
Guest editorial

Accentuating the negative: Tom Wedgwood (1771–1805), photography and perception

“White paper, or white leather, moistened with solution of nitrate of silver, undergoes no change when kept in a dark place; but, on being exposed to day light, it speedily changes colour, and, after passing through different shades of grey and brown, becomes at length nearly black.” (Davy 1802, page 170)

These are the opening words in the article taken by historians to be one of the foundations of photography. They reflect the experiments conducted by Thomas Wedgwood (figure 1) to copy paintings (on glass) and profiles onto a light-sensitive surface. Newhall (1982), in his authoritative history of photography, commenced his chapter on the invention of the process with the statement that: “The first person to attempt to record the camera image by means of the action of light was Thomas Wedgwood” (page 13).

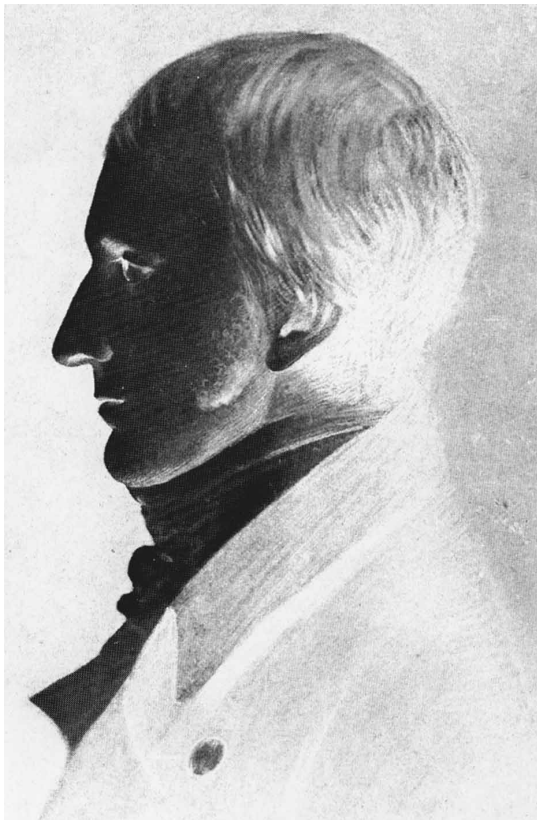


Figure 1. A negative portrait of Tom Wedgwood (1771–1805) derived from a frontispiece photograph of a chalk drawing in Litchfield (1903).

Wedgwood had attempted to capture images in a camera with a lens, but without success:

“The images formed by means of a camera obscura, have been found to be too faint to produce, in any moderate time, an effect upon the nitrate of silver. To copy these images was the first object of Mr. Wedgwood, in his researches on this subject, and for this

purpose he first used the nitrate of silver, which was mentioned to him by a friend, as a substance very sensible to the influence of light; but all his numerous experiments as to their primary end proved unsuccessful.” (Davy 1802, page 172)

The article appeared without a named author in the first and only volume of the *Journals of the Royal Institution of Great Britain*, and is generally attributed to Humphry Davy (figure 2, left); he was the newly appointed Professor of Chemistry at the Royal Institution and one of the editors of the *Journals*. It is not known when Wedgwood conducted the experiments, but the dates of 1799 and early 1802 are possibilities (Barnes 2005; Batchen 1993; Litchfield 1903). In 1798, Wedgwood had been instrumental in funding and founding the Pneumatic Clinic at Clifton, near Bristol, where Davy conducted research (including the discovery of ‘laughing gas’) before moving to London.

