

The mind's magic lantern: David Brewster and the scientific imagination

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Abstract

The imagination has always been thought to operate primarily in conjunction with the sense of vision, imagined objects and scenes being conjured up before the 'mind's eye'. In early nineteenth century Scotland the natural philosopher David Brewster developed a theory of the imagination that explained its operation through a reversal of the normal processes of visual perception. These ideas were rooted in the mental philosophy of the eighteenth-century Scottish Enlightenment. For Brewster the mind's eye was also the eye of the body, and images from the memory and imagination were projected onto the retina in the same manner that images were projected onto the screen in a magic lantern show. This theory underpinned his belief that imagination played an essential role in scientific discovery. Brewster believed that this process was as essential to the discoveries of science as it was to the creation of great poetry. The writings of Brewster can tell us a great deal about the connections between science and literature in the early nineteenth century, as well as showing that the philosophy of science in contemporary Britain was far from monolithic.

Keywords: David Brewster; Romanticism; Common Sense philosophy; Scottish Enlightenment; natural philosophy; philosophy of science

1. Introduction

Science in early nineteenth-century Britain is often portrayed as dominated by a rigid interpretation of the inductive method proposed by Francis Bacon (1561–1628), which privileged data gathering and experiment over speculative theorizing. Indeed, Bacon often appeared as a semi-legendary founder figure in contemporary accounts of the history of science. No lesser authority than Charles Darwin wrote that, while collecting the data that would form the basis of this theory of evolution, he had 'worked on true Baconian principles, and without any theory collected facts on a wholesale scale'.¹ Speculative theorizing was often dismissed as worthless daydreaming and associated with the armchair system builders of the previous century. This may have been the hegemonic discourse on scientific methodology, but it did not go entirely unchallenged. Kate Flint has suggested that during the Victorian era 'observation of the natural world had to yield place to the importance of the imagination, increasingly recognized as having a central role within scientific inquiry'.² I will argue here that the acknowledgment of an important role from the imagination in Victorian science was as much a holdover from the Romantic period as a development of later decades. David M. Knight has pointed out that a reading of *Consolations in Travel* (1830) by Humphry Davy (1788–1829) 'must undermine the notion that the early nineteenth century was a time when scientists followed a "Baconian" program and eschewed theory'.³ However, despite his poetic predilections and highly speculative early work, Davy still at times felt the need to pay obeisance to the god of Baconian inductivism; in his accounts of his own research he often attempted to represent his work as following the approved inductive model, claiming that 'his aim was not to advance hypotheses but simply to announce the discovery of new

facts'.⁴ Jonathan Smith has observed that for Davy hypothesizing became 'a guilt-ridden activity that should be carried out covertly'.⁵

At around the same time that Davy was writing *Consolations In Travel*, an alternative model of scientific progress that celebrated the role of the imagination and deprecated sterile fact gathering was being championed by the Scottish natural philosopher David Brewster (1781–1868). As a natural philosopher Brewster is not today as well known as some of his contemporaries, such as Davy or Michael Faraday (1791–1867). Aside from *The Home Life of Sir David Brewster* (1869) by his daughter Margaret Maria Gordon, the closest thing to a biography we have of Brewster is '*Martyr of Science*', an excellent collection of essays on various aspects of his life and work edited by A. D. Morrison-Lowe and J. R. R. Christie and published in 1984.⁶ But in his own time he was an important and influential figure. He was first secretary (1819–28), then vice-president (1831–64), and finally president (1864–68) of the Royal Society of Edinburgh. He was principal first of the University of St Andrews (1838–59) and then of the University of Edinburgh (1859–68). The British Association for the Advancement of Science was established in 1831 at Brewster's suggestion. Brewster was also heavily engaged in many of the key controversies of the day in natural philosophy, including the debates over the existence of the luminiferous ether and the particle versus the wave theory of light. He was one of the chief antagonists in the controversy stirred up by Charles Babbage's *Reflections on the Decline of Science in England* (1830). A well-known and respected figure in his native Scotland, across Great Britain, and even internationally, his views he expressed so forcefully in his numerous publications were widely read and his opinions were influential. But yet his frequent forays into the philosophy and methodology of science have not been previously subject to sustained attention from historians of science; it is hoped that this paper will go some way to remedying this.

In his published work and private correspondence Brewster portrayed science as an essentially creative activity, even likening it to poetry. Like poetry, Brewster saw scientific discoveries as products of the human imagination. Brewster was a member of the literary circles around Sir Walter Scott (1771–1832) in the heyday of the Scottish Romantic literary boom, the origins of which can be traced to the Ossianic poetry of Brewster's father in law, James Macpherson (1736–96).⁷ English Romantic science, along with English Romantic literature, is often portrayed as inspired by German Idealist philosophy. In Davy's case the main influence was Kant, mediated by his friend Samuel Taylor Coleridge.⁸ However, Richard Olson has argued that characteristic aspects of nineteenth-century Scottish science, which had been widely 'attributed to Kantian influence on British physics ... must be reassessed in light of an independent native philosophical tradition'.⁹ In this paper I will show how Brewster's vision of Romantic science did indeed draw on a native Scottish tradition of philosophical speculation on vision and the imagination associated with David Hume and the Common Sense philosophers of the previous century.

Brewster was fascinated by the ways the eye could be deceived. He wrote extensively both about optical illusions and other phenomena resulting from errors of visual perception and about the more mysterious phantasms that had their origin in the human mind. These latter could be in the form of supposedly supernatural apparitions or the more mundane images conjured up by the memory and imagination. In his *Letters on Natural Magic* (1832) he devoted an entire volume to a popular exposition of these phenomena, which he also discussed in a number of journal articles. Iwan Rhys Morus has

explored the early nineteenth-century fascination with optical technologies that deceived the eye. Brewster, the inventor of the kaleidoscope, was no stranger to such technologies, and they provided a useful metaphor for the more enigmatic phenomena of the human visual sense and its mysterious relations with the imagination. As Ralph O'Connor has pointed out, '[t]he rise of new theatrical moving-picture technologies in the nineteenth century gave fresh substance to the eighteenth-century pictorialist concept of the imagination, according to which the business of language (especially poetry) was to stimulate pictures before the mind's eye.'¹⁰ Brewster took a lively interest in these technologies and saw their relevance not only to the language of poetry, but to the language of science. In recent years much has been written about imagination and visual culture on the second half of the nineteenth century by a number of notable scholars, including Kate Flint, Srdjan Smajic and Martin Willis; however, with the notable exception of Iwan Rys Morus and Jonathan Crary, these themes have been less well explored for the early part of the century.

