
Guest editorial

Toying with science

There is much contemporary concern with the dissemination of scientific ideas to a wider public. Science centres proliferate and scientific societies devote increasing efforts to engage the young and to popularise research. Perhaps we should take an example from the past, when science sought to amuse and entertain, as well as provide utilitarian application.

The term ‘philosophical toys’ rightly has an anachronistic ring to it. Philosophy and toys are strange bedfellows. It was not so in the early nineteenth century when the term was in common currency. Philosophy was associated with the study of nature, and what we now refer to as physics was called natural or experimental philosophy. Indeed, it is still so called in some universities. Toys were simpler and rarer at that time, and they were sources of amusement or entertainment. Philosophical toys fulfilled the dual role of instruments for scientific experiment and devices for extending awareness of the senses (see Turner 1998). They are associated with developments in London in the 1820s when scientists were exploring and extending the range of perceptual phenomena that could be experienced. The scientists and physicians included Thomas Young (1773–1829), Peter Mark Roget (1779–1869), John Ayrton Paris (1785–1856), Michael Faraday (1791–1867), Charles Babbage (1792–1871), John Herschel (1792–1871), and Charles Wheatstone (1802–1875). All were or were to become Fellows of the Royal Society of London for Improving Natural Knowledge, although some expressed dissatisfaction with its organisation. In the next decade, Babbage, together with David Brewster (1781–1868), was instrumental in founding the British Association for the Advancement of Science (see Morrell and Thackray 1981).

Wheatstone (1827) provided a succinct definition of philosophical toys:

“The application of the principles of science to ornamental and amusing purposes contributes, in a greater degree, to render them extensively popular; for the exhibition of striking experiments induces the observer to investigate their causes with additional interest, and enables him more permanently to remember their effects. I shall not, therefore, need an apology for presenting the tyro in science with another combination of philosophy with amusement, in addition to those already extant.” (page 344)

The philosophical toy Wheatstone was referring to was called a kaleidophone or phonic kaleidoscope and the phenomenon it manipulated was visual persistence. Despite the fact that this had been known to the ancients (in the form of whirling embers), and had been measured accurately by Patrice D’Arcy (1725–1779) in 1765, it was applied in novel ways in the early nineteenth century (see Wade 1998). Paris’s thaumatrope or wonder-turner (figure 1) was displayed to scientific audiences in London in 1825, and he described it in print two years later (Paris 1827). An entry in *John Bull* of 24 April 1825 trumpeted its arrival: “Of all the discoveries in the world of science—of all the surprising developments which have been made during the last century, none, perhaps, has equalled in magnitude and importance that of the THAUMATROPE” (page 133). The first eight editions of Paris’s book were published anonymously, but its popularity led to the unmasking of the author. The ninth edition, published after his death (Paris 1861), was the first to bear the author’s name (see Barnes 1995).

There always appears to have been a varnished view of the past, and it was so expressed by Paris from the first to the final edition of his work: “If scientific dialogues are less popular in our times than they were in ancient days, it must be attributed to