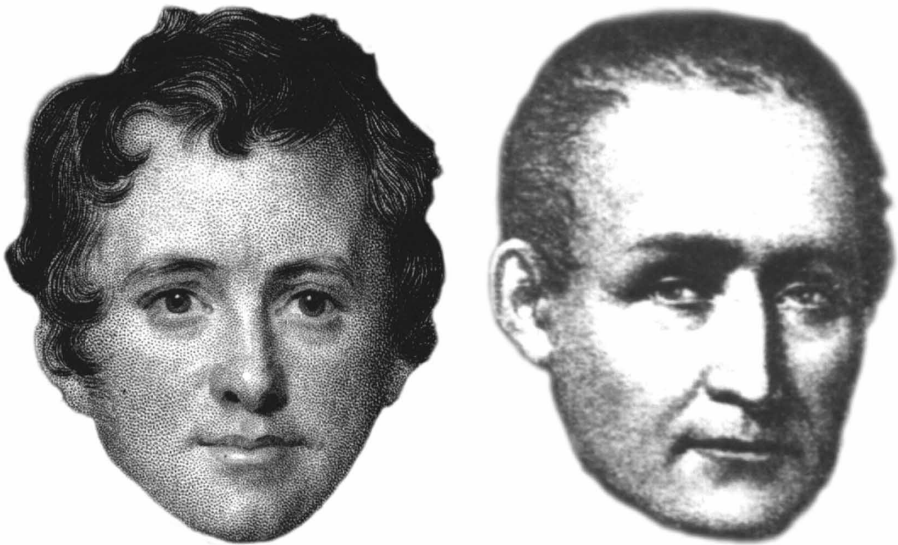


Figure 2. Left, Humphry Davy (1778–1829) after an engraving in *The Gallery of Portraits: with Memoirs*, volume 1 (London: Charles Knight, 1833); in 1802 he described the negative process invented by Wedgwood. Right, Joseph Nicéphore Niépce (1765–1833) who formed the first permanent positive camera images on metal and glass in 1826 (after a frontispiece photograph of a painting in Werge 1890).

Davy did suggest that muriate (chloride) of silver was more sensitive to light than nitrate, but the main problem faced by Wedgwood was one of fixing the images once the paper or leather had been exposed. They had to be viewed by candlelight otherwise the whole surface would blacken. That is, Wedgwood found a way of forming negative images by blocking the light reaching the paper (what would now be called contact printing) but he could not fix the images so formed:

“No attempts that have been made to prevent the uncoloured part of the copy or profile, from being acted upon by light have as yet been successful. They have been covered with a thin coating of fine varnish, but this has not destroyed their susceptibility of becoming coloured; and even after repeated washings, sufficient of the active part of the saline matter will still adhere to the white parts of the leather or paper, to cause them to become dark when exposed to the rays of the sun.” (Davy 1802, page 172)

The images could be fixed by applying sodium hyposulphite, but this was not discovered in the lifetimes of Wedgwood or Davy. As Werge (1890) ruefully remarked: “What would Thomas Wedgwood not have given for a handful of that now common commodity?” (page 7).

Tom Wedgwood was the youngest son of Josiah Wedgwood (figure 3, left), whose Staffordshire pottery was in the vanguard of the industrial revolution. Josiah was a member of the Lunar Society (see Uglow 2002), and a close friend of Erasmus Darwin (figure 3, right). The young Tom mingled with this select group of inventors and industrialists, and part of his education was with Darwin's son, Robert Waring Darwin (1766–1848) the father of Charles Robert Darwin (1809–1882). Tom was dogged by ill-health throughout his short life. Like the Darwins, Tom went to Edinburgh University, but unlike them he did not study medicine. He spent two years there, rounding off his education and carrying out studies in chemistry; golf provided a distraction from his headaches (Litchfield 1903). He was also exposed to the philosophy of Thomas Reid (1710–1796), which he applied in his later writing on perception. Tom became a partner in the family pottery business for a few years (1789–1793), but thereafter sought solace for his debilitating ailment through exercise, travel, and interactions with friends. While at the pottery he conducted experiments that linked light and heat; the results were published in the *Philosophical Transactions of the Royal Society* (Wedgwood 1792a, 1792b). He reduced a range of substances to fine powder and heated them until they glowed. He found that all substances glow at the same temperature. Despite the promise the experiments displayed, Wedgwood decided to abandon further experimental work on heat and light because of his poor health.

