalists.

A work quoted by Tyndall in his lecture 'Matter and Force' (*FoS*, p. 89), Emerson's 'The Rhodora' told of the poet's encounter with a flower growing in a remote and inhospitable swamp, far from potential human observers – a flower, it would seem, languishing pointlessly:

> Rhodora! If the sages ask thee why
> This charm is wasted on the earth and sky,
> Tell them, dear, if eyes were made for seeing,
> Then beauty is its own excuse for being:
> Why thou wert there, O rival of the rose!

I never thought to ask, I never knew:
But in my simple ignorance suppose
The self-same Power that brought me there brought you.

This precise perplexity confronted Tyndall, and he could not, in 'A Morning on Alp Lusgen', despite the lapsed decades, for all the relentless progress of cosmological theory, give an answer any less rooted in 'simple ignorance', nor more sophisticated than further noddings towards that 'self-same Power'.

Furthermore, the security of scale, so central to Tyndall's earlier 'To the moon', is, here, unmistakably absent, almost extravagantly so – that sense of nature conceived as unity, of parts fitted to whole, of a kind of synergistic rightness. (It also, of course, features climactically in the account of 30 June 1856.) Common sense, he argues in 'A Morning', asserts the absurdity of any genealogy linking starburst with marigold, evanescent flower with cataclysmic astrophysical event unimaginably distant in both time and space. This seems the obverse of Francis Thompson's epigrammatic observation later that century (beloved nowadays by some chaos and quantum theorists) set forth in his poem 'The Mistress of Vision': 'Hiddenly / To each other linkèd are, / That thou canst not stir a flower / Without troubling of a star' (p. 69). Conversely, the materialist, as here described, can't seem to trouble a star without stirring a flower, somehow, somewhere. This could seem almost too implausible, or hubristic, to be regarded as sane belief. Put another way, the very panorama Tyndall glimpses, the evidence of his own eyes, seems to suggest, even confirm, the illogic of the nebular hypothesis, and *inter alia* the correctness of Rev. Martineau's persistent objections. An Alpine rose, it seems, can challenge all materialisms, threatening to debunk any reductive or ateleological system of metaphysical conjecture. And yet more ludicrous still, Tyndall proposes, is that correlated internal mental state – a variety of Romantic 'worship' – triggered within him alongside these rather more esoteric reflections, allegedly by mere rearrangement of molecules! Incredulity is his initial response to the concept that somehow ethereal waves of light, of quantifiable wavelength, are interpreted as vista and then endowed with something beyond themselves: a sense of the Burkean sublime. All this enacted, effortlessly and with near instantaneity, amid the chemistry-store ordinariness of brain-stuff and perceptive-networks. Consequently, Tyndall distances himself, momentarily disillusioned, from the whole interpretive charade espoused by 'rationalist' colleagues, their extreme fetishisations of the material – this excerpt begins with a bitter: 'pristine seeds, *they* say / Were sown amid the flames of nascent stars' – before, finally, achieving a sort of peace, though not content. The stanza ends with a sigh of weary supplica-

tion: 'Science dumb / We yearn, and grope, and guess, but cannot know' (*NF*, p. 499).

His 'they' has become 'we', but not blindly, nor without fevered introspection. Materialism's disciple, in other words – as with the querulous soul encountered in Mark – had his doubts, too, it seems, moments in which the world's parable seemed to poise unsteadily on the epistemological axis lying between absurdism and maddening incomprehensibility, like an Alpinist precariously traversing some knife-like ridge.

In *Forms of Water*, Tyndall – amidst a (somewhat boastful) discussion of materialistic science's expertise in their remorseless, even surgical, disentangling – spoke of 'the way in which the various threads of what we call Nature are woven together' (p. 123). In an essay on 'Prayer and Natural Law', however, he conceded that mountains in particular can provide a noteworthy challenge to reductive and syncretic interpretive methodologies, where the impossible cornucopia of physical form – 'World is crazier and more of it than we think', as Louis Macneice phrased the predicament in 'Snow' (1935) – seems to shirk off any single or simple explanation. Up high, he suggests, the 'threads' of nature can seem unkempt or knotty; their 'woven' aggregations, matted and makeshift. 'Accounts of mountain-goers from the 1800s', as Robert Macfarlane has explained, 'tend to be exuberant with detail, written by travellers whose eyes have become newly sensitive to the particular beauties of the mountains. […] Again and again in travel journals, attention is drawn to curious geological outcrops: arches, caves, stalactites and pinnacles […]' (p. 211). Ruskin's *Modern Painters* IV, for instance, provided its readers with formidable catalogues of topographic exotica, while Whymper's *Scrambles Among the Alps* (1871) – featuring such listings as '[t]here are precipices, apparent, but not actual; there are precipices absolutely perpendicular; there are precipices overhanging: there are glaciers, and there are hanging glaciers; there are glaciers which tumble great *séracs* over greater cliffs […]' (p. 83) – threatens at times to collapse under the burden of precise description.

