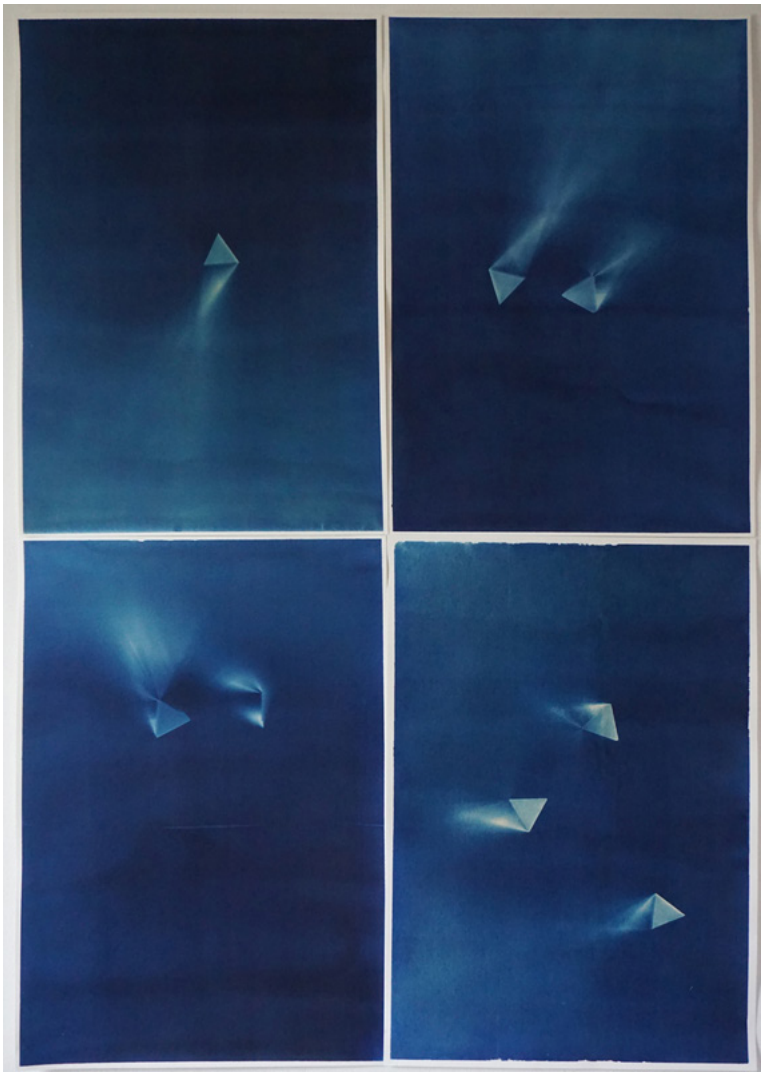
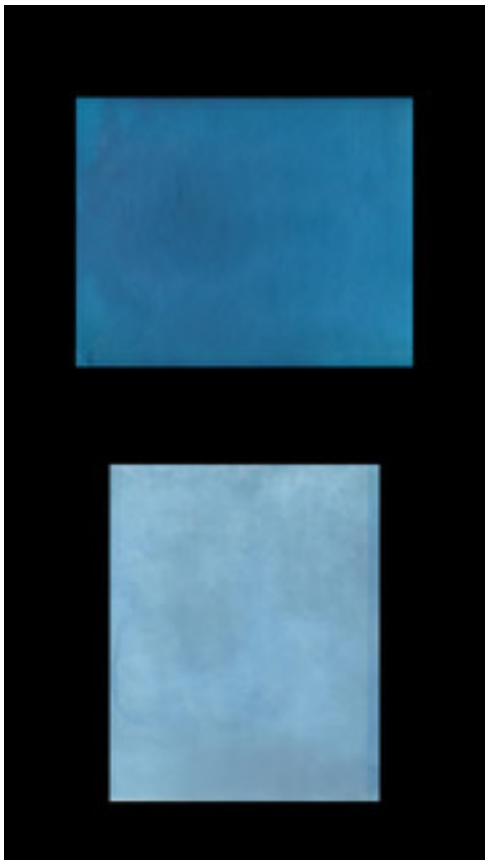


Mike Ware *A Study of Shadows*

Dr. Mike Ware is an Honorary Fellow in Chemistry at the University of Manchester.



Kathleen Herbert *Everything is Fleeing to its Presence* 2018
video still
binaural sound and video installation, 15 mins

In Kathleen Herbert's exhibition at Danielle Arnaud, a binaural sound and video presentation is matched by an installation of panels of rectangular blue photograms of illuminated glass prisms in varied configurations, together with composite images of Chernobyl and upland Britain mounted against unfixed blueprint paper. The artist's poetical audio narrative, titled *Everything is Fleeing to Its Presence*, is accompanied visually by projected blue rectangles – varying abstract voids, or perhaps symbols of the walls of a confining room. The entire work is dominated by a monochrome blue, realised by means of the photographic process called cyanotype, which yields images in the pigment Prussian blue. My purpose here is to explain this process and its substance, in non-technical language, and to outline the origin and implications of its colour. It will remain for the viewer to infer any metaphorical allusions to the artist's message.