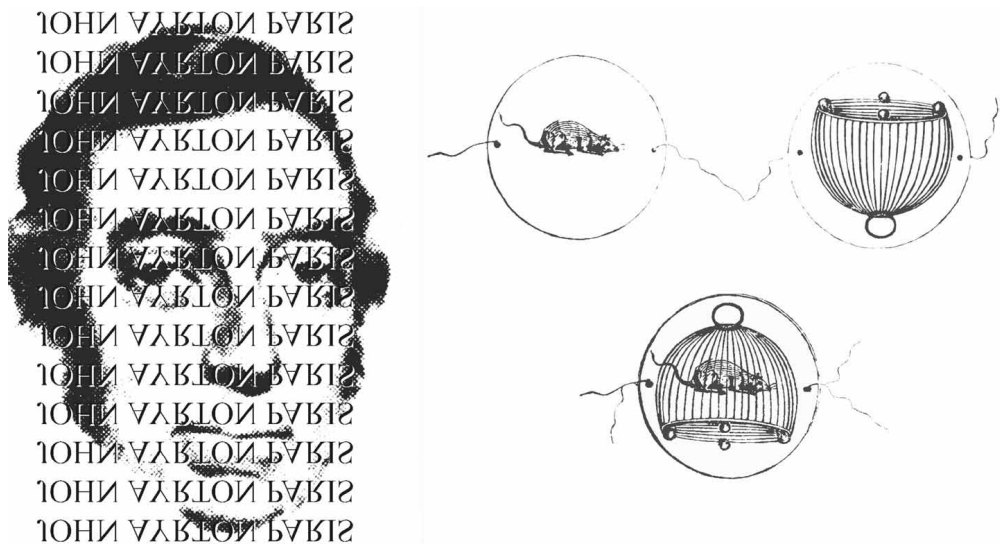


Figure 1. John Ayrtton Paris (1785–1856) and the thaumatrope. The two designs were drawn on opposite sides of a circular disc, as shown at the upper right. When the disc was rotated, the two images were superimposed, as is indicated at the lower right. Paris described it thus: “*A Wonder-turner*”, or a toy which performs wonders by turning round ... This philosophical toy is founded upon the well-known optical principle, that an impression, made on the retina of the eye, lasts for a short interval, after which the object which produced it has been withdrawn. During the rapid whirling of the card, the figures on each of its sides are presented in such quick transition that they both appear at the same instant, and thus occasion a very striking and magical effect” (1827, volume 3, page 6). Portrait derived from an illustration in Williams (1965); the upper thaumatrope images are from Paris (1827).

the frigid and insipid manner in which they have too frequently been executed” (1827, pages xii–xiii). In the eighth edition (Paris 1857), the last that he was involved in, he claimed that the thaumatrope had influenced the development of other devices for synthesising motion from a sequence of static images, although this view was not widely accepted. The thaumatrope rendered two stimuli on opposite sides of a disc visible simultaneously when it was rotated. It was ridiculed by some, like Babbage and Faraday, but it was phenomenally popular.

As with most of the instruments invented at that time, arguments about priority were commonplace. The origins of the thaumatrope were described by Babbage (figure 2, left) in his autobiographical sketch, and it was not attributed to Paris. His account is worthy of reprinting:

“One day Herschel, sitting with me after dinner, amusing himself by spinning a pear upon a table, suddenly asked whether I could show him the two sides of a shilling at the same moment. I took out of my pocket a shilling, and holding it up before the looking-glass, pointed out *my* method. “No”, said my friend, “that won’t do”; then spinning my shilling upon the table, he pointed out *his* method of seeing both sides at once. The next day I mentioned the anecdote to the late Dr. Fitton, who a few days after brought me a beautiful illustration of the principle. It consisted of a round disc of card suspended between two pieces of sewing-silk. These threads being held between the finger and thumb of each hand, were then made to turn quickly, when the disc of card, of course, revolved also. Upon one side of the disc was painted a bird; upon the other side, an empty bird-cage. On turning the thread rapidly, the bird appeared to have got inside the cage. We soon made numerous applications, as a rat on one side and a trap upon the other, &c. It was shown to Captain Kater, Dr. Wollaston, and many other friends, and was, after the lapse of a short time, forgotten. Some months after, during a dinner at the Royal Society Club, Sir Joseph Banks being in the chair, I heard Mr. Barrow, then

though shadowy resemblance of cogs moving slowly in one direction” (1831, page 205). He constructed a simple arrangement of cut-out sectored discs to examine the effects further.

Faraday wrote: “The eye has the power, as is well known, of retaining visual impressions for a sensible period of time; and in this way, recurring actions, made sufficiently near to each other, are perceptibly connected, and made to appear as a continuous impression” (1831, page 210). In the same year, Faraday’s article was translated into German (Faraday 1831) and excited the interests of others to construct instruments that could synthesise motion from a sequence of discrete images. In 1833, both Joseph Plateau (1801–1875), with his phenakistiscope or fantascope, and Simon Stampfer (1792–1864), with his stroboscopic disc, developed similar instruments for presenting a series of still pictures in rapid succession. Stampfer’s stroboscopic disc was very similar to Plateau’s phenakistiscope, and both acknowledge the stimulus provided by Faraday’s article. The issue of priority of invention inevitably ensued, and it remains a matter of debate (see Hecht 1993).