Crary, in a work heavily influenced by the writings of Michel Foucault, posits a radical discontinuity in visual culture in the early 1800s in which 'the status of the observing subject was transformed'.¹¹ He sees this transformation as having taken place earlier than and independently of the advent of new optical technologies such as photography. It will become evident in the course of this paper that I find little evidence for such a fundamental rupture having taken place in the early nineteenth century in the context discussed here. Morus has given us an exemplary study of 'the role of the eye as an instrument for the making of knowledge' in the early nineteenth century.¹² However, the knowledge the eye revealed was not only of the external world, or the workings of the organs of vision themselves; the eye could also look inward to explore the secret operations of the human mind. The eye therefore was the portal through which the material, external world and the internal, immaterial world of the human imagination could meet, interact and even become strangely intermingled; for, in David Brewster's words from his *Letters on Natural Magic*, the eye 'may be considered as the sentinel which guards the pass between the worlds of matter and of spirit, and through which all their communications are interchanged'.¹³ In this paper I will show how Brewster's ideas on vision and imagination, rooted in Enlightenment theories of the mind, can help us bridge the gap between Enlightenment and Romanticism in the early nineteenth-century Scottish culture. Often seen as antithetical to the supposed rationalism of the Enlightenment, in Scotland Romanticism is revealed as having surprisingly deep roots in the thought of the philosophers of the previous century.

2. Theories of vision, memory and imagination in the Scottish Enlightenment

Brewster's interest in the sense of vision and its connection with the operations of the mind was hardly novel in the Edinburgh of the early nineteenth century. Vision had been a major preoccupation of the philosophers of the Scottish Enlightenment in the previous century. Thomas Reid (1710–96), the most prominent representative of the so-called Common Sense School of philosophy, devoted a considerable portion of one of his major works, the *Inquiry into the Human Mind on the Principles of Common Sense* (1764), to a detailed discussion of the visual sense. Reid was aware that a clear and distinct, although

inverted, image of the external world was projected onto the retina at the back of the eye, and that 'if there is no picture upon the *retina*, there is no vision'.¹⁴ How these impressions were transmitted from the retina to the brain was, however, a great mystery. Nonetheless, Reid was sure that whatever travelled along the optic nerve from the retina to the brain, it was not simply some straightforward representation of the image on the retina. He wrote that:

There is not the least probability, that there is any picture or image of the object either in the optic nerve or the brain. The pictures on the *retina* are formed by the rays of light; and whether we suppose with some that their impulse upon the *retina* causes some vibration of the fibres of the optic nerve; or, with others, that it gives motion to some subtile fluid contained in the nerve; neither that vibration, nor this motion, can resemble the visible object which is presented to the mind.¹⁵

He did not exclude the possibility that it would one day be discovered how the visual impressions were transmitted from the retina to the brain, but was forced to admit that 'while we know so little of the nature and office of these more immediate instruments of vision, it seems to be impossible to trace its laws beyond the pictures upon the *retina*'.¹⁶ The relationship between the material brain and the immaterial mind was an even deeper mystery, and, like most of his contemporaries, Reid, while maintaining an essentially dualist view of the mind–body problem, avoided speculation on the nature of their connection.

Reid was aware that the visual impression of a tree, for example, which had been presented to the mind by the senses could later be brought again before it through the operation of the memory or imagination. However, for Reid, while the remembrance or imagination of the tree resembled its perception, the experience was qualitatively different: 'It is vain that a philosopher assures me, that the imagination of the tree, the remembrance of it, and the perception of it, are all one, and differ only in degree of vivacity'.¹⁷ The philosopher Reid had in mind was his great rival and compatriot, David Hume. Hume had argued that there was no essential difference between sense impressions and ideas derived from the memory and imagination. The only way they could be distinguished was by their different degrees of 'vivacity'. As Hume himself put it:

We find by experience, that when any impression has been present with the mind, it again makes its appearance there as an idea: and this it may do after two different ways: either when in its new appearance it retains a considerable degree of its first vivacity, and is somewhat intermediate between an impression and an idea; or when it intirely [sic] loses that vivacity, and is a perfect idea. The faculty, by which we repeat our impression in the first manner, is called the MEMORY, and the other the IMAGINATION.¹⁸

Hume famously argued that there is no essential difference between the impressions received from the senses and those originating in the memory or imagination. It is therefore impossible to determine whether impressions are derived from external objects, from the mind itself, or from some other source: 'As to those *impressions*, which arise from the *senses*, their ultimate cause is, in my opinion, perfectly inexplicable by human reason, and 'twill always be impossible to decide with certainty whether they

arise from the object, or are produc'd by the creative power of the mind, or are deriv'd from the author of our being'.¹⁹ The only distinction that can be made between them is their varying degrees of vivacity. But for Hume even this did not provide a dependable way to distinguish sense impressions from ideas derived from the memory or the imagination, as the vivacity of an idea could be either augmented or diminished over time, with the consequence that 'an idea of the memory, by losing its force and vivacity, may degenerate to such a degree, as to be taken for an idea of the imagination, so on the other hand an idea of the imagination may acquire such a force and vivacity, as to pass for an idea of the memory, and counterfeit its effects on the belief and judgment'.²⁰ Reid, who never doubted that sense impressions represented an objectively existing external reality, was horrified by Hume's scepticism, which seemed to leave us trapped 'in an enchanted castle, imposed upon by spectres and apparitions'.²¹ Hume was, however, not the only contemporary thinker who believed that the barrier between imagination and reality was, if not altogether illusory, at least a highly permeable one. Hume's contemporary and friend, Henry Home, Lord Kames (1696–1782), developed the idea that the memory could restore past visual impressions to a pitch of vivacity where they appeared to really be present. Kames wrote in his *Elements of Criticism* that 'in a complete idea of memory their [sic] is no past nor future: a thing recalled to the mind with the accuracy I have been describing, is perceived as in our view, and consequently as existing at present'.²²

