

Teaching colour in art and design: A documented history

Roy Osborne

BlackChalk Workshops, Bath, Somerset, UK

Email: art.school.net@outlook.com

The article briefly surveys what has been taught about colour from the mid-sixteenth to the mid-twentieth century, primarily to students of art, design and crafts. Its selection of publications starts with Lomazzo's manual of 1585 that appraises almost all the skills and guidance that artists of the time needed to know, including the theory of the four humours. After 1704, Newton's investigations into optics and vision influenced such artists and authors as Le Blon, Hogarth and Harris. Newton's findings were resisted in Germany and France but important contributions to colour theory and practice were made by Goethe, Runge and others, and by Chevreul in the 1830s. Following publications by Bezold and Rood, the inclusion of basic colour science becomes standard in most educational manuals, such as those published by Prang and Bradley in Massachusetts. Fewer than 100 instructional books on colour were published in the twentieth century; among the most comprehensive earlier examples were those by Weinberg (1918), Sargent (1923) and Guptill (1935). Innovative courses at the Bauhaus later led to the inclusion of basic-design and colour-theory modules in many educational institutions. The article concludes with a proposal of how investigation of colour in relation to form might offer a pathway for the future teaching of colour in the visual arts.

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The legacy of educational colour literature

Published teaching manuals offer valuable insights into the various ways in which theoretical and practical information about colour were made available to students and apprentices of art and decoration¹. The earliest printed European books on the subject, notably those by Gilles Corrozet (1527) and Fulvio Morato (1535), explored the symbolism of colour as it might be interpreted in clothing worn by nobles and historical or mythological figures². That such publications were of interest to artists is proven by parts of them being included for example in Gian Paolo Lomazzo's *Trattato dell'arte della pittura, scoltura, et architettura*, published in Milan in 1585.

¹ Details of all the publications mentioned are included in: Osborne R (2020), *Books on Colour 1495-2020: History and Bibliography*, Morrisville NC: Lulu Press.

² The original texts and translations of both books are included in: Osborne R (2022), *Renaissance Colour Symbolism: Primary Sources*, Morrisville NC: Lulu Press.

In terms of art, music, literature and etiquette, the courts of northern Italy nurtured a model of cultural civility that was imitated and developed throughout Europe in the centuries that followed. Lomazzo's substantial treatise offers valuably comprehensive insight into late-Renaissance art education. Twenty-eight of its chapters are specifically on colour, most of which are grouped in the manual's shortest section (Book 3, *Del colore*), which itself indicates that colour was already considered as a subject in its own right. Lomazzo had practised as a successful painter until losing his sight at the age of 32, after which he devoted himself to teaching and writing. While he considered colour's main function was to enliven the outward appearance of objects, he added that it could also reveal certain inner passions, 'laying before our eyes the affections of the soul'³.

Chapters in Lomazzo's Book 3 also examine mixtures obtained from basic colours, the 'agreement and disagreement' of colours, which pigments are compatible with each medium, how transparent colours are used, and the method of imitating 'changeables' – *cangianti* in Italian⁴. The latter, on how to depict silken cloths 'whose highlights are of one colour and their shadows of another,' was one of four main skills that painters needed to master, the others being the handling of light and shade (*chiaroscuro*), the blending of colour boundaries (*sfumato*), and colour harmonisation (*unione*). Portraitists (not unlike the physicians of the time) additionally needed to assess the temperament of their sitters, and how the assessed proportions of the four humours – white phlegm, red blood, yellow bile and black bile – affected them not only inwardly but outwardly in terms of their demeanour and skin-complexion. This long-obsolete theory can be traced back to Hippocrates (circa 400 BC), and its later revision by Claudius Galen was translated into Italian in 1548 by Lodovico Dolce, a close friend of Titian, who, as Lomazzo appears to confirm, applied it in his portraiture⁵.

At the start of the 1500s, Italy could boast the greatest artists, musicians, writers, and natural philosophers. As a consequence of the reactive censorship of the Catholic Counter-Reformation (circa 1560-1610), its status diminished, and the centre of artistic and scientific innovation shifted to the Netherlands and then to France. Prior to 1500, artists generally relied on priests and scholars to inform them about the narrative and symbolism of their paintings. By mid-century, they needed to find this out for themselves – hence the usefulness of printed manuals, some 20 of which were issued in the 1600s, mostly by French theorists, including François du Jon (Junius) 'on the painting of the ancients' and Charles-Alphonse Dufresnoy (1611-68), whose long Latin poem, *De arte graphica*, was in part inspired by the recent publication of Leonardo da Vinci's writings on art. Some of Rubens' colour theories, including his promotion of red, yellow and blue as primary colours, were contained in François d'Aguilon's *Opticorum* of 1613,⁶ but the most prominent colour theorist of the time was Roger de Piles (1635-1709), who translated Dufresnoy's poem and added his own *Dialogue sur le coloris* (on colouring) in 1673. De Piles' recommendations for handling colour and choosing palettes (and favouring Rubens' liberal use of colour over the decorum of Poussin) is set out in *Les Premiers Elémens de la peinture pratique* (1684), compiled with the aid of artist Jean-Baptiste Corneille, who taught (with his father Michel) at the Académie royale de Peinture et de Sculpture in Paris.