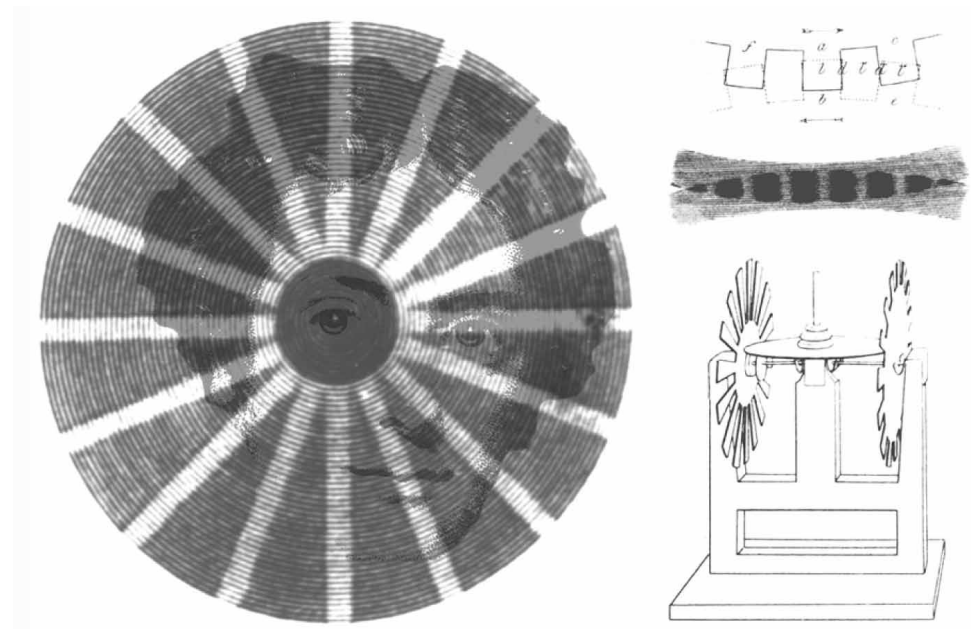


Figure 3. Michael Faraday (1791–1867), together with diagrams of counter-rotating cogwheels, and the simple device for studying the effect. Portrait derived from an engraving in Taylor (1846) and a diagram from Faraday (1831), as are figures on the right.

Roget (1834) suggested, in his *Bridgewater Treatise*, that he had made such a device even earlier than Plateau and Stampfer. As noted above, Faraday’s forays into visual persistence had been stimulated by Roget’s (1825) analysis of the curved appearance of spokes passing behind vertical railings. Now Roget’s interests were rekindled by Faraday’s article:

“About the year 1831, Mr. Faraday prosecuted the subject with the usual success which attends all his philosophical researches, and devised a great number of interesting experiments on the appearances resulting from combinations of rotating wheels ... This again directed my attention to the subject, and led me to the invention of the instrument which has since been introduced into notice under the name of the *Phantasma-scope* or *Phenakistiscope*. I constructed several of these at that period (in the spring of 1831), which I showed to my friends; but in consequence of occupations and cares of a more serious kind, I did not publish any account of this invention, which was reproduced on the continent in the year 1833.” (Roget 1834, page 416, original italics)

Phenakistoscopes and stroboscopic discs could be used by just one person at a time, whereas William Horner (1789–1837, 1834) developed a variant for group viewing: it consisted of a cylinder mounted on a vertical axis, with slits at regular intervals, and a sequence of drawings on the opposite inside surface of the cylinder. Horner called it the *dædaleum*, but it became widely used in the latter half of the nineteenth century under the name of *zoetrope*.

However, the source for many of these manipulations of visual persistence derived from the experiments by Young (1800, figure 4) on sound and light. He described a technique in which the reflection of light from the extremities of vibrating wires could be seen through a microscope:

“Take one of the lowest strings of a square piano forte, round which a fine silvered wire is wound in a spiral form; contract the light of a window, so that, when the eye is placed in the proper position, the image of the light may appear small, bright, and well defined, on each of the convolutions of the wire. Let the chord be now made to vibrate, and the luminous point will delineate its path like a burning coal whirled round, and will present to the eye a line of light, which, by the assistance of a microscope, may be accurately observed.” (Young 1800, page 135)

He illustrated these patterns (see figure 4) and he touched upon the phenomena of visual persistence in his lectures on natural philosophy and the mechanical arts, delivered at the Royal Institution (Young 1807/2002). Both Young and Wheatstone (figure 5) shared a fascination in the acoustic figures that had been demonstrated by Ernst Chladni (1756–1827), and it was Young’s observation that led to the invention of Wheatstone’s *kaleidophone* (see Wade 2002). It was so named after Brewster’s *kaleidoscope*.

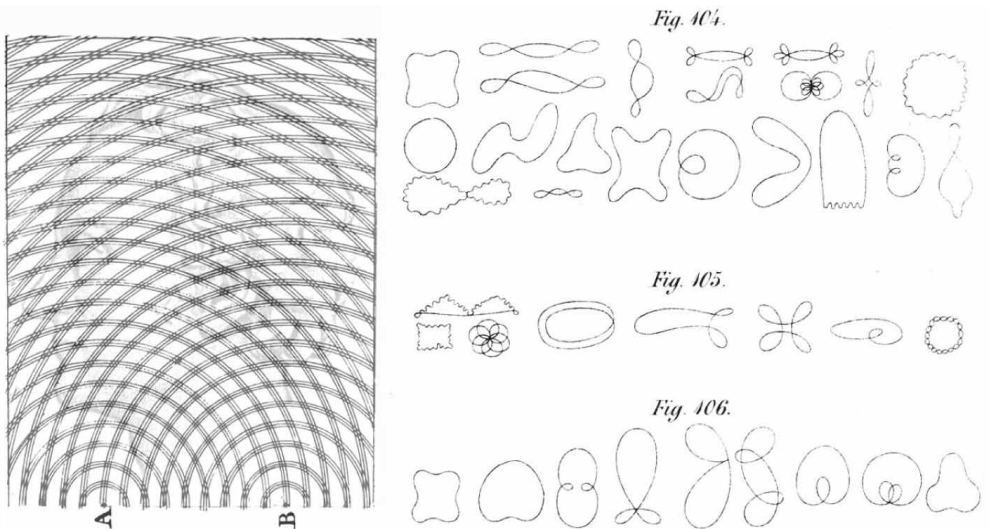


Figure 4. Left, Thomas Young (1773–1829); portrait (derived from an illustration in Peacock 1855) embedded in an interference pattern illustrated in Young (1807). Right, the patterns formed by reflections from vibrating piano wires (from Young 1800).