The influences of both Reid and Hume were still strong in Edinburgh in the early decades of the nineteenth century and can be clearly discerned in the work of both the philosophers Dugald Stewart (1753–1828) and Thomas Brown (1778–1820). Stewart, who was the professor of moral philosophy at the University of Edinburgh from 1785 until 1810, was particularly influenced by Reid, whose lectures he had attended while a student at the University of Glasgow. Stewart used the term 'conception' to signify 'that faculty, whose province it is to enable us to form a notion of our past sensations, or of the objects of sense that we have formerly perceived'.²³ Quoting Shakespeare, he went on to designate this faculty as 'the mind's eye'. Conception, according to Stewart, is distinguished from memory in that it does not include the idea of past time, but is rather a timeless representation of the object. As well as forming conceptions derived from sense impressions, the mind is also capable of 'modifying our conceptions, by combining the parts of different ones together, so as to form new whole of our own creation'.²⁴ This power of the mind is called by Stewart the imagination, and he credits it with giving 'birth to the productions of the poet and the painter'.²⁵

Thomas Brown succeeded Stewart as professor of moral philosophy at the University of Edinburgh in 1810 and held the chair until his death in 1820. His lectures, published posthumously in 1820, became one of the most successful and influential philosophical works of the period. Thomas Dixon has rightly suggested that Brown can best be described as a 'common sense sceptic,' combining elements of the Common Sense philosophy of Reid with Humean scepticism. Inspired in part by Brown's teaching, Hume's philosophy had experienced something of a revival in Edinburgh, with the publication of a second edition of his *Treatise on Human Nature* in 1817.²⁶ In common with the philosophers of the Common Sense School, Brown's theory of the mind saw it as an indivisible, immaterial entity, the 'thinking principle' of Reid. Ideas all represented different states of this indivisible, unitary mind, whether they be sense impressions, memories or products of the imagination. In Brown's own words,

'[a]n idea, however, in all these applications of the term, whether it be a perception, a remembrance, or one of those complex or abstract varieties of conception, is still nothing more than the mind affected in a certain manner, or, which is the same theory, the mind existing in a certain state'.²⁷ Like Hume, Brown believed that ideas derived from the imagination or memory could, under certain circumstances, achieve a level of vividness that allowed them to present themselves to the mind almost as forcefully as sense impressions: 'Thus, when in *reverie*, our conceptions become particularly vivid, and the objects of our thoughts seem almost to exist in our presence'.²⁸

3. The body's eye and the mind's eye

The philosophers of the Scottish Enlightenment and their immediate successors, whose thoughts on the relations between vision, memory and imagination have been discussed in the preceding section, all assumed that the immaterial mind was the locus of perception, memory and imagination. The relationship between the images cast upon the retina and the ideas of the mind was shrouded in mystery. Even Reid, who optimistically speculated that philosophers might one day understand how images on the retina became ideas in the mind had to admit the complete ignorance of the workings of the optic nerve and brain in his own day. Given this avowed ignorance of the role of the nerves and mind in vision, early nineteenth-century understandings of vision were, as Srdjan Smajic has noted, essentially 'physiological, corporeal, retinal'.²⁹ Only one thing was certain, and that was that, whatever was transmitted down the optic nerve, it could not simply be the image as it appeared on the retina, carried along the nerve and projected into the sensorium as if in an internal magic-lantern show. The retina itself, on the other hand, was indeed a screen onto which images of the outside world were cast by the optical apparatus of the eye in just the same manner as the image is projected by a magic lantern. The purely optical workings of the eye were therefore relatively well understood and unproblematic. But what happened on the other side of the screen was a mystery. It was in the mid-1820s that David Brewster attempted to cast aside the veil and explore the mechanics of the interactions between the visual apparatus of the eye and the ideas present in the mind.

Morus has pointed out that Brewster's work on vision was rooted in 'Scottish common sense philosophy and its emphasis on sensation – and sight in particular – in the process of knowing'.³⁰ I would argue that Brewster also drew on the sceptical philosophy of the great opponent of the Common Sense philosophers, David Hume (1711–76), and in particular the role of the imagination in his thought. Even if he had never read Hume's works, he would have been introduced to his ideas as a student at the University of Edinburgh in the moral philosophy lectures of Dugald Stewart, who was highly critical of Hume's scepticism.³¹ Brewster had a longstanding interest in the science of optics, so it is hardly surprising to find him taking an interest in visual phenomena. The immediate inspiration for his writings on the subject from 1825 onwards, however, seems to have been the publication in 1824 of *Sketches of the Philosophy of Apparitions* by his friend, the Edinburgh-based geologist and antiquarian Samuel Hibbert (1782–1848). Its theme had been suggested by Walter Scott, to whom it was dedicated. As a medical student at the University of Edinburgh, Hibbert had attended Thomas Brown's moral philosophy

lectures and had been deeply influenced by his theory of the mind and his own theories were heavily indebted to Brown. In this work Hibbert explains apparitions as 'ideas equalling or exceeding in vividness actual [sense] impressions'.³² It is clear that Hibbert adopts an essentially Humean model of the operations of the mind, mediated by the influence of Brown. While Hibbert does not mention Hume in his books, he pays fulsome tribute to Brown, stating that: '[t]he essential view of the mind which I have adopted in preference to every other is that of the late much-lamented Professor of Moral Philosophy in the university of Edinburgh. Dr Brown, in considering the mind as simple and indivisible, conceives that every mental feeling is only the mind itself, existing in a certain state'.³³ Hibbert speculated that apparitions are simply ideas derived from the memory or imagination that, due to an abnormal physiological state, have increased in 'vividness' so as to be mistaken for sense impressions.