In the cyanotype process, fine watercolour paper is hand-prepared by coating it with an aqueous solution of two light-sensitive iron chemicals. Non-scientific readers – do not be daunted! These are substances with quite familiar origins in everyday experience. One is prepared from a ferric oxide (as seen in rust) combined with an organic 'fruit acid', such as citric, tartaric, or oxalic acid – chemicals that are present in lemons, grapes, and rhubarb, respectively. The product (in the first case) is called ferric ammonium citrate – a useful substance that was added to the pharmacopaeia in 1840, prescribed then as an iron tonic, which it still is to this day. The other chemical is a trifle more exotic: called potassium ferricyanide, it does not arise naturally but was first prepared by decomposing nitrogenous organic matter containing iron, such as dried animal blood. I hasten to reassure vegans that its manufacture today is purely inorganic!

The discovery of the cyanotype process was a stroke of pure serendipity: On 23 April 1842, in the third year of his photographic research, the notable scientist Sir John Herschel brushed an aqueous solution of the bright red potassium ferricyanide onto a sheet of paper, dried it, and exposed it to sunlight, expecting only that the red colour would be bleached. Instead, it turned deep blue. Herschel's well-founded chemical reasoning quickly told him that the product must be the same as the artists' colour, Prussian blue. He soon found that adding ferric ammonium citrate greatly increased the sensitivity of this photographic printing process. We read in his experimental notes for that day: 'Tried it for copying engravings. It does them very beautifully, but the copies are *negative* in the lights are blue the shades white.'[1] Note Herschel's emphatic appropriation of the word 'negative' here to describe its inversion of the luminous scale. Thus he accidentally discovered the process that he eventually named 'cyanotype', from the Greek for 'blueprint'. This was destined to become

the chief method for photocopying plans in every drawing office of the world over the next hundred years, and it also provided an easy and inexpensive way of printing positive images from photographic camera negatives.

The pigment called Prussian blue (also Berlin blue) does not occur in nature but had first been created in 1706 – entirely accidentally – by Johann Jacob Diesbach, an artists' colour-maker in Berlin. The chance production of such a spectacular hue must have instantly captured his attention, since he was keenly aware of the rarity and expense of good blue pigments, such as ultramarine. The profitable manufacture of Prussian blue soon spread to Britain. With advances in chemistry, the pigment, which had gained commercial importance by the early nineteenth Century, could be made from purely inorganic materials – air, charcoal, potash, and iron filings. Thus, Prussian blue was already a familiar artists' colour by 1842, when Sir John Herschel discovered — also quite accidentally — that it could be produced by the action of sunlight upon a particular compound of iron.

Today, chemists identify Prussian blue formally as ferric ferrocyanide which, as Herbert's audio text explains, contains iron atoms in two different states of oxidation: ferric and ferrous. A quintessential property of such 'mixed oxidation state' compounds is intense colour, the origin of which also engages Herbert's imagination: electrons jumping easily from ferrous to ferric ions by absorbing light energy from the red region of the visible spectrum, creating for our eyes the complementary colour of deep blue. She enquires deeper into this world of chemical spectroscopy; the submicroscopic domain of light energy interacting with electrons, atoms and molecules. Prussian blue has a simple but unusual molecular structure: an open cubic lattice like a scaffolding, spacious enough to allow metal ions such as potassium and caesium to wander in, but then become trapped. This makes Prussian blue a useful antidote to certain metallic poisons, which remain sequestered until harmlessly excreted – an effective method of detoxifying both animals and humans. Following the disastrous Chernobyl reactor explosion of April 1986, the rainfall on the uplands of Britain became contaminated with the radioactive isotope caesium-137. This dangerous poison was eliminated from our food chain by feeding Prussian blue to the sheep grazing the slopes, and the antidote continues to be used to detoxify livestock in the contaminated regions of Belarus, Russia and Ukraine.

Because the cyanotype blue can be partially faded by strong light, the conservation and display of precious images in this process is also a matter of curatorial concern. The colourless product resulting from this photochemical fading is called ferrous ferrocyanide (or more familiarly, Berlin white); all its iron atoms are ferrous, but the molecular structure is otherwise unchanged. This colourless reduced state is slowly — but completely — restored to Prussian blue over a period of many hours, because the open structure of the lattice is porous to oxygen of the air, which re-oxidizes half of the ferrous ions back to ferric ferrocyanide. Storing cyanotypes in the dark, exposed to air, actually revives their deep blue tones.

Herbert's audio-visual piece also celebrates the work of 'the first woman photographer' Anna Atkins, over the decade 1843-1853, when she hand-printed her book of *British Algae: Cyanotype Impressions* in an edition of about 15, each volume containing more than 400 cyanotype photograms of seaweeds gathered from the British coast. A copy of this treasured work – the first photographically illustrated book – was exhibited at the New York Public Library in 2019, accompanied by an exhibition of related works by several contemporary artists, including Herbert's audio-visual presentation. In this account, she records the tactile impact of handling a rare original volume by Anna Atkins, wherein the residual images have long outlived the ephemeral botanical specimens used to imprint them.