The very snowy variousness, and causal suddenness, of mountain landscape was, however, for Tyndall, one key to its uncompromising aesthetic appeal. 'In this entanglement of [Alpine] phenomena it seems hopeless to seek for law or orderly connection', he asserted in that essay – before, with considerable élan, adducing law and orderly connection (*FoS*, p. 31).

But such an explanatory aptitude still leaves, for all its impressiveness and transferability, some cardinal questions unaddressed. This he admitted with unusual forthrightness in 'A Morning on Alp Lusgen', a poem which received its widest circulation as an epilogue (the 'last word') to *New Fragments* (itself – as it turned out – the scientist's final major publication).

The personified mountain in Emerson's 'Monadnoc' had expressed anticipation, even impatience: 'I await the bard and sage, / Who, in large thoughts, like a fair pearl-seed, / Shall string Monadnoc like a bead' (p. 79). Tyndall, while asserting his own science's fitness for the peak's physical encapsulation, finally has to concede – in 'A Morning', most poignantly – that he, like his science, remains dismayingly ill-equipped for any attempt at such a mightier task.

STRANGE MATTERS: TYNDALL'S STRUNG COSMOS

Unheard or not, the concept of a celestial music is – beyond its inherent playfulness – one that has been, since the beginning of recorded physical speculation and across a range of world cultures, endlessly revitalised. From the Pythagorean music of the spheres, to the plucked strings quivering in a 10-dimensional manifold in superstring theory, whose 'vibrational patterns orchestrate the evolution of the cosmos', many have argued that 'the winds of change […] gust through an aeolian universe' – so physicist Brian Greene has phrased things, in *The Elegant Universe* (1999; p. 135). Such analogies, if properly chosen, can have pleasingly heuristic functions as well, revealing, or suggesting, rules and properties which might not otherwise be so evident: such was certainly the case with the symphonic cosmology set forth by Tyndall.

'Rhythm', he wrote in *Mountaineering in 1861*, 'is the rule with nature […]. The passage of a resined bow across a string is typical of her operations' (p. 264). She has a pulse, too: 'thus beats the heart of the universe […]' – this a comparison from a discussion of the conservation, and endless interconvertibility, of potential energy and *vis viva* (or 'kinetic energy', in the modern nomenclature [*FoS*, p. 22]). Event follows event, he explained, in accord with implacable causality, thumping 'ever onward in the uninterrupted rhythm of cause and effect […]' (p. 45): from the frantic *moto perpetuo* of oscillating atoms on an Ångström scale to the lugubrious, lento tempos of planets orbiting suns. Tyndall enacted some of these metaphors in his demonstrations at the RI, in his 'singing' (and dancing!) 'jets of gas', behaving like a conductor at the podium. He urged his listeners to attempt similar exploits at home. In the Rede Lecture, given 16 May 1865 in the Senate House of the University of Cambridge, he spoke midway through of the fashion in which the 'air of a room accommodates itself to the requirements of an orchestra, transmitting each vibration of every pipe and string'; he continued (testing the pliancy of such an undulatory or 'wave' model, and moving thereby from concert hall to cosmic void), 'so does the inter-stellar æther accommodate itself to the requirements of light and heat', two phenomena re-conceptualised by nineteenth-century

science as transverse wave oscillations, as (in materialism's iconic phrase) 'modes of motion'.

