CHAPTER 1

Professionals and amateurs, work and play: William Rowan Hamilton, Edward Lear and James Clerk Maxwell

Having met William Wordsworth for the first time during a visit to the Lake District in September 1827, the 22-year-old Irish mathematician and astronomer William Rowan Hamilton wrote to his sister Eliza of the 'burning thoughts and words' that drew the two together as fast friends.[1] Hamilton became Wordsworth's 'poetic disciple',[2] sending and addressing many of his poems to him, while the eminent romantic poet, who was then fifty-seven, compared his new friend to Samuel Taylor Coleridge, describing them as 'the two most wonderful men, taking all their endowments together, that he had ever met'.[3] Three months before their meeting, while still an undergraduate, Hamilton had been made Andrews Professor of Astronomy at Trinity College Dublin, a position that included with it the title of Astronomer Royal for Ireland and the directorship of the Dunsink Observatory, where he would live. Although he kept this position for the rest of his life, his most important contributions to science would be not in astronomy but in mathematics, principally in the field of quaternions that he largely invented.

Looking back to his youth, Hamilton wrote to his friend and fellow astronomer, mathematician and poet John Herschel in 1847 that 'it would really seem to have been at one time a toss-up, whether I should turn out a rhymer or an analyst [i.e., a mathematician working with continental calculus]'. Wordsworth encouraged his interests in science. The main theme of Wordsworth's sustained campaign of criticising Hamilton's verse is summed up by the charge he makes in his first letter on the subject, that 'the workmanship (what else could be expected from so young a writer?) is not what it ought to be'. Wordsworth pushed Hamilton to make a choice between the two vocations, although not in favour of poetry:

You send me showers of verses, which I receive with much pleasure, as do we all; yet have we fears that this employment may seduce you from the path of Science which you seem destined to tread with so much honour to yourself and profit to others. Again and again I must repeat, that the composition of verse is infinitely more of an art than men are prepared to believe, and absolute success in it depends upon innumerable *minutiæ*, which it grieves me you should stoop to acquire a knowledge of.[4]

In such letters to Hamilton, Wordsworth consistently stresses the need for what is effectively a professional commitment to the practice of poetry, a dedication he assumes that science also requires.

Wordsworth came to Ireland as Hamilton's guest in August 1829, staying with him and his sisters at the Observatory. Eliza kept a journal of the visit, which documents a particularly intense discussion that her brother had with Wordsworth about poetry and science. It appears to have been prompted by Wordsworth's recitation of a provocative passage from Book IV of *The Excursion* (1814) as part of his argument that current positivist, utilitarian and materialist applications of science, as Eliza records him saying, 'waged war with and wished to extinguish Imagination in the mind of man'.[5] Science is characterised in the poem as a slavishly positivist brute, which, the poet allows, could nonetheless be admitted to the realm of poetry and the imagination, but only in a chastened form and on a strictly temporary, probationary and subordinate basis:

> Science then
> Shall be a precious visitant; and then,
> And only then, be worthy of her name:
> For then her heart shall kindle; her dull eye,
> Dull and inanimate, no more shall hang
> Chained to its object in brute slavery;
> But taught with patient interest to watch
> The processes of things, and serve the cause
> Of order and distinctness, not for this
> Shall it forget that its most noble use,
> Its most illustrious province, must be found
> In furnishing clear guidance, a support
> Not treacherous, to the mind's *excursive* power.[6]

Science is addressed as a Caliban that can be freed from its enslavement to materialism, tutored and refined to join for a time Ariel and Prospero's realm. Invited to lend its strength to the imagination, it must first overcome a vicious native propensity to undermine such poetic vision. Soon after Wordsworth's return to England, in October 1829, Hamilton formally renounced his poetic ambitions. Indeed, risking the charge of performative

contradiction, he reported his decision to the muse directly and courteously in his poem 'To Poetry'.[7] He continued to write poetry privately, often as an adjunct to his science, for the rest of his life.