Compared with modern photographic processes, cyanotype is very 'slow' and insensitive, requiring lengthy exposures to strong ultraviolet light. It is not suited for use in a camera, because lenses restrict the passage of light through a small aperture, and so it would require exposures of many hours. Cyanotype is useful only for 'contact printing': making photograms that record the silhouettes and shadows cast by objects placed between the surface of the sensitive paper and a strong light source. In the absence of any lens to focus the image, the further the object is from the paper surface, the more diffuse its image becomes. Herbert's work consists of panels of cyanotype photograms of illuminated prisms, arranged on the sensitized paper. The negative-working cyanotype process translates the shadows cast by the objects apparently as diffuse rays of lighter tonality against a deep blue ground – an optical inversion suggesting streams of emitted light, like meteor or comet tails, imparting a dynamic quality to the diamond-shaped prisms, as if flying through deep blue space. In her choice of these objects there lies a remarkable historical coincidence, of which Herbert admits she was totally unaware. During his scientific investigations of the nature of light, Sir John Herschel himself made frequent use of prisms. Having invented cyanotype sensitizer for making blueprints, he then used a prism to disperse the ray of sunlight into a Newtonian optical spectrum from red through to violet, across his paper. His purpose was to assess the relative sensitivity of the cyanotype to different wavelengths of light or, as he put it, to discover 'the photographic powers of the colours of the prismatic spectrum'. He found the most effective were the

short wavelengths of blue, indigo and violet light, and beyond – into the invisible ultraviolet radiation that had only recently been discovered by Johann Wilhelm Ritter in 1801.

Of all the colours on the artist's palette before the 18th Century, blue held the traditional place of honour, as ultramarine, the rarest, finest, most costly pigment then available, made from the gemstone Lapis Lazuli. In the history of painting, therefore, blue was often reserved for a noble role, symbolising some of the loftiest sentiments: spiritual devotion, heavenly love, and innocence. The traditions of Renaissance religious art, for instance, invariably rendered the Virgin Mary's mantle in blue. In Hindu religious painting, Lord Krishna, one of the incarnations of Vishnu the Preserver, is always represented with blue skin.

There are paradoxes within our associations of the colour blue. Thanks to the subjectivity of human feelings, its connotations may be ambivalent: a 'joyous but ominous colour'. It also operates as the space between darkness and light: 'Blue is darkness made visible.'[2] Colour symbolism derives from several sources, and we should distinguish the mystical and esoteric from those associations forged by primitive logic and intuition, on which modern psychology would put more weight. The diurnal life of early humankind was dictated by the cycle of night and day; and night was when action had to cease. According to the colour theories of Lüscher, the dark blue of the night sky is therefore the colour associated with quiescence and passivity. He further claims that long contemplation of pure dark blue has calming physiological effects on the central nervous system, reducing blood pressure and lowering the rates of pulse and respiration. Lüscher lists the affective aspects of dark blue as tranquility, contentment, tenderness, love and affection. Even a lighter blue may claim to have calming effects, as evidenced by its widespread use for hospital garb.

According to the aesthetic theories of the painter Wassily Kandinsky, the first great antithesis of colour lies between yellow and blue, between warmth and coolness, between advance and retreat. Concerning blue, he observed: 'Depth is found in blue...The deeper its tone, the more intense and characteristic the effect. We feel a call to the infinite, a desire for purity and transcendence. Blue is the typical heavenly colour; the ultimate feeling it creates is one of rest. When it sinks almost to black, it echoes a grief that is hardly human. It becomes an infinite engrossment in solemn moods. As it grows lighter it becomes more indifferent and affects us in a remote and neutral fashion, like a high cerulean sky.'[3]

Notes :

1. Sir John F. W. Herschel, *Memoranda*, Manuscript Library, Harry Ransom Humanities Research Center, University of Texas at Austin.
2. John Wood, 'The Art of the Cyanotype and the Vandalous Dreams of John Metoyer', in *The Photographic Arts*, Iowa: University of Iowa Press, 1997, pp. 32-44.
3. Wassily Kandinsky, *Concerning the Spiritual in Art*, New York: Wittenborn Art Books, Inc., 1947, p. 58.

About the author
Following an academic career as a Chartered Chemist and Fellow of the Royal Society of Chemistry, Mike committed himself in 1992 to an independent study of the history, science, and conservation of early and 'alternative' photographic processes, especially those invented by Sir John Herschel. Mike's researches into updating the siderotype processes are described in seventy publications in both the popular and academic literature, including six books. He has supervised postgraduate research in photograph conservation at the Victoria & Albert Museum and the Royal College of Art, and in alternative photographic processes at the University of Derby. He has consulted for national museums and galleries in the UK and USA, exhibiting his personal photographic work and conducting workshops worldwide. In 1990 he was awarded the Hood Medal of the Royal Photographic Society, and in 2016 he received the Special Recognition of the American Institute for Conservation.

Cover: **Kathleen Herbert** *A Study Of Shadows* 2019
cyanotype photograms of prisms on watercolour paper
21 x 29.7 cm each

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