³ Giovanni Paolo Lomazzo, *Trattato dell'arte della pittura, scoltura, et architettura* (1585), Milan, Paolo Gottardo Pontio. Book 3, Chapter 1: *Ne solamente esprime nelle figure le cose come sono, ma mostra ancora alcuni moti interiori quasi pingendo e ponendo sotto gl'occhi l'affettione de gl'animi*.

⁴ Lomazzo, *ibid.*, Book 3, Chapter 10: *Dell'ordine che si tiene in fare i cangianti*. A fine example is Andrea Mantegna's *Virgin and Child with Saints* (National Gallery, London, circa 1500).

⁵ Lomazzo, *ibid.*, Book 1, Chapter 1, and Book 6, Chapter 9; see also Lodovico Dolce, *Oratione di Galeno* (1548), Venice: Gabriel Giolito.

⁶ François d'Aguilon, *Opticorum* (1613), Antwerp, Balthasar Moretus. See also François du Jon, *The Painting of the Ancients* (1638), London, Richard Hodgkinson, and Dufresnoy's *De arte graphica*, translated by John Dryden as *The Art of Painting* (1695), London: William Rogers.

The Académie, founded in 1648, became the model for other European art schools, but the majority of aspiring artists had to rely on studio apprenticeships, with theoretical advice provided by cheap manuals. The most popular of these was the *Traité de la miniature* (1672), a small but extensive tract that offered guidance comparable to De Piles' grander publication. The treatise was attributed to Claude Boutet, though this may be a pseudonym for its publisher Christophe Ballard. It was subtitled 'the art of teaching painting without a master' and included instructions for lightening, darkening and matching colours, and fidelity in representing flesh colours, draperies, landscapes, and flowers⁷. The first instructional book by a female author was Catherine Perrot's *Les Leçons royales* (1686), on painting flowers and birds in miniature, which had earlier been included in André Félibien's *Entretiens* (Discourses), together with other academicians' advice on teaching colour.

One of Rembrandt's late portraits (now in New York's Metropolitan Museum) was of Gérard de Lairesse (1640-1711), the author of another major compilation, *Het groot schilderboek* (The Complete Painting-book, 1707) that again usefully records the artistic theory of its age. Like Lomazzo, Lairesse was a successful artist – accomplished enough to be called the 'Dutch Poussin' – before he lost his sight (aged 50) and turned to teaching and writing. His two dozen chapters on colour predictably offer advice on choosing and modelling the colours of clothing, assigning colours to dominant versus subordinate figures, near and distant features in landscapes, and on human complexions, which he reduces to the healthy, the sick and the dead, applied to children, men and women⁸.

The beginnings of colour classification

After 1660, new scientific investigations expanded north of the Alps, as usefully documented by contributions to the Royal Society of London's *Philosophical Transactions*. An early subscriber was the young Isaac Newton, who later became its president.

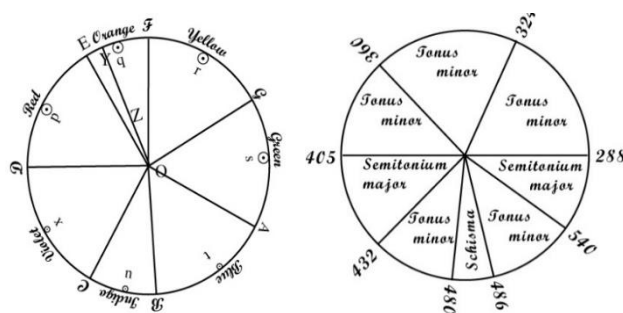


Figure 1: Linear diagrams from Newton's *Opticks* (1704), left, and Descartes' *Musicae compendium* (1650), right.

An important discovery of Newton, in his initial experiments with glass prisms, was that colour is not the property of objects, nor even a property of the light illuminating them, but that within the light 'there is nothing else than a certain Power or Disposition to stir up a Sensation of this or that Colour' (*Opticks*, 1704). His well-known linear colour circle (to the left in Figure 1), representing spectral colour proportions, bears similarities to René Descartes' 1650 diagram (to the right), delineating the diatonic

⁷ *Traité de la miniature, pour apprendre aisément à peindre sans maistre* (1672), Paris: Christophe Ballard.

⁸ Gérard de Lairesse & John Fritsch, translator, *The Art of Painting* (1735), London, John Brotherton; see Part I, Chapter 10, 'Of the Different Colouring of the Naked, in a Child, Man and Woman.'

scale in his *Musicae compendium*⁹. Early evidence of Newton's influence on art education was demonstrated by the inclusion of two colour circles (Figure 2) in the 1708 (The Hague) edition of Boutet's book, using 'red crimson' to link their red and violet segments.