While Hibbert was largely preoccupied with the question of apparitions, Brewster had a much more general interest in the interaction of the visual organs with the memory and imagination. For Brewster, the increased vividness of ideas in the mind was not always interpreted as a supernatural visitation; nor was it always the consequence of an abnormal physiological state. States of mind in which the input of sense impressions was temporarily absent or suppressed, such as periods of intense concentration, could allow images derived from the memory or imagination to gain the vividness of real objects of perception:

When the eye is not exposed to the impressions of external objects, or when it is insensible to these impressions, in consequence of the mind being engrossed with its own operations, any object of mental contemplation which has either been called up by the memory, or created by the imagination, will be seen as distinctly as if it had been formed from the vision of a real object.³⁴

Under normal circumstances, however, the ideas of the memory and imagination present in the mind are for Brewster as for Hume, lacking in the vivacity of sense impressions. While we are aware of them these 'mental pictures are transient and comparatively feeble, and in ordinary temperaments are never capable of disturbing or effacing the direct images of visible objects'.³⁵ Hibbert had proposed that a 'train' of such faint ideas drawn from memory and imagination is constantly flowing through the mind, linked together by 'the law of association'. However, we are not aware of this constant flow of ideas through our minds, because they are generally 'in so faint a state as not to be the object of consciousness'.³⁶ Hibbert came to the startling conclusion that there was therefore a constant flow of ideas strung together by free association in the mind at all times of which we are, under normal circumstances, not conscious. A state of mental excitement may raise this train of associated ideas to the level of consciousness, giving no indication to the individual from whence it came. Megan Coyer rightly points out in this regard that, while a reading of the discussion of subconscious ideas in early nineteenth century texts as prefiguring the Freudian subconscious would risk falling into anachronism, 'contemporary scientific writings on proto-psychological subjects in the early nineteenth century could have provided a formulation for a purely hallucinatory experience deeply connected to the mind and body of the individual'.³⁷ The possibility that vivid pictures presented to the mind's eye by the imagination could be projections of unconscious ideas was in fact entirely consonant with the Scottish

Enlightenment theories of the mind in which Brewster, Hibbert and their contemporaries were immersed.

While Hibbert had not speculated as to the mechanism by which the ideas of the imagination could overwhelm and supplant the impressions received directly from the senses, Brewster promised to 'go much farther' than his friend in his *Letters on Natural Magic*, a book that, like Hibbert's, was addressed to Walter Scott. Brewster proposed that the visual apparatus that linked the retina and the brain could work in both directions, either carrying images from the eye to the brain or from the brain to the eye. In a remarkable passage in that work he identifies the retina as the physical screen onto which the mind projects images the objects of memory and imagination as well as images of the objects of the external world:

the 'mind's eye' is actually the body's eye, and [...] the retina is the common tablet on which both classes of impressions are painted, and by means of which they receive their visual existence according to the same optical laws. Nor is this true merely in the case of spectral illusions : It holds good of all ideas recalled by the memory or created by the imagination[.]³⁸

The visual apparatus is thus thrown into reverse, and ideas from the mind are transmitted along the optic nerve and projected as images on the retina in the same manner as an image from a magic lantern slide is projected onto a screen. Visual information cannot, however, travel in both directions at the same time; as the 'same nervous fibre which is carrying from the brain to the retina the figures of memory, could not at the same instant be carrying back the impressions of external objects from the retina to the brain'. The perception of external objects was therefore temporarily extinguished while images are being transmitted from the brain to the retina.³⁹ Brewster solved this problem by suggesting that we are generally not aware of this interruption in perception because the alternation between the two contending impressions is so rapid that it is imperceptible. While Brewster was prepared to make these radical speculations regarding the two-way connection between the mind and the eye, he did not attempt to explain the functioning of the optic nerve, or to speculate as to the form in which sense impressions were transmitted along it. Just as it was for Reid, for Brewster the eye was essentially 'a small camera obscura, by means of which the pictures of external objects are painted on the retina, and in a way of which we are ignorant, it conveys the impression of them to the brain'.⁴⁰ Although the transmission of images from the mind to the eye was still a great mystery, Brewster believed he had identified the retina as the physical screen within the visual apparatus onto which these images were cast. O'Connor has noted that '[n]ow that the magic lantern was selling dreams for all to see, dreams themselves could be characterized as taking place on some mental stage'.⁴¹ For Brewster, this stage was the retina.

4. The visual imagination and Romantic literature

It might seem counter-intuitive to link the empiricist philosophers of the Scottish Enlightenment in the second half of the eighteenth century with the school of Scottish Romantic literature

that flourished in the early decades of the nineteenth century. The former were interested in testing the limits of human reason, while the latter were fascinated by the world of fantasy and imagination that lay beyond reason. It should be remembered at this point, however, that, as Thomas Reid pointed out, Hume's scepticism had the power to unleash the 'spectres and apparitions' in the enchanted castle of the mind and break down the barrier between perceived reality and imagination. The towering figure of Walter Scott in many ways embodies the complex relationship between Enlightenment and Romanticism in Scotland. As Duncan Forbes pointed out in 1953, while Scott is often seen as the 'King of the Romantics', he is also steeped in the rationalist thought on man and society of the Scottish Enlightenment, and his historical novels can be seen as vividly coloured illustrations of the progress of human society from rudeness to refinement portrayed in the conjectural history of Adam Smith, Lord Kames and Adam Ferguson. Here there is no great rupture between Enlightenment and Romanticism, at least in their Scottish manifestation, but rather a significant degree of continuity.

Cairns Craig has argued that the Humean emphasis on the mysterious origin of our ideas and the power of the imagination can be seen as an important element in the intellectual climate out of which sprang Scottish Romanticism. Craig notes that 'from a Scottish perspective, one might argue that Enlightenment and Romanticism are symbolically intertwined, a fact obscured by the assimilation of eighteenth-century Scottish culture to European conceptions of Enlightenment'.⁴² The Romantic fascination with mystery, imagination and the exploration of subjective mental states can be seen as natural outgrowths of the philosophical preoccupations of the thinkers of the Scottish Enlightenment and their early nineteenth century heirs and disciples. Hume's view in particular that 'sense, memory, and understanding' are 'all founded on imagination'⁴³ has been claimed by Ian Duncan as particularly fertile ground for the authors of the Scottish Romantic movement to explore.⁴⁴

It is no coincidence that two of the key works on the relationship between eye and mind discussed in this paper, Hibbert's *Sketches of the Philosophy of Apparitions* and Brewster's *Letters on Natural Magic* were dedicated to Walter Scott, the godfather of Scottish Romantic literature. Both made much of their association with Scott, whose dominant role in the cultural life of the Scottish capital in this period it is hard to exaggerate. Indeed, a significant proportion of Brewster's correspondence is concerned with passing on news of Scott to various friends and acquaintances, especially regarding his health in the last few years of his life. It was a commonplace of literary criticism in the period that great literature could literally summon up images of the scenes described before the enthralled eyes of the reader. As Lord Kames had written in his *Elements of Criticism*:

The power of language to raise emotions, depends entirely on the raising such lively and distinct images as are here described: the reader's passions are never sensibly moved, till he be thrown into a kind of reverie; in which state, forgetting that he is reading, he conceives every incident as passing in his presence, precisely as if he were an eye-witness.⁴⁵