Hamilton's friendship with Wordsworth, and the parity he gave to his practices of poetry and science in the 1820s, are telling of, and indeed emblematic for, an historical moment of transition in British culture, in which poetry, beginning its gradual decline in power and prestige with the waning of romanticism, meets with ascendant science. His choice of science over poetry came on the eve of a decade in which British science strove forthrightly to become professional. This occurred primarily through the efforts of the British Association for the Advancement of Science (BAAS). Established at a meeting organised by the Scots natural philosopher Sir David Brewster at York in September 1831, the Association was the outcome of a public debate about the decline of science in Britain. Led initially by Herschel and the Scots geologist John Playfair in the late 1820s, then Brewster and the mathematician Charles Babbage, much of the discussion focused upon the inadequacies of the Royal Society. These had been brought to the fore during the heated 1830 campaign for the Society's president, principally through Babbage's provocative *Reflections on the Decline of Science in England, and on Some of Its Causes*, but also by the physician Augustus Granville's *Science Without a Head: or, the Royal Society Dissected*. Drawing upon their experience as Fellows, since 1816 and 1817 respectively, Babbage and Granville criticised the Society as a bastion of aristocratic class privilege, ill suited to recognising scientific merit and facilitating scientific research.[8]

Anxious to distinguish themselves from the old order represented by the Royal Society, the delegates to the early meetings of the BAAS accordingly felt, as the Cambridge polymath William Whewell recalls in 1834, 'the want of any name by which we can designate the students of the knowledge of the material world collectively'. Early efforts to clarify the amorphous principle of science that prevailed at the time made appeals to a broad range of interested parties, including Coleridge, who attended the 1833 meeting at Cambridge. Whewell records his contribution to the discussion: '*Philosophers* was felt to be too wide and too lofty a term, and was very properly forbidden them by Mr. Coleridge, both in his capacity of philologer and metaphysician.' Coleridge was, as Trevor H. Levere observes, keen to distinguish philosophers from 'those who merely studied the material world', a generic identity that is caricatured by such further suggestions from the meeting 'for these *naturæ curiosi*' as '*nature-poker*, or *nature-peeper*'. Whewell's account of the 1833 meeting credits Coleridge's

observation with prompting 'some ingenious gentleman' (actually Whewell himself) to momentously distinguish the new professional with the coinage '*scientist*'.[9] While this term would not receive general acceptance until the early twentieth century, the need that was felt for it during the early 1830s marks a decisive shift in the conception of professional science.

It was largely through the efforts of the BAAS that, as Jack Morrell and Arnold Thackrey observe, 'the word "science" took on new and narrower meanings in the 1830s and 1840s', so that it applied to a specialist, purportedly superior, form of understanding, which for the Victorians 'came to be seen as the intellectual progenitor of technology, the guarantor of God's order and rule, the proper way of gaining knowledge, and the key to national prosperity and international harmony'.[10] Radical reforms to the Cambridge Mathematical Tripos course during this time also yielded Britain's first professional science qualification, which, as the following chapters document, furnished the foundation for a new research culture, indeed a renaissance, in British mathematics and physics during the mid-Victorian period.

The last chapter of Babbage's *Reflections on the Decline of Science* is entitled 'Suggestions for the Advancement of Science in England', while the book reprints as an appendix a report on the 1828 meeting of the *Gesellschaft Deutscher Naturforscher und Arzte*, the body that the *natur-philosophe* Lorenz Oken had begun in 1822. Prompted by Babbage's book and modelling itself on the German organisation, the BAAS responded to the growth and increasing diversity of the sciences by arranging itself in discrete sections, 'each with its own president and committee, and indicated by letters', as the biologist T. H. Huxley reports from the 1851 Ipswich meeting: 'For instance, Section A is for Mathematics and Physics; Section B for Chemistry, etc; my own section, that of Natural History, was D.'[11] The alphabetical arrangement was deliberate and hierarchical. Much as the incipient discipline of English literature was at the time rallying around the figure of Shakespeare, the British Association traced its pedigree to Isaac Newton and made his disciplines of mathematics and physics the paradigm for its science, twinning and honouring them as Section A. This was largely the work of Whewell, who coined the word '*Physicist*' in 1840, for the scientist who investigates 'the ideas of force, matter, and the properties of matter'.[12] Physics was taken as the type for the new professional science, so that as an 1839 report in the periodical *British Critic* observes of the BAAS, 'Physical science, the science, in other words, of matter and material things, now arrogates in effect the name "science" to itself.'[13] At the original York meeting, Whewell suggested that an eminent representative of each area of science should report on 'the present state of the science',[14] which in

subsequent meetings became the sectional president's address. Each meeting of this 'parliament of the scientific world',[15] as Whewell described it in 1833, would appoint an overall president, who would present an address on the current state and progress of British science.