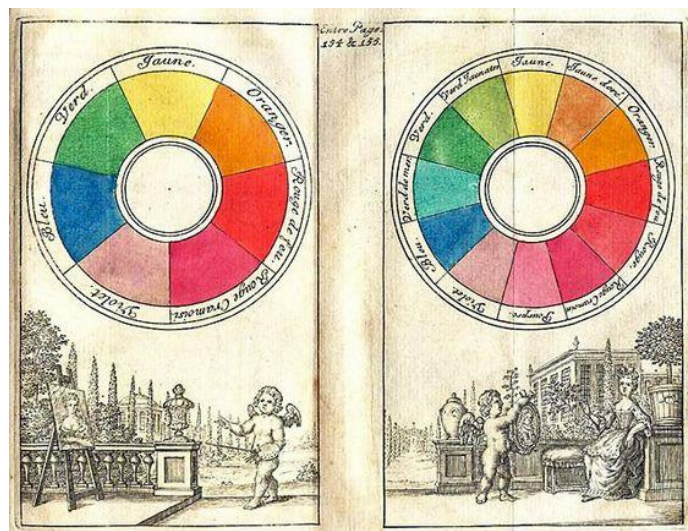


Figure 2: Hand-coloured circles from Loui's Van Dole's edition of the *Traité de la peinture en miniature* (1708).

Three prominent artists who displayed interest in Newton's colour theories were Jakob Christoph Le Blon (1667-1741), William Hogarth (1697-1764) and Moses Harris (1730-88), who were also engravers and authors of instructional books. Le Blon invented an early form of three-colour printing, and his 1725 booklet, *Coloritto; or The Harmony of Colouring in Painting*, similarly confirmed that 'Painting can represent all visible Objects, with three Colours, Yellow, Red, and Blue; for all other Colours can be compos'd of these Three, which I call Primitive.' Hogarth, the greatest of the English Baroque colourists, published *The Analysis of Beauty* in 1753. In his Chapter 14, he proposed a novel palette inspired by Newton that consists of five principal hues (or 'virgin tints') set down the middle and flanked on one side by hues mixed progressively with white and on the other by shades mixed with black (as imagined in Figure 3). The red, yellow, green, blue, and violet chosen correspond to those later selected by Albert Munsell. In oil painting, the persistent use of red and yellow ochres and umbers ensured that Hogarth's spectral palette was rarely utilised before Impressionism, but the use of small sets of purer colours was approved by watercolourists, as demonstrated in Moses Harris' *Natural System of Colours* (circa 1770). His 'prismatic colour circle' showed clearly how a small selection of transparent colours could be used to obtain numerous 'compound colours'. His slim volume was dedicated to Joshua Reynolds, first president of London's Royal Academy, who, like other teachers of his time, expressed disappointment that the great colourists of the past (especially the Venetians) had not passed their 'colour secrets' down to later artists, even going so far as to state that 'There is not a man on earth who has the least notion of colouring; we all of us have it equally to seek for and find out; as at present it is totally lost to the art.'¹⁰

⁹ Isaac Newton, *Opticks* (1704), Book 1, Part 2, London, Samuel Smith. René Descartes, *Musicae compendium* (1650), Frankfurt, Friedrich Knoch. Newton's first prismatic experiments were summarised in 'A Letter ... containing his New Theory about Light and Colors,' included in volume 80 of the *Philosophical Transactions* (1671-72).

¹⁰ Sir Joshua Reynolds, *Discourses on Art* (1795), New Haven CT: Yale University Press. Discourse XV, 1790.



Figure 3: Roy Osborne, *Hogarth's Palette* (2010), based on *Hogarth's Rake's Progress* (Sir John Soane's Museum, London, 1733), and painted using his five 'virgin tints.'

Over the next century, English artists proved themselves particularly proficient in watercolour painting (especially in landscapes) and at least 30 instruction books were issued on the method, almost all of which offered advice on the mixing and matching of colours. One of the most original was *An Essay on Light and Shade, on Colours, and on Composition in General*, by Mary Gartside (1755-1819). In his writings on art, Leonardo had proposed that, by throwing a sponge soaked with various colours against a wall, interesting compositions might be imagined in the resulting stains, such as figures, animals, battles, rocky scenes, and forests. Gartside proposed something similar, illustrating each copy with eight hand-painted abstract 'nebulæ' emphasising 'white' followed by yellow, orange, green, blue, scarlet, violet and crimson (to the left in Figure 4). These were intended to illustrate her theories of harmony, composition, proportion, contrasts of tone and brightness, and advancement and recession of colour. An engraving (to the right) added to her second (1808) edition indicates a coloured ball or sphere that, if three-dimensional, would show the gradation of light and shade for each of the colours applied.



Figure 4: Hand-coloured illustrations from the 1805, left, and 1808, right, editions Mary Gartside's *Essay on Light and Shade*.