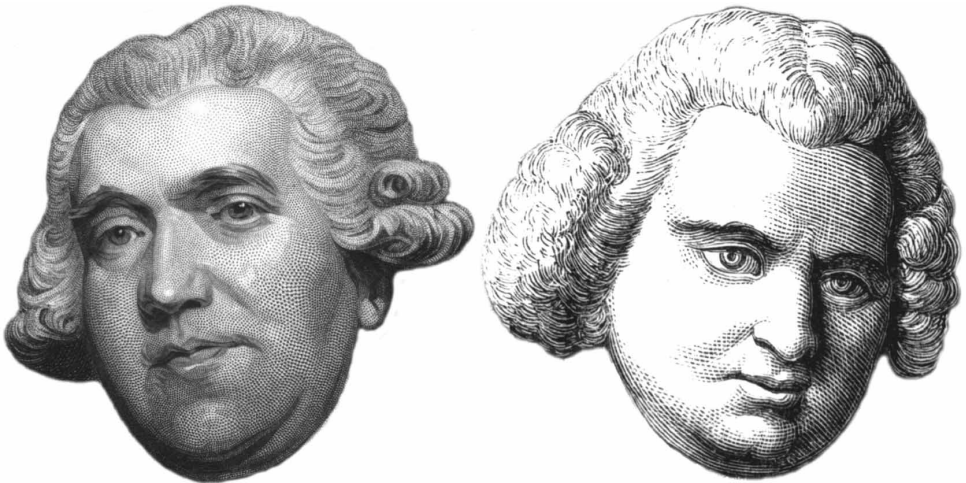


Figure 3. Left, Josiah Wedgwood (1730–1795) and right, Erasmus Darwin (1731–1802), both after engravings in Meteyard (1865).

Erasmus Darwin played an important role in the development of Tom Wedgwood's ideas, not only in the context of photography, but also regarding perception (see Barnes 2005). Wedgwood was both a pupil and a patient of Darwin, and they later became correspondents. Wedgwood's health was not improved by Darwin's prescription of opium, to which he became addicted (King-Hele 1999). Darwin expressed his ideas about perception in *Zoonomia*, the first edition of which was published in 1794. He was particularly influenced by the theory of vision advanced by George Berkeley (1685–1753; 1709). That is, the motor component of perception was stressed, and touch was considered to be the dominant sense. In the notes accompanying his poem *Temple of Nature*, Darwin (1803) stated that: "The word perception includes both the action of the organ of sense in consequence of the impact of external objects and our attention to that action" (page 87). In the poem itself, he wrote: "the mute language of the touch is sight".

Wedgwood developed an early interest in light and vision, and had purchased a copy of Newton's *Opticks* when he was only sixteen. He would have been well acquainted with Priestley's (1772) treatise on vision, light, and colours, as his father was a subscriber to it (Meteyard 1871). He would also have been familiar with Darwin's experiments on afterimages (or ocular spectra as he called them), expressed either indirectly in the article under his son's name (R W Darwin 1786) and in *Zoonomia* (E Darwin 1794). Afterimages are notable for having brief positive phases following which a longer-lasting negative is visible. The link between the negative afterimage and the negative Sun pictures would not have been lost on Wedgwood.

Wedgwood did not conduct experiments on light and heat following his departure from the family business, but he did write extensively on matters metaphysical and particularly on perception (Barnes 2005; Meteyard 1871). Only a fragment of his writings has been published, and parts of his "Essay on vision" were included in an anonymous compilation (Anon 1817, reprinted in Meteyard 1871). Wedgwood addressed a number of issues in perception which were of interest then as now. His principal aim was to cast doubt on the primacy of touch in determining the third dimension of space—distance. A second concern was with perceptual learning. This he addressed via the concepts of perceptions and ideas, and the ways in which they can interact: "The two acts or states of mind, called perception and idea, have a common nature" (Anon 1817, page 6). By idea he was referring to memory: "Every perception of the object leaves behind it an idea which instantly coalesces with the subsequent perception" (page 7). Thus, he was trying to integrate perception with recognition to which he added the aspect of expectation. He adopted a cognitive approach to vision which would not be viewed negatively by many present-day theorists: "Perception becomes a language, of which the chief use is to excite the correspondent series of thought, and the senses are seldom intensely and long employed but in the examination of new objects" (page 9).