Scott's historical novels were regularly described as summoning the past up before the eyes of the reader in just the manner described by Kames. *Blackwood's Edinburgh Magazine's* review of Scott's *Ivanhoe* provides a fine example of this critical trope. The reviewer constantly alludes the almost magical power of the author to summon up images of the distant past before the mind's eye of the reader:

‘Such has been the mastery of the poet – such the perfect working of the spell by which he has carried us with him back into his troubled but majestic sphere of vision, that we feel as if we had just awakened from an actual dream of beauty and wonder’. Through the authors mastery of words, readers will be able to see before them ‘every thing in the very faces of the personages called up before us’.⁴⁶ The much more critical review of the same work in the *Edinburgh Review* also alludes to the power of Scott’s words to conjure images before the eyes of the reader, although here the reviewer sees the author’s evocation of striking visual images as masking a lack of emotional depth and criticizes the work for ‘[t]hese bright lights and deep shadows – this succession of brilliant pictures, addressed as often to the eye as to the imagination, and oftener to the imagination than the heart’.⁴⁷

Nobody expressed these ideas more powerfully and eloquently than the geologist, journalist and popular science writer Hugh Miller (1802–56). O’Connor has convincingly argued that ‘[f]or Miller, bringing landscapes before the mind’s eye was one of the primary functions of a man of letters’.⁴⁸ In a passage cited by O’Connor, Miller, himself a wonderfully evocative writer, discussed the power of the poetry of William Shenstone (1714–63) to produce images in the mind’s eye in his *First Impressions of England and its People* (1847). In this work Miller made an explicit comparison between the images evoked by the Shenstone’s poems and those produced by the magic lantern in his vivid description of the act of reading: ‘the imagery seemed broken up into detached slips, like the imagery of a magic lantern; but then nothing could be finer than the insulated slips; and my mind was filled with gorgeous pictures, all fresh and bright’.⁴⁹ Brewster too understood and celebrated the power of words to bring the past to life before the eyes of the reader. In an 1842 review of the *Encyclopaedia Britannica* he invoked the power of its entries on geology, zoology and botany to evoke the deep past of the earth:

such is the force with which these revivals are presented to our judgement, that we almost see the mammoth, the megatherion, and the mastodon, stalking over the plains or pressing through the thickets; the giant ostrich leaving its foot-writing in the sands; the voracious ichthyosaurian swallowing the very meal which its fossil ribs enclose[.]⁵⁰

Both Miller and Brewster wrote prose works which made use of the full repertoire of Romantic literary devices to bring the scenes they described to life before the eyes of their readers, especially in those works that were aimed at a popular readership. The following passage from Miller’s first great publishing success, *The Old Red Sandstone* (1841), gives a flavour of these stylistic techniques in action as he summons up:

a wild and desolate landscape of broken and shattered hills, separated by deep and gloomy ravines, that seem the rents and fissures of a planet in ruins, and that speak distinctly of a period of convulsion, when upheaving fires from the abyss, and ocean-currents above, had contended in sublime antagonism[.]⁵¹

Brewster was capable of conjuring up equally powerful imagery in support of his own more fanciful ideas. In the passage which follows from *More Worlds than One* (1854), he conjures up a succession of vivid images as he speculates on the possible nature of intelligent beings on other planets:

The being of another world may have his home in subterraneous cities warmed by central fires;— or in crystal caves cooled by ocean tides;— or he may float with the Nereids upon the deep, or mount upon wings as eagles, or rise upon the pinions of doves, that he may flee away and be at rest.⁵²

Brewster had had literary ambitions in his youth, and had published a number of poems in the early 1800s. These mostly appeared in the pages of the *Edinburgh Magazine*. That he was the editor of this periodical must help to explain the ease with which he got his rather pedestrian verse into print. His true literary gifts, however, are much more apparent in his prose writing. Indeed J.B. Morrell characterizes him as ‘one of the great writers of English prose’.⁵³ In his voluminous prose writings he was able to combine his dramatic, colourful literary style with his scientific interests in a series of popular works. In her biography of her father, his daughter Margaret neatly summed up his literary talents when she wrote that ‘[h]is prose, however, was often far less prosaic than his poetry, and the music and consonance of its stately march show that within him there were the elements of the true poet’.⁵⁴ Brewster made full use of his vigorous, colourful prose style and his readers imagination to summon up vivid images before the mind’s eye to bring to life the scientific ideas he presented in his popular works. As we will see in the next section, he also championed the power of the imagination in the sphere of scientific discovery. For Brewster the powers of imagination played the same role in the discoveries of scientific genius as the same ‘rich poetical fancy’ did in literary creation.

5. Brewster’s Romantic science

In 1831 the great English natural philosopher John Herschel (1792–1871) published his *Preliminary Discourse on the Study of Natural Philosophy*. This immensely influential work represented nothing less than a manifesto for science in the nineteenth century. In his book Herschel holds up the Baconian inductive method as the model of correct scientific practice and the key to unlocking nature’s secrets. (Although it is true, as Richard Yeo has pointed out, that Herschel’s attitude to hypotheses was, to say the least, ambivalent.⁵⁵) Not only does a bust of Bacon adorn the title page, but Herschel chose a quotation from his hero to open his book. According to Herschel, ‘[i]t is to our immortal countryman Bacon that we owe the broad announcement of this grand and fertile principle; and the development of the idea, that the whole of natural philosophy consists of a series of inductive generalizations’.⁵⁶ The Baconian method consisted of the collection of observed facts from which generalizations could be made in order to establish general axioms. There was little room for the imaginative leaps of Romantic science in this mechanical inductive methodology. While Herschel and others advocated the Baconian method as the only correct way to conduct good science, it was less evident in contemporary scientific practice, so that Brewster could with some justification sneer that ‘[t]he process of Lord Bacon was, we believe, never tried by any philosopher but himself’.⁵⁷ And, as Brewster pointed out, the one attempt made by Bacon, which purported to shed light on the nature of heat, did not yield any lasting benefits to science. Nonetheless, ‘early and mid-nineteenth-century science in Britain at least, had to be ceremonially Baconian if it aspired to respectability’.⁵⁸ Not only does the imagination play little part in

the Baconian scheme, but Herschel went to some lengths to warn his readers specifically against ‘the unrestrained exercise of the imagination’.⁵⁹ Any role that the imagination is to play in science must be tightly constrained: ‘The liberty of speculation which we possess in the domain of theory is not like the wild licence of the slave broke loose from his fetters, but rather like that of the freeman who has learnt the lessons of self-restraint in the school of just subordination’.⁶⁰