Brewster (figure 5), in fact, devised two of the most popular philosophical toys of the nineteenth century—the *kaleidoscope* and the *lenticular form of the stereoscope*. The *kaleidoscope* is a simple optical instrument involving two plane mirrors inclined at an angle like 45° (which can be divided into 360°) and located in a tube. Viewing through one end of the tube multiplies the images of objects at the other. Brewster invented the *kaleidoscope* in 1816, after which its popularity was phenomenal. His *Treatise on the Kaleidoscope* was published in 1819. Much to Brewster’s displeasure he had mismanaged his patent, and so received little profit from the toy. Writing to

his wife from London in 1818, he noted: “You can form no conception of the effect which the instrument excited in London; all that you have heard falls short of the reality. No book and no instrument in the memory of man ever produced such a singular effect” (Gordon 1870, page 99). As with most of Brewster’s inventions there was controversy regarding its originality (see Wade 1983). One of those who supported Brewster’s originality was Roget; his entry on the Kaleidoscope for the *Encyclopaedia Britannica* read: ‘The particular application of this principle in the case where two reflectors are inclined to one another at a small angle, so as to form a series of symmetric images, distinctly visible only in a particular position of the eye, was a discovery reserved for Dr. Brewster’ (Roget 1824, page 163).



Figure 5. Left, kaleidoscopic portrait of David Brewster (1781–1868) and right, a kaleidophonetic portrait of Charles Wheatstone (1802–1875); both images derived from Wade (1983).

Wheatstone named his kaleidophone after Brewster’s kaleidoscope, because both produced beautiful forms. However, Brewster followed Wheatstone into the realm of stereoscopic vision. In 1838, Wheatstone displayed to the public his mirror stereoscope which enabled the perception of depth from two suitably paired pictures. With the invention of photography paired photographs replaced outline drawings and provided a greater degree of realism: the union between the stereoscope and photography held the public in thrall. Although Brewster did not add substantially to theory in the context of binocular vision, he did devise, in 1849, the most popular design of stereoscope used in nineteenth century households. It consisted of a single lens cut in half so that the two half-lenses, when appropriately mounted, acted as magnifiers as well as prisms, fusing adjacent stereophotographs. The first model was made by George Lowdon (1825–1912) in Dundee, but large-scale production was undertaken by Louis Jules Duboscq (1817–1886) in Paris. It was Duboscq’s model that excited the interest of Queen Victoria when it was displayed at the Great Exhibition of 1851:

“In the fine collection of philosophical instruments which M. Duboscq contributed to the Great Exhibition of 1851, and for which he was honoured with a Council medal, he placed a lenticular stereoscope, with a beautiful set of binocular Daguerreotypes. This instrument attracted the particular attention of the Queen, and before the closing of the Crystal Palace, M. Duboscq executed a beautiful stereoscope, which I presented to Her Majesty in his name.” (Brewster 1856, page 31)

Philosophical toys united science with a public eager to be amused and puzzled by these novel devices. They extended the effects that pictures could produce, adding

the dimensions of motion and depth to them. The toys did little to unite scientists themselves. While most of the optical toys had their genesis in London, the inventors often squabbled about priority. The squabbles are now largely forgotten, and the potency of the devices has survived. The simulations of motion we constantly experience in films and on television have their origins in these instruments of amusement. It remains a paradox that greater interest in these devices has been expressed by historians of photography and filmmaking than by psychologists (see Hecht 1993; Herbert 2000; Nekes 2003).

The philosophical toys were not produced in a cultural vacuum, and there were many competing visual amusements. Panoramas and dioramas were attracting large audiences in London, and the magic lantern was employed in novel ways to deceive and delight (see von Dewitz and Nekes 2002). The filmmaker Werner Nekes has assembled a magnificent collection of optical toys, as well as anamorphoses, camera obscuras, dioramas, magic lanterns, panoramas, perspective peepshows, stereoscopes, printed tricks, together with historical accounts of optics, film, photography, and magic. It is most fitting that these will be exhibited at the Hayward Gallery in London between October 2004 and January 2005. The title of the exhibition is “Eyes, Lies and Illusions”.

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