He concluded this memorable address with an exponential zooming in, a 'return' from the illimitability of space to the confines of a drawing room, and, from thence (penetrating further, and more intimately, inwards), to precepts derived from materialistic physiology, explaining to his audience: 'If you open a piano and sing into it, a certain string will respond. Change the pitch of your voice; the first string ceases to vibrate, but another replies. […] [T]hus is sentient man acted on by Nature, the optic, the auditory, and other nerves of the human body being so many strings differently tuned, and responsive to different forms of the universal power' (p. 218).

That invocation of a 'universal power' seems, again, decidedly Carlylean, but then so is the musical model precipitating it, and those analogies used in illustration. As Turner has noted: 'Transmitted through Carlyle the romantic heritage of seeking the meaning of life through a particularistic or empirical apprehension and examination of nature allowed the scientific publicists to confront the naturalistic universe without regret for past supernaturalism' ('Victorian', p. 338). Often, for instance, Tyndall invoked the language of clothing in a conventional way – he wrote, for example, in 'Atoms, Molecules, and Ether Waves' of the 'cloak' provided by our earthly atmosphere: 'Were that garment removed, terrestrial life would probably perish through the consequent refrigeration' (*NF*, p. 93) – but at other times the speculations of Teufelsdröckh seem not far beneath, plainly visible through the diaphanous weavings of the scientist's own allusive vocabulary. He began his 'Lecture on Magnetism', to take one instance, with a suitable disclaimer, declaring himself an 'exponent' of the view of nature finding it 'an organic whole, as a body each of whose members sympathises with the rest, changing, it is true, but without one real break of continuity, or a single interruption in the fixed relations of cause and effect' (*FoS*, p. 378). Such a concept, and such language, clearly evidences the heritage of Carlylean metaphysics. 'To him', the scientist said of Carlyle, 'the universe was not a Mechanism, but an Organism – each part of it thrilling and responding sympathetically with all other parts' (*NF*, p. 335); so, too, that 'supply' accommodating universe of materialistic cosmology, as the scientist explained in his Rede Lecture. In it, he defined the 'temperature of space' as a function correlated with the visible and invisible radiations emitted by the panoply of stars: a measure derived, he explained, from 'the ceaseless *thrill* of those distant orbs collectively in the æther […]'; moreover, like the separate instruments constituting any orchestra, the light from each remains individual and distinct – a point glimpsed clearly 'across the entanglement of wave-motions produced by all other stars'

(*FoS*, p. 178; my italics).

This sense of organism was abetted by a renewed appreciation among his scientific peers for the mortality of all material things, stars as much as starfish. 'We had only solar and stellar chemistry' – Lord Kelvin announced of the early days of spectroscopic analysis (in his 1871 BAAS Inaugural) – 'we now have solar and stellar physiology' (Thomson, p. xcviii), a theory of the life processes and internal workings of stars, not just awareness of ascensions and declinations.

The Earth-Spirit in Goethe's *Faust, Part One* had declaimed to the terrified doctor:

> In the tides of life, in Action's storm,
> A fluctuant wave,
> A shuttle free,
> Birth and the Grave,
> An infinite sea,
> A weaving, flowing,
> Life, all-glowing,
> Thus at Time's humming loom 'tis my hand prepares
> The garment of life which the Deity wears! (1: 25 - 26)

Sartor Resartus's harried 'editor' – noting the indebtedness to Goethe of Teufelsdröckh's 'clothes philosophy', in particular such outpourings as the professor's ecstatic: 'O Nature! – Or what is nature? Ha! Why do I not name thee GOD? Art not thou the "Living Garment of God"?' (p. 142) – wonders whether or not the 'clothes philosophy' being set forth within the book was ever likely to have a transformative effect on an English readership, a population beaten down by Mill's Utilitarianism and mechanistic philosophy. He needn't have worried, however. (Tyndall, by the way, quoted Carlyle's/Goethe's 'living garment' line explicitly in his essay 'On the Scientific Use of the Imagination' [*FoS*, p. 165].) In America, too, the book made an impact. Do the following lines from Emerson's 'Monadnoc', however, allude to Goethe? Carlyle? both? neither? Is this the voice of the mountain (a 'constant giver') as surrogate – transcendental, after a fashion, though hardly divine – for *Faustus*'s Earth-Spirit?: 'In his own loom's garment dressed / By his proper bounty blessed / Fast abides this constant giver, / Pouring many a cheerful river' (p. 70).