Reviewing the BAAS in his address as Secretary to the 1834 meeting at Edinburgh, James David Forbes, the newly elected professor of natural philosophy at Edinburgh University, describes 'the perfectly *unique* character of this Association, and the high aims to which its efforts are directed'. He notes that no other British scientific body, including the Royal Society, had made such an 'attempt to guide in any specific direction the investigations of their members, or to form any school of science for the initiation of fresh inquirers'. Unlike the continental models that inspired it, the BAAS not only met annually to offer research papers, but resolved that it 'should continue to operate during the intervals of these public assemblies, and should aspire to give an impulse to every part of the scientific system, to mature scientific enterprise, and to direct the labours requisite for discovery'. Various committees were established by the Association to promote the welfare of science in Britain and by its sections to commission particular programmes of research, which would be funded by members' dues and report back to the meetings. Even at this early date, its work in professionalising and regularising scientific practice included devising 'instructions for conducting uniform systems of observation', and disseminating them 'in the New World', while Forbes also notes a grant to establish a committee on standard measurements, 'the Numerical Constants of Nature and Art', to be led by Babbage. Furthermore, 'the Association has fulfilled its pledge of stimulating Government to the aid of science', with £500 having been advanced by the Chancellery for 'Greenwich Observations'.[16]

The argument that informed Brewster's push for a new scientific association made common cause with literature and the arts, observing, for instance, that 'the sciences and the arts of England are in a wretched state of depression' and noting 'the indirect persecution of our scientific and literary men by their exclusion from all the honours of the State'.[17] Furthermore, many provincial scientific societies at the time treated literature as integral to moral and natural philosophy. Despite such arguments and precedents,[18] the BAAS chose not to include literature amongst the sections, a decision that effectively institutionalises the separation of poetry and science at the inception of British professional science. It mirrors the opposition between the two that Wordsworth also makes, which similarly became institutional with the growth of his reputation amongst the Victorians as the greatest and definitive romantic poet, and the consequent

consolidation of his thought within a British Romantic ideology that shaped the emergent discipline of English literature, originally through F. D. Maurice's teaching of the new subject at King's College London from 1840 to 1853, in working men's institutes, in schools and from the 1890s at Oxford and other universities.[19]

The adoption by the rising discipline of English literature of a Wordsworthian and Coleridgean romantic ideology was also facilitated by the BAAS's blanket rejection of metaphysics, despite Hamilton's strong advocacy of it, as 'merely ideal'.[20] The new professional science repudiated romantic science and its harmonious, indeed integral relations with metaphysics and poetry. In the early 1850s the young physicist James Clerk Maxwell, having completed a degree at Edinburgh University that had strong elements of both experimental science and metaphysics, was frustrated to find that his subsequent Mathematical Tripos studies at Cambridge offered little scope for philosophical inquiry. While at Cambridge, he accordingly turned to writing poetry as the private medium in which he further developed the epistemological grounds for his scientific practice and, through a critique of the Tripos system, his intellectual ethics.

Victorian and twentieth-century academic philosophy, other than British Idealism, has, like science, demonstrated little interest in Romantic metaphysics, which accordingly found refuge in English literature, where it has continued the Wordsworthian battle against positivist, utilitarian and materialist science. Consistent with this Romantic ideology, studies in Victorian science and literature have until quite recently dwelt exclusively upon the responses of canonical literary figures to geology and evolutionary biology rather than mathematics and physics, while conversely poetry and literary criticism by Victorian scientists have been largely ignored.[21]

SCIENTISTS AND ARTISTS

The neologism '*scientist*' was formed at the 1833 meeting of the BAAS not only out of respect for Coleridge's proprietorial use of the term 'philosopher', but, as Whewell notes, 'by analogy with *artist*'. He elaborates this formal relation in 1840, writing in the preface to his *Philosophy of the Inductive Sciences* that 'as an Artist is a Musician, Painter, or Poet, a Scientist is a Mathematician, Physicist, or Naturalist'.[22] Indeed Whewell also wrote poetry and so may, as both his analogy and balanced phrasing suggest, have found similarities and correspondences to exist between the activities of the artist and those of the scientist, much as his friend Hamilton did. While the formal analogy by which Whewell arrives at his coinage

bequeaths a nominal trace of the artist to the new Victorian 'scientist', the relation between the two becomes substantive in the work of some of the age's greatest scientific practitioners. Hamilton asserts definitively the kinship he sees to exist between science and poetry in 'To Poetry' as, referring nostalgically to an original prelapsarian unity of poetry and science, the 'joint abode' of the 'Spirit of Beauty' and her 'sister Truth', he advises the former that 'my life be now / Bound to thy sister Truth by solemn vow'.[23]