Four years later, in his *New Elucidation of Colours* (1809), another botanical painter, James Sowerby (1757-1822), applied layers of red, yellow, and blue watercolour to a triangular diagram (Figure 5) to demonstrate degrees of colour saturation. About the same time, the German painter Philipp Otto Runge (1777-1810) realised that to combine hue, tonality and saturation effectively needed a three-dimensional model. Hence his own ingenious colour-sphere was devised and illustrated in his *Farben-Kugel* of 1810, subtitled 'construction of the relationship between all mixtures of colours together.' In

the same year, Johann von Goethe (1749-1832) published his voluminous *Zur Farbenlehre* that, despite its occasionally questionable optics, gave artists a rich resource of historical and innovative observations on colour. Goethe's associations of colours with human attributes may have seemed novel at the time, but as far back as the 1300s, heralds had selected an invested knight's colours based on their meanings in relation to his perceived virtues¹¹. The Age of Reason largely rejected such sentiments, but Goethe's reassessment of them may have paved the way for *Des Couleurs symboliques* (1837), by Frédéric de Portal (1804-76), the first book wholly on colour symbolism since Antoni Calli's *Discorso di' colori* of 1595. Though not an instruction book as such, its English translation (1844) may have informed the by-gone symbolism of colour revived by students at the Royal Academy who soon after formed the Pre-Raphaelite Brotherhood¹².

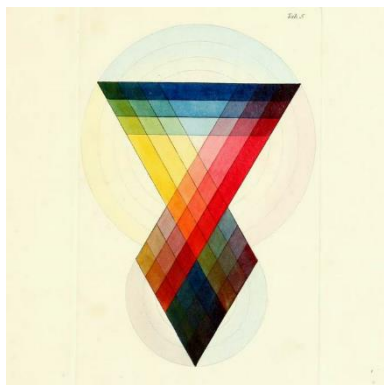


Figure 5: James Sowerby's hand-painted colour triangle in *A New Elucidation of Colours* (1809).

The infiltration of modern science into colour-theory teaching

In his *Chromatography* of 1835, the English chemist George Field (1777-1854) noted that painters depicting figures needed to develop skills that enabled them to distinguish for example between 'the redness indicative of anger and ardent passions, and the blush of bashfulness and shame,... the shallowness or yellowness of grief, envy, resentment, and the jealous passions, the cold pallid blueness of hate, fear, terror, agony, despair, and death.'¹³. Field's book, like many others since Robert Boyle's *Experiments and Considerations Touching Colours* (1664), also examined the chemistry of colorants as well as 'accidental colours', or optical illusions, but it was not until Michel-Eugène Chevreul (1786-1889) began working with weavers at the Gobelins tapestry works in Paris that the first thorough and systematic study of such visual experiences was undertaken. His findings, categorised and published in 1839 in *De la Loi du contraste simultané des couleurs*, led to a widening of the scope of colour teaching from traditional studio or workshop practice into psychophysical aspects of colour perception.

Of over 70 instructional books on colour published in the nineteenth century, most were aimed at painters in oil or watercolour¹⁴. After mid-century, an increasing number were aimed at apprentices of

¹¹ See Sicille hérault (Jean Courtois), *Le Blason de toutes armes et éscutz* (1495), Paris: Pierre Le Caron.

¹² Antonio Calli, *Discorso de' colori* (1595), Padua, Lorenzo Pasquati. See also Frédéric de Portal & Elihu Rich, translator, *An Essay on Symbolic Colours, in Antiquity, the Middle Ages, and Modern Times* (1844), London: John Weale.

¹³ George Field, *Chromatography* (1835), London: Charles Tilt; see page 12.

¹⁴ See Leslie Anne Carlyle, *The Artist's Assistant: Oil Painting Instruction Manuals and Handbooks in Britain, 1800-1900* (2001), London: Archetype.

house decoration as well as those in trade and industry. The earliest example was *The Art of Painting* (1676) by John Smith (1647-1727). *On the Laws of Harmonious Colouring* (1828) by David Ramsay Hay (1798-1866) utilised a colour triangle and colour plates, while *The House Painter* (1841) by William Higgins (1807-84) included 30 painted papers. The latter was subtitled ‘decorator’s companion: being a complete treatise on the origin of colour, the laws of harmonious colouring, the manufacture of pigments, oils, and varnishes, and the art of house painting, graining, and marbling, to which is added a history of the art in all ages.’

Even in artists’ manuals, personal experimentation with colour was rarely encouraged, as exemplified by *An Elementary Manual of Colour* (1853) by Richard Redgrave (1804-88), England’s Inspector General for Art, who (not unlike Dufresnoy) considered that that colouring could be reduced to a defined set of rules. It stands in contrast for instance to *The Elements of Drawing* (1857) by John Ruskin (1819-1900), written as a consequence of his teaching at the Working Men’s College in London. Of necessity its advice needed to be clear and simple, and its section on colour contains advice still valid today. Voicing an odd premonition of later Impressionist methods, like those of Paul Cézanne, Ruskin comments that, ‘Everything that you see in the world around you presents itself to your eyes as an arrangement of patches of colours variously shaded.... The perception of solid Form is entirely a matter of experience. We see nothing but flat colours; and it is only by a series of experiments that we find out that a stain of black or grey indicates the dark side of a solid substance, or that a faint hue indicates that the object in which it appears is far away.’¹⁵