Tyndall's own usage, on first appraisal, of such Goethian 'weaving' metaphors seems more materialistic still. In '"Materialism" and Its Opponents' – that defence of the prerogatives of naturalism (and the rightness of his pontifications at Belfast), perhaps excusing an arch tone which seems calculated to shock – he speaks of human gestation: 'I figure it [the baby] growing in the womb, woven by something not itself, without the conscious participation of

either the father or mother, and appearing in due time, a living miracle […]' (p. 598). Similarly, in an essay nearly as prickly, Tyndall seems blithely – perhaps freakishly – disinterested, not only in making any distinction between raw organic elements and biological life, but between different *orders* of biological life: 'So also as regards the reunion of the carbon and the oxygen, the molecular machinery through which the combining energy acts may, in one case, weave the texture of a frog, while in another it may weave the texture of a man' (*FoS*, p. 440). This seems, on one level, the sort of assertion – a corrosive debasement of humanity augured by the devices of industrialism – which drove Teufelsdröckh to contemplate suicide prior to 'The Everlasting "Yea"': 'To our less philosophical readers […]', *Sartor Resartus*'s 'editor' explains, 'it is now clear that the so passionate Teufelsdröckh precipitated through "a shivered Universe" in this extraordinary way, has only one of three things which he can next do: Establish himself in Bedlam; begin writing Satanic Poetry [that is, atheistic, after Shelley]; or blow out his brains' (p. 114).

But, on another level, as we have seen, the cosmology of Tyndall was not so much 'shivered' (broken apart) as 'shivering', trembling with a sensuous feeling for matter-in-life and life-in-matter (the same double sense animating a stanza in Maxwell's '*Tyndallic Ode*'). 'Reaction against mechanistic science led to nature's being perceived as living and growing', Barton explains, 'nature was appreciated in its fecundity, its grandeur, and its immensity' (p. 123). As such, Tyndall's 'weaving' metaphors can be seen as encoding a view of the world, and as suggestive of a philosophy about being in that world, as distinct in its own way from eighteenth-century mechanical theories (which, as practiced by Harriet Martineau and others, persisted in the 'practical materialism of the present') as it is from 'the torn swaddling bands of the past', those fetters – or outgrown, moth-eaten clothes – of unreconstructed theological orthodoxy ('Materialism', p. 599).

CONCLUSION

> The world does not speak. Only we do. The world can, once we have programmed ourselves with a language, cause us to hold beliefs. But it cannot propose a language for us to speak. Only other human beings can do that.
>
> - Richard Rorty, *Contingency, Irony, and Solidarity*, 1989

Bertrand Russell – a man tremendously influenced by W. K. Clifford's *The Common Sense of the Exact Sciences* (1885), which he read before he was sixteen (Monk, pp. 26 - 27) – set forth his decidedly Cliffordian worldview in 'A Free Man's Worship', an article of 1903. After enumerating first a catalogue of cultural failure and entropic decay (descriptive of a universe inextricably sunk into the final thermodynamic equilibration of 'heat death'), he concluded by noting that such eschatological predictions, though undeniably gloomy, 'if not quite beyond dispute, are yet so nearly certain that no philosophy which rejects them can hope to stand. Only within the scaffolding of these truths, only on the firm foundation of unyielding despair, can the soul's habitation henceforth be safely built' (p. 13). The words 'scaffold' and 'scaffolding', of course, have a dark double meaning: at once support and essential apparatus of construction (and, by extension, clear sign of civilisation ascendant, of a society rebuilding), they name also the platform from which the condemned go to meet their doom by hanging. In a later essay, 'What I Believe', reprinted in the volume *Why I am Not a Christian* (1957), this double-ness of signification was made explicit: 'Many a man has borne himself proudly on the scaffold; surely, the same pride should teach us to think truly about man's place in the world. Even if the open windows of science make us shiver after the cosy indoor warmth of traditional humanizing myths, in the end the fresh air brings vigour, and the great spaces have a splendour of their own' (p. 43). These are sentiments with which Clifford himself would surely have concurred, and their phrasing brings to mind not only that scientist's defence of scientism (discussed in chapter three) but also the coda to *The Origin of Species*, in which Darwin insisted that, despite the apparent nihilism inherent in his doctrine of speciation and evolution by the ruthless mechanisms of predation and natural selection, there was nonetheless still 'a grandeur

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Epigraph from Rorty, p. 6; following epigraph page quotation from Van Wylen, Sonntag and Borgnakke, p. 272.

in this view of life' (p. 396) – though scant comfort it must have seemed to many among his generation, if not to Darwin himself.