The fettering of the scientific imagination advocated by Herschel was anathema to Brewster. In 1830 he wrote the following piece of advice to his protégé James David Forbes: ‘Forget entirely all that you have heard of Lord Bacon’s Philosophy. Give full reins to your imagination. Form hypotheses without number; but put them all the test of Experiment’.⁶¹ For Brewster it is the imagination that was the fount of all progress in science. Of course, as the quote above suggests, the theories which emerged from the imagination of the natural philosopher had to stand the test of experiment in order to be considered valid, but imagination was still the source from which everything flowed. I would argue that Brewster’s faith in the power of imagination was rooted in his exposure to the philosophy of David Hume and his contemporaries in early nineteenth-century Edinburgh. These doctrines of Hume and his Common Sense critics were a commonplace of the philosophical and literary circles in which Brewster moved in Romantic-era Edinburgh. Dugald Stewart, who had taught Brewster moral philosophy as a student, had a positive opinion of the role of hypotheses in science (although many of the Common Sense philosophers, including Reid and Stewart, also held Bacon in high regard.⁶² As Olson has pointed out, Stewart considered that ‘the value of a hypothesis may be equally great whether it leads to experiments which confirm it, demand its modification, or demand its abandonment’.⁶³ This relative openness to speculation was shared by others among Stewart’s former students, including Brewster’s friend a patron Henry Brougham, who wrote in a review of Playfair’s *Illustrations of the Huttonian Theory of the Earth* that ‘[i]t cannot be denied, however, that observations accumulate but slowly when unassisted by the influence of system. The observer never proceeds with more ardour than when he theorises’.⁶⁴

Open disparagement of Bacon was unusual in the early nineteenth century, and Brewster was somewhat ahead of the curve in his attitude towards the inductive method. While B. J. Malkin, reviewing Brewster’s *Life of Sir Isaac Newton* (1831) in the *Edinburgh Review*, could comment that ‘with one or two exceptions, he is the only man of science of any considerable name, who has laboured to detract from the glory of the great reformer of philosophy’.⁶⁵ However, enthusiasm for the Baconian method in British science was to fall away markedly in the latter half of the century. Olson has argued the concurrent reevaluation of the scientific imagination may in large part have been inspired by the disciples of the Scottish Common Sense philosophers. In the later nineteenth-century English thinkers such as George Henry Lewes and John Tyndall also came increasingly to abandon their allegiance to the inductive method and to portray science ‘as an imaginative, speculative, creative enterprise’.⁶⁶

Cairns Craig has convincingly argued that, unlike English Romanticism, Scottish Romanticism owed its philosophical underpinnings not to German Idealism, but rather to a native strand of Humean scepticism that effaced the distinction between perception and imagination. This was as true for Romantic science as for literature. It is perhaps therefore not surprising that Brewster leapt to the defines of John Leslie when, as a candidate for the chair of natural philosophy at the University of Edinburgh, he was attacked for having praised Hume’s treatment of the problem of causation in his *Experimental Inquiry into the*

Nature and Propagation of Heat (1804).⁶⁷ In a satirical pamphlet published in 1806 under the pseudonym 'A Calm Observer' and entitled *An Examination of the Letter Addressed to Principal Hill*, Brewster skewered the pretensions of Leslie's clerical enemies to judge his scientific achievements and prevent him from '[sitting] down in his academical chair with the ghost of Mr Hume at his side'.⁶⁸

Brewster's earliest known scientific work was in astronomy, perhaps the archetypal Romantic science. In a work first published in 1759 the Scottish astronomer James Ferguson, new editions of two of whose popular works would later be edited by Brewster, described astronomy as 'the sublime science'.⁶⁹ Even Herschel notes that astronomy deals with 'celestial objects, of a nature so wonderful as to give room for unbounded speculation on the extent and construction of the universe' of the kind he condemns unreservedly elsewhere in the same book.⁷⁰ The untrammelled scope for the imagination provided by astronomy clearly appealed deeply to Brewster. In place of Bacon, Isaac Newton was Brewster's great scientific hero, and he wrote not one but two important biographies of him. For Brewster, the astonishing fertility of Newton's imagination was at the root of his great discoveries, not his conformity to some rigid inductive methodology. In the first of his Newton biographies, published in 1831, Brewster wrote: 'Were we to judge of the qualities of his mind from the early age at which he made his principal discoveries, and from the rapidity of their succession, we should be led to ascribe to him that quickness of penetration, and that exuberance of invention, which is more characteristic of poetical than of philosophical genius'.⁷¹

For Brewster the imagination was as vital for the scientist as for the poet. It is from the depths of the imagination, and not from Baconian fact gathering and the mechanical method of inductive reasoning that great scientific discoveries owe their origins. As Brewster wrote to his friend the author Maria Edgeworth (1768–1849) in April 1824:

It is often some hidden relation, some deep-seated affinity, which is required to complete, or rather constitute, a great discovery; and this relation is often discovered among the wildest conceptions and fancies after they have been sobered down by the application of experiment and observation. The extravagant speculations which often precede and lead to discovery differ in no respect from the creations of a rich poetical fancy.⁷²

At this point I want to bring together two of the key themes of this paper. As we have seen, for Brewster the images conjured up by the scientific imagination come from the same source as the poetic imagination. Great scientific discoveries as much as great works of literary art are presented before the mind's eye by the imagination. For Brewster the mind's eye was also the eye of the body, and in particular the retina, that magic-lantern screen on which images were projected either inward from the external world or outwards from the memory and imagination. Scientific creativity no less than artistic creativity relied on the power of the imagination. In the following passage from his *Letters on Natural Magic* Brewster, who is surely thinking of his own experience of the scientific imagination at work, makes this point unambiguously:

With persons of studious habits, who are much occupied with the operations of their own minds, the mental pictures are much more distinct than in ordinary persons; and in the midst of

abstract thought, external objects even cease to make any impression on the retina. A philosopher absorbed in his contemplations experiences a temporary privation of the use of his senses. His children or his servants will enter the room directly before his eyes without being-seen.⁷³

Brewster himself here makes clear that the insights of the natural philosopher come to him in the form of 'mental pictures', linking together the visual imagination with the speculative conjectures of the scientific mind. Ideas, imagined as visions, rise up before the natural philosopher's eyes from the depths of the subconscious mind to form the raw material which, when sifted and refined by experiment, reveal new truths about the natural world. Brewster's vision of a Romantic science is a world away from the dry fact-gathering of the followers of Bacon. For Brewster, great art and great science both draw their substance from the same mysterious wellsprings of the Romantic imagination.