Hamilton took the opportunity in his 1831 Introductory Lecture on Astronomy at Trinity College to discourse upon 'the latent imagination that is involved in the processes of Science'. He begins by reciting and recommending to his students the passage from *The Excursion* that Wordsworth had read to him during his stay at the Observatory. While the BAAS would effectively make Newton the patron saint of their new British science, Hamilton describes him in his lecture as an artist, whose powers of imagination 'caused many ideal worlds to pass before him', an image that may have informed the lines that Wordsworth added to his description of the great natural philosopher in the 1850 version of *The Prelude*, as 'a mind for ever / Voyaging through strange seas of Thought, alone'.[24] Hamilton provides a more personal and radical introduction to astronomy, and the relations he sees science to have to poetry, in his early poem 'Ode to the Moon under Total Eclipse'. Written in 1823 a few weeks before his eighteenth birthday, the 'Ode' remained a favourite with Hamilton throughout his life. His friend and first biographer Robert Perceval Graves records that 'among his papers are several copies of it in his own handwriting, showing that even to the last year of his life he attached a special value to it'.[25] The poem offers a perspective on science that Hamilton evidently felt able to affirm throughout his distinguished career.

Dated 'July 23', the day of the eclipse it records, the 'Ode' is prefaced with a text that provides the empirical datum for all that follows: '*The moon under Total Eclipse is not invisible, but of a dark red colour.*' The poem observes that this raw phenomenon has itself been eclipsed by various hypotheses:

> O queen of yon ethereal plain,
> With slow majestic step advancing,
> 'Mid thine attendant starry train,
> The subject waves beneath thee dancing,
> As Dian moves through Delian Shades,
> Above her circling Oread maids:
> Why had that crimson red
> Thy lovely brow o'erspread?

Oh! wherefore that portentous gloom,
Meet for the tenants of the tomb?

Say is it but a passing cloud
  Far in some higher sphere,
Which thus around thee winds its shroud,
  While all the heaven is clear:
When all the stars are brightly burning,
Each in his wonted orbit turning?

Or wizard from his murky cell,
  Who bows thee to his power,
By magic word and muttered spell
  In this, Night's witching hour?

Or is it, as the sages say
  Versed in celestial lore,
Our Earth athwart Light's pathless way,
  Which bars it from thy shore:
Whose shadowy cone, with noiseless pace,
Through the infinity of space,
Hath darkly crossed thine orb on high,
And dimmed it to our wondering eye?

On thee the Nations gaze,
With looks of wild amaze,
  And anxious ask what means the sign:
What dread disaster nigh
Is boded by thine eye
  Lowering with aspect thus malign?

Surveying his subject, Hamilton acknowledges that historically most of its sources have been literary, and that his scientific discipline of astronomy has its roots in mythology and poetry. The opening stanza draws upon allegories by Edmund Spenser, William Shakespeare, Walter Raleigh and their contemporaries, which figure Queen Elizabeth I as the moon goddess Astraea, to dramatise the eclipse as a Renaissance masque. While the regal moon's power over its 'subject waves' makes a scientific observation about the tides, this case of action-at-a-distance also licenses the succeeding hypothesis, in which the moon is in turn subjected to eclipse, as 'By magic word and muttered spell' a wizard 'bows thee to his power'. With its invocation of courtly politics and fate, a 'portentous gloom', the Elizabethan allegory also introduces classical hermeneutic concerns with the eclipse as an omen, as 'Nations' ask 'what means the sign[?]', figuring it as an evil 'eye' looking down upon them: 'Earthquake or famine, sword or fire, / Is menaced by that look of ire.' The

scientific account of the lunar eclipse, which explains that the Earth's 'shadowy cone / . . . / Hath darkly crossed thine orb on high', is placed unobtrusively amongst the other hypotheses. Its proponents are described as 'sages', an archaic designation that suggests an affinity with the 'wizard' of the earlier stanza. 'Versed in celestial lore', their science is cast as simply another tradition, another mode of explanation, which, like lyric poetry, tells of a transcendent sphere. Its scientist sages are like bards, being 'versed' in a lore that is presumably transmitted orally. The poem sees phenomena to signify richly and reverberantly, and correspondingly to accommodate and require a range of hermeneutics. 'I unite', Hamilton writes to Eliza in a letter on an earlier eclipse, 'in some degree the poet with the astronomer.'[26]