Such sanguine consolations were indeed commonplace (if not commonplaces) in mid- to late-Victorian scientific perorations, suffusing many of them with a fatalistic melancholy. However, they, like their authors, only rarely shaded into the outright 'unyielding despair' anticipated by Russell.

This was in large part due, as argued throughout this dissertation, to the persistence of, if not always the substances, then at least the languages of those 'traditional humanizing myths' which Russell, himself a scientific propagandist in the Turnerian mould, would later reference – and dismiss – with such an evocative admixture of arrogance and nostalgia. Tyndall had his Romanticism, his residue of Carlylean or Emersonian transcendentalism; Clifford, the boisterous humanism of Swinburne or Whitman, the steely stoicism of Spinoza and Epicurus, the examples set by nineteenth-century positivists (for instance, Harrison and Comte), and by his own 'materialistic' predecessors (for instance, Tyndall).

Both Tyndall and Clifford had also, like the Romantic poets and Carlyle before them, the cadences of the King James Bible from which to borrow, if not earn, a linguistic gravitas and moral authority. This final resource was invaluable, as it was commonly – and, in the case of, say, Clifford's implementation, correctly – perceived by many in the mid-Victorian reading public that atheism was a necessary appurtenance to contemporary 'materialism'. As phrased by one particularly vehement opponent, such an approach to cosmology was 'imperfect in a scientific sense, destructive in a religious, and degrading to humanity in every point of view […]'; moreover, its various explanatory elaborations, despite 'superficial' literary and philosophical idiosyncrasies, were to be uniformly condemned as fruits 'from one and the same tree – "The boundless Upas, the all-blasting tree," the tree of atheism' (*Materialistic*, p. v). Clifford was well aware of this widespread perception, observing that 'it cannot be doubted that theistic belief is a comfort and a solace to those who hold it, and that the loss of it is a very painful loss. It cannot be doubted, at least, by many of us in this generation, who either profess it now, or received it in our childhood and have parted from it since with such searching trouble as only cradle-faiths can cause' ('Influence', p. 355). He, personally, was resolute in his atheism, his abandonment of those 'cradle-faiths'. In that, he was the polar opposite of Maxwell, who, as he wrote in a letter 7 March 1852, believed that '[y]ou may fly to the ends of the world and find no God but the Author of Salvation. You may search the scriptures and find not a text to stop you in your explorations' (qtd. in *LJCM*, p. 179). This he asserted to the

end of his days, for all the rumblings made by colleagues. Tyndall, however, unlike both Clifford and Maxwell, was always one to remain guarded in public proclamations on the existence – or non-existence – of divinity. This was a fact lost on many observers, but some acknowledged at least an agnostic trend to his thought.

A few even saw Tyndall's 'supernatural naturalism' as a prolegomena to some future faithfulness, one sympathetic commentator at *The Westminster Review*, for example, writing in 1879:

> To emancipate the minds of men from any form of slavery by substituting intelligent comprehension for unreasoning formulae or wonder, has ever been the first step in the liberation of human energies, so that they may produce greater happiness for the individual and advance the progress of the whole community; and we cannot doubt that these utterances of Professor Tyndall will go far towards creating a new element of religious belief in this country […]. ('Science' [1879], p. 604)

Nevertheless (as argued in chapters four and five), Tyndall's emergent faith, for all its appeal, was not without its own novel challenges, nor were its rewards entirely commensurate with those stereotypically associated with more normative systems of theological belief.