It was in the analysis of distance that Wedgwood was most influenced by Reid. Berkeley had introduced the concept of superficial distance (the dimensions of length and breadth that are present in the retinal image) and contrasted that with the experience of 'outness' (depth). Wedgwood maintained that this projective aspect of vision, the perception of depth, could be achieved by associating many different views of the same object. An example he gave is of looking at a globe; from the separate views of it an impression of its whole structure can be formed. The process is not dissimilar to the shift from a viewer-centred to an object-centred description, as Marr (1982) proposed. Wedgwood wrote: "The idea of the invisible part of the globe instantaneously blends with the perception of that which is visible, and they jointly form my notion of the globe" (Anon 1817, page 12).

Contrary to Berkeley and Darwin, Wedgwood argued that touch was not essential for learning the dimensions of solid space. He summarised his position thus:

"Here then is a visual idea of an object which may be substituted for the tangible magnitude of Berkeley. This idea furnishes what we call the real magnitude of the object. All the other perceptions of the object being comparatively indistinct and uninteresting, are chiefly useful in calling up this idea. Thus a standard visual idea of every object is formed, which instantly blends with every fugitive perception, and corrects it. A visual perception is a sign which excites the standard visual idea, and the whole of that process is performed by the sense of sight alone, for which Berkeley called in the assistance of the sense of touch." (Anon 1817, page 12)

A clear indication of the gulf that separated Erasmus Darwin and Wedgwood was their interpretation of phantom limbs. They took on personal significance to both men because Josiah Wedgwood had a leg amputated three years before Tom was born, and Darwin was Josiah's physician. It would seem that Josiah experienced sensations from his missing leg as one of his biographers wrote: "Yet, for many years, the severed

nerves continued to convey sensations to the brain or to the nervous system which had been affected, so that he continued to feel the remains of the pain in what he called his ‘no-leg’” (Smiles 1894, page 121). Darwin related the phantom sensations to prior sensory-motor associations, whereas Tom Wedgwood used the experiences to cast doubt on the primacy of touch. Darwin’s account read:

“After the amputation of a foot or a finger, it has frequently happened, that an injury being offered to the stump of the amputated limb, whether from cold air, too great pressure, or other accidents, the patient has complained of a sensation of pain in the foot or finger, that has been cut off. Does this not evince that all our ideas are excited in the brain, and not in the organs of sense? This objection is answered, by observing that our ideas of shape, place, and solidity of our limbs, are acquired by our organs of touch and of sight, which are situated in our fingers and eyes, and not by any sensations in the limb itself. In this case the pain or sensation, which formerly has arisen in the foot or toes, and been propagated along the nerves to the central part of the sensorium, was at the same time accompanied with a visible idea of the shape and place, and with a tangible idea of the solidity of the affected limb: now when these nerves are afterwards affected by any injury done to the remaining stump with a similar degree or kind of pain, the ideas of the shape, place, or solidity of the lost limb, return by association; as these ideas belong to the organs of sight and touch, on which they were first excited.” (Darwin, 1794, page 28)

Wedgwood’s theory was also based on Hartley’s (1749) notions of association, and he believed that associations could be forged between visual ideas themselves. The occurrence of phantom sensations in a missing limb was taken as evidence that touch was not primary:

“A person who has lost a hand, often fancies that he feels pain in a finger of that hand, and refers it to that place in the air which his finger would have occupied if he had not lost it. Nothing can more incontestibly prove the inadequacy of touch to mark position, since the touch or pain is here supposed to suggest its having position in a place where there is no part of the body existing.” (Anon 1817, pages 5–6)

The experience of sensations in amputated limbs was an acknowledged phenomenon at that time. Ambroise Paré (1510–1590) initiated medical interest in this intriguing aspect of perception and it had been described by many subsequent writers (see Price and Twombly 1978). Both Darwin and Wedgwood were using it to advance particular theoretical positions. The same applied to Charles Bell (1774–1842) and Johannes Müller (1801–1858) who employed phantom limb phenomena as support for their doctrines of specific nerve energies (Wade 2003). The term ‘phantom limb’ was not adopted until 1871 by Silas Weir Mitchell (1829–1914); it was selected from a range of alternatives to convey the reports of the many amputees he treated during and after the American Civil War.