Quite a lot of Ruskin’s advice found its way into one of the period’s most reliable textbooks on science for artists, namely *Modern Chromatics* by Ogden Rood (1831-1902), a physicist based at Columbia University, New York. Other than Chevreul, Ruskin and James Clerk Maxwell, Rood had the advantage of consulting *Die Farbenlehre im Hinblick auf Kunst und Kunstgewerbe* (1874) by Wilhelm von Bezold (1837-1907), translated two years later under the title, *The Theory of Color in Its Relation to Art and Art-Industry*. While acknowledging the freedom of fine artists not to consult his book, Bezold emphasised the need for others to receive instruction in the principles of colour theory. As stated in his introduction, ‘This is more especially true of those branches of art-workmanship which are compelled to employ colours that have been fixed upon beforehand, such as the weaving of coloured stuffs, for instance, or the manufacture of paper-hangings, chromolithography, and similar art-industries.’ The translation of Bezold’s book was published in Boston by Louis Prang (1824-1909), who ran an educational-supply company. He later collaborated with his wife, Mary Dana Hicks (1836-1927), to publish *Color Instruction: Suggestions for a Course of Instruction in Color for Public Schools*, in 1893, which offered a seven-stage course employing 24 standard colours.

Such books presented summaries of colour science as it had evolved thus far and ensured that almost all significant colour-teaching books thereafter would include aspects of optics, colour measurement and visual perception. Rood’s comments in Chapter 10 (adapted from Ruskin, 1857 ¶ 172) that mention ‘the custom of placing a quantity of small dots of two colours very near each other and allowing them to be blended by the eye’ not only inspired the Pointillism of Georges Seurat but the two earliest manuals that teach the method – Paul-Signac’s *D’Eugène Delacroix au néo-impressionnisme* (1899), and Gaetano Previati’s *I principii scientifici del divisionismo* (1906). A key omission from Chevreul’s book, later clarified by Maxwell (1855), and by Rood, was its failure to deduce that the optical fusion of colours seen from a distance (or rapidly rotated on a disc) adhered in principle to the additive mixing of colour. Almost every progressive painter in Paris between 1890 and 1910 experimented with some variation of Pointillism, and its fragmentation of the picture surface was an influential precursor of Cubism.

¹⁵ John Ruskin, *The Elements of Drawing* (1857), London: Smith, Elder; see ¶ 5 & footnote.

In 1882, the State Board of Education in Massachusetts commissioned Lucretia Crocker (1829-86), supervisor of Boston's public schools, to prepare a plan for colour lessons for classroom use. The resulting (22-page) booklet, *Lessons on Color in Primary Schools*, was initially printed in the board's annual report. In her introduction, Crocker asserted that, 'Lessons on color should have a place of primary importance in schools, both for the good fundamental training they give and because a knowledge of the distinctions and harmonies of color is indispensable to success in many occupations.' Coloured cards and watercolour paints were recommended, with the use of a prism introduced in the third year. Several years later a more substantial book, *Colour Study: A Manual for Teachers and Students* (1887), was published in Boston by Anson Cross (1862-1944), where he taught (with Albert Munsell) at the Normal Art School. Its stated aim was 'to give to public-school teachers suggestions which may assist them to create in their pupils a love for color and a power to see the delicate and beautiful effects which Nature presents.' Without using the term 'colour constancy', Ruskin had stressed how learners needed to be dissuaded from recording colours as they think they should be, rather than accurately matching those that present themselves for viewing. Echoing him, Cross observes (in Chapter 2) that 'The local color of an object is rarely the color which the eye sees. This point is so important that special consideration is given to it.' The book's second part, prepared by Amy Swain, outlines proposals for an eight-year classroom colour programme.

In 1890, the educational supplier Milton Bradley (1836-1911), based in Springfield, Massachusetts, published *Color in the School-room*, with 52 printed colour samples. In the same year, his company introduced standardised watercolour paints and sets of crayons. Its reputation had grown owing to its production of board-games, and it later published pamphlets on the educational theories of Friedrich Fröbel, who advocated creative activities for children, using boxes of toys that included red, orange, yellow, green, blue, and purple balls. Printed coloured papers gained favour in classroom teaching, and became lucrative products for Prang and Bradley, as well as for Munsell's company later on. Bradley's *Color in the Kindergarten* (1893) was followed by *A Class-book for Color* (1896), by Mark Maycock (1854-1904), *Practical Color Work for Primary and Ungraded Schools* (1896), by Helena Chace (1854-1912), and *A Note on Color for Teachers of Elementary Schools* (1902) by Caroline Van Helden (1847-1924). Also in 1902, a substantial college textbook – *Color Problems: A Practical Manual for the Lay Student of Color* – was published in New York by Emily Vanderpoel (1842-1939), offering a useful overview of current colour theories, including references to Chevreul, Rood, and the architect William Benson, inventor of a red-green-blue colour cube¹⁶. Her teaching assignments include a series of squared grids (advocated by Johannes Itten after 1917) used for analysing the proportions of colour displayed in various decorative artefacts from the author's own collection.