Others, including many not considered among Turner's 'publicists', could still accept, even proselytise, the facts of nineteenth-century materialistic science – its reduction of everything to *Stoff* and *Kraft*, matter and force – but only as *temporary* approximations to some superseding truth. Among those discussed, Hinton insisted that the 'meaning' of matter must eventually be appreciated from the standpoint of transcendent geometric dimensions. Myers hypothesised that the supraliminal – he was to label it the 'methereal' (*Human*, 1: 8) – reality in which departed souls reside was founded not on impersonal quantity, but rather private human affection ('Shall they not recognize that no terrene Matter or Energy, but Love itself is the imperishable of that higher world […]'? ['Modern', p. 110]). Jefferies, searching for an egress from the perceived bleakness of contemporary reductionism, speculated that there might be an infinite hierarchy of cosmological 'conditions' ('All natural things known to us as yet may be referred to those two conditions: One, Force; Two, Matter. A third, a fourth, a fifth – no one can say how many conditions […] may exist […]' ['Dawn', p. 311]). For such thinkers, materialism, a stripping away of some (now outgrown or irrelevant?) 'humanizing myths', was a starting point, the ideological foundation for humane and revivifying conjecture.

Russell, in a preface to an edition of *The Common Sense of the Exact Sciences*, composed during dreary days towards the end of World War II, had hoped that readers of Clifford's text (full of its enthusiasm for human progress and rationalism) might 'imbibe something of its author's belief in the possibility of excellent things, and that this [might] help them to acquire

some of the strength that is needed to fight against the evils of the age in which we are compelled to live' (p. x). Yet many of the agnostic thinkers discussed in this dissertation, not just Clifford, looked towards humanity's future with hope, even ebullience, foreseeing comparable possibilities in the advancement of science. Tyndall, for instance, predicted a cultural climate more amenable to the claims of his Belfast Address, even as he anticipated a science more fit to answer some of his most riddling concerns. This perhaps surprising undercurrent of optimism – evident despite fears of religious revival or secular strife; evident despite the seeming darkness of their several anthropological, biological and thermodynamic visions, and perhaps made most conspicuous by the continued emphasis in their writings on the joy of discovery rather than the drudgery of duty and routine – was, however, not merely a consequence of personal psychology, but also a by-product of the 'sort' of science they were attempting to describe, as analysed in my opening chapter. One final example illustrates this perfectly.

Whitehead made an apposite point when he noted midway through *Science and the Modern World*:

> The nineteenth century has been a perplexed century, in a sense which is not true of any of its predecessors of the modern period. In the earlier times there were opposing camps, bitterly at variance on questions which they deemed fundamental. But, except for a few stragglers, either camp was wholehearted. The importance of Tennyson's poem [*In Memoriam A. H. H.*] lies in the fact that it exactly expressed the character of its period. Each individual was divided against himself. In the earlier times, the deep thinkers were the clear thinkers, – Descartes, Spinoza, Locke, Leibniz. They knew exactly what they meant and said it. In the nineteenth century, some of the deeper thinkers among theologians and philosophers were muddled thinkers. (pp. 101 - 02)

I would suggest that, to Whitehead's list, one might add 'scientists', too, for is there not something 'muddled', 'perplexed', if not tremulous and over-awed, about, say, Tyndall's mediations on the governing principles of thermodynamics?

> I have called the philosophy of Heat a new philosophy, without, however, restricting the term to the subject of Heat. The fact is, it cannot be so restricted: for the connection of this agent with the general energies of the universe is such, that if we master it perfectly, we master all. Even now we can discern, though but darkly, the greatness of the issues which connect themselves with the progress we have made – issues which were probably beyond the contemplation of those, by whose industry and genius the foundations of our present knowledge were laid. (*Heat*, p. xv)

Tyndall strives for a language overmatching previous technical vernaculars, cobbling here, as elsewhere, his response to specific forms of contemporary scientific belief from whatever vocabularies were thought suitable. His sly wheeling in of the extraordinarily familiar Biblical phrase (from 1 Corinthians 13: 12) 'though but darkly' (and, alongside it, all the intimations of

a steady and required progression from childish ignorance to the comprehension of responsible adulthood that such a reference would automatically entail) allows him, for instance, to convey a clear sense of undelimited disciplinarity; such a reference also implicitly suggests something of the increased spiritual significance attributed by Tyndall to 'materialistic' theorising in mid-Victorian intellectual life. At the same time, Tyndall's 'heat philosophy' recalls Herr Prof. Teufelsdröck's transcendental fulminations – occasioned by the chance sighting of a blacksmith's convective hearth – on cosmological and 'thermodynamic' interconnectedness.