6. Conclusion

As we have seen, theories of the imagination derived from the philosophers of the Scottish Enlightenment form a bridge between the late Enlightenment world of the last decades of the eighteenth century and the Romantic science and literature of the early nineteenth. For Brewster, the imagination was the mysterious source of great scientific discoveries just as it was of great works of literature. The theory of the mind embraced by Brewster, Hibbert and many of their contemporaries pictured the human mind as an inscrutable singularity from whose depths emerged the imaginative insights that formed the raw material for both great literature and great science. Their model strongly privileges the sense of vision and it is onto the mind's eye that the pictures conjured up by the imagination are projected. The magic lantern, whose workings Brewster had discussed in his *Letters on Natural Magic*, provided a powerful metaphor for the operation of the imagination. For Brewster, the retina, which not only received images of the objects of the external world, but also acted as a screen across which flickered the pictures that emerged from the mind. The optic nerve could therefore carry images both from the eye to the brain and vice versa. Hibbert speculated that images from the mind, linked together by chains of association, could emerge from the unconscious mind and, taking on a ghostly reality, parade before the eyes when they reached a sufficient degree of vivacity. For Brewster the reveries into which the philosopher fell, allowing vivid mental images to flow before the mind's eye, provided the raw material for the development of new scientific theories, which could then be put to the test of experiment.

In the long view from the late eighteenth century through to the mid-nineteenth century, Brewster's attitudes can be seen as a point on a progression tending towards the devaluation of the Baconian method and consequent revaluation of the role of hypotheses. While Bacon suffered eclipse, Newton was reimagined by Brewster as a Romantic visionary rather than as the supreme exponent of Bacon's inductive method. We can see this trend already in the work of Stewart and Brown, although neither were prepared to abandon Baconianism altogether and continued to pay Bacon and his ideas the customary deference. Behind this new value placed on the scientific imagination stands the Humean

model of the relationship between sense impressions, memory and imagination. This is essentially the model employed by Brewster, derived either from his own reading of Hume or through the medium of Stewart's lectures. Indeed, the idea that images formed on the retina could be either sense impressions or projections from the imagination seems striking confirmation of Hume's view that the two are qualitatively identical.

Brewster's Romantic science provided an alternative model of scientific practice in the early nineteenth century to the Baconian inductive method lauded by many of his contemporaries. His vision of the scientific imagination at work would find echoes later in the century in the writings such luminaries as Lewes and Tyndall. It clearly demonstrates that early nineteenth century scientific thought and practice was very far from monolithic. Brewster was an important and respected natural philosopher, responsible for a number of significant discoveries in the field of optics. It is significant that he vigorously advocated a model of scientific practice that actively promoted the free play of imagination and the positive contribution of the 'poetic fancy' in science as in literature. While the prophets of Baconian science sought to fetter the scientific imagination, the philosophical legacy of Humean associationist philosophy set it free to explore an infinity of conjectures. Brewster's singular vision of science demonstrates that, in the Scottish context at least, the relationship between Enlightenment and Romanticism was not one of rupture and contradiction, but rather of continuity and development. This celebration of the creative power of the imagination and distrust of rigid methodologies is surely one of the most significant scientific legacies of the Scottish Enlightenment.

Notes

¹ Charles Darwin, 'My several publications,' in Charles Darwin, *Charles Autobiographies*, ed. Michael Neve (London: Penguin, 2002), 72.

² Kate Flint, *The Victorians and the Visual Imagination*. (Cambridge: Cambridge University Press, 2000), 62.

³ David M. Knight, *Science in the Romantic Era* (London: Routledge, 2016), 24.

⁴ *Ibid.*, 25.

⁵ Jonathan Smith, *Fact and Feeling: Baconian Science and the Nineteenth-Century Literary Imagination* (Madison, WI: University of Wisconsin Press, 1994), 86–7.

⁶ Ian Duncan, 'Walter Scott, James Hogg, and Scottish Gothic, in' David Punter (ed.), *A New Companion to the Gothic* (Oxford: Blackwell, 2002), 123.

⁷ A. D. Morrison Lowe and J. R. R. Christie (eds), *'Martyr of Science' Sir David Brewster, 1781–1868* (Edinburgh: Royal Scottish Museum, 1984).

⁸ Jan Golinski, *The Experimental Self: Humphrey Davy and the Making of a Man of Science* (Chicago, IL: Chicago University Press, 2016), 31.

⁹ Richard Olson, *Scottish Philosophy and British Physics 1750–1880*. Princeton, NJ: Princeton University Press, 1975), 5.

¹⁰ Ralph O'Connor, *The Earth on Show : Fossils and the Poetics of Popular Science, 1802-1856* (Chicago, IL: University of Chicago Press, 2008), 281.

¹¹ Jonathan Crary, *Techniques of the Observer: on Vision and Modernity in the Nineteenth Century* (Cambridge, MA: M.I.T. Press, 1992), 16.

¹² Iwan Rhys Morus, 'Illuminating illusions, or, the Victorian art of seeing things,' *Early Popular Visual Culture* 10: 1 (2012): 37–50, 84.

¹³ David Brewster, *Letters on Natural Magic Addressed to Sir Walter Scot, Bart.* (London: John Murray, 1832), 10.

¹⁴ Thomas Reid, *An Inquiry into the Human Mind on the Principles of Common Sense* (Edinburgh: Edinburgh University Press, 1997), 120.

¹⁵ *Ibid.*, 120–1.