Twentieth-century developments in colour-educational publishing

By 1900, almost everything of importance that most artists and craftspeople needed to know about colour had been made available in print. An area of study that had not been examined to any great extent was the symbolism of colours, and their mental and emotional effects. Starting with Auguste Marqués' *The Human Aura* (1896), a series of books was published by Theosophists that revived the notion that individual colours possessed distinct and intrinsic powers. Such ideas had no place in general educational practice, the aim of which was usually to impose conformity rather than foster individuality, but they were starting to be explored in Vienna for example by Itten, Rudolph Steiner and Franz Cizek,

¹⁶ William Benson, *Principles of the Science of Colour* (1868), London: Chapman & Hall.

in Stuttgart by Adolf Hölzel (1853-1934), and in Munich by Wassily Kandinsky (1866-1944), whose personal thesis, *Über das Geistige in der Kunst* (On the Spiritual in Art), was published in 1912. From the 1920s, as at the Bauhaus, colour psychology began to be included as a factor in art and design, later embracing market research, but it was not until the 1950s that many Modernist colour theories became widely available in print.

Fairly typical of college textbooks of the time, Herbert Rankin's *The Teaching of Colour* (1914) offered a practical if uncreative design-and-crafts syllabus. In it the author comments that, 'Even to-day, when colour-training is insisted on in every school, there is little done beyond the mere casual observation of colour and empirical attempts to copy it.'¹⁷ A year later, Henry Barrett Carpenter (1861-1930) of Rochdale School of Art, Lancashire, published *Suggestions for the Study of Colour* that presents a coloured colour circle (rejected by Rankin) and a systematic examination of colour harmony, contrast and discord as well as a personal vocabulary that found its way via Phyllis Shillito (1895-1980) to Sydney, New South Wales, and to her student Eva Fay, who co-founded her own School of Colour there in 1983.¹⁸

Though abstraction in fine art appeared as an innovation in the 1910s, much of the advice given to decorative artists, as in books by Hay, Chevreul, Higgins and Bezold, was equally applicable to it. Abstraction in paintings did however widen the span of what teaching colour theory could mean. The first artists who rejected pictorial realism, like Kandinsky and Robert Delaunay, had then to consider how organising abstract elements might give as much integrity to their artworks as chiaroscuro and perspective had given to pictorial art – something decorative artists commonly solved by combining geometry with regular patterning. Fortunately, colour theory came to the rescue, owing to the intrinsic 'laws of colour' that Chevreul and others had identified and categorised. What developed out of the colour circles and scales illustrated by such enquirers was an awareness of a 'grammar' or syntax that colour appeared to possess within itself. This gave new impetus to the teaching of colour, as clearly expounded by Paul Klee (1879-1940) in his 1924 lecture to the Jena Kunstverein, published posthumously as *Über die moderne Kunst* in 1945.

In 1905, adapting Rood's three parameters for measuring light into dimensions for pigment-colour, Munsell had published *A Color Notation: A Measured Color System, based on the Three Qualities, Hue, Value, and Chroma*. Though his choice of five primaries tended to deter its use as a basis for colour mixing, his system of notation gained considerable favour in the USA, and was applied educationally for instance in the *Syllabus of Design and Color* (1933), by Anna Marie Anderson (1890-1944), and by Maitland Graves (1902-73), a teacher at Pratt Institute, Brooklyn, whose *Art of Color and Design* (1941) presented an early basic-design course, examining line, tone and texture as well as colour. The main competitor to Munsell's system was one devised by the German chemist Wilhelm Ostwald (1853-1932) and published in 1916 as *Die Farbenfibel* (The Colour-primer). Whereas Bezold's and Rood's colour circles had 12 hues, Van Helden's 18, Munsell's 10, and Carpenter's 14, Ostwald selected 24 hues that integrated four primary colours. His system rapidly gained favour in Europe, promoted in ten books by Ostwald himself, and another dozen by other authors who adapted his system in their own colour teaching, from Eugen Ristenpart (in 1926) to Aemilius Müller (in 1945 and after)¹⁹. Ostwald's system was further promoted by Winsor & Newton, whose chief chemist, John Scott Taylor, edited a three-volume translation of Ostwald's teaching texts (1931-35), with the company manufacturing tubes of

¹⁷ Herbert Rankin, *The Teaching of Colour* (1914), London: Sir Isaac Pitman; see page 15.

¹⁸ Eva Fay, *Shillito Design School* (2021), San Francisco: Blurb.

¹⁹ Eugen Ristenpart, *Die Ostwald'sche Farbenlehre* (1926), Leipzig, Theodor Martins. Aemilius Müller, *Schweizer Farbenatlas* (1945), Wintherthur: Chromos.

gouache in all 24 colours. Though *The Color Primer* was republished by Faber Birren (1900-88) as late as 1969, from the 1980s onwards, Ostwald's system was eclipsed by the Swedish Natural Colour System, devised by a team led by Anders Hård²⁰.