Returning to photography, the role of Wedgwood in the invention of negatives took on further turns after his death. Before these advances, however, Joseph Nicéphore Niépce (figure 2, right) exhibited his positive and permanent camera images in 1827. He had been conducting experiments with camera images since 1816 and had formed negative images on white paper, but like Wedgwood, could not fix them. As a consequence of copying engravings onto metal plates he applied a similar procedure to the camera—forming positive images on metal or glass (see Newhall 1982). Niépce went into partnership with Louis Jacques Mandé Daguerre (1789–1851) in 1829, but died before Daguerre had devised a way of exposing iodised silver or copper plates in a camera and developing the latent image with mercury vapours. The resulting metal-plated positives were given the name *Daguerreotypes*.

The birth of photography is generally taken as the year 1839, when first Daguerre’s positive method was made public, followed quickly by the announcement by William Henry Fox Talbot (figure 4, left) of his paper-based negative process. Positives could be

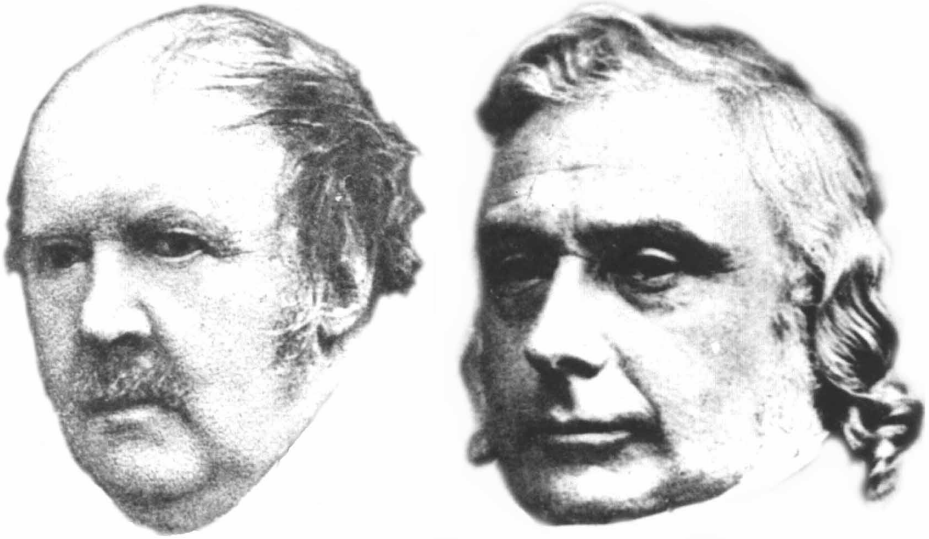


Figure 4. Left, William Henry Fox Talbot (1800–1877) and right, Joseph Bancroft Reade (1801–1870) both after frontispiece photographs in *Werge* (1890).

produced by contact printing the negatives. Talbot delivered a paper entitled “Some account of the art of photogenic drawing” to the Royal Society on 31 January 1839, and a brief account of it was published in *The Athenaeum*. Wedgwood’s work was acknowledged but he stated that “his experiments were begun without being aware of this prior attempt” (Talbot 1839, page 97). The quality of Talbot’s photographs was inferior to that of Daguerreotypes, but David Brewster (1781–1868) championed the former in terms of cost, portability and reproducibility:

“In point of expense, a Daguerreotype picture vastly exceeds a Calotype one of the same size. With its silver plate and glass covering, a quarto plate must cost five or six shillings, while a Calotype will not cost as many pence. In point of portability, permanence, and facility of examination, the Calotype picture possesses a peculiar advantage The great and unquestionable superiority of the Calotype pictures, however, is their power of multiplication. One Daguerreotype cannot be copied from another; and the person whose portrait is desired must sit for every copy that he wishes. When a pleasing picture is obtained, another of the same character cannot be produced. In the Calotype, on the contrary, we can take any number of pictures, within limits, from a negative; and a whole circle of friends can procure, for a mere trifle, a copy of a successful portrait.” (Brewster 1843, page 333)

Talbot had been experimenting with images formed in a camera obscura (with a lens) since 1834, and he described his progress in the first photographic book, *The Pencil of Nature* (Talbot 1844). In it, he expressed his debt to Wedgwood and Davy:

“It is curious and interesting, and certainly establishes their claim as the first inventors of the Photographic Art, though the actual progress they made in it was small. They succeeded, indeed, in obtaining impressions from solar light of flat objects laid upon a sheet of prepared paper, but they say they found it impossible to fix or preserve those pictures: all their numerous efforts to do so having failed. And with respect to the principal branch of the Art, viz. the taking pictures of distant objects with a Camera Obscura, they attempted to do so, but obtained no result at all, however long the experiment lasted. While therefore due praise should be awarded to them for making the attempt, they have no claim to the actual discovery of any process by which such a picture can really be obtained. It is remarkable that the failure in this respect appeared so complete, that the subject was soon after abandoned both by themselves and others, and as far as we can find, it was never resumed again. The thing fell into entire oblivion for more

than thirty years: and therefore, though the Daguerreotype was not so entirely new a conception as M. Daguerre and the French Institute imagined, and though my own labours had been still more directly anticipated by Wedgwood, yet the improvements were so great in all respects, that I think the year 1839 may fairly be considered as the real date of the birth of the Photographic Art, that is to say, its first public disclosure to the world." (Talbot 1844, no pagination is provided in the book)

Wedgwood's comment that leather was more readily acted upon by light than paper led Joseph Bancroft Reade (figure 4, right) to claim that he not only formed but also fixed images on leather and paper, two years before the published account of Talbot's experiments producing negatives on paper. Reade wrote:

"No one can dispute my claim to be the first to suggest the use of gallic acid as a sensitizer for prepared paper, and hyposulphite of soda as a fixer. These are the keystones of the arch at which Davy and Young had laboured—or, as I may say in the language of another science, we may vary the tones as we please, but here is the fundamental base. My use of gallate of silver was the result of an inference from Wedgwood's experiments with leather." (Reprinted in Werge 1890, pages 15–16)

Reade's first experiments were with his wife's leather gloves, but he had to resort to using paper as she would not comply with further requests for source material! Reade's claim has been discredited (Wood 1971) and it appears that his experiments took place in 1839, after Talbot had delivered his paper to a meeting at the Royal Society. The use of sodium hyposulphite as a fixing agent was determined by John Frederick William Herschel (1792–1871) in a paper presented to the Royal Society on 14 March 1839: "I find the surest and best fixing material to be a liquid hyposulphite, and of these I prefer that of soda" (Herschel 1840, page 4); he recommended that the photograph should be well washed before it is fixed. Before it was printed in the *Philosophical Transactions* a report of his paper appeared in *The Athenaeum*:

"The author inquires into the methods by which the blackened traces can be preserved, which may be effected, he observes, by the application of any liquid capable of dissolving and washing off the unchanged chloride, but of leaving the reduced, or oxide of silver, untouched. These conditions are best fulfilled by the liquid hyposulphites. Pure water will fix the photograph, by washing out the nitrate of silver, but the tint of the picture resulting is brick-red; but the black colour may be restored, by washing it over with a weak solution of hyposulphite of ammonia." (Herschel 1839, page 223)

It is this description that led to Reade's researches. Talbot also modified his methods in order to form a latent image on specially prepared paper, and then to develop and fix it in darkness; this was the calotype process he patented in 1841. Herschel had an enormous and understated influence on the development of photography (see Schaaf 1992). In addition to his chemical discoveries, he introduced the terms 'positive' and 'negative' and considered that 'photography' was a better term than Talbot's 'photogenic drawing'.

Tom Wedgwood died on 10 July 1805, thirty four years before the birth of photography. His experiments were the catalyst for the production of camera images even though his results were negative. If you fix long and intently Wedgwood's eye in the portrait shown in figure 1, then look at a white sheet of paper (or leather) his positive characteristics will be revealed.

Acknowledgments. I am most grateful to Alan Barnes for providing material on Tom Wedgwood. He organised a symposium to mark the bicentenary of Wedgwood's death, which was held, appropriately, in the Royal Institution of Great Britain, where Wedgwood's experiments with photography were presented to the public. There is also a small exhibition at the Royal Institution, which is on display until July, relating to Tom Wedgwood's life.

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