- ¹⁶ Ibid., 131.
- ¹⁷ Ibid., 168.
- ¹⁸ David Hume, *A Treatise of Human Nature* (London: Penguin, 1969), 56.
- ¹⁹ Ibid., 132.²⁰ Ibid., 132.
- ²¹ Reid, *Inquiry into the Human Mind*, 22.
- ²² Henry Home, Lord Kames, *Elements of Criticism*, 7th ed., vol. 1 (Edinburgh: John Bell and William Creech, 1788), 90.
- ²³ Dugald Stewart, 'Elements of the philosophy of the human mind,' in Dugald Stewart, *The Works of Dugald Stewart*, vol. 1 (Cambridge: Hilliard and Brown, 1829), 100.
- ²⁴ Ibid., 100.
- ²⁵ Ibid., 100–1.
- ²⁶ Ian Duncan, *Scott's Shadow: The Novel in Romantic Edinburgh* (Princeton, NJ: Princeton University Press, 2007), 133.
- ²⁷ Thomas Brown, *Lectures on the Philosophy of the Human Mind*, vol. 1 (Andover: Mark Newman, 1822), 415.
- ²⁸ Ibid., 273.
- ²⁹ Srdjan Smajic, *Ghost-seers, detectives, and spiritualists: theories of vision in Victorian literature and science* (Cambridge: Cambridge University Press, 2010), 5.
- ³⁰ Morus, 'Illuminating illusions', 38.
- ³¹ Margaret Maria Gordon, *The Home Life of Sir David Brewster* (Edinburgh: Edmonston and Douglas, 1869), 36.
- ³² Samuel Hibbert, *Sketches of the Philosophy of Apparitions*, 2nd ed. (Edinburgh: Oliver & Boyd, 1825), vi.
- ³³ Ibid., 62.
- ³⁴ David Brewster, 'Observations on the vision of impressions on the retina in reference to certain supposed discoveries respecting vision announced by Mr Charles Bell,' *Edinburgh Journal of Science* 2: 3 (1825): 1–8, 8.
- ³⁵ Brewster, *Letters on Natural Magic*, 49.
- ³⁶ Hibbert, *Philosophy of Apparitions*, 289–90.
- ³⁷ Megan Coyer, 'The Embodied Damnation of James Hogg's Justified Sinner,' *Journal of Literature and Science*, 7: 1 (2014): 1–9, 1.
- ³⁸ Brewster, *Letters on Natural Magic*, 49.
- ³⁹ Ibid., 49–50.
- ⁴⁰ Ibid., 10.
- ⁴¹ O'Connor, *Earth on Show*, 281.
- ⁴² Cairns Craig, 'Coleridge, Hume, and the chains of the Romantic imagination,' in Leith Davis, Ian Duncan and Janet Sorenson (eds), *Scotland and the Borders of Romanticism* (Cambridge: Cambridge University Press, 2004), 21.
- ⁴³ Hume, *Treatise of Human Nature*, 313.
- ⁴⁴ Duncan, *Scott's Shadow*, 120–1.
- ⁴⁵ Kames, *Elements of Criticism*, 93.
- ⁴⁶ Anon, Review of *Ivanhoe*, *Blackwood's Edinburgh Magazine* 6: 33 (1819): 262–72, 263.
- ⁴⁷ Anon, Review of *Ivanhoe*, *The Edinburgh Review* 33: 65 (1820): 1–54, 8.
- ⁴⁸ O'Connor, *The Earth on Show*, 392.
- ⁴⁹ Hugh Miller, *First Impressions of England and its People* (London: John Johnstone, 1847), 135.
- ⁵⁰ [David Brewster], Review of the *Encyclopaedia Britannica*, *Quarterly Review*, 70: 139 (1842): 44–72, 58.
- ⁵¹ Hugh Miller, *The Old Red Sandstone; or New Walks in an Old Field*, 2nd ed. (London: John Johnstone, 1842), 48.
- ⁵² David Brewster, *More Worlds than One: The Creed of the Philosopher and the Hope of the Christian* (London: John Murray, 1854), 68–9.
- ⁵³ J. B. Morell, 'The Leslie Affair: Careers, Kirk and Politics in Edinburgh in 1805.' *Scottish Historical Review* 54: 157 (1975): 63–82, 26.
- ⁵⁴ Gordon, *Home Life of Sir David Brewster*, 305.
- ⁵⁵ Richard Yeo, 'An idol of the market-place: Baconianism in nineteenth century Britain,' *History of Science* 23 (1985): 251–98, 269.
- ⁵⁶ John Frederick William Herschel, *A Preliminary Discourse on the Study of Natural Philosophy* (London: Longman, Rees, Orme, Brown and Green, 1831), 104.
- ⁵⁷ David Brewster, *The Life of Sir Isaac Newton* (London: John Murray, 1831), 335.

- ⁵⁸ Antonio Pérez-Ramos, *Francis Bacon's Idea of Science and the Maker's Knowledge Tradition* (Oxford: Oxford University Press, 1988), 24.
- ⁵⁹ Herschel, *Preliminary Discourse*, 190.
- ⁶⁰ *Ibid.*, 190–1.
- ⁶¹ Special Collections, St Andrews University Library, msdep7 - Incoming letters 1830, no.52 David Brewster to James David Forbes, 8 November 1830, f.1 recto.
- ⁶² Yeo, 'Idol of the market place', 260.
- ⁶³ Olson, *Scottish Philosophy and British Physics*, 111.
- ⁶⁴ [Henry Brougham], review of John Playfair, *Illustrations of the Huttonian Theory of the Earth*, *Edinburgh Review* 1: 1 (1802): 201–214, 201.
- ⁶⁵ [B. H. Malkin], 'Brewster's life of Newton,' *Edinburgh Review* 56 (1832): 1–37, 37.
- ⁶⁶ Smith, *Fact and Feeling*, 13.
- ⁶⁷ Morell, 'The Leslie Affair.
- ⁶⁸ [David Brewster], *An Examination of the Letter Addressed to Principal Hill, on the Case of Mr Leslie, In a Letter to its Anonymous Author. With Remarks on Mr Stewart's Postscript and Mr Playfair's Pamphlet. By a Calm Observer* (Edinburgh: Mundell and Son, 1806), 5.
- ⁶⁹ James Ferguson, *An Easy Introduction to Astronomy for Young Gentlemen and Ladies* (London: T. Cadell, 1772), 3.
- ⁷⁰ Herschel, *Preliminary Discourse*, 260.
- ⁷² Brewster, *Life of Sir Isaac Newton*, 293.
- ⁷² Gordon, *Home Life of Sir David Brewster*, 128.
- ⁷³ Brewster, *Letters on Natural Magic*, 50–1.

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