Each of the explanations that Hamilton's 'Ode' proffers *correlates* with its phenomenon, but only one can be said in fact to *cause* it, and so be distinguished as a scientific principle. It is a measure of the transcendental epistemic authority that scientific explanations have since acquired that merely to juxtapose them with 'poetic' glosses, as Hamilton's verses do, is enough to make the latter appear nonsensical. However, while such discriminations are easily, and often patronisingly, made in hindsight, they are much more problematic in practice. For Victorian scientists in particular, for whom many new disciplines, and indeed new conceptions of science itself, were being formed, while such established disciplines as mathematics and physics were increasingly pursuing speculative fields of inquiry, the difference between science and nonsense was not always clear-cut. Indeed the Victorian period marks a renaissance not only in research science but in nonsense literature. That the great inventors of Victorian nonsense Edward Lear and Lewis Carroll also practised science, the former as a natural history illustrator, the latter as a mathematician, suggests that the relation between the two fields is not merely contingent. Jean-Jacques Lecercle argues in his *Philosophy of Nonsense* that the genre borrows the themes of 'exploration and taxonomy' from natural history, and, while he focuses upon Carroll, acknowledges that the discipline 'is a direct source for [Lear's] nonsense'.[27] The following sections of the chapter examine the legacy for Lear's nonsense verses and drawings of the innovative natural history work he did during the transformative decade of the 1830s.

NATURAL HISTORY AND HISTORIC NONSENSE

While writing flawed poetry may, as Wordsworth suggests to Hamilton, be an occupational hazard for scientist-poets, ostensibly 'bad' verse becomes professional, indeed canonical, with Lear's limericks. The liminal nature of

both Lear's scientific work as a natural history illustrator and his literary work as a writer of nonsense contrast neatly with Hamilton's classical scientific credentials in mathematics and astronomy and the high art inspirations and aspirations of his poetry, his 'fondness for classical and for elegant literature'.[28]

Lear's brief but spectacular career as a natural history lithographer began in 1830, the year he turned eighteen and started working on his *Illustrations of the Family of Psittacidae, or Parrots*, two folios of which were published later that year, with the monograph itself appearing, albeit incomplete, in 1832. The first book of imperial folio lithographed birds published in Britain, it immediately gained Lear international recognition as an ornithological draughtsman. The genre of the grand natural history plate pioneered in the *Psittacidae* monograph is best known through the examples published by John Gould, who took from Lear the folio format and use of lithography, and indeed employed him during the 1830s. Gould included plates by Lear, often without acknowledgement, in *A Century of Birds Hitherto Unfigured from the Himalaya Mountains* (1830–2), *A Monograph of the Ramphastidae, or Family of Toucans* (1834), *The Birds of Europe* (1832–7), *The Birds of Australia* (1837), *Icones Avium* (1837) and *A Monograph of the Trogonidae, or Family of Trogons* (1858–75). Due to his deteriorating eyesight, however, Lear had to leave such work in 1837, turning instead to the complementary hypermetropic exercise of landscape painting, and to the nonsense writings and drawings for which he is best known.

One of the admirers of Lear's *Psittacidae* monograph, Edward Stanley, the President of the London Zoological Society and (from 1834) the thirteenth Earl of Derby, employed Lear from 1832 until 1837 to make an illustrated catalogue of the mammals and birds kept in his private zoo at Knowsley Hall, near Liverpool. Lear lived with Stanley and his family for much of this period, during which time he made paintings of about a hundred of the creatures and, to amuse the children in the family, began writing and drawing his nonsense works, including the 128 limericks that survive in the Knowsley album. Seventeen of his paintings of Stanley's animals were published in *Gleanings from the Menagerie and Aviary at Knowsley Hall* in 1846, the same year that he gathered many of his limericks from this productive period in his first *Book of Nonsense*, which he dedicates to his patron's 'great-grandchildren, grand-nephews and grand-nieces'. Their parallel histories suggest that his natural history and nonsense were for Lear compatible, even comparable, activities.

While Lear's flourishing as a natural history illustrator dates from the beginnings of Victorian professional science, modern nonsense, which he