Three of the most comprehensive colour-teaching books of the inter-war period were *Color in Everyday Life* (1918), 'a manual for lay students, artisans and artists,' by Louis Weinberg (1885-1964), a teacher at New York University, *The Enjoyment and Use of Color* (1923), by Walter Sargent (1868-1927) of the University of Chicago, and *Color in Sketching and Rendering*, by Arthur Gupitill (1891-1956), another teacher at Pratt Institute, and co-founder of Watson-Gupitill art-book publishers. One of the most prolific and informative writers on colour during this period was Matthew Luckiesh (1883-1967), a lighting engineer and inventor at General Electric (Ohio) also interested in the physiological and psychophysical effects of light and vision. Faber Birren was an equally prolific author whose books on all aspects of colour found their way into many art-school libraries. As a leading colour consultant, most of his books were on design and psychology, but a résumé of his studio-art theories was presented in *Creative Color* in 1961. Mention should also be made of the Canadian painter Michel Jacobs (1877-1958), whose *Art of Color* (1923) was augmented two years later by a course of 38 exercises, set out in *The Study of Color*. He later founded the Metropolitan Art School in New York, and, as in Arthur Hatt's *The Colorist* (1908), stressed the red-green-blue 'spectrum primaries' in his teaching over the usual pigment primaries.

Johannes Itten (1888-1967) left the Bauhaus in 1923 and his strategy for teaching colour was not published until 1961, in *Die Kunst der Farbe*²¹. His three sequential categories of 'impression' (objective observation), 'expression' (emotional response), and 'construction' (the abstracted or formal use of colour) were not unlike Kandinsky's 1912 distinctions between 'impressions' (based on an external reality), 'improvisations' (images emerging from the subconscious), and 'compositions' (formal constructions). Almost all of Itten's theories, including his seven varieties of colour contrast, came from Hölzel, as did those of Caroline van Biema (1881-1942), whose *Farben und Formen als lebendige Kräfte* (Colours and Forms as Living Forces) was printed in 1930. Other theorists to publish books on colour teaching – some 60 of which appeared between 1900 and 1950 – included the painter and psychologist Hilaire Hiler (1898-1966), whose *Color Harmony and Pigments* (1942) presents a structured course not unlike that of the typographer Paul Renner (1878-1956), whose *Ordnung und Harmonie der Farben* (1947) was translated in 1964 as *Color, Order and Harmony*. Hiler also published a reference book on artists' pigments (1934), and founded Fremont College in Los Angeles a decade later in order to disseminate his Structuralist theories of colour and abstraction in art.

A large and influential volume of Paul Klee's teaching notes (including his Jena lecture) was issued by Jürg Spiller in 1956.²² His fellow Bauhaus-master Josef Albers (1888-1976) eventually distilled and published his own teaching strategy in 1963 as *Interaction of Color*, initially an annotated portfolio of 150 examples of his own and his students' work. One of many differences between them is that Klee explored colour using a myriad of forms, and preferably using paints, whereas Albers mostly preferred geometrical forms and printed coloured papers. Albers openly admitted (in Chapter 20) that his colour course offered no opportunity 'to decorate, to illustrate, to represent anything, or to express something – or one's self'. Hence another difference was that, whereas Albers' colour exercises tended to remain

²⁰ Anders Hård, Gunnar Tonnquist & Lars Sivik, editors, *Swedish Standards Institution Colour Atlas*, (1979), Stockholm: Scandinavian Colour Institute.

²¹ Johannes Itten, *Die Kunst der Farbe* (1961), Ravensburg, Otto Maier; translated by Ernst van Hagen as *The Art of Color* (1973), New York: Reinhold.

²² Paul Klee & Jürg Spiller, editor, *Das bildnerische Denken* (1956), Basle, Benno Schwab; translated by Ralph Manheim as *The Thinking Eye* (1961), London: Lund Humphries.

as such, Klee's encouraged a further dimension to be added, 'the dimension occupied by questions of content.' In other words, Klee's students might first construct abstract colour structures upon which they then allowed their imagination to act, thereby bridging the gap from abstraction to envisioned imagery. Another omission from Albers' *Interaction of Color* was mention of the dependence of surface colour on the physics of light and the physiology of vision. According to its author, 'the scientific analysis of the physical qualities is not the problem of the colorist.' By contrast, a predominantly scientific approach to colour teaching was presented as a series of 41 lessons and experiments in *Grundgesetz der Farbenlehre* (1978), by Harald Küppers (1928-2021), a reprographic engineer and deviser of a 1,400-colour rhombohedron.

By the 1970s, colour in the visual arts had extended far beyond painting, printing, and even colour photography, and into the manipulation of light sources and their colorimetric measurement, projected light and cinema (as noted by Graves), plastics, video, and holography. In order to augment traditional art media with emerging ones, the author of this article compiled *Lights and Pigments: Colour Principles for Artists*, published in 1980. Thereafter, most texts on colour for college use covered much the same ground, as clearly with Paul Zelanski's *Color* in 1989, and with later manuals by Edith Feisner, Becky Koenig, David Hornung, and Christopher Dorosz²³.

The interaction of colour and form: a proposal

In Chapter 11 of the second edition of Janet Best's *Colour Design: Theories and Applications* (2017), I proposed that 'The extent of what most artists and designers need to know about colour is not excessive, and can be summed up as source, surface, sight, semblance, standards and significance. In other words, anyone teaching colour eventually needs to acquire awareness of physical factors associated with different light sources, chemical factors relating to colorants, sensory factors associated with vision, perceptual factors associated with colour illusions, psychophysical factors associated with measuring colour appearance, and psychological factors relating to colour symbolism and communication of thought and feeling.' Added to this, when it comes to proposing how to teach all or part of such a curriculum, a seventh factor is that of strategy, meaning how it can best be taught. An eighth factor is the provision of scope to allow learners to develop their own intuition and creativity.

With reference to the paragraph above, Albers' *Interaction of Color* examined semblance and colour appearance, and offered a clear strategy, but it almost entirely ignored source, surface, sight, standards and significance. Not long after its publication, a brief analysis of it from the viewpoint of experimental psychology was included in *The Hidden Order of Art* (1967) by Anton Ehrenzweig (1908-66), a lecturer at Goldsmiths College, London. Ehrenzweig argued that, while Albers' systematic exercises (unlike Klee's) undoubtedly succeeded in increasing the student's interest in colour, they did so at the expense of variety of form. In other words, Albers' (constructivist) strategy of 'non-distracting form' posed the possibility of leading teachers and students of colour into something of a dead end. As early as 1857, Ruskin had considered the indispensable affinity between colour and form and invited the reader to examine the relationship under the nine headings of principality, repetition, continuity, curvature, radiation, contrast, interchanging, constituency and harmony. In 1874, Bezold had insisted, in writing on 'The Decorative or Ornamental Arts,' that 'the color must be adapted to the form.' Kandinsky (1912)

²³ Edith Feisner, *Colour* (2001), London, Laurence King; Becky Koenig, *Color Workbook* (2003), Upper Saddle River NJ: Prentice-Hall; David Hornung, *Color* (2004), New York: McGraw-Hill; Christopher Dorosz (2011), *Designing with Color*, New York: Fairchild.

makes the equally obvious statement that ‘colour cannot dispense with boundaries of some kind,’ and Herbert Rankin (1914) similarly acknowledged that ‘the study of colour is interdependent on the study of form.’

As an artist and art teacher, manipulating colour in relation to form not only became central to my own image-making but a key factor in teaching principles of colour theory in the classroom. It is a matter of fact that most artists and designers work with complex and often irregular designs or images. One aspect of Gestalt psychology was how efficiently (and as a matter of necessity) the human mind isolates and unifies cohesive figures from backgrounds. Examining this in the context of colour perception, Ehrenzweig observed that, ‘If the interest of the subject matter makes us focus with greater intensity on a particular shape, this shape will become separated from the rest of the painting; hence its colours will be isolated.’²⁴ From this he deduced a simple principle that degrees of colour interaction can be controlled by intensifying or weakening figure-ground divisions and the formal factors (or visual clues) that define them. In response, in 1984, I wrote the first draft of *Color Influencing Form*, the latter half of which encouraged the reader to examine colour in relation to degrees of figure-ground segregation by the systematic (but not uncreative) manipulation of such elements as line (contour) and opacity versus transparency and such pictorial factors as perspective of shape, texture, tonality and colour, with the ultimate aim of creating artworks that can be abstract, pictorial, decorative, functional or semantic²⁵. The text was not published until 2004 but offered an usable teaching strategy that, as with Klee, embraced not only what was practicable in the classroom but ideally resulted in examples of visual art suitable for a portfolio, rather than banal diagrams, colour scales and exercises.

To conclude: Colour remains a vast and wide-ranging subject of study, with an abundant and well-documented 500-year history, much of which remains unexamined by current academic historians. Recent and noteworthy exceptions include Patrick Baty (2017) and Alexandra Loske (2019)²⁶. As implied even by the limited selection of publications cited in this article, the application and teaching of colour ranges from all aspects of arts, design, crafts and manufacturing to more obviously scientific subjects examining light sources and visual display screens, the measurement of colour, the nature of paints, inks and dyes, normal and defective vision, afterimage and contrast effects, the influence of memory and constancy, in addition to its value in conveying information, ideas and feelings. The study of vision itself remains largely unexplored by artists. If investigating the interaction of colour and form – a central concern for the perceptual (rather than conceptual) artist – the learner can be directed to examine colour in relation for example to degrees of figure-ground division and their potential to inhibit or enhance ease of comparison between colours within an image, design, or pattern and the formal elements that constitute them, ideally in order to clarify and prolong the exploration of the viewer in some preferred or comprehensible manner.

²⁴ . Anton Ehrenzweig, *The Hidden Order of Art: A Study in the Psychology of Artistic Imagination* (1967), London: Weidenfeld & Nicholson; see page 157.

²⁵ Roy Osborne, *Color Influencing Form* (2004), Boca Raton FL, Universal Press; revised & expanded in 2020 as *The Color Coursebook for Art Teachers and Students*, Morrisville NC: Lulu Press.

²⁶ Patrick Baty, *The Anatomy of Colour: The Story of Heritage Paints and Pigments* (2017), London, Thames & Hudson. Alexandra Loske, *Color: A Visual History, from Newton to Modern Color Matching Guides* (2019), Washington DC: Smithsonian.