Whitehead continued, speaking again of nineteenth-century philosophers, theologians and poets: 'Their assent was claimed by incompatible doctrines; and their efforts at reconciliation [between doctrines] produced inevitable confusion' (p. 102). So was it commonly for the era's scientists as well, with their several allegiances and often conflicting aspirations. Maxwell's unflappable commitment to the Church of Scotland; Tyndall's, to a sort of Romantic pantheism; and Clifford's, to a meliorist and reassuring quasi-positivism, did not sit altogether easily alongside their equal fealties to the methods of rationalism and empiricism as espoused by nineteenth-century inductive science; nor did the vernaculars associated with such diverse interpretive traditions meld without disjointedness. At the same time, a degree of disjointedness was sometimes actively courted. Clifford's extraordinary (to modern ears) essay 'Cosmic Emotion' had its genesis in a talk given 4 May 1873 before the Sunday Lecture Society, 'The Relations between Science and some Modern Poetry' (Pollock, p. 68). Such a title was neither accidental nor a non sequitur. Note how he made use of the plural, 'relations'. Scientists needed poetry – needed literature more generally – even as poets (to be relevant to the rapidly changing culture in which they – and their readers – lived) needed science. Science, in effect, enabled poets and philosophers to suggest at one stroke something about their world, a certain unsettling confluence of epistemologies and beliefs, which needed making sense of (serving immediately to justify their own disparate efforts to somehow try and do so, through 'explanatory' productions in prose and verse), while poetry, conversely, enabled scientists to insinuate what they might never have dared to argue so openly otherwise – or, in other words, it allowed them to more readily give voice in their writings to the not-said, though frequently implicit.

For some, therefore – such publicists, for instance, as P. G. Tait and John Tyndall – a redolently poetic or allusive language became the characteristic tenor of expository prose throughout this period, the ideal dialect in which they could address their own particular concerns, wage their own private battles, and, to borrow Russell's phrase, fight resolutely

'against the evils of the age in which [they were] compelled to live'. That each of them was able to do so so effectively acts as a testimony to both the multivalency of the discourses available at the time and also their often considerable prowess in shaping these extant, subtly incompatible vocabularies towards their own peculiar ends. Others – for instance, W. K. Clifford and James Clerk Maxwell – in pursuit of the same goals, chose different tactics, plainer idioms, marshalling alternative registers of metaphor and citation. This, too, they went about with both zeal and success – again, further evidence of the discursive diversity in play. For all these reasons, then, 'materialistic' language in the latter decades of the nineteenth century was predestined to be anything but monotonic.

'If the second law is valid for the universe (we of course do not know if the universe can be considered an isolated system), how did it get in the state of low entropy? On the other end of the scale, if all processes known to us have an entropy increase associated with them, what is the future of the natural world as we know it?

Quite obviously it is impossible to give conclusive answers to these questions on the basis of the second law of thermodynamics alone. However, we see the second law of thermodynamics as the description of the prior and continuing work of a creator, who also holds the answer to our future destiny and that of the universe'.

- *Fundamentals of Classical Thermodynamics*, 1994

'The ancient writers who celebrated the heavens' declaration of the glory of the Lord saw only through a glass darkly. Unbeknown to them and countless others who followed them, the Universe has revealed itself by the instruments that modern science has made possible to be far bigger, more spectacular, and more humbling than we ever imagined it to be'.

- John D. Barrow, 15 March 2006, Templeton Prize News Conference

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Where possible, all citations from the works of W. K. Clifford are based on the texts as they first appeared in Victorian-era periodicals; this has been necessary as many of the versions incorporated within Stephen and Pollock's *Lectures and Essays* were either revised (sometimes subtly) or, in a few instances, merely condensed (often indiscriminately) by his two posthumous

editors, occasionally through excision of entire sections. Such modifications were made, or so they claim, in part to avoid duplication between articles but also because, from time to time, they believed that such a process of selective expurgation would have been in accordance with the author's wishes. '[C]ertain passages', they explain, somewhat disingenuously, 'have been omitted which we believe that Clifford himself would have willingly cancelled, if he had known the impression they would make on many sincere and liberal-minded persons whose feelings he had no thought of offending' (p